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Geology of the Lost Creek schroeckingerite deposits, Sweetwater County, Wyoming

By D. M. Sheridan, C. H. Maxwell, and J. T. Collier

Trace Elements Investigations Report 302

UNITED STATES DEPARTMENT OF THE INTERIOR
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Geology and Mineralogy

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Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOLOGY OF THE LOST CREEK SCHROECKINGERITE DEPOSITS SWEETWATER COUNTY, WYOMING*

By

D. M. Sheridan, C. H. Maxwell, and J. T. Collier

April 1956

Trace Elements Investigations Report 302

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*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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GEOLOGY OF THE LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

By D. M. Sheridan, C. H. Maxwell, and J. T. Collier

ABSTRACT

Caliche-type deposits of schroeckingerite, a uraniferous fluocarbonate-sulfate, occur near the surface over an area of about half a square mile in the vicinity of Lost Creek in northern Sweetwater County, Wyo. This area contains the largest known group of schroeckingerite deposits in the world.

The Lost Creek area is on the northeastern edge of the Red Desert and is in the north-central part of the Great Divide Basin, a topographic basin of interior drainage. The entire region is land of low relief, with altitudes between 6,000 and 7,000 feet above sea level. The climate is arid to semi-arid.

The Lost Creek area is underlain by sedimentary rocks which are characteristic of the entire Great Divide Basin. The bedrock consists entirely of Tertiary formations. Older rocks of Mesozoic and Paleozoic age are exposed only near the margins of the Great Divide Basin.

The Tertiary sequence in the Lost Creek area comprises about 5,200 feet of fluviatile, flood-plain, and lacustrine deposits; only fragmentary parts of the section are exposed. The rocks are predominantly sandstones, siltstones, and shales, but coal beds and volcanic effusive material are found in parts of the section. The oldest unit, the Paleocene Fort Union formation, is overlain unconformably by intertongued Eocene sedimentary rocks. The lowermost unit of the Eocene sequence is the

Hiawatha member (Nightingale, 1930) of the Wasatch formation. The Tipton tongue of the Green River formation separates the Hiawatha member of the Wasatch formation from the overlying Cathedral Bluffs tongue of the Wasatch formation. Above the Cathedral Bluffs tongue is the Morrow Creek member of the Green River formation. Overlying the intertongued sequence is the Eocene Bridger formation. Later Tertiary rocks include a conglomerate of Oligocene(?) age and tuffaceous sandstones of Miocene age.

Quaternary deposits overlie much of the Tertiary bedrock in the Great Divide Basin. These deposits are fluviatile, lacustrine, alluvial, colluvial, and eolian. In the Lost Creek area there are at least 8 discernable levels of terracing, 2 of which are probably Recent.

No single structural feature, such as a prominent basin or uplift, dominates the Great Divide Basin. In general, the major part of the Great Divide basin south of the Lost Creek area is characterized by gentle folds and a minor amount of faulting, whereas the northern part of this topographic basin is characterized by more intense folding and by abundant faults.

The most prominent structural feature of the Lost Creek area is a northwestward-trending syncline. Dips ranging from 4° to 53° in the major part of this synclinal structure are in strong contrast to the gentle dips which characterize broad folds in that part of the Great Divide Basin to the south.

The Lost Creek area is cut by northeasterly-trending and northwesterly-trending sets of faults. The largest fault, a long curving fault along the northern limb of the syncline, has an apparent stratigraphic displacement of between 2,500 and 4,000 feet. The Cyclone Rim zone of faulting occurs along the southern limb of the syncline and trends N. 72° W. for a distance of at least 14 miles. The Cyclone Rim zone consists of a complex pattern of faults, but in most places along the zone the net stratigraphic displacements are probably less than 400 feet.

Much of the faulting in the Lost Creek area is either late Miocene or post-Miocene in age. The fault system in the Lost Creek area is probably part of the same structural system as the long Continental fault northwest of the Lost Creek area. Together these fault systems form a major regional structure that extends at least 75 miles across southwestern Wyoming.

The area containing schroeckingerite deposits is on the east side of Lost Creek along the southern limb of the synclinal structure. The mineralized area is partly within and partly north of the Cyclone Rim zone of faulting. Most of the known deposits of schroeckingerite occur in a zone 2 to 8 feet below the surface of the ground, but some deposits have been found to depths of 14 feet in drill holes. The lower limit of occurrence seems to be the level of ground water. The deposits are found mainly in the northward-dipping Eocene strata but some occur wholly or partly in the overlying Quaternary material. The major portion of the deposits are in rocks belonging to the Cathedral Bluffs tongue of the Wasatch formation.

The schroeckingerite deposits are mostly elongate lenticular bodies, but some are branching to irregular in shape. The average thickness of individual deposits is about 1.5 feet. Some deposits containing irregular areas barren of schroeckingerite are as much as 80 feet wide and 390 feet long. Many of the deposits occur with their longest dimension parallel or subparallel to the strike of the bedding in the Eocene rocks. In detail, however, individual deposits commonly cross bedding planes and fault planes, and some overlap the unconformity at the base of the Quaternary overburden. Most of the deposits lie subparallel to the surface of the ground, although some extend downward along the dip of the bedding. The richest concentrations of schroeckingerite occur in fine-grained rocks, especially siltstone and silty or sandy claystone; but deposits have been found in all the types of rocks, ranging from shale to coarse pebbly sandstone. Some of the deposits in the Cyclone Rim zone of faulting are directly associated with faults, whereas other deposits in the zone have no apparent relationship to any faults.

The uranium content of samples obtained from schroeckingerite deposits in U. S. Geological Survey trenches ranges from 0.001 percent to 0.260 percent. Most of the samples contain less than 0.050 percent uranium. Although a large amount of schroeckingerite occurs in the Lost Creek area, it is irregularly disseminated in the individual deposits so that large samples are generally low in grade.

Schroeckingerite is a greenish-yellow to yellow platy uranium mineral having the chemical formula, $NaCa_3(UO_2)(CO_3)_3(SO_4)F \cdot 10\ H_2O$. The outstanding physical characteristic of the mineral is its brilliant yellow-green fluorescence in ultra-violet light. The mineral most commonly occurs in the form of concretions or pellets; individual pellets are commonly 0.2 inch in diameter, but some are as much as 1.5 inches in diameter. Gypsum is usually interleaved with the schroeckingerite flakes in the pellets. Schroeckingerite also occurs as small flaky crystals coating sand grains, as small tabular masses along bedding planes in shale and along shrinkage cracks, as fine grains associated with silica, carbonate, or gypsum in encrustations and small veinlets, and as minute grains in the white efflorescent salts of surface encrustations. No other uranium mineral has been identified in the Lost Creek schroeckingerite deposits; and the only other associated minerals, other than the minerals of the host rock, are gypsum, opal, and carbonates.

Schroeckingerite contains about 27 percent uranium but is only weakly radioactive, because samples generally contain about twice as much uranium as equivalent uranium. Field evidence and supporting laboratory tests indicate that the schroeckingerite deposits are continually undergoing processes of solution and redeposition during fluctuations of the ground water and during seasonal influx of surface waters. The result of these continuing processes is that the uranium in the schroeckingerite does not have time to attain radioactive equilibrium with its disintegration products.

In addition to the schroeckingerite deposits other examples of radioactivity occur in the near-surface area. Many of these are caused by small low-grade concentrations of uranium having no identified mineralogic form; these probably represent the sites of incipient mineralization by schroeckingerite or the sites of schroeckingerite deposits which have migrated short distances elsewhere by solution and redeposition. Other examples of radioactivity occur in iron-cemented sandstone and along some of the faults; all of these occurrences are low in uranium content.

The ground water in the Lost Creek area is abnormally high in uranium, with individual samples containing as much as 46 parts per million. With the exception of abnormal amounts of uranium, fluorine, and nitrate the composition of the water samples from the Lost Creek area matches closely the composition of ground waters in other arid regions of similar geology.

The schroeckingerite deposits in the Lost Creek area are epigenetic in character, because their deposition is later than the deposition of the rocks in which they are found. The schroeckingerite is believed to form by a simple process of crystallization from uraniferous waters, and deposition is continuing at the present time. This process is similar to the process by which caliche deposits of similar salts are formed in other arid and semi-arid regions. The immediate source of the uranium in the schroeckingerite is the uraniferous ground water.

The authors believe that the most probable source of the uranium in the schroeckingerite and in the ground water is in concealed uranium deposits in the Lost Creek area. These hypothetical deposits are believed to be relatively high in grade compared to the schroeckingerite deposits and are believed to contain uraninite or other so-called "primary" uranium minerals. The source deposits may be hydrothermal veins or they may be deposits of uncertain origin. These source deposits may be located at depth in the general area of the schroeckingerite deposits or they may be located laterally from the area of schroeckingerite deposition along or near one or more of the faults in the area. Points favoring this genetic hypothesis are: (1) the location of the schroeckingerite area along a prominent regional fault system, and (2) the fact that schroeckingerite occurrences in other uranium districts are all related directly or indirectly to source deposits of relatively high grade. Other genetic hypotheses involving widespread uraniferous source rocks of low grade are considered less probable because they do not explain the concentration of so much schroeckingerite in this single relatively restricted part of the Great Divide Basin.

The Lost Creek schroeckingerite deposits constitute a large reserve of low-grade uraniferous material. The ready solubility of the mineral is a factor in favor of the potential economic use of the deposits, but the low grade of the naturally occurring material has been detrimental to the commercial development of the deposits.

INTRODUCTION

Deposits of schroeckingerite, a uraniferous fluo-carbonate-sulfate, occur over a large area in the vicinity of Lost Creek in northern Sweetwater County, Wyo. This area contains the largest known concentration of schroeckingerite in the world. Elsewhere, schroeckingerite generally occurs in relatively small quantities as a secondary mineral associated with other uranium minerals. No other uranium mineral has been identified as yet in the immediate vicinity of the Lost Creek deposits.

No commercial production has been recorded from the Lost Creek area, but a large reserve of low grade uraniferous material is contained in the near-surface schroeckingerite deposits.

This report presents the geologic results of an exploration program conducted by the U. S. Geological Survey in the Lost Creek area.

Location and accessibility

The Lost Creek area, in Sweetwater and Fremont Counties, Wyo., is on the northeastern edge of the Red Desert and in the north-central part of the Great Divide Basin (pl. 1). All of the known schroeckingerite deposits are in an elongate area covering approximately half a square mile on the east side of Lost Creek in northern Sweetwater County. The known deposits are in parts of secs. 29, 30, 31, 32, and 33, T. 26 N., R. 94 W., and in part of sec. 25, T. 26 N., R. 95 W., sixth principal meridian.

The Lost Creek schroeckingerite deposits may be reached by travelling north 41 miles from Wamsutter, Wyo., which is 40 miles west of Rawlins on U. S. Highway 30 and the main line of the Union Pacific railroad (pl. 1). The road from Wamsutter to the deposits is in part graded and in part unimproved. Other unimproved roads connect the schroeckingerite locality with Baroil, Lamont, and U. S. Highway 287 to the east; Crooks Gap and U.S. Highway 287 to the north; State Highway 28 to the west, and U. S. Highway 30 and Rock Springs to the southwest.

Geography

The major physiographic feature of southwest Wyoming that includes the area described in this report is the Great Divide Basin. The Continental Divide splits near the southeast end of the Wind River Range. One part of the Continental Divide extends eastward toward the Seminoe Mountains and swings unevenly southward near Rawlins; the other part extends southward toward Superior, turns to the east and extends along the Cathedral Bluffs south of Wamsutter. The splits converge and join again at the north end

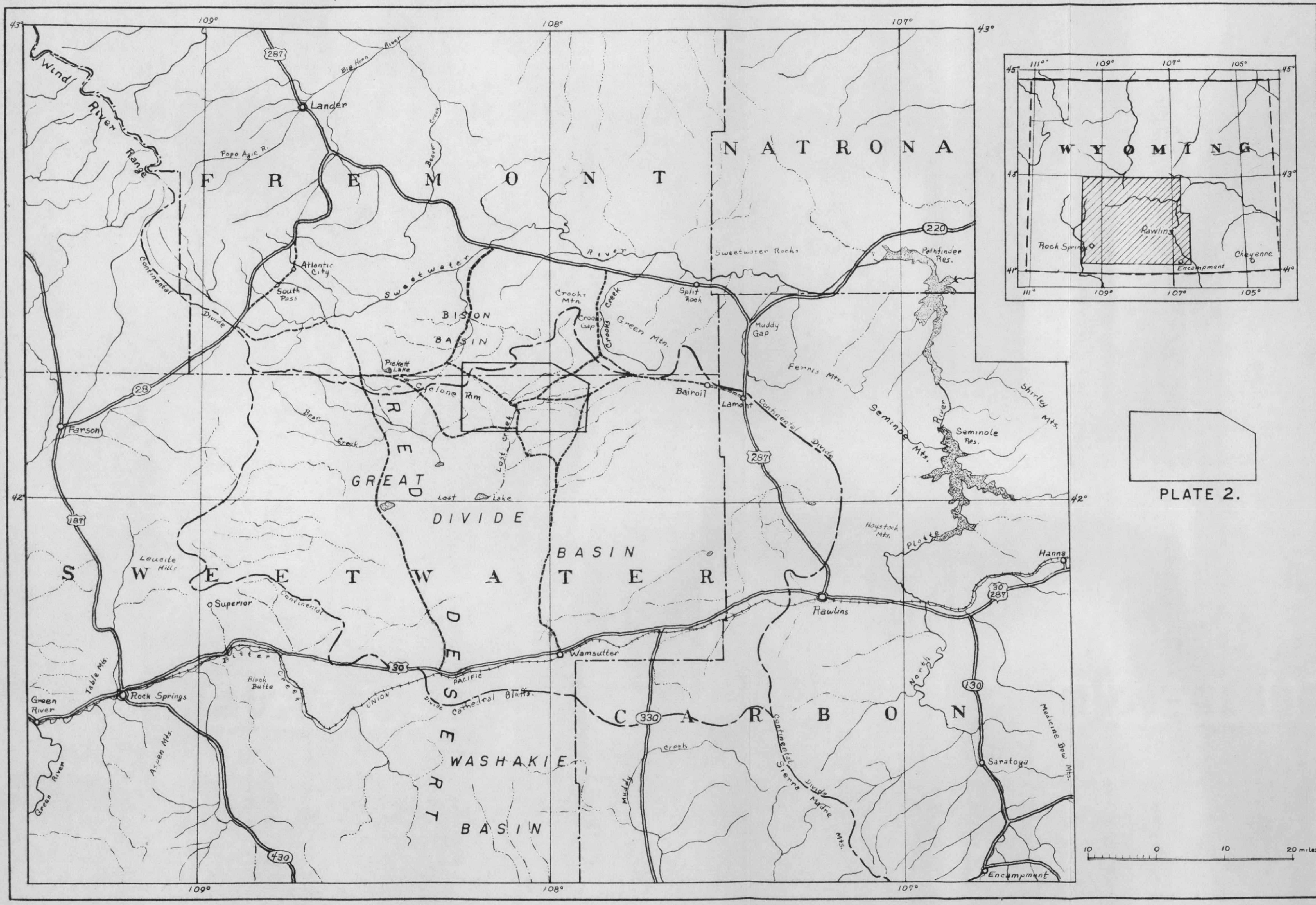

PLATE I. — INDEX MAP SHOWING LOCATION OF LOST CREEK AREA, SWEETWATER AND FREMONT COUNTIES, WYOMING of the Sierra Madre (pl. 1). The area enclosed by these two "Continental Divides", 3,600 square miles in extent, is a basin of interior drainage. It is not a single topographic depression but includes a number of drainage basins with alkali lakes and playas.

Most of the Great Divide Basin (Fenneman, 1931, p. 143-144) is included in the larger area of the Red Desert of Wyoming. The Red Desert, which was named from the prevalent red color of the soil (Hague and Emmons, 1877, p. 211; Hayden, 1871, p. 72; King, 1878, p. 364), extends from Pickett Lake (pl. 1) southward into Colorado.

The region comprising the Great Divide Basin and the Red Desert is a land of low relief, with altitudes ranging between 6,000 and 7,000 feet above sea level. It is broken only by small rounded hills and low buttes. In describing this region south of the Sweetwater River, Hayden (1871, p.34) wrote:

> "From the summits_/ the eye extends far southward, fifty miles or more, over a most desolate, barren plain, with here and there a table-top butte to show that the surface was once much higher than at present. It is cut up into innumerable valleys, which give to the surface an irregular, wavy appearance. Not a tree or shrub greets the vision over this vast desert waste."

_/ The summits referred to here are the lower range of hills on the south side of the Sweetwater River along the northern branch of the Continental Divide, probably the Cyclone Rim in the vicinity of Pickett Lake.

The principal topographic feature of the Lost Creek area (pl. 1) is the dissected hogback of Cyclone Rim, which lies to the north and west of the schroeckingerite locality. Lost Creek has its source near Crooks Mountain and drains southward into Lost Creek Lake. The creek is seasonally intermittent over most of its course, and the lake is dry except in flood season.

The climate of the region is arid and semiarid, and all of the Red Desert area is subject to great variations in local climate. The maximum annual variation of temperature may be over 150° Fahrenheit. Sudden and violent blizzards are common during the winter months, with temperatures as low as -40° Fahrenheit not uncommon. During much of the year there are steady westerly winds with velocities probably averaging over 10 miles per hour. Gusts of wind may reach high velocities. Summer thunderstorms reach cloudburst proportions, with high winds and large hailstones. Flash floods and deep mud are common travel hazards during the rainy season. Deep sand and sand dunes are additional travel hazards in parts of the area.

The vegetation is sparse and consists of low-growing shrubs of greasewood, saltbrush, sagebrush, and some desert and prairie grasses and herbs. Much of the area is underlain by sedimentary rocks relatively high in sulfate minerals. There is a considerable development of caliche and of alkali flats and alkali lakes. This undoubtedly accounts for much of the sparseness of the vegetation and for the selective growth of the sagebrush. Sagebrush is an indicator of deep soils largely free from alkali.

The region is primarily used for sheep-grazing. A few cattle are ranged in the places where forage is heavy enough to support them. Pronghorn antelope are very numerous and wild horses are not uncommon. A small herd of buffalo is seen occasionally. Sage hens and prairie chickens are abundant where there is natural water, and ducks and geese are common on the larger bodies of water during migration times. The natural supply of water is augmented by numerous wells throughout this desert country.

Previous work

Deposits of an unidentified yellow mineral in the Lost Creek area were first noted by the late Mrs. Minnie McCormick of Wamsutter, Wyo. Her discovery was made prior to 1936, but the exact date is not known. The yellow mineral was thought to be a new mineral species and was named "dakeite" (Larsen, 1937, p. 7; Larsen and Gonyer, 1937, p. 561-563). Novacek (1939, p. 317-323) later proved that "dakeite" is identical to the previously described species, schroeckingerite, and the name "dakeite" was discredited.

Many geologic examinations of the Lost Creek schroeckingerite deposits have been made since their discovery by Mrs. McCormick. Early reports include those by Knight and Gilbert (1937) and by Dake (1938, p. 7-8, 23-25). Harder and Wyant (1944, p. 21-22), Slaughter and Nelson (1946, p. 12, 30-37), and Wyant (1948) made field examinations of the Lost Creek deposits as part of a reconnaissance search for uranium by the U. S. Geological Survey. Guillotte (1945) examined the deposits for the Manhattan Engineer District, and Towle (1948) made a field examination for the Atomic Energy Commission.

In 1948 the deposits were explored by Uranium Inc. of Denver, Colorado. This exploration consisted of about 3,900 feet of trenches, 13 pits, a few bulldozed cuts, and many shallow auger-holes. Other exploration by Uranium Inc. and by various claim-owners has been conducted from time to time.

During 10-1/2 weeks in 1949 and 1950 the U. S. Geological Survey conducted preliminary field mapping and auger-drilling of 13 holes in the Lost Creek area as part of a reconnaissance study of uranium in the Red Desert. This work was done under the supervision of D. G. Wyant, who was assisted at various times by W. N. Sharp, D. M. Sheridan, H. L. Bauer, and A. J. Erickson. The results of the preliminary studies have been described by Page (1950), Wyant and Sheridan (1951), and Wyant, Sharp, and Sheridan (1951).

Present investigation

The purpose of the present investigation was to study the geology of the Lost Creek area and to evaluate the schroeckingerite deposits as a potential source of uranium. The preliminary work in 1949 and 1950 (Wyant, Sharp, and Sheridan, 1951) had shown that additional exploration was necessary in order to make an adequate study of the economic geology of the deposits.

In 1951 and 1952 a total of 51 weeks of field studies and exploration was done under the supervision of Sheridan. Collier began field work in August 1951, and Maxwell began field work in September 1952. The three authors were assisted at various times by L. R. Page, A. J. Erickson, R. S. Sears, W. S. Cavender, E. P. Beroni, C. T. Pierson, A. M. Heyman, and A. W. Ross. Engineering work during the exploration was done by E. S. Hanley, J. S. Adair, and H. B. Nickelson, who were assisted at various times by J. C. Thomas, D. E. Blake, and H. L. Bittle.

Exploratory work by the U. S. Geological Survey during the present investigation included the excavation of 13 trenches, totalling 16,460 feet in length, and the drilling of 116 auger holes and 70 bucket holes. The trenches averaged 8 feet in depth and 4 feet in width and had essentially vertical walls. The maximum depth of all drill holes excavated by the Survey, including the 13 holes drilled in the previous study, was 51 feet.

Geologic field work included: detailed mapping of both walls of each trench by tape and level methods (scale 1:120); mapping of 7-1/2 square miles by plane-table methods (scales, 1:2,400 and 1:9,600); logging of lithology and gamma-ray radioactivity of drill holes; field-checking stratigraphic data in the area; making a plane-table traverse, one mile in length, for additional control in mapping. Water samples were obtained from representative parts of the Lost Creek area and nearby localities, and traverses were made with a scintillometer for radioactivity data over representative parts of the mapped area. A total of 2,024 samples were obtained from schroeckingerite deposits and host rock in the trenches in order to make a detailed study of grade.

Preliminary reports concerning the plans and the results of the exploration project were prepared by Sheridan (1951), Sheridan, Collier, and Sears, (1952), Sheridan (1953), and Sheridan, Collier, and Maxwell (1953).

The present report is the product of 2 stages of office work. From December 1952 to June 1953 the 3 authors compiled the basic field data and prepared some of the illustrations. Additional office work on illustrations and the report was done intermittently from July 1953 to April 1955 by Sheridan and Maxwell.

Supplementary data, including information on ownership of claims, methods and results of exploration, drill logs, and information on reconnaissance for radioactivity, are given as Appendices A-G at the end of this report.

Acknowledgments

All work by the U. S. Geological Survey at the Lost Creek schroeckingerite deposits was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. The authors are indebted to C. C. Towle, Jr., and J. F. Foran, both of the Atomic Energy Commission, for their helpful advice.

Many members of the U. S. Geological Survey contributed valuable comments and advice during the field and office work. Fossil identifications were made by D. H. Dunkle, Richard Rezak, J. B. Reeside, Jr., and I. G. Sohn. Field data contributed by G. N. Pipiringos and Harold Masursky proved valuable in mapping the areal geology of the Lost Creek area. Analytical work was supervised by L. F. Rader, Jr., and A. T. Myers. Wayne Mountjoy and Harold Masursky contributed data from leaching experiments.

Stockmen and residents of neighboring communities were courteous and cooperated in every way possible. Mrs. Minnie McCormick, before her untimely death, provided much valuable information, and her friendly generosity and inspiration are gratefully remembered. Particular thanks are due to John McCormick and his family for their kindness and cordial western hospitality. The writers also wish to thank Kleber Hadsell, Frank Hadsell, and Gasper Meyer for the use of their cabin at Lost Creek and for their cooperation on many occasions. Tom Whelan, Mr. and Mrs. John Bugas, Mr. and Mrs. Ed Grynch, Vic Westberg, Ed Westberg, and a great many others extended their hospitality on many occasions.

The authors wish to express their appreciation for the cooperation of all Survey colleagues and contractual personnel during the extreme weather conditions under which much of the field work was done.

GENERAL GEOLOGY

Regional geologic setting

Tertiary sedimentary rocks make up most of the bedrock of the Great Divide Basin. Rocks of Eocene age are predominant, with less abundant rocks of Paleocene, Oligocene, and Miocene age. To the east, the Tertiary terrane is delimited by exposures of Cretaceous sedimentary rocks along the Ferris Mountain and Muddy Gap area, along the Rawlins uplift, north of Rawlins, and along the Sierra Madre Mountains. Tertiary sedimentary rocks extend southward from the Great Divide Basin through the Washakie Basin to the Uinta Mountains in Colorado and Utah, where Precambrian, Paleozoic, Mesozoic, and Cenozoic rocks are exposed. To the west, the area of Tertiary sedimentary rocks extends nearly to the western border of Wyoming but is broken by the Rock Springs anticline and the Leucite Hills, where Cretaceous sedimentary rocks and Tertiary intrusive and extrusive rocks are exposed. To the northwest, Precambrian granitic rocks in the core of the Wind River Range border the Great Divide Basin. The anticlinal nose of the Wind River Range, with its exposed Mesozoic and Cenozoic sedimentary rocks, lies in the Bison Basin area north of the Great Divide Basin. To the northeast, the Great Divide Basin is bordered by the Precambrian, Paleozoic, Mesozoic, and Cenozoic rocks of Green Mountain and Crooks Mountain, and to the north of these are the Precambrian rocks of the Sweetwater arch.

The Tertiary sedimentary rocks of the Great Divide Basin consist predominantly of lacustrine and fluviatile sandstones, siltstones, claystones, and shales. Coal beds and volcanic effusive material are also found in parts of the Tertiary section.

Quaternary deposits consisting of fluviatile, lacustrine, alluvial, colluvial, and eolian deposits are widespread in the Great Divide Basin. In many areas these deposits obscure the bedrock geology.

Structurally, the Great Divide Basin may be a part of the Washakie Basin to the south (Longwell and others, 1944). Major structural uplifts form the other boundaries of the basin: --- the Rock Springs anticline to the west, the Wind River uplift to the northwest, the Sweetwater uplift to the north and northeast, and the Rawlins uplift to the east. Northeast-trending normal faults are common at the western edge of the basin along the flank of the Rock Springs uplift. Numerous faults occur along the north side of the basin around the nose of the Wind River Mountains and along the Green Mountain-Crooks Mountain area. Along the east side of the basin, faults are associated with the Rawlins uplift.

No single structural feature, such as a prominent basin or uplift, dominates the Great Divide Basin. Rather, it is a region of relatively minor structural elements. In general, the major part of the basin lying to the south of the Lost Creek area is characterized by gentle folds and a minor amount of faulting, whereas the Lost Creek area in the northern part of the basin is characterized by more complex folding and by faulting. Faults in the Lost Creek area are probably related structurally to the Continental fault, mapped by Nace (1939, pl. 1) to the northwest of the Lost Creek area.

The various features of the regional geology are included on maps by Love (1955) and by Longwell and others (1944). Regional structural features have been summarized by Eardley (1951, p. 362-374).

Stratigraphy

Sedimentary rocks exposed in the Lost Creek area have an aggregate thickness of about 5,200 feet. They comprise a fluviatile and lacustrine sequence that ranges in age from Paleocene to Miocene. A mantle of Quaternary alluvium, colluvium, and stream terrace material covers most of the area.

The sequence of Tertiary sedimentary rocks may be divided into six formations. The oldest is the Fort Union formation of Paleocene age. Unconformably overlying the Fort Union formation is an intertonguing sequence assigned to the Wasatch and Green River formations of Eocene age. Above this intertonguing sequence is the Bridger formation of Eocene age. Boulder and pebble conglomerates of Oligocene (?) age, and tuffaceous sandstones of Miocene age overlie the Eocene formations.

Older sedimentary rocks that range in age from Pennsylvanian to late Cretaceous are exposed on the western, northern,and eastern margins of the Great Divide Basin and probably underlie the Lost Creek area at depth.

The distribution of the various rock units in the Lost Creek area is shown by the areal geologic map, plate 2. The age and relative stratigraphic positions of the various formations, and the intertonguing relations of the Green River formations in the Lost Creek area, are shown on plate 3.

The distribution of the major Eocene units and of the thicker Quaternary deposits is shown in relation to topography on the geologic map and cross-sections of the Lost Creek schroeckingerite area and vicinity (pl. 4). Maps of larger scale (pls. 5, 6, and 7) indicate more detailed features of the stratigraphy in the exploration areas. The relative locations of the mapped areas shown on plates 2, 4, 5, 6, and 7 are indicated on the index on plate 4.

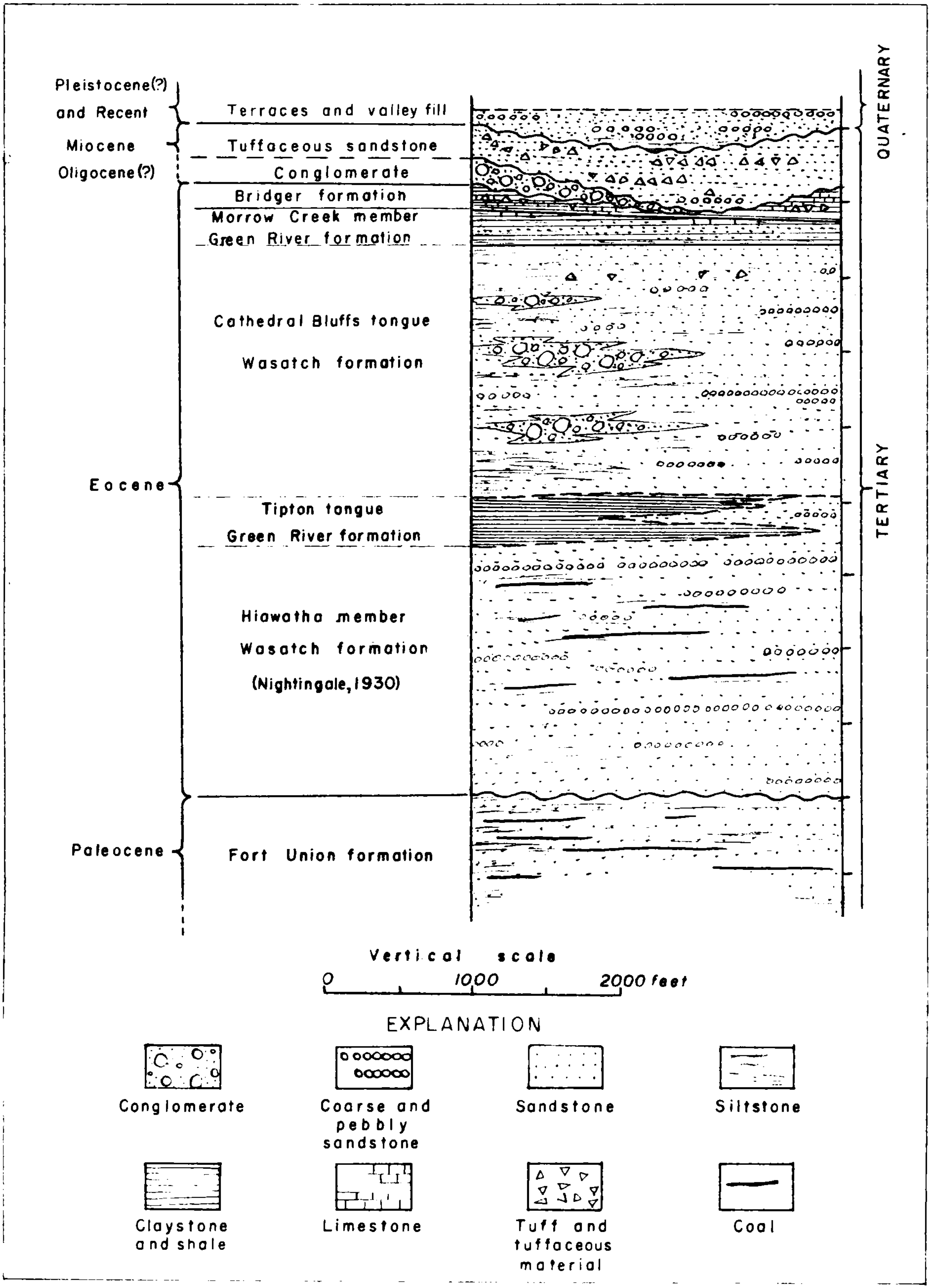

PLATE 3.—GENERALIZED DIAGRAM SHOWING AGE AND INTERTONGUING RELATIONSHIPS OF FORMATIONS IN THE LOST CREEK AREA.

Detailed features of parts of the Green River and Wasatch formations are shown in the geologic sections of trenches excavated by the U. S. Geological Survey (pls. 8-20).

Paleocene rocks

Fort Union formation--The Fort Union formation was named by Meek and Hayden (1861, p. 433) for a sequence of sedimentary rocks exposed near old Fort Union, now Buford, N. Dak. Ball (1909, p. 249) applied the name in the Great Divide Basin to rocks of similar lithology that underlie the Wasatch formation of Eocene age and overlie the Lance formation of Upper Cretaceous age.

The Fort Union formation is about 1,000 feet thick in Bison Basin north of the mapped area (W. G. Bell, 1954 p. 1371); the upper 500 feet is exposed in the Lost Creek area. The formation crops out in the northern part of the area (pl. 2) along the northern branch of the Continental Divide. It consists predominantly of interbedded buff to gray, massive, coarse- to fine-grained sandstone, buff and gray shale and siltstone. Some of the sandstones contain lenses of pebble conglomerate. Numerous thin beds of lignite crop out in the upper part of the formation, and the top is commonly marked by a resistant bed of platy ferruginous sandstone. No detailed study of the Fort Union formation was made, but its distribution is indicated on the geologic map (pl. 2).

Vertebrate fossils of Paleocene age were found by Wallace Bell (oral communication, 1953) just north of the area of plate 2.

Eocene rocks

The Eocene rocks in the Lost Creek area include the Wasatch, Green River, and Bridger formations, totalling 4,200 feet in thickness. In the Lost Creek area the representatives of these formations are, in stratigraphic sequence from oldest to youngest: the Hiawatha member (of Nightingale, 1930) of the Wasatch formation, the Tipton tongue of the Green River formation, the Cathedral Bluffs tongue of the Wasatch formation, the Morrow Creek member of the Green River formation, and the Bridger formation. _/

_/ During the time this report was in preparation, new names were proposed by G. N. Pipiringos (1955, p. 100-104) for certain Eocene stratigraphic units in the central part of the Great Divide Basin. These names have now been adopted for official use by the U. S. Geological Survey. The changes in nomenclature have not been made in the text or illustrations of this report, but the probable correspondence of names is indicated by footnote where applicable in the descriptive sections of the report. (See discussions of Hiawatha member of the Wasatch formation and Tipton tongue of the Green River formation.)

Bradley (1945) described the generalized stratigraphic relations of these formations in the following words:

> "In the broadest and simplest terms the Green River formation is a huge lens of relatively fine-grained, generally calcareous, lake sediments embedded in a thick body of fluviatile sandy mudstone that formerly filled a huge intermontane basin...

The mudstone is divided into two formations: (1) the Wasatch formation, below the lens of Green River formation, and (2) the Bridger formation above. The sedimentary history of the intermontane basin was complicated, however, by changes in the level of the lake, which resulted in an intertonguing relationship between the Wasatch and the overlying Green River..."

The Lost Creek area lies near the northern edge of the intermontane basin described above, near the shoreline of the lake in which the Green River sediments were deposited.

Wasatch formation.--The Wasatch formation was named by Hayden (1869, p. 191)for a sequence of variegated sands and clays west of Fort Bridger, Wyo. Sears and Bradley (1924, p. 24) applied the name to rocks in the southern part of the Great Divide Basin. They divided the Wasatch formation into the main body below the Tipton tongue of the Green River formation and the Cathedral Bluffs Tongue above the Tipton tongue (1924, p. 98-99). The part of the Wasatch formation which lies below the Tipton tongue of the Green River formation was named the Hiawatha member by Nightingale (1930, p. 1023). It is, in part, the same sequence of sedimentary rocks as the main body of the Wasatch, as described by Sears and Bradley (1924).

Hiawatha Member (of Nightingale, 1930).--The main body of the Wasatch formation, the Hiawatha member of Nightingale, is believed to be about 1,700 to 2,000 feet thick in the Lost Creek area, but the complete section is not exposed. The main body of the Wasatch formation will be referred to as the Hiawatha member in this report.

The Hiawatha member is mapped separately only in the northern part of the Lost Creek area, where the lower part of the section and the unconformable contact with the Fort Union formation are exposed (plate 2).[1] The lower part of the section consists predominantly of fine-grained sandstone with some coarse-grained to pebbly sandstone in thin lenses. Lesser amounts of reddish and green siltstone and minor amounts of coal are interbedded with the sandstone.

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[1] The lower part of the Hiawatha member, as mapped separately in the northern part of the Lost Creek area (pl. 2), probably corresponds to a part of the Battle Springs formation, a new name proposed by G. N. Pipiringos (1955, p. 103) and now adopted for official use by the U. S. Geological Survey.

In the southern part of the Lost Creek area the upper part of the Hiawatha member is present. Numerous lenticular extensions of the Tipton tongue of the Green River formation interfinger with rocks of the Hiawatha member.

Detailed tracing of the contacts is impossible over much of this area because the bedrock geology is obscured by overburden. Consequently, the Hiawatha member and the Tipton tongue were combined and mapped as an undifferentiated unit in the southern part of the area (pls. 2 and 4).[1]

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[1] The beds of the upper part of the Hiawatha member that are included in this undifferentiated unit probably correspond to the new name, Niland tongue of the Wasatch formation. The new name, Niland tongue, was proposed by G. N. Pipiringos (1955, p. 100-102) and has been adopted for official use by the U. S. Geological Survey.

The uppermost contact of this undifferentiated unit is defined by the thin uppermost lenticular extension of the Tipton tongue and is illustrated at a larger scale on (plates 5, 6, and 7.)

The following stratigraphic section contains detailed lithologic data for beds of the Hiawatha member lying immediately below the uppermost extension of the Tipton tongue. Fragmentary exposures elsewhere suggest that the lithology of the remainder of the upper part of the Hiawatha section is similar to the lithology of the lower part of the section exposed in the northern part of the area. All of the beds in this stratigraphic section belong to the Hiawatha member of the Wasatch formation.[1] On the detailed map (pl. 6), however, these beds form the

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[1] The new name, Niland tongue of the Wasatch formation, as proposed by Pipiringos (1955, p. 100-102), probably should be extended to beds represented in this section.

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uppermost part of the more general mapping unit (Tgw) shown as undifferentiated Tipton tongue of the Green River formation and Hiawatha member of the Wasatch formation. The beds are also indicated by the symbol Tgw on the geologic sections of the trench (pl. 19, sections A-B, A'-B').

Section 1, stratigraphic section of upper part of Hiawatha member of the Wasatch formation as exposed in Trench 12.

Top of measured section

Green River formation

Tipton tongue

Wasatch formation

Hiawatha member:

	Feet
Sandstone, silty, pale green, mottled with maroon to green sandy siltstone	5
Claystone, sandy, brown-gray	1.8
Sandstone, fine-grained to coarse-grained pebbly, brown-white to white	19
Claystone, sandy, blocky, brown-gray.	1.5
Sandstone, coarse-grained pebbly, brown-white; minor interbedded grown-gray claystone	4.5
Claystone, blocky, maroon to brown-gray	1
Siltstone, clayey, buff-white, with 0.5-inch layer of maroon claystone in center of unit.	.5
Shale, gray-green	1.2
Shale, green-black, carbonaceous (?).	.5
Shale, maroon	.5
Sandstone, coarse-grained pebbly, brown-white	6
Claystone, sandy, brown-gray, maroon at base	1.2
Siltstone, clayey, brown-white to red-white	.8
Shale, maroon to gray	.8
Sandstone, fine-grained to coarse-grained pebbly, gray-white to brown-white, interbedded with brown-gray sandy claystone	13.5

Wasatch formation	Feet
Hiawatha member--Continued	
Sandstone, poorly sorted, pale brown	6
Sandstone, pebbly gray	9
Claystone, sandy, brown-gray, interbedded with gray sandstone.	2.5
Sandstone, coarse-grained, gray, irregularly iron-stained.	1
Sandstone, fine-grained, gray-white	1
Sandstone, pale brown, with 4 inches of red stain at base	1
Sandstone, gray-white	2.2
Sandstone, silty, red-white	.8
Sandstone, coarse-grained, gray-white; with minor irregular lenses of brown-gray sandy claystone near top; unit contains irregularly-distributed iron-oxide and manganese oxide stains.	9
Total thickness of measured section.	90.3

Lower beds not exposed

Cathedral Bluffs tongue.--The Cathedral Bluffs tongue, as named by Schultz (1920, p. 28-29), was included in the Green River formation. Sears and Bradley (1924, p. 98-99) and Sears (1924, p. 276-293) placed the Cathedral Bluffs tongue in the Wasatch formation, in its present usage. Bradley (1926, p. 122) applied the name to the tongue in northern Sweetwater County, west of the Lost Creek area.

The Cathedral Bluffs tongue forms a persistent unit in the central part of the Lost Creek area where it occurs on both limbs of a synclinal structure (pls. 2 and 4). It is about 1,650 feet thick in the Lost Creek area and forms the host rock for almost all of the schroeckingerite mineralization. The Cathedral Bluffs tongue lies between the Tipton tongue and Morrow Creek member of the Green River formation. The stratigraphic relations are shown on plate 3.

In the Lost Creek area the Cathedral Bluffs tongue consists of interbedded green and maroon variegated claystone; green, gray, buff, and brown claystone and siltsone; green, gray, and buff fine-grained sandstone; and buff to white, medium-to coarse-grained sandstone and pebbly sandstone. Most of the sandstones are poorly indurated and friable, although a few beds contain irregular and concretionary cemented lenses. Most of the medium- to coarse-grained and pebbly sandstones and a few of the fine-grained sandstones are arkosic. The claystones and silty claystones are blocky to subfissile, but there are a few beds of green, brown, gray, and bright maroon shale. Remains of volcanic shards are visible in some specimens, and much of the claystone and shale can be classified as bentonitic.

Most of the individual beds in the Cathedral Bluffs tongue are lenticular and can be traced for only a few hundred feet. Typical examples of lenticular beds are illustrated in the large scale cross-sections (pls. 8, 13, 17, 18, and 20). There are many abrupt changes in lithology, such as a claystone bed between two coarse pebbly sandstone beds (pl. 14, south end of section B-C). The lenticularity and abrupt changes in the size of sedimentary particles in adjacent beds at many places indicate a complex depositional history.

The relative amounts of fine material and coarse material in the Cathedral Bluffs tongue vary considerably from place to place, depending on the relative positions of source streams and their intervening flood plains. For example, about 10 miles west of the Lost Creek exploration area a thick sequence of lenses of conglomerate in the Cathedral Bluffs tongue was probably deposited near the mouth of one of the larger source streams. In the main exploration area, siltstones and claystones, probably of floodplain origin, are interbedded with channel sandstones, but a mile or so east the equivalent rocks contain considerably less siltstone and claystone, indicating another source stream to the east.

In general, the broad regional relations indicate that the Cathedral Bluffs tongue thins toward the west and southwest, and correspondingly, the relative amounts of fine-grained material become less toward the north and northeast. This relationship has been noted and discussed by several authors who have worked near the Great Divide basin (Bradley, 1926, Plate 59; Bradley, 1945; Nightingale, 1930; Schultz, 1920).

In most places where the Cathedral Bluffs tongue is present, including the type locality at Cathedral Bluffs, west of Wamsutter, it consists of gray siltstone banded with red and pink layers of clay. The red clay washes out and coats the rest of the formation, giving the impression that it is all red. The name Red Desert was derived from this coloration in the Cathedral Bluffs tongue. The red clay bands become less numerous near the edges of the basin of deposition.

Five stratigraphic sections (secs. 2-6) of parts of the Cathedral Bluffs tongue in the Lost Creek area are given below. Except where specifically mentioned to the contrary, all sandstones described in the sections are poorly indurated and relatively friable. Most of the sandstone beds are arkosic with the exception of some of the silty sandstones and the fine-grained sandstones Many of the beds do not persist laterally with uniform thickness owing to their lenticularity. Corrections for faulting were made wherever possible.

Section 2, Stratigraphic section of Cathedral Bluffs tongue of Wasatch formation as exposed in Trench 8. (pl. 4) _/

_/ The beds in Trench 8 (pl. 15) described in this section lie north of the exposure of the Tipton tongue and are indicated by the symbol Twc.

Top of section

Green River formation

Morrow Creek member

Wasatch formation

Cathedral Bluffs tongue:

Covered interval, approximate composition and thickness as follows: Feet

Shale, green, interbedded with green subfissile to blocky claystone and green and gray-green siltstone 100

Wasatch formation

Cathedral Bluffs tongue --Continued

	Feet
Siltstone interbedded with sandy siltstone and claystone, tan, buff, and light green	65
Siltstone, buff and green, interbedded with fine- to medium-grained buff and tan sandstone	60
Claystone, green, interbedded with buff, green, and olive-green siltstone	145
Sandstone, coarse-grained and pebbly, white and tan	55
Siltstone and fine-grained sandstone, green, green-white, and buff	70
Sandstone, silty, buff-brown, interbedded irregularly with gray-green sandy siltstone	4.5
Siltstone, sandy, mottled gray-green and maroon	7.5
Sandstone, coarse-grained, buff-white	.8
Siltstone, sandy, mottled gray-green and maroon	5.5
Sandstone, poorly sorted, buff-white to buff; contains lenses of white cemented sandstone, 1 foot in length	12
Sandstone, medium- to coarse-grained, green-white to buff, interbedded irregularly with pale brown, gray-brown, and green siltstone	23
Sandstone, silty, green-brown to buff, irregularly iron-stained at base	12

Wasatch formation

Cathedral Bluffs tongue --Continued

	Feet
Siltstone, partly sandy, mottled green, gray-green, maroon, and gray-brown	12
Sandstone, pebbly, brown-white; contains minor interbedded green-brown sandy siltstone	17
Sandstone, pebbly, brown-white, interbedded irregularly with green-brown sandy siltstone	8
Sandstone, coarse-grained pebbly, brown-white, iron-stained at base.	11
Siltstone, pale green-brown to gray-green	10
Sandstone, medium-grained to pebbly, brown-white to buff-white	12
Sandstone, silty, pale green-brown, lenticular.	8
Sandstone, medium-grained to pebbly, brown-white to buff-white	13
Siltstone and clayey siltstone, green to brown-green	22
Sandstone, coarse-grained, buff-white, iron-stained at top and at base, lenticular.	2.5
Siltstone and clayey siltstone, green to brown-green	12
Sandstone, medium- to coarse-grained, brown-white, interbedded irregularly with gray-green to green-brown sandy siltstone.	10

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Claystone, silty, mottled green, maroon-brown, and brown-green, iron-stained at base; contains minor lenses of brown-green fine-grained sandstone	5
Siltstone, brown-gray	2
Sandstone, pebbly, brown-white to buff-white	36
Siltstone, partly sandy and partly clayey, gray-brown, green, and brown-green, interbedded irregularly with green sandstone near base	29
Sandstone, pebbly, brown-white	5
Claystone, sandy, maroon-brown, gray-green, and brown-green, interbedded irregularly with green-white to pale brown-green poorly sorted sandstone.	10
Sandstone, coarse-grained, brown-white to green-white	4
Claystone, sandy, mottled brown-green and maroon-brown; contains minor lenses of brown-green silty sandstone; iron-stained at base.	26
Sandstone, pebbly, brown-white to gray-white	17
Claystone, maroon-brown, iron-stained at top	.2
Claystone, sandy, green to gray-green; contains minor irregularly interbedded brown-white fine-grained sandstone near top.	28

Wasatch formation

Cathedral Bluffs tongue --Continued	Feet
Covered interval, deep alluvium along Lost Creek. The lithology of the Cathedral Bluffs tongue in this area is not known in detail, but nearby auger holes indicate that the covered interval consists partly of interbedded gray-green, brown-gray, gray, and chocolate brown claystone and siltstone and gray, gray-white, green-white, buff-white, and yellow-buff silty to pebbly sandstone. The approximate thickness of the covered interval is	275
Siltstone, sandy, gray-green to brown-green, iron-stained at base.	4
Sandstone, pebbly, gray-white	10
Sandstone, pebbly, brown-white to pale green.	36
Sandstone, silty, mottled green-gray and maroon-gray	1
Claystone, blocky, gray-green to brown-green; contains rosettes of gypsum	7
Sandstone, medium-grained, buff-white to gray-white, interbedded irregularly with maroon-gray to green-gray sandy siltstone.	7
Covered interval, probably sandstone as above and below	3
Sandstone, medium-grained, buff-white to gray-white, interbedded irregularly with maroon-gray to green-gray sandy siltstone.	5

Wasatch formation	Feet
Cathedral Bluffs tongue -- Continued	
Sandstone, pebbly, brown-white to buff-white	10
Sandstone, silty, green-gray to maroon-gray, mottled with gray-white coarse-grained sandstone.	4
Sandstone, pebbly, brown-white	7
Sandstone, silty, green-gray, maroon at top and at base.	3
Sandstone, pebbly, brown-white; contains minor irregularly interbedded gray-green to maroon-gray sandy siltstone	5
Claystone, mostly blocky but partly subfissile, gray-green to brown-green mottled with purple, iron-stained at top and at base; contains limestone concretions and geodes, 0.5 inch to 5 inches in diameter; also contains minor lenses of brown-white pebbly sandstone and gray-green to maroon-gray sandy siltstone	7
Sandstone, medium-grained to pebbly, gray-white, interbedded irregularly with buff-green silty fine-grained sandstone.	8
Sandstone, cemented, red-gray.	0.5
Sandstone, pebbly, cross-bedded, gray-white.	8
Sandstone, medium- to coarse-grained, cross-bedded, brown-gray	7

Wasatch

Cathedral Bluffs tongue -- Continued

	Feet
Sandstone, pebbly, cross-bedded, gray-white to brown-gray; contains vari-colored clay galls along the cross-bedding	8
Siltstone and sandy siltstone, gray-green and brown-green, interlensed irregularly with green-gray, maroon-gray, brown-white, and green-white fine- to medium-grained sandstone	10
Sandstone, fine-grained, green-gray to maroon-gray, iron-stained at base.	1.5
Claystone, mostly blocky but partly subfissile, gray-green; contains limestone concretions, 3 to 6 inches in diameter	4.5
Claystone, blocky, dark gray.	.4
Claystone, mostly blocky but partly subfissil, gray-green, iron-stained at base.	2
Sandstone, pebbly, gray-white, partly cross-bedded, with brown-gray clay galls along cross-bedding	2.5
Sandstone, silty, brown-green, maroon at top and at base	.2
Sandstone, coarse-grained pebbly, cross-bedded, brown-gray, maroon-gray, gray-white, and brown-white; contains gray clay galls along cross-bedding	6
Sandstone coarse-grained pebbly, gray-white.	1.5
Siltstone, sandy, brown-gray and maroon-gray	.5

Wasatch formation	Feet
Cathedral Bluffs tongue — Continued	
Sandstone, coarse-grained pebbly, gray-white.	3
Sandstone, silty, brown-gray; 1 foot above base is a lens, 1 foot thick, of gray-white pebbly sandstone	4.5
Sandstone, coarse-grained pebbly, gray-white	5.5
Sandstone, silty, and sandy siltstone, mottled brown-green and gray-green, at top and at base are layers maroon-gray silty sandstone, 2.5 inches thick.	2.2
Sandstone, coarse-grained, gray-white.	4
Sandstone, silty, and sandy siltstone, mottled brown-green and gray-green; at top and at base are layers of maroon-gray silty sandstone, 2.5 inches thick.	1.8
Sandstone, coarse-grained pebbly, gray-white	8
Fault interval. Thickness of missing section unknown.	--
Sandstone, coarse-grained pebbly, gray-white but iron-stained near base.	3
Shale, brown-gray to gray, finely interbedded with brown-white to red-gray fine-grained sandstone; jarosite stains near base; discontinuous seams of lignite, 1/8 inch thick, along base	2
Total	1338.6

Green River Formation

Tipton tongue

Section 3, stratigraphic section of Cathedral Bluffs tongue of Wasatch formation as exposed in trenches 6 and 11. (pl. 4) [1]

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[1] The beds in this section exposed in Trench 6 (pl. 13) and Trench 11 (pl. 18) are indicated by the symbol Twe.

Top of section

Green River formation

Morrow Creen member

Wasatch formation

Cathedral Bluffs tongue:

Covered interval, approximate composition and thicknesses as follows:

	Feet
Shale, green, interbedded with green subfissile to blocky claystone and green and gray-green siltstone	105
Siltstone and sandy siltstone, tan, buff, and light green.	50
Sandstone, coarse-grained and pebbly, gray, buff, and white.	60
Siltstone and claystone, olive green	20
Sandstone, coarse-grained and pebbly, white and tan.	55
Siltstone, green and buff.	30
Sandstone, coarse-grained, white	50
Claystone and siltstone, mottled green, brown and tan.	30

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Sandstone, medium-grained, white and buff	35
Siltstone, green, interbedded with green and maroon blocky claystone	35
(North end of Trench 11)	
Sandstone, poorly sorted, fine-grained to coarse-grained pebbly, brown-white, parts of the sandstone in the form of lenses, 6 inches to 4 feet in length, are well cemented by carbonate.	12
Claystone, silty, blocky, mottled maroon and gray-green.	2
Siltstone, pale brown in upper part, green at base	.5
Claystone, blocky, mottled maroon and gray-green. . . .	16
Siltstone, sandy, gray-green.	3
Sandstone, fine-grained to coarse-grained pebbly, brown-white	16
Siltstone, sandy, gray-green; 4 feet above base is a lens of brown-white to green-white sandstone, 2 feet thick, with one calcite cemented concretion, 1.5 feet in diameter, containing 0.25 to 0.5 inch concretions of pyrite	20

Wasatch formation

Cathedral Bluffs tongue -- Continued	Feet
Sandstone, brown-white to green-white, with sparse carbonate-cemented sandstone lenses, 6 inches to 2 feet in length; in center of unit is irregular lens of gray-green sandy siltstone, at least 5 feet in maximum thickness; unit is iron-stained at base	13
Claystone, sandy, gray-green mottled with maroon-brown, interbedded irregularly with brown-green siltstone	26
Claystone, sandy, gray-green mottled with maroon-brown, interbedded irregularly with brown-green siltstone and lenses of brown-white sandstone; iron-stained at base	12
Sandstone, coarse-grained pebbly, brown-white, with minor interbedded gray-white fine-grained sandstone; iron-stained at base.	17
Claystone, silty, blocky, green-gray	6
Siltstone and silty sandstone, irregularly interbedded, green and gray-green	29
Siltstone, maroon-gray, iron-stained at top and at base	2.5
Claystone and sandy claystone, irregularly interbedded, green and gray-green; contains two lenses of brown-white sandstone.	19
Faulted interval. Thickness of missing section unknown	--

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Claystone and sandy claystone, irregularly interbedded, green and gray-green	7
Siltstone, clayey, green-gray and gray-brown, interbedded irregularly with pale brown fine-grained sandstone.	8
Sandstone, coarse-grained pebbly, brown-white.	10
Faulted interval. Thickness of missing section unknown.	--
Sandstone, coarse-grained pebbly, brown-white.	23
Sandstone, coarse-grained pebbly, iron-stained, with thinly interbedded brown-green claystone.	.5
Sandstone, coarse-grained pebbly, brown-white, with minor interbedded pale brown siltstone	14
Claystone, silty, blocky, green-gray, interbedded irregularly with brown-white sandstone.	9
Sandstone, coarse-grained pebbly, brown-white.	14

(South end of Trench 11)

Covered interval, approximate composition and thickness as follows:-

Sandstone, coarse-grained, white and brown-white	25
Siltstone, gray-green and brown.	20
Sandstone, coarse-grained, brown-white	45
Claystone, green, interbedded with gray-green and brown siltstone.	50

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Siltstone, gray-green and brown, interbedded with green-white and buff-white fine-grained sandstone	70
Sandstone, coarse-grained, brown-white and white.	50
Claystone, green, interbedded with buff and green siltstone	20
Siltstone, buff and green-white, interbedded with buff and tan fine-grained sandstone.	65
Sandstone, buff-white	110
Claystone, green, interbedded with buff, brown, and pale green siltstone and sandy siltstone.	65
(North end of Trench 6)	
Siltstone, sandy, pale brown.	1
Shale, bright red	2
Siltstone, clayey, dull brown and dull green.	4
Siltstone, sandy, pale green.	6
Sandstone, coarse-grained, pale gray-green.	5
Siltstone, clayey, dark gray and pale maroon.	1.5
Siltstone, pale maroon, mottled irregularly with pale green sandstone	.5
Sandstone, medium-grained, pale green-gray.	1
Siltstone, pale maroon and pale green	5
Sandstone, medium-grained, pale green-gray.	1.5
Siltstone, pale maroon and pale green	2.5
Sandstone, partly silty, fine-grained, gray-green	7

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Sandstone, fine-grained, pale green, interbedded irregularly with pale maroon and pale brown siltstone	19
Claystone, dark brown and pale green, iron-stained at top	2.5
Siltstone, light tan, with minor interbedded medium-grained sandstone.	8
Siltstone, clayey, brown.	3
Sandstone, medium-grained, heavily iron-stained.	.8
Sandstone, medium-grained to coarse-grained pebbly, pale green-gray	10
Siltstone, sandy, light brown	.2
Sandstone, poorly sorted (silty to very coarse-grained), pale gray-green.	12
Siltstone, clayey, pale maroon-brown, with minor gray-green fine-grained sandstone	1
Sandstone, fine- to coarse-grained, pale gray-green	9
Claystone, dark brown and dark green.	6.5
Siltstone, clayey, pale maroon and green, interbedded with pale green fine-grained sandstone	4.5

Wasatch formation

Cathedral Bluffs tongue --Continued

	Feet
Sandstone, fine- to coarse-grained, pale gray, white, and brown-white	23
Sandstone, gray-white to brown-white, mottled with irregular masses of gray-green and pale maroon siltstone.	3
Claystone, silty, green, pale maroon, and gray-green, mottled irregularly with gray-green and green-brown siltstone, partly sandy. . . .	7
Sandstone, medium- to coarse-grained, brown-white to green-white, with minor similarly colored sandy siltstone.	4
Siltstone, clayey, pale brown, gray-green, and pale maroon	1
Sandstone, fine- to medium-grained, brown to brown-white, mottled with green-gray and pale brown sandy siltstone	4
Sandstone, white, green-white, and brown-white.	1.5
Siltstone, green-gray and pale maroon, mottled irregularly with pale green-brown silty sandstone	1.5
Claystone, silty, and sandy siltstone, mottled gray-green, maroon, and brown-gray	1.5
Sandstone, medium-grained, brown-white	2

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Claystone, silty, and sandy siltstone, mottled gray-green, maroon, and brown-gray.	1.8
Sandstone, medium- to coarse-grained, pale brown to green-white.	7
Siltstone and sandy siltstone, gray-green and maroon.	2.5
Sandstone, medium-grained, green-white to white	1
Siltstone and sandy siltstone, gray-green and maroon	1.5
Sandstone, medium- to coarse-grained, gray to light brown	9
Siltstone, sandy, pale green.	1.5
Sandstone, coarse-grained, yellow-tan	2
Siltstone, sandy, pale maroon, pale purple, and pale green.	4
Sandstone, coarse-grained, gray-green	3
Siltstone, mottled pale purple and pale green with minor pale green to tan fine- to coarse-grained sandstone	2
Sandstone, well sorted, interbedded fine-grained and coarse-grained pebbly, pale brown-green, irregularly iron-stained.	2.5
Siltstone, clayey, pale green	.5
Sandstone, well sorted, interbedded fine-grained and coarse-grained, pale brown	3.5

Wasatch formation

Cathedral Bluffs tongue --Continued

	Feet
Claystone, dark green-gray, iron-stained at top	.8
Sandstone, coarse-grained, light brown	1
Siltstone, clayey, pale green to purple, with minor interbedded pale brown fine-grained sandstone.	1
Sandstone, medium- to coarse-grained, gray-green, contains irregular lenses of green and purple clayey siltstone.	9
Siltstone, clayey, gray-green and purple-maroon, with minor interbedded fine-grained sandstone.	13
Sandstone, fine- to medium-grained, pale green, iron-stained at base	3
Claystone, blocky, green	1
Siltstone, pale brown-gray, irregularly iron-stained at top and at base	.2
Claystone, blocky, and silty claystone, green and gray-green	6
Shale, dark green-brown to dark brown-gray; at top is 1 inch of gray-purple claystone; unit is iron-stained at base.	.8
Sandstone, tan	.2
Sandstone, gray-green, complexly and irregularly inter-bedded with pale maroon and gray-green sandy siltstone.	8.5

Wasatch formation	feet
Cathedral Bluffs tongue -- Continued	
Siltstone, maroon and gray-green	.8
Sandstone, coarse-grained, green-white	1
Siltstone, maroon and gray-green	1
Sandstone, fine- to medium-grained, gray-green	.5
Siltstone, sandy, gray-green	1
Siltstone, maroon.	.2
Siltstone and sandy siltstone, gray-green, pale green, and minor maroon.	6
Sandstone, pebbly, gray-white to green-white	10
Sandstone, pebbly, gray-brown to brown-black	1
Sandstone, pebbly, gray-white to green-white	3
Siltstone and sandy siltstone, maroon-gray, brown-green, and gray-green, lenticular and discontinuous	1
Sandstone, pebbly, gray-white to green-white	2
Sandstone, medium- to coarse-grained, green-gray	3.8
Siltstone, dark green, purple at top and at base, interbedded with lenticular pale green-gray fine- to medium-grained sandstone.	1.8
Sandstone, medium- to very coarse-grained, gray-green	5
Claystone, silty, dark green-brown	.8
Sandstone, medium-grained, yellow-tan, iron-stained at base	.8
Claystone, silty, dark green-brown	1.5

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Claystone, purple	.2
Claystone, dark gray and dark blue-gray, silty near top.	4.5
Sandstone, medium- to very coarse-grained, gray, iron-stained in upper part.	7.5
Sandstone, medium-grained, pale brown	.5
Claystone, dark brown-green, iron-stained at top.	3
Sandstone, medium-grained, light tan, iron-stained at top.	1
Siltstone, dark green and brown, with minor interbedded blue-green fine-grained sandstone; 2 feet above base is a lens of gray to yellow-tan fine- to medium-grained sandstone, 1 foot thick	9
Sandstone, fine- to coarse-grained, gray-green; near base contains lenticular masses, 1 to 3 feet in length, of pale orange-brown well cemented sandstone	3.5
Sandstone, medium-grained to very coarse-grained pebbly, yellow-tan to green-gray	10
Siltstone, clayey, dark green and dark brown with irregularly interbedded green to gray-green fine-grained sandstone; near top contains lenticular masses, 1 to three feet in length, of pale orange-brown well cemented sandstone.	9

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Sandstone, medium- to coarse-grained, pale yellow and pale green-brown; minor dark green-gray claystone	5
Claystone, dark green-gray.	.5
Sandstone, fine- to coarse-grained, gray-green; minor interbedded brown siltstone	4.5
Sandstone, fine- to coarse-grained, pale green, interbedded as lenses with pale brown siltstone	3.5
Siltstone, clayey, dark brown	.5
Sandstone, fine- to coarse-grained, gray-green.	1.5
Siltstone, clayey, dark purple-brown and dark green, with interlensed pale yellow-brown and green-gray fine-to coarse-grained sandstone.	2.5
Sandstone, fine- to coarse-grained, pale yellow-brown and green-gray	4.8
Siltstone, clayey, purple-brown and brown-green	1
Sandstone, fine- to coarse-grained, brown-green	1.5
Siltstone, brown.	.8
Sandstone, fine- to coarse-grained, brown-green	2
Siltstone, brown.	.5
Sandstone, medium- to coarse-grained, green-gray, minor interbedded brown siltstone	3.8
Siltstone, clayey, dark purple-brown.	.5
Sandstone, medium- to coarse-grained, yellowish green-gray	2

Wasatch formation

Cathedral Bluffs tongue -- Continued

	Feet
Sandstone, fine-grained, gray-green, with dark brown clayey siltstone at top of unit	.8
Sandstone, medium- to coarse-grained, green-gray.	.8
Claystone, silty, maroon-brown, maroon-green, and purple; minor iron stain and pale green sandstone	1.5
Sandstone, fine- to medium-grained, gray-green.	1.8
Claystone, silty, maroon-brown to maroon-gray, irregular	.2
Sandstone, fine- to medium-grained, gray-green	.5
Claystone, silty, gray-green and maroon-brown	1.5
Sandstone, green-white, interbedded with maroon-brown, maroon, and maroon-gray silty claystone; at base is a discontinuous yellow-white to red-gray sandstone, 3 inches thick	5.5
Claystone, silty, yellow-white, lenticular.	.5
Total	1645.

(Near South end of Trench 6)

Green River formation

Tipton tongue

Section 4, stratigraphic section of lower part of Cathedral Bluffs tongue of Wasatch formation as exposed in Trench 3. _/

_/ Beds in this section are indicated by the symbol Twc on plate 10 (northern part of sections A-B and A' - B'; sections B-C, B'-C', C-D, and C'-D').

Top of measured section

Wasatch formation

Cathedral Bluffs tongue, lower part

	Feet
Sandstone, green, interbedded with maroon siltstone	11
Claystone, sandy, brown	1.8
Sandstone, coarse-grained, silty, yellow-brown.	15
Siltstone, maroon, iron-stained at base	1
Sandstone, coarse-grained, green-gray	3.8
Sandstone, coarse-grained, gray, interbedded with pale maroon siltstone.	4.5
Shale, bright maroon.	1.8
Siltstone, sandy, gray.	4.5
Sandstone, silty, coarse-grained, yellow-gray	10
Claystone, brown; minor interbedded pale green silty sandstone	10
Sandstone, silty, coarse-grained, gray.	15
Claystone, brown, discontinuous	.2
Sandstone, silty, coarse-grained, gray.	5
Siltstone, brown; minor interbedded green sandstone . . .	3
Claystone, brown, iron-stained at top	.5
Claystone, maroon, interbedded irregularly with green sandstone and yellow-brown silty sandstone. . . .	10

Wasatch formation	Feet
Cathedral Bluffs tongue, lower part -- Continued	
Claystone, brown, iron-stained at top	1
Claystone, maroon, interbedded irregularly with green sandstone and yellow-brown silty sandstone.	7
Sandstone, coarse-grained, yellow-brown and gray.	29
Sandstone, silty, fine-grained, green	.8
Claystone, blocky, green, brown, and yellow, iron-stained at top	8
Siltstone, sandy, yellow-gray	10
Sandstone, coarse-grained pebbly, gray and green-gray	16
Faulted interval. Thickness of missing section unknown . . .	-- --
Sandstone, silty, fine- to coarse-grained, gray; contains minor lenses of pale brown sandy siltstone.	15
Shale, dark brown, iron-stained at top and at base.	.2
Sandstone, silty, light brown, pale green at base	1.8
Claystone, dark brown	2
Siltstone, sandy, pale maroon	1.5
Sandstone, coarse-grained, pebbly, pale green-gray, iron-stained at top	8.5
Siltstone, brown, green, and red, interbedded with gray and green fine- to coarse-grained sandstone; iron-stained at top.	31
Claystone, purple-brown and dull green, iron-stained at top.	11
Siltstone, sandy, brown and green	1.2

Wasatch formation

Cathedral Bluffs tongue, lower-part -- Continued

	Feet
Sandstone, silty, fine-grained, pale green, iron-stained at top	2
Siltstone, light brown.	4
Sandstone, coarse-grained, brown-gray	3
Sandstone, fine-grained, pale brown	5
Faulted interval. Thickness of missing section unknown	--
Sandstone, fine-grained, pale brown	1
Sandstone, pale green; minor interbedded siltstone. . . .	.2.5
Claystone, brown, iron-stained at top	4
Sandstone, silty, pale brown-green.	5
Siltstone, green and brown.	.1.5
Siltstone, green-brown, interbedded with maroon and dark green clayey siltstone and green-brown fine- to coarse-grained sandstone; iron-stained at top.	7
Siltstone, clayey, brown and dark green, iron-stained at top	.2.5
Sandstone, coarse-grained pebbly, pale green to gray, with a tongue of brown and dark green clayey siltstone near top	5
Sandstone, fine- to coarse-grained, pale green, interbedded with brown siltstone.	14

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Siltstone, clayey, brown-green, iron-stained at top	5.5
Sandstone, fine-grained, brown-gray.	6
Sandstone, coarse-grained, green-brown	11
Sandstone, green-brown to brown-green, interbedded irregularly with maroon-brown and green claystone	11
Sandstone, coarse-grained, white to green-white, lenticular, irregular in thickness; brick red iron-stain at base	4
Siltstone, interbedded with sandstone, both pale green; unit is lenticular with irregular brick red iron-stain at base	1.5
Claystone, green-brown, with irregular lenses of pale green and brown-white sandstone.	3.5
Sandstone, pale green, irregularly iron-stained.	7
Sandstone, coarse-grained, pale green and brown-green, interbedded with pale green fine-grained sandstone.	8.5
Siltstone, sandy, brown-green.	1
Sandstone, coarse-grained, pale brown-green and light brown.	1.2
Claystone, pale brown-green and maroon, interbedded irregularly with pale brown-green sandstone; iron-stained at base.	3

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Claystone, blocky, dark brown-green to gray-green	4
Sandstone, brown-white to green-white, iron-stained at top and at base	.8
Claystone, brown-green to brown-gray	8
Sandstone, green-white to gray-white; with minor lenses of claystone	7
Claystone, blocky, gray-green, minor interbedded sandstone.	1.2
Sandstone, silty, gray-green	6
Claystone and sandy claystone, gray-green.	2.5
Claystone, light brown, brown-purple at top and at base	.2
Claystone and sandy claystone, gray-green	1.2
Sandstone, green-white to white, interbedded irregularly with gray-green and light brown siltstone	11
Sandstone, green-gray, interbedded irregularly with mottled maroon-gray and green-gray siltstone.	11
Sandstone, white, brown-white, and green-white, iron-stained at top and at base.	.8
Claystone, yellow-green, iron-stained; at base is layer of purple claystone, 1 inch thick.	1.2

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Shale, gray to brown-green, with discontinuous lenses of brown-white sandstone, 0.8 foot thick, about 0.2 foot above base	3.8
Sandstone, white, with pale green and maroon clayey sandstone distributed irregularly at top and at base, irregular.	.5
Total thickness of measured section	420

Green River formation

Tipton tongue

Section 5, stratigraphic section of lower part of Cathedral Bluffs tongue of Wasatch formation as exposed in Trench 12. _/

_/ Beds in this section are indicated by the symbol Twc on plate 19.

Top of measured section

Wasatch formation

Cathedral Bluffs tongue, lower part: -- Continued

Sandstone, coarse-grained pebbly, gray-white	24
Claystone, sandy, green and maroon	2.5
Sandstone, coarse-grained pebbly, white.	14
Sandstone, coarse-grained, brown-white to white, interbedded with irregular lenses of mottled green, maroon, and pale brown sandy claystone	12

Wasatch formation

Cathedral Bluffs tongue, lower part:--Continued

	Feet
Claystone, sandy, mottled green, maroon, and pale brown, interbedded with green-white sandstone	9
Sandstone, coarse-grained, green-white to brown-white	5
Siltstone, sandy, brown-green and maroon-gray, interbedded irregularly with green-white silty sandstone	9
Sandstone, pebbly, green-white.	1
Sandstone, silty, brown-green and maroon-gray	1
Sandstone, pebbly, green-white.	4.5
Siltstone, sandy, and silty sandstone, mottled gray-green, maroon-gray, and buff-brown	2.5
Sandstone, pebbly, gray-white	3.5
Siltstone, sandy, and silty sandstone, mottled gray-green, maroon-gray, and buff-brown.	8
Sandstone, fine-grained to coarse-grained pebbly, brown-white	7.5
Siltstone, sandy, and silty sandstone, mottled gray-green, maroon-gray, and buff-brown.	14
Sandstone, medium-grained to coarse-grained pebbly, green-white	2.5

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Sandstone, silty, brown-green and maroon-gray, interbedded with brown-green sandy claystone	7.5
Sandstone, pebbly, green-white	1.2
Sandstone, coarse-grained, pale green, with minor interbedded varicolored siltstone.	14
Claystone, sandy, gray-green, maroon-gray, and buff-brown, interbedded with green-white sandstone.	3.2
Sandstone, coarse-grained, pale brown-green.	6
Claystone, sandy, gray-green, maroon-gray, and buff-brown, interbedded with green-white sandstone.	13
Sandstone, gray-green, minor interbedded maroon siltstone.	9.5
Siltstone, sandy, pale brown and maroon-gray, interbedded irregularly with pale green sandstone; at top is layer of maroon-brown claystone, 1 to 6 inches thick	8
Sandstone, coarse-grained, white	9
Siltstone, gray-green and maroon-gray, interbedded with green-white sandstone	16
Sandstone, coarse-grained, green-white	3.5
Siltstone, gray-green and maroon-gray, interbedded with green-white sandstone	15
Sandstone, coarse-grained, green-white	6.5

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Claystone, blocky, dark maroon-gray	2
Sandstone, fine- to coarse-grained, green-white to pale green	15
Siltstone, sandy, gray-green and maroon-gray, interbedded with green-white sandstone	15
Sandstone, green-white, with minor interbedded siltstone	13
Siltstone, sandy, gray-green and maroon-gray, interbedded with green-white sandstone.	6.5
Sandstone, green-white, with minor interbedded siltstone	10
Sandstone, green-white, interbedded with gray-green and maroon-gray sandy siltstone	9
Sandstone, green-white, with minor interbedded siltstone	6.5
Sandstone, green-white, interbedded with gray-green and maroon-gray sandy siltstone	23
Claystone, blocky, green-gray	3
Sandstone, green-white, interbedded with brown-green to gray-green sandy siltstone	4
Claystone, blocky, gray	.5
Sandstone, green-white, interbedded with brown-green to gray-green sandy siltstone	14.5
Total thickness of measured section	354.4

Green River formation

Tipton tongue

Section 6, stratigraphic section of lower part of Cathedral Bluffs tongue of Wasatch formation as exposed in Trench 13._/

_/ Beds in this section are indicated by the symbol Twc in the northern part of Trench 13 (pl. 20, sections C-D, C'-D', D-E, D'-E', and E-F, E'-F')

Wasatch formation

Cathedral Bluffs tongue, lower part:

	Feet
Claystone, sandy, blocky, mottled brown-gray and maroon-gray; contains irregular discontinuous layers of iron-cemented sandstone, 0.5 to 1 inch thick; at base is discontinuous layer of iron-cemented sandstone, 1 inch thick. . . .	10
Sandstone, poorly sorted, medium-grained to pebbly, red-gray to yellow-white, contains sparse carbonate-cemented sandstone concretions, 4 to 12 inches in diameter.	8
Sandstone, silty, gray, lenticular.	1.5
Sandstone, poorly sorted, medium-grained to pebbly, red-gray to yellow-white; contains one irregular lens of buff-green silty sandstone, at least 4 feet thick; base of unit is iron-stained.	18
Sandstone, silty, buff-green; at base is irregular lens of brown-gray clayey siltstone about 0.5 foot thick	5

Wasatch formation

Cathedral Bluffs tongue, lower part. -- Continued

	Feet
Sandstone, pebbly, poorly sorted, red-gray to gray-brown; contains sparse carbonate-cemented concretions, 6 to 12 inches in diameter	12
Sandstone, silty, buff-green; at base is red-brown, iron-stained sandstone, 1 inch thick	5
Sandstone, coarse-grained, pebbly, brown-gray; contains sparse carbonate-cemented sandstone concretions, 6 inches in diameter	18
Sandstone, clayey, gray-brown, lenticular	3
Sandstone, coarse-grained, pebbly, gray, irregularly iron-stained, but stain is heavy near base	9
Sandstone, coarse-grained, pale brown	1
Claystone, silty, blocky, gray to brown-gray, with lenses of pale red-brown to brown-white fine- to coarse-grained sandstone, 6 feet in maximum thickness	10
Sandstone, fine-grained and brown-gray in upper part, grading to coarse-grained and pale brown in lower part; contains one lens of brown-gray silty claystone, 0.5 foot thick	22_/

_/ Thickness only approximate. Bed is cut by a fault, displacement along which is unknown.

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Sandstone, silty, pale brown, irregularly interfingered with next unit below.	5
Claystone, silty, blocky, pale green-gray, with maroon blocky claystone layers, 1 inch to 2 inches thick, along lenticular contacts; contains lenses of brown, gray, and brown-white sandstone, as much as 3 feet thick	10
Sandstone, coarse-grained in upper part, fine-grained in lower part, pale green-white, gray, and brown-white.	10
Sandstone, well-sorted with pebbly layers alternating with finer grained layers; contains one lens of gray clayey siltstone, 1 foot thick; at base is discontinuous lens of gray to gray-brown blocky claystone, 0.5 foot thick	18 _/

_/ Thickness only approximate. The unit is cut by faults; displacement is known on only one of the faults.

Sandstone, silty, brown-gray	6
Siltstone, clayey, brown-gray, very irregular and interfingered with lenses of brown-white sandstone.	7

Wasatch formation

Cathedral Bluffs tongue, lower part -- Continued

	Feet
Sandstone, fine-grained and green-gray in upper part, coarse-grained and pale brown to red-brown in lower part	30 _/

_/ Thickness only approximate. Unit is cut by numerous faults, the displacements along which are unknown.

Claystone, gray	2
Sandstone, white to brown-gray.	6
Faulted interval. Thickness of missing section unknown	—
Claystone, silty, and siltstone, mottled gray, pale brown, and maroon.	3
Sandstone, fine-grained, finely interbedded with siltstone, iron-stained, gray to brown-white.	.5
Total thickness of measured section	220

Green River formation

Tipton tongue

<u>Green River Formation</u>.-- The Green River formation was first named the Green River shales by Hayden (1869, p. 89-92) for the sequence of thinly laminated shales near Green River, Wyoming. The formation is divided into four members, from oldest to youngest, 1) Tipton tongue, and 2) Laney shales, named by Schultz (1920, p. 27-28, 30), 3) Tower sandstone lentil (Powell, 1876, p. 45, 63), and 4) Morrow Creek member (Bradley, 1926, p. 123). The Green River formation covers an area of more than 25,000 square miles, with an average thickness of about 2,000 feet (Bradley 1929, p. 88). The formation is made up of fresh water lake deposits, light gray, buff, and brown, varved and thin-bedded marlstone, oil shale, oolitic limestone and bedded algal deposits. Fossil fish, plants, gastropods and ostracods are common. Locally limy sandstone or sandy marlstone make up facies of the formation (Bradley, 1945).

The Tipton tongue and the Morrow Creek member are the only parts of the Green River formation exposed in the Lost Creek area (pl. 2).

<u>Tipton Tongue</u>.--The Tipton tongue is the middle subdivision of the Green River lake deposits. It is present over most of southwest Wyoming, as the major unit of the Green River formation. Bradley (1926, Plate 59) and Pipiringos (1955) described the general stratigraphic relationship of the Tipton tongue to the other formations in various parts of the Green River Basin.

In the Lost Creek area the Tipton tongue is near its northeastern limit of deposition, within the area of shoreline fluctuation, and is made up of several lenticular extensions, which interfinger with the Wasatch formation. Only the uppermost "tongue" is exposed in the exploration area. One or more lower tongues may be present south of the exploratory trenches within the area of plate 2, but thick overburden prevented accurate mapping of the tongues. They were mapped together with the Wasatch formation as an undifferentiated unit. On the geologic maps, plates 2 and 4, the top contact of this upper extension of the Tipton tongue is the contact of the undifferentiated unit.

Plates 5, 6, and 7 show the configuration of the uppermost Tipton tongue in the eastern part of the main exploration area. This shale tongue is 53 feet thick in Trench 1 (pl. 8), 52 feet thick in Trench 12, (pl. 19) and 20 feet thick in Trench 13, (pl. 20) showing a general thinning toward the east. It consists predominantly of thin-bedded, lamellar, and subfissile brown and gray-brown shale, with lesser amounts of brown-green, gray-green, and yellow-brown shale and subfissile claystone, and a few thin beds of tan to cream-colored, waxy, bentonitic claystone, pale green bentonitic claystone and gray to brown-white sandstone. Parts of the shale locally contain limestone concretions and nodules, 0.5 inch to 5 inches in diameter. In a few exposures, thin discontinuous seams of lignite up to 1 inch thick are interbedded with the shale.

Some of the beds in the Tipton tongue in the exploration area are persistent enough to be used for local correlation across faults in the trenches and from trench to trench. It was not possible to obtain perfect correlation of all the subdivisions of the Tipton sequence in going from trench to trench, because some of the exposures in the trenches are incomplete and because some of them are complexly faulted. Although no sharp erosional channels were observed at the contact of the Tipton with the overlying Cathedral Bluffs tongue, the local absence of some of the subdivisions in the Tipton sequence can probably be explained by local unconformities at the top of the Tipton.

The only complete exposures of the upper extension of the Tipton tongue are in Trenches 1, 12, and 13. An incomplete section of this "tongue" in Trench 3 is 70 feet thick, thicker than any of the other exposures. This thickening may have been an original sedimentary feature, or it may be an apparent thickening caused by erosion of the upper part of the Tipton elsewhere in the area. It could also be caused by undetected faults in the shale beds, but corrections for known faults were made in calculating the thickness.

The uppermost Tipton tongue was exposed in Trenches 1, 3, 4, 6, 8, 12, and 13, (pls. 8, 10, 11, 13, 15, 19, and 20). Details of the stratigraphy were recorded only in Trenches 3, 8, 12, and 13, as shown by the following stratigraphic sections:

Section 7, stratigraphic section of Tipton tongue of Green River formation as exposed in Trench 8. _/

_/ Beds in this section are indicated by the symbol Tgt on plate 15 (sections A-B, A' -B')

Top of measured section

Wasatch formation

Cathedral Bluffs tongue

Green River formation

Tipton tongue:

	Feet
Shale, brown-green to brown-gray, iron-stained	1.7
Shale, brown-green	1

Green River formation

Tipton tongue: -- Continued

	Feet
Sandstone, fine-grained, biotitic, gray	.2
Shale, brown-green to gray-green; contains limestone concretions, 1.5 inches thick and 5 inches long . . .	3.5
Sandstone, fine-grained, gray-white	.2
Shale, brown to brown-gray; contains a 1.5-inch layer of green-gray clayey fine-grained sandstone, 1.7 feet above base; shale above sandstone layer is iron-stained	2.5
Claystone, waxy, bentonitic, cream colored.	.2
Shale, brown to brown-gray.	2 (+)
Faulted interval. Thickness of missing section unknown	--
Total thickness of measured section	11.3

Section 8, stratigraphic section of Tipton tongue of Green River formation as exposed in Trench 3. _/

_/ This is a section of the large southernmost exposure of the Tipton tongue (Tgt) in Trench 3 (pl. 10, southern part of sections A-B and A' - B')

Top of measured section

Wasatch formation

Cathedral Bluffs tongue

Green River formation

Tipton tongue

	Feet
Shale, brown and brown-gray, iron-stained; contains discontinuous seam of gypsiferous lignite, 1 inch thick, 3.5 feet above base; jarositic stains near top	5.5
Shale, brown and brown-gray	3.5
Claystone, waxy, bentonitic, tan, iron-stained.	.2
Shale, brown and brown-gray	6
Claystone, pale green	.5
Shale, brown and brown-gray; at base is an iron-stained, light brown layer of silty sandstone, 1.5 inches thick.	6.5
Claystone, blocky, yellow-green to yellow-brown, iron-stained; contains limestone concretions, 0.5 inch to 3 inches in diameter.	1.2
Shale, brown; 3.5 feet below top is fossil locality No. 1	7

Green River formation

Tipton tongue -- Continued

	Feet
Sandstone, cemented, white, iron-stained, irregular in thickness	.3
Shale, brown	1.2
Sandstone, cemented, white, iron-stained, irregular in thickness	.3
Faulted interval. Thickness of missing section unknown	--
Claystone, blocky, green, iron-stained; contains irregular lenses of limestone	13
Faulted interval. Thickness of missing section unknown.	--
Shale, brown	25
Lower beds not exposed.	
Total thickness of measured section	70.2

Section 9, stratigraphic section of Tipton tongue of Green River formation as exposed in Trench 12. _/

_/ Beds in this section are indicated by the symbol Tgt on plate 19 (sections A-B and A'-B')

Top of section

Wasatch formation

Cathedral Bluffs tongue

Green River formation

Tipton tongue:

	Feet
Shale, brown-green	1.5
Claystone, waxy, bentonitic, gray.	.2
Shale, brown	4
Claystone, bentonitic green-white	.3
Shale, brown.	7
Sandstone, partly cemented, gray-white, iron-stained at top and at base	.7
Shale, brown to brown-gray; contains a discontinuous seam of lignite, 1/4 inch thick, 0.5 foot below top	10
Faulted interval. Thickness of missing section unknown	--
Claystone, sandy, brown-green, interbedded with gray-white sandstone.	4
Sandstone, brown-white, iron-stained at base; contains a cemented sandstone lens, 1 foot long, and minor interbedded gray claystone.	5

Green River formation	Feet
Tipton tongue: -- Continued	
Shale, gray-green, partly blocky near top	6
Claystone, bentonitic, green-white.	.2
Shale, gray-green	1.3
Shale, brown, iron-stained at base.	12.5
Total thickness of measured section	52.7

Hiawatha member of Wasatch formation and lower interfingering tongues of Tipton tongue of Green River formation, undifferentiated. _/

_/ The beds immediately below the above section of Tipton tongue in Trench 12 probably belong to the Hiawatha member of the Wasatch formation. The Hiawatha beds are described in Section 1. The new name, Niland tongue of the Wasatch formation, as proposed by Pipiringos (1955, p. 100-102), probably can be extended to these beds, here designated as Hiawatha.

Section 10, stratigraphic section of Tipton tongue of Green River formation as exposed in Trench 13._/

_/ This is a section of the large northernmost exposure of the Tipton tongue (Tgt) in Trench 13 (pl. 20, northern part of sections B-C and B'-C', southern part of sections C-D and C'-D')

Top of section

Wasatch formation

Cathedral Bluffs tongue

Green River formation

Tipton tongue:

	Feet
Shale, pale brown, gray-brown, and brown-gray	2
Sandstone, fine-grained, green; bed lenses out up dip.	.2
Shale, pale brown, gray-brown, and brown-gray; 1.2 feet above base is 0.5-inch layer of green-gray sandy biotitic claystone.	2
Claystone, gypsiferous, gray-white.	.1
Shale, gray-brown, iron-stained	1
Claystone, waxy, bentonitic, cream-colored.	.2
Shale, pale brown, gray-brown, and brown-gray; contains minor yellow-brown silty claystone in layers 1 inch thick; a discontinuous iron-stained layer in the shale has an average thickness of 9 inches and is 1 to 2 feet below the top of the unit . .	12

Green River formation

Tipton tongue: -- Continued

	Feet
Claystone, waxy, bentonitic cream-colored; bed lenses out up dip	.2
Shale, pale brown, gray-brown, and brown-gray; contains minor yellow-brown silty claystone in layers 1 inch thick.	1.2
Shale, brown and gray-brown, iron-stained; at base is discontinuous layer of brown and red-brown iron-cemented sadstone with average thickness of 1 inch	1.5
Total thickness of measured section	20.4

Hiawatha member of Wasatch formation and lower interfingering tongues of Tipton tongue of Green River formation, undifferentiated.

Several sets of Green River fossils were collected in the Lost Creek area. At Fossil Locality 1 (FL-1, pl. 2, and pl. 10, section A-B) in Trench 3 the following fossils were obtained from the brown shale of the upper extension of the Tipton tongue: *Mioplosus* cf. *beani*, *Phareodus* sp?, and a matted mass of smooth ostracod valves. *Mioplosus* cf. *beani*, a Green River fish, is illustrated in pl. 21. At Fossil Locality 4 (Fl-4, pl. 2) a coquina layer in brown shale contains abundant ostracods. Data on these ostracods and the fossils listed above are given in table 1.

Fossil Locality 4 is in a part of the Tipton, which is about 150 feet stratigraphically lower than the Tipton "tongue" mapped in the exploration area. This shale unit at Fl-4 has been mapped as the Tipton tongue by Pipiringos (oral communication, 1954).

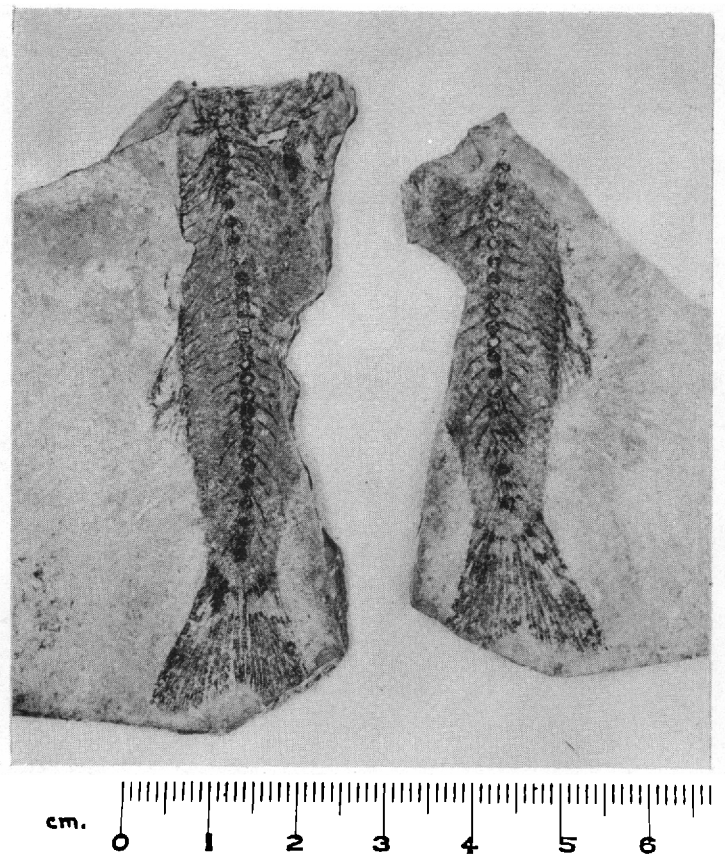


Plate 21. Green River fossil fish, Mioplosus cf. beani, in brown shale of the uppermost lenticular extension of the Tipton tongue, Green River formation (Fossil locality 1, pl. 2, pl. 10, table 1). Photograph is about 1.2 times natural size.

Morrow Creek Member.--The Morrow Creek member was named by Bradley (1926, p. 23 and pl. 59) for the sequence of lacustrine sedimentary rocks at the top of the Green River formation. It is a distinct lithologic unit that, in the Lost Creek area, overlies the Cathedral Bluffs tongue of the Wasatch formation and underlies the Bridger formation (pl. 3).

The Morrow Creek member in the Lost Creek area is about 240± feet thick and is characterized by a series of well cemented, gray to brown, white-weathering sandstones with cement in part silica and in part carbonate. Some of the sandstone beds are arkosic. Between the well cemented sandstone beds are brown-white friable sandstone and gray, green, and brown-gray siltstones and claystones.

The Morrow Creek member extends from the western boundary of the geologic map, pl. 2, southeastward along the southern limb of a syncline, curves around the southeastern nose of the syncline and northwestward along the northern limb of the syncline. Pipiringos (oral communication, 1954) has traced the same sequence, farther to the west.

The designation of the Morrow Creek member in the Lost Creek area was based largely on lithologic characteristics. The base of the Morrow Creek was arbitrarily assigned to a thin well indurated sandstone bed, which overlies a green claystone bed at the top of the Cathedral Bluffs tongue. The top of the member was assigned to a limestone bed containing characteristic lobate algal structures. These lobate structures are *Chlorellopsis coloniata* Reis, with thick covering layers of *Rivularia*-like mats (FL-5, FL-6, pl. 2; table 1). A well-cemented sandstone bed 33 feet below the top of the Morrow Creek is irregularly fossiliferous along strike; it contains *Unio shoshonesis* White and *Goniobasis nodulifera* Meek (FL-2, pl. 2; table 1). None of these fossils are diagnostic; they are useful only in local correlation of beds.

The following stratigraphic section of the Morrow Creek is exposed east of Lost Creek on the south limb of the syncline (Section 11, pl. 4).

Section 11, stratigraphic section of Morrow Creek member of Green River formation, as exposed on south limb of syncline along Cyclone Rim east of Lost Creek and north of Osborne Draw. (pl. 4)

Top of section

Bridger formation

Green River formation

Morrow Creek member:

	Feet
Limestone, partly sandy and partly clayey, partly silicified with lobate algal structures (fossil locality number 5, table 1), green-brown to green-white	.8
Claystone, silty, blocky, green-brown; contains limestone nodules	13.5
Covered interval. Composed predominantly of brown and brown-green siltstone interbedded with thin layers of buff-white fine-grained well-sorted sandstone	18
Sandstone, medium- to coarse-grained, gray to pale green-brown, weathering white, well cemented but only part of the cement is carbonate, rest of cement is silica or hardened clay; fossiliferous (fossil locality No. 2, table 1) but fossil content is discontinuous along strike of bed. This bed caps much of the Cyclone Rim east of Lost Creek and forms north-facing dip-slopes	4.8

Green River formation

Morrow Creek member: -- Continued	Feet
Sandstone, fine- to medium-grained, friable, brown-white to white	8
Claystone, silty, gray	2.2
Sandstone, fine- to medium-grained, well cemented (silica), gray.	.5
Claystone, fissile in upper part and blocky in lower part, pale green.	2.2
Siltstone, clayey, brown-gray; contains 3/4-inch limestone nodules	10.5
Sandstone, fine-grained, white, massive, well-cemented by carbonate.	1.8
Sandstone, fine-grained, friable, gray	3.2
Sandstone, medium-grained, massive, well-cemented, white.	.8
Siltstone, brown-gray.	2
Sandstone, fine- to medium-grained, well cemented by carbonate, pale brown-white; fossiliferous.	.5
Sandstone, brown-white, friable; contains a layer of green-gray shale, 2 inches thick, in middle of bed	3.5
Sandstone, medium-grained, white, massive, cemented	.5

Green River formation

Morrow Creek member -- Continued

	Feet
Siltstone, clayey, creamy white to brown-white, partly fissile	21
Covered interval. Composed of interbedded green fissile claystone, brown-gray and green-gray siltstone, and brown-white and white friable medium-grained sandstone. About 50 percent claystone, 30 percent siltstone, and 20 percent sandstone. Base of Morrow Creek member assigned to a thin cemented sandstone bed, which overlies green claystone of the Cathedral Bluffs tongue in the area to the east of the section (projected to the section on the basis of float). Thickness of this covered interval	145
Total	238.8

Wasatch formation

Cathedral Bluffs tongue

<u>Bridger formation</u>.--The Bridger formation was named by Hayden (1869, p. 191) for a series of rocks near Old Fort Bridger, Wyoming. It consists, in various parts of southwest Wyoming, of poorly consolidated lenticular beds of sandstone, gray, and green-gray clay, shale, and mudstone, volcanic ash beds, and light gray marlstone, limestone, and chert beds. The base of the Bridger is indistinct; the Bridger lithology grades into the lithology of the underlying Morrow Creek member

of the Green River formation (Sears and Bradley, 1924, p. 95). The Bridger commonly weathers into pronounced badlands and the beginning of the badlands type of weathering is usually drawn as the base (Bradley, 1926, p. 123).

The writers mapped a sequence of rocks about 245± feet thick in the Lost Creek area as the Bridger formation, largely on the basis of lithologic similarities with parts of the formation exposed elsewhere in Wyoming. The Bridger sequence in the Lost Creek area is characterized by interbedded limestones and friable biotitic sandstones. Some of the limy beds are argillaceous and siliceous. Many of the beds contain abundant volcanic material. A thin section of one carbonate-cemented fine-grained sandstone contained abundant remnants of shards. According to Sinclair (1906), almost the entire Bridger formation has been found to be of volcanic origin-tuffs and tuffaceous shales, sandstones, and marls.

On the geologic map, plate 2, the Bridger formation extends from the western boundary southeastward along the southern limb of a syncline. On the east side of Lost Creek the Bridger forms the entire central part of the syncline. Love and others (1955) also show the Bridger formation in a similar pattern in the Lost Creek area. Pipiringos (oral communication, 1954) has traced the same sequence farther to the west. The writers have mapped the base of the Bridger as immediately overlying the characteristic algal horizon, which occurs at the top of the Morrow Creek member of the Green River formation. The upper part of the Bridger sequence in the Lost Creek area is truncated by an unconformity. In the western part of the area (pl. 2) the Bridger sequence is overlain by Oligocene (?) conglomerates. In the vicinity of Soda Lake and on the east side of Lost Creek, the Oligocene (?) conglomerates and the basal conglomerates of the Miocene sequence are absent, and the Bridger is overlain directly by Miocene tuffaceous sandstones. The general stratigraphic relations of the Bridger formation in the Lost Creek area are shown on plate 3.

Fossils found in the Bridger sequence in the Lost Creek area include Australorbis spectabilis (Meek) and some laminated algal structures suggestive of the form genus collenia (table 1). Some of the limy beds contain abundant ostracods.

The stratigraphic section given below is located just east of Lost Creek on the southern limb of the syncline.

Section 12, stratigraphic section of Bridger formation, as exposed just east of Lost Creek on south limb of syncline. (pl. 4)

Top of section

Tuffaceous sandstone (Miocene)

UNCONFORMITY

Bridger formation

	Feet
Claystone, subfissile, green to brown-green, biotitic. . . .	1
Covered interval. Approximate composition: green and gray-green micaceous siltstone interbedded with shaly green claystone, scattered small lenses of limestone, and thin beds of well-sorted fine-grained sandstone. . . .	23

Bridger formation -- Continued

	Feet
Claystone, generally calcareous and locally silicified, pale green-yellow; contains turtle fragments. On the north side of the syncline, this same bed contains algal structures (fossil locality No. 7 pl. 2), but algal structures seem to be lacking in the limited exposure on south side of syncline. This bed is locally a ridge-former	1
Siltstone, siliceous, gray to brown-gray, massive, possibly tuffaceous (?), breaks with conchoidal fracture	12.5
Sandstone, medium-grained, pale brown-gray, biotitic, poorly cemented by carbonate, possibly tuffaceous (?). . . .	4.5
Limestone, siliceous, white, minor biotitic material	.8
Sandstone, medium-grained, gray-brown, biotitic, friable . . .	1
Limestone, siliceous, brown-white	.5
Sandstone, medium-grained, brown-gray in upper part, green-gray in lower part, biotitic, friable	5.7
Sandstone, fine-grained, silty, gray, well cemented by carbonate, biotitic, tuffaceous, massive	2
Sandstone, medium-grained, brown-gray to brown-green, iron-stained, biotitic, friable	5.2
Siltstone, clayey, brown-gray, subfissile.	6
Siltstone, silicified, green to green-gray	4
Sandstone, fine-grained, brown-gray, biotitic, friable	2.8
Claystone, gray-green, blocky.	2
Limestone, argillaceous, white, abundant ostracods	.8

Bridger formation -- Continued

	Feet
Claystone, gray-green, blocky	2.2
Limestone, argillaceous, silicified (?), white to brown-white	.5
Sandstone, fine-grained, brown-green, biotitic, friable	1.5
Covered interval, approximate composition and thicknesses as follows:	
Claystone, blocky, gray-green, interbedded with green to gray-green micaceous siltstone.	26
Sandstone, fine-grained, friable, light brown-green, interbedded with green to gray-green siltstone	25
Claystone, blocky, gray-green, interbedded with green to gray-green micaceous siltstone.	33
Sandstone, fine-grained, friable, light brown-green, interbedded with green to gray-green siltstone.	22
Siltstone, brown and green-brown	8
Limestone, argillaceous, white and brown-white	2
Siltstone, brown and green-brown	10
Limestone, argillaceous, partly silicified, white and brown-white; local algal structures	4
Siltstone, subfissile, green	35
Total	242

Green River formation

Morrow Creek member

Oligocene (?) rocks

To the west of Lost Creek along Cyclone Rim, a series of boulder conglomerates is separated by unconformities from the Bridger formation below and from the Miocene rocks above. This conglomerate unit may be equivalent to the Bishop conglomerate, or the lower Browns Park formation, both of Miocene age. However, because of the proximity and similar lithology to the lower part of the White River group just north of the mapped area, it has been designated as Oligocene (?), correlative with the similar White River conglomerates (Bauer, 1934).

The conglomeratic section was not measured, but the thickness along Cyclone Rim to the west is about 100 feet. It thins rapidly toward the east and disappears about 1-1/4 miles west of Lost Creek, (pl. 2). The conglomerate is composed of boulders and pebbles of crystalline igneous and metamorphic rocks, with sandstone and quartzite in a fine to granular quartz sand matrix.

In an area about 25 miles west of Lost Creek, Nace (1939) described and named a sequence of coarse detrital rocks above the Bridger formation as the Continental Peak formation (Eocene), overlain by the Beaver Divide conglomerate member of the Chadron formation (Oligocene). The writers experienced difficulty in clearly delineating a "Continental Peak lithology" in the Lost Creek area. Most of the sequence mapped in the Lost Creek area as Oligocene (?) rocks directly overlies typical Bridger sedimentary rocks and has a lithology similar to that described by Nace as the Beaver Divide conglomerate.

Miocene rocks

Above the Oligocene (?) rocks in the Lost Creek area is a sequence of tuffaceous sedimentary rocks ranging in thickness from about 40 feet east of Lost Creek (pl. 2) to a probable maximum of about 400 feet west of Lost Creek. This sequence of rocks is lithologically indistinguishable from beds of middle Miocene age in the vicinity of Split Rock (McGrew, 1951), about 20 miles northeast of the Lost Creek area. On the basis of this similarity of lithology, the sequence at Lost Creek was designated as Miocene by the authors. It may be equivalent in part to the Browns Park formation in the southern part of the Washakie Basin, and in part to the North Park formation.

The base of the Miocene rocks in the Lost Creek area consists of a conglomerate of variable thickness grading upward into gray and white medium and fine-grained sandstones, with lenses and thin beds of gray and green marl, clay and, volcanic ash. The basal conglomerate is present only in the area extending westward from Soda Lake (pl. 2). East of Soda Lake the basal conglomerate is absent and the sandstones rest directly on the Bridger formation.

Overlying the basal sequence is a thick series of pink, pinkish-gray, and gray, fine-grained sandstone, tuffaceous sandstone, and volcanic ash. Local unconformities occur within the formation, and an angular unconformity separates it from the underlying Oligocene (?) and Eocene rocks.

The series of Miocene rocks in the Lost Creek area had previously been assigned by Wyant and others (1951, p. 51) to the Chadron formation of the White River group, lower Oligocene in age. Nace (1939) also assigned similar rocks in the area west of Lost Creek to the Chadron formation. The writers of the present report believe, however, that the Oligocene (?) conglomerates (pl. 2) are the only remnants of the White River group left, and that the tuffaceous sandstones above them are of much younger age.

Quaternary deposits

Quaternary deposits consisting of fluviatile, lacustrine, alluvial, colluvial, and eolian sediments overlie much of the Tertiary bedrock in the Great Divide Basin. In some parts of the basin the sites of Pleistocene lakes are indicated by broad shallow depressions. During Pleistocene and Recent time there was development of a number of extensive terraces, both depositional and erosional, remnants of which are still discernible over most of the Great Divide Basin.

There are at least eight discernible levels of terracing in the Lost Creek area, two of which are probably Recent. No attempt has been made here to delineate these terraces or to evaluate the geomorphic significance of the surfaces.

The varied character and distribution of the Quaternary sediments indicate a complex physiographic history since Tertiary time. Because the deposits are complex in detail and because the exact age of much of the surficial material is indeterminate, the surficial deposits in the Lost Creek area were not differentiated as Pleistocene and Recent, but are shown on the various illustrations simply as Quaternary deposits. Only the thickest deposits and some of the prominent high terraces, some of which are capped by conglomerate beds, are shown on the geologic maps, (pls. 2 and 4). Much of the remaining area, shown as Tertiary bedrock, is actually mantled by Quaternary overburden. The presence of thin overburden over much of the area is indicated by the abundant concealed contacts and concealed faults shown on plates 5, 6, and 7.

The sites of deposition and erosion probably shifted frequently in Pleistocene and Recent time. Numerous examples of old channel sands were found in the surficial material. In some instances the thickest alluvium occurs on topographic highs, indicating that the present erosional pattern has shifted from preceding patterns.

The lithologic character of the Quaternary deposits in the Lost Creek area is extremely varied. Along Lost Creek and its tributaries the alluvium and colluvium are predominantly gray-brown sandy clay and silty clay, with irregularly distributed coarse pebbly sand lenses, representing the former sites of stream channels. The maximum thickness of the alluvial deposits along Lost Creek could not be determined but is probably more than 8 feet. In the parts of the area away from present stream courses the Quaternary deposits are partly alluvial and partly colluvial, and they range in thickness from 6 inches to over 8 feet.

An unconformity at the base of the Quaternary alluvium and colluvium truncates the northward-dipping Eocene strata in the exploration area. In cross-section the unconformity ranges from a relatively smooth, regular surface, as in Trench 2 (pl. 9), to a highly irregular, complexly channeled surface, as in part of Trench 1 (pl. 8, section A-B). Near the south end of Trench 9 (pl. 16) irregular erosional remnants of claystone in the Cathedral Bluffs tongue protrude upward into the Quaternary alluvium; elsewhere in Trench 9, sharp erosional channels were cut in other claystone and sandy claystone beds in the Cathedral Bluffs tongue.

Source of sediments

All of the sediments in the Lost Creek area seem to have originated from the north. The Paleocene sediments were apparently derived mostly from the ancestral Sweetwater mountains - the Sweetwater arch, which was a prominent positive area during late Cretaceous and early Tertiary time. There are no clear stratigraphic relationships in the Lost Creek area upon which to base a statement of origin and source of sediments for the early Tertiary deposits. The middle Eocene sediments are the first to give clues as to the source.

The Wind River mountains, about 20 miles northwest of the Lost Creek area, probably furnished much of the middle Eocene sediments carried into the area. The Wind River range contains considerable coarsely crystalline granite; the middle Eocene stream channel deposits contain fresh and angular grains and are generally arkosic, suggesting that they probably came from the Wind River range. Blackwelder (1915) indicated that the Wind River mountains were sufficiently high above the basin of deposition during Eocene time to furnish abundant rock waste to the basin. The relationship between the Wasatch and Green River formations also indicates that the source of the sediments was to the north. These formations interfinger in such a way that the fluvatile sediments of the Cathedral Bluffs tongue of the Wasatch formation thin or disappear to the south and the lacustrine sediments of the Green River formation either thin or disappear entirely to the north. The Morrow Creek member of the Green River formation becomes more sandy and thins northward and rests directly on the Cathedral Bluffs tongue. (Bradley, 1926, p. 125).

At the beginning of deposition of Bridger sediments there was further active erosion and sedimentation and considerable volcanic activity. The sources of the sediments for this sequence were not determined in the Lost Creek area, but were probably also from the north. The Oligocene (?) sediments apparently came from the north and are probably related to the structural activity along the southern flank of the Sweetwater arch.

Structure

The major structural features of the Lost Creek area are a northwest-trending syncline, a northwesterly set of faults, and a northeasterly set of faults. A long curving fault occurs along the north flank of the syncline and has a displacement of at least 2,500 feet. The northwesterly-trending Cyclone Rim zone of faulting occurs along the southern limb of the syncline; the net stratigraphic displacements in most places along this zone are less than 400 feet. Much of the faulting is either late Miocene or post-Miocene in age. The faults in the Lost Creek area probably are part of a major regional fault system that extends at least 75 miles across southwestern Wyoming.

The general structural features are shown on plate 2, and the more detailed features and the topography are shown in relation to the area of schroeckingerite mineralization on plate 4. Typical features of complex faulting in the Cyclone Rim zone are illustrated on the large-scale surface maps (pls. 5, 6, and 7) and in the geologic sections of some of the Trenches (pls. 8-16, 19-20).

Folds

The most prominent structural feature in the Lost Creek area is a syncline that trends approximately N.60°W. (pls. 2 and 4). The structure of the syncline is relatively simple in the central and southeastern parts of the mapped area. The dips range from 4° to 53°. The fold is slightly asymmetric with the more steeply dipping limb on the southwest side (pl. 4). In the northwestern part of the area (pl. 2) the syncline either flattens out or is cut off by the complex faulting. The diverse orientation of beds north and northwest of Soda Lake may indicate minor cross-structures subordinate to the major fold or may be, in part, a result of the faulting.

The general strike of the beds in the mineralized area (pl. 4) on the southern limb of the syncline is about N.60° - 75° W. and the average dip is about 22°NE. In detail, however, the strike and dip of the beds range considerably (pls. 5 and 6). The local departures from the general trend are caused in part by the extreme lenticularity of beds and in part by complex faulting.

Anticlines along the southern margin of the area (pl. 2) are relatively minor structural features and are typical of the gentle folding that is characteristic of the major part of the Great Divide Basin to the south of the Lost Creek area.

Faults

The Lost Creek area is cut by numerous faults that range widely in attitude and in magnitude of displacement. Detailed information on some of these faults was obtained during mapping of the trenches, but a complete areal study of the fault pattern was not possible in the time available. A generalized interpretation of the fault pattern, however, was made possible by the data from exploratory openings, the stratigraphic data from studies of outcrops, and the study of persistent linear elements on aerial photographs.

<u>Description of faults</u>

From the geologic map (pl. 2), it can be seen that the major faults fall into 2 sets--a northwesterly set and a northeasterly set. The northwesterly set of faults is subparallel to the long axis of the syncline. Detailed data for many of the faults are not available because Quaternary deposits form a persistent mantle over much of the area. At least one of the main fault trends is known to be a zone of faulting--the Cyclone Rim zone (pl. 2). Some of the other fault lines shown on plate 2 also may represent zones of faulting rather than individual fault planes.

The largest fault in the Lost Creek area belongs to both sets of faults. This major fault extends from the northwestern corner of the area (pl. 2) southeastward along the northern limb of the syncline. In the eastern part of the area the fault swings northeasterly to parallel the faults with a northeasterly trend. The total length of this fault is at least 16 miles. West of Flattop Mountain in the northwest corner of the area, the north side of the fault is upthrown, bringing beds of the Hiawatha member of the Wasatch formation into fault contact with the

Miocene tuffaceous sandstone. The stratigraphic displacement in this part of the area is at least 2,500 feet and possibly as much as 4,000 feet. The amount of displacement may decrease toward the east. The dip of the fault plane could not be determined, and parts or all of this major structure actually may be a zone of faulting rather than a discrete fault.

The Cyclone Rim zone of faulting extends along the southern limb of the syncline (pl. 2) parallel to the northwestern part of the large fault along the northern limb of the syncline. This zone of faulting lies south of and parallel to the local topographic feature called the Cyclone Rim. The zone was named and cited as an important structural feature by Wyant and others (1951, p. 28, 53). It is about 14 miles long and trends N.72°W. The northern and southern limits of the zone, as shown on the small-scale geologic map (pl. 2), are arbitrary and are drawn to include the major part of the complex faulting. The northwestern and southeastern extensions of the Cyclone Rim zone are shown as single fault lines because field data in those areas were less complete. A study of aerial photographs has suggested that the zone of faulting may extend even farther to the southeast. According to G. N. Pipiringos (oral communication, 1954) a study of stratigraphy to the northwest along a possible projection of the zone of faulting disclosed no major breaks in the section. It has been assumed, therefore, that the northwestern extension of the Cyclone Rim zone terminates as shown (pl. 2)--possibly losing its identity along the bedding planes in the Cathedral Bluffs tongue. A group of minor faults, previously described by Wyant and others as being part of the fault zone, occur about 3/4 mile north of the northwestern extremity of the zone.

According to the present interpretation, these minor faults lie outside the main zone and have been omitted from plate 2, along with similar minor faults elsewhere in the mapped area.

On the geologic map of the Lost Creek schroeckingerite area (pl. 4), the arbitrary limits of the Cyclone Rim zone of faulting are omitted, and individual faults, both within the zone and extending outside it, are shown. The effects of the faulting are illustrated by the complexly broken contact between the Cathedral Bluffs tongue (Twc) and the underlying undifferentiated rocks (Tgw) of the Tipton tongue and the Hiawatha member. Typical of the complex fault relations are those in the area around Trench 8 and Trench 13 and those in the area between trenches 3 and 4. The data are incomplete in the large unexplored interval between Trench 12 and Trench 13 and in the area northwest of Trench 8, so that the relations in these areas are somewhat diagrammatic. In general, the longer faults in the zone trend northeast, but other faults in the zone trend in every conceivable direction.

The complexity of faulting in the Cyclone Rim zone is illustrated at a larger scale on plates 5, 6, and 7. Faults and geologic contacts are shown as concealed because much of the area is covered by Quaternary deposits. Locations of the faults and contacts were determined partly by interpretation of aerial photographs and partly by projection of data from exploratory openings. The dips of the fault planes and the upthrown and downthrown sides are indicated, wherever such data were available from the exposures in the trenches.

Typical examples of some of the faults in the Cyclone Rim zone are illustrated in some of the large scale cross-sections (pls. 8-16, 19-20). These include normal and reverse faults, that cut the bedding at various angles, and thrust faults and other faults of unknown relative movements, many of which are parallel or subparallel to the bedding. True displacements could not be measured accurately because data are incomplete in the large intervals between trenches and because the extreme lenticularity of the beds in the Cathedral Bluffs tongue causes difficulty in correlating units across faults. The apparent displacements are small, ranging from less than an inch to several hundred feet. Many of the fault planes are iron-stained, and some of the larger faults are irregularly filled with clay gouge.

Normal faults are the most abundant of the various types of faults mapped in the trenches. A southward-dipping normal fault in the southern part of Trench 8 (pl. 15, section A-B) is accompanied by strong drag of shale beds of the Tipton tongue (Tgt) on the footwall side; the dip component of the displacement on this fault is about 150 feet. Farther north in this same trench a group of normal faults causes complex repetition of a sequence of beds of pebbly sandstone and claystone in the Cathedral Bluffs tongue; the net apparent displacement caused by this group of faults is only about 40 feet. A similar example of complex faulting with small displacements on individual faults is shown in the southern part of Trench 6 (pl. 13, section A-B). Some of the normal faults in the zone have a surprisingly low angle of dip. Typical examples, having dips of 22° to 27°, are in the southern part of Trench 7 (pl. 14, section A-B), in the southern part of Trench 3 (pl. 10, section A-B, above FL-1), and in the southern part of Trench 4 (pl. 11, section A-B). In Trench 3 (pl. 10, section A-B) and Trench 13 (pl. 20, section B-C) normal faults have caused major repetition of the marker unit of Tipton shale. In Trench 3 the apparent displacement on this southward normal movement is approximately 95 feet, and in Trench 13 the apparent displacement is about 65 feet. Farther north in Trench 13 (pl. 20 south end of section C-D) is a series of four steeply dipping faults which, together, represent one of the strongest normal faults exposed in the zone; although the exact amount of displacement is not known, studies of aerial photographs suggest that the dip component of the displacement is approximately 200 to 300 feet.

An example of a reverse fault is shown in Trench 3 (pl. 10, section A-B) at the north end of the northernmost exposure of the Tipton shale (Tgt). This fault cuts the top of the Tipton unit at a low angle to the bedding.

Thrust faults in the southern part of Trench 3 (pl. 10, section A-B) have caused small displacements in the beds of the Tipton tongue. An example of a thrust fault lying nearly parallel to the bedding is shown in Trench 2 (pl. 9, section A-B).

On the basis of preliminary geologic studies, Wyant and others (1951, p. 28) had described the Cyclone Rim zone as en echelon faulting and had interpreted it essentially as a high-angle northward-dipping thrust fault. On the basis of tentative correlation of stratigraphic units on opposite sides of the zone, they interpreted an apparent stratigraphic displacement of 400 to 700 feet, with the north side upthrown.

The more recent exploratory work has indicated that the fault pattern (pl. 4) in the Cyclone Rim zone is much more complex than simple en echelon faulting. Furthermore, the newer data indicate that stratigraphic units are in their proper sequence, going northward across the zone of faulting, and the only repetitions of units are on a minor scale within the zone.

Presently available data suggest that the net stratigraphic displacement in most places along the zone is less than 400 feet; in no place along the zone is the overall displacement believed to be over 700 feet. Instead of an overall movement downward on the south side of the zone, parts of the zone appear to be downthrown on the south side whereas other parts appear to be downthrown on the north side. Examples of apparent downward movement to the south are in the area along Trench 3 (pl. 6) and in the area midway between Trench 12 and Trench 13 (pl. 4). Examples of apparent movement downward to the north are in the Trench 13 area and in the Trench 8 area (pl. 4). These apparent displacements along the zone possibly may represent a series of scissors movements.

Despite the apparently small net displacements along the Cyclone Rim zone of faulting, the prominent trend and extent of the zone, and the complexity of faulting are probably indicative of a major fault at depth.

In addition to the long northwesterly faults on the northern and southern limbs of the syncline, other long faults in the Lost Creek area trend northeasterly (pl. 2). The longest of these follow Lost Creek and Arapahoe Creek in the northeastern part of the area. Additional northeasterly faults of shorter length occur in the north central part of the area and in the central and eastern part of the syncline north and east of Osborne Draw.

Age of faults

The relative ages of faults in the Lost Creek area could not be determined in all instances. The study of aerial photographs suggests that the long fault on the north flank of the syncline displaces the northeasterly fault that follows Lost Creek (pl. 2). But the long fault, in turn, is apparently displaced by the northeasterly fault that follows Arapahoe Creek.

The absolute age of faulting cannot be determined from the study in this Lost Creek area alone. Much of the faulting is either late Miocene of post-Miocene in age, as suggested by the relations of the major fault in the northwestern part of the area (pl. 2). In the trenches none of the fault planes in the Eocene rocks could be traced upward into the Quaternary deposits. This suggests that the faulting in the Cyclone Rim zone occurred between Eocene and Quaternary time. On the aerial photographs, however, the physiographic terraces appear to be tilted in the vicinity of some of the linear fault trends; this suggests possible movement on some of the faults in the Pleistocene or Recent epochs.

Relation to regional structure

The fault system in the Lost Creek area probably is related to the Continental fault, which was mapped by Nace (1939, p. 44-46, pl. 1) in the region northwest of the Lost Creek area. On the Geologic Map of Wyoming (Love and others, 1955) Nace's Continental fault extends from the southeastern part of Sublette County to the vicinity of Pickett Lake near the southern border of Fremont County; on this map the Continental fault is terminated by northeasterly faults southeast of Pickett Lake.

The position of the northwest-trending fault pattern in the Lost Creek area relative to the Continental fault pattern strongly suggests that the 2 patterns together form a major regional fault system that extends at least 75 miles across southwestern Wyoming.

URANIUM DEPOSITS

Three types of uraniferous material have been found in the near-surface portion of the Lost Creek area: (1) schroeckingerite; (2) other radioactive materials containing small amounts of uranium; and (3) uraniferous ground water. Schroeckingerite is the only uranium mineral which has been identified in the area.

The Lost Creek area contains the largest known concentration of schroeckingerite in the world. Schroeckingerite, a hydrated fluo-carbonate-sulfate of sodium, calcium, and uranium, is distributed irregularly and sparsely in elongate lenticular deposits, most of which are in a zone 2 to 8 feet below the surface of the ground. The deposits are on the southern limb of a syncline and are partly within and partly north of the Cyclone Rim zone of faulting. The principal host rocks are beds of the Cathedral Bluffs tongue of the Wasatch formation. Most of the samples from the deposits contain less than 0.050 percent uranium. No production has been recorded, but the deposits constitute a large reserve of low-grade uraniferous material.

In addition to the schroeckingerite deposits, the Lost Creek area is characterized by abnormal concentrations of uranium in the ground water, with individual samples containing as much as 46 parts per million. In the same area as the schroeckingerite deposits are some low-grade occurrences of uranium, which contain no identified uranium mineral. These occurrences may represent sites of incipient mineralization by schroeckingerite or sites of former schroeckingerite deposits Other occurrences of radioactive materials are in iron-cemented sandstone and similar rocks; these materials are very low in uranium content.

The immediate source of the uranium for the schroeckingerite deposits is the uraniferous ground water. The deposits are epigenetic in character and, like other caliche-type deposits, are deposited by simple crystallization from water. The writers have concluded that the most likely source of the uranium is in concealed uranium deposits in the Lost Creek area. These hypothetical source deposits are believed to be relatively high in grade compared with the schroeckingerite deposits.

Schroeckingerite deposits

Areal distribution

The approximate outline of the area that contains known deposits of schroeckingerite is shown on plate 4. This area, about ½ square mile in size, is located on the east side of Lost Creek. It is shaped like 2 elongate lenses that are joined near the western end. The long dimension of the area trends N. 67° W. The northern part of the area is 8,800 feet long and the southern part is 10,000 feet long. Near the west central part of the area, the width is as much as 3,000 feet, but tonguelike extensions taper to the southeast and to the northwest.

The distribution of known deposits and groups of deposits is indicated on plates 5 and 6. Wide deposits and areas of abundant small deposits along the trenches are indicated by series of closely spaced "x" symbols. The distribution of individual schroeckingerite deposits in trenches 1-12 is shown in detail on the geologic sections (pls. 8-19). The distribution of schroeckingerite in drill holes is indicated on plates 5 and 6 and is described in Appendix C and Appendix D. The maps and sections show that the known deposits are distributed irregularly along the trenches and along the lines of drill holes in the mineralized area. Additional deposits of schroeckingerite probably are distributed in a similar manner in the areas between exploratory openings.

Vertical range

The vertical range of the known deposits of schroeckingerite is from the ground surface to a depth of 14 feet. Most of the deposits, however, are distributed irregularly in a zone 2 to 8 feet beneath the surface of the ground. No deposits were found below the level of the ground water in trenches or drill holes. In areas where the water table is fairly deep, it is entirely possible that additional deposits may occur at greater depths.

Geologic setting

The area containing schroeckingerite deposits is situated on the southern limb of the northwestward-trending syncline (pl. 4). The southern part of the mineralized area lies within the Cyclone Rim zone of faulting. The relation of the area containing schroeckingerite deposits to the larger structural features may be seen by reference to plate 2. Plate 2 shows that the general position of the schroeckingerite area (in the vicinity of the main group of trenches) is near the junction of the Cyclone Rim zone of faulting and the group of long northeasterly faults.

The majority of the schroeckingerite deposits are in Eocene sedimentary rocks but some deposits occur partly or wholly within the Quaternary overburden. Most of the deposits occur in the Cathedral Bluffs tongue of the Wasatch formation (pl. 4). A few deposits also occur in the Tipton tongue of the Green River formation (for example, Trench 3, pl. 10).

Size and shape

Detailed information pertaining to the cross-sectional character of the schroeckingerite deposits was obtained in the U. S. Geological Survey trenches. Typical examples of sizes and shapes in cross-section are illustrated in plates 8-19.

Individual deposits range in thickness from 2 inches to about 7 feet, but the average thickness is about 1.5 feet. The thickest known deposit occurs in Trench 5 (pl. 12, section B-C), where an incomplete exposure extends 6.3 feet vertically from the unconformity at the base of the Quaternary overburden to the base of the trench. Other individual deposits are as small as 0.5 square foot in cross sectional area.

The width of individual deposits is commonly less than 10 feet, and the maximum width is probably 80 feet. The widest known deposit occurs in Trench 2 (pl. 9 , section A'-B'), where a continuous exposure extends 41 feet along the trench. Small gaps between adjacent exposures in this vicinity are probably small barren areas within a larger deposit, so that a projection of the width can be made logically over a total distance of 80 feet.

Data on the lengths of individual deposits are less complete because the U. S. Geological Survey trenches were excavated at right angles to the general trend of elongation of the deposits. Combined data from drill holes, old excavations, and trench mapping in the vicinity of Trench 1 suggest that the ratio of width to length is between 1:4.5 and 1:6.5. If it can be assumed that this ratio can be applied to deposits elsewhere in the mineralized area, then the majority of the deposits are probably less than 50 feet in length. The longest known deposit near Trench 1 extends about 390 feet, but it is irregular, with unknown gaps and barren areas totalling 100 feet in length.

Most of the schroeckingerite deposits are elongate lenticular bodies, but some are irregular to branching in shape. In cross section the most common shape is the elongate lens which lies parallel or subparallel to the surface of the ground (Trench 2, pl. 9, section A-B; Trench 10, pl. 17, section A-B). Small rounded to elongate shapes are also fairly common (Trenches 4, 6, 7, and 9, plates 11, 13, 14, 16). Less common are crudely tabular deposits that extend parallel or subparallel to the bedding of the Eocene rocks (southern part of Trench 2, pl. 9, section A-B; Trench 5, pl. 12, section C-D). Some of the deposits are very irregular in cross-sectional shape (Trench 3, pl. 10, section C-D). Data from the vicinity of Trench 1 suggest that many of the separate exposures in Trench 1 (pl. 8) are probably connected to the southeast and northwest of the trench, forming elongate branching deposits with irregular barren areas.

Relations to lithologic and structural features

Presently available data suggest that many of the schroeckingerite deposits occur with their longest dimension parallel or subparallel to the general strike of the bedding in the Eocene rocks. This general trend of the elongation of the deposits is about N. 60° - 80° W. In detail, however, individual deposits commonly cross bedding planes and fault planes in the Eocene rocks, and some deposits overlap the unconformity at the base of the Quaternary overburden.

Detailed mapping in the trenches indicated that the schroeckingerite deposits are not restricted to any single lithologic type or color of the host rock. For example, deposits in Trench 3 (pl. 10) occur in shale of the Tipton tongue, in the wide range of sedimentary sizes from claystone to pebbly sandstone in the Cathedral Bluffs tongue, and even in the sands and silts of the Quaternary overburden. The colors of these host rocks range from brown through maroon and green to gray. Although the schroeckingerite is found in many types and colors of host rock, the richest concentrations of the mineral are found in green and gray-green fine-grained rocks ---especially in beds of siltstone, clayey or sandy siltstone, and sandy or silty claystone.

The deposits exposed in the trenches commonly cross lithologic boundaries. For example, in Trench 2 (pl. 9, section A-B) individual deposits cross lithologic boundaries between shale, sandy claystone, sandstone, clayey siltstone, sandy siltstone, and pebbly sandstone. In Trench 10 (pl, 17, section A'-B') a lenticular deposit extends northward across sandy siltstone and clayey siltstone of the Cathedral Bluffs tongue, then across sand and silt of Quaternary age, and finally back into pebbly sandstone of the Cathedral Bluffs tongue.

Deposits restricted essentially to individual beds are less common than the deposits which extend across bedding planes. In Trench 2 (pl. 9) one deposit in section A-B is restricted mainly to a shale bed that overlies sandstone, and another deposit in section B-C is in a claystone bed overlying pebbly sandstone.

The schroeckingerite deposits apparently are not restricted completely to the immediate vicinity of complex faults. The southern part of the mineralized area (pl. 4) is in the complexly faulted Cyclone Rim zone, whereas the northern part of the mineralized area contains fewer evidences of faulting. In detail, some of the faults in the trenches are directly associated with schroeckingerite deposits, whereas other faults are barren of deposits. For example, in Trench 3, (pl. 10) the schroeckingerite deposits at the north end of section A-B are directly adjacent to southward dipping normal faults, but some of the other faults in the same trench are not associated with deposits. Some of the deposits extend across fault planes. For example, in Trench 1 (pl. 8), deposits in the immediate vicinity of a southward-dipping normal fault are confined to the hanging-wall side on the southeast wall of the widecut (section X'-Y'); but going northwest along the strike of the fault (progressively through sections C'-D', C-D, X-Y), the deposits cross the fault, and on the northwest wall of the widecut (section X-Y) are confined largely to the footwall side. Other deposits within the area of complex faulting have no apparent relationship to any faults.

Grade

Schroeckingerite forms less than 1 percent of the rock within the boundaries of individual schroeckingerite deposits in the Lost Creek area. The detailed distribution of schroeckingerite in the mineralized rock is so irregular that the boundaries of individual deposits in the trenches were mapped according to the presence or absence of schroeckingerite. The uranium content of samples from schroeckingerite deposits in the

U. S. Geological Survey trenches ranges from 0.001 to 0.260 percent; most of the samples contain less than 0.050 percent uranium. The highest uranium content of any of the samples obtained from drill holes during the exploration is 0.063 percent.

The uranium content of trench samples from host rock containing no schroeckingerite ranges from 0.000 to 0.039 percent; most of these samples contain less than 0.005 percent uranium.

Mineralogy

Schroeckingerite was described by Schrauf (1873, p. 137-138), who named it after J. Von Schröckinger. Schröckinger (1875, p. 66-68) later described the occurrence of schroeckingerite in the type locality at Joachimsthal, Bohemia. At Joachimsthal the schroeckingerite is an alteration product of uraninite.

Schroeckingerite from the Lost Creek locality in Wyoming has had an interesting descriptive history. An unidentified yellow mineral had long been noted in the Lost Creek area by Mrs. Minnie McCormick (now deceased) of Wamsutter, Wyoming. The exact date of her discovery is not known, but it was made before 1936. Mrs. McCormick's interest in learning the identity of the mineral led eventually to its description by Larsen (1937, p. 7) and Larsen and Gonyer (1937, p. 561-563) as "dakeite", a new secondary uranium mineral named in honor of H. C. Dake. The "dakeite" from Wyoming was also described by Knight and Gilbert (1937) and by Dake (1938, p. 7-8, 23-25). The mineral "dakeite" later was proved by Novacek (1939, p. 317-323) to be identical with schroeckingerite, and the name "dakeite" is no longer accepted.

Schroeckingerite is a micaceous, pseudohexagonal mineral with perfect basal cleavage. Its hardness is 2.5 and specific gravity is 2.51. The color in daylight ranges from greenish-yellow to yellow. One of the outstanding physical characteristics of schroeckingerite is its brilliant yellow-green fluorescence in ultraviolet light. The optical properties of schroeckingerite have been described by Larsen and Gonyer (1937, p. 562, for "dakeite"), by Novacek (1939, p. 319), and by Jaffe and others (1948, p. 156).

Chemically, schroeckingerite is a hydrated fluo-carbonate-sulfate of sodium, calcium, and uranium ---$NaCa_3(UO_2)(CO_3)_3(SO_4)F \cdot 10H_2O$ (Palache and others, 1951, p. 236). An analysis of schroeckingerite from the Lost Creek locality by Sherwood (in Jaffe and others, 1948, table 2) is as follows:

CaO	18.14
Na_2O	3.63
UO_3	31.44
CO_2	14.20
SO_3	9.17
F	2.15
H_2O	20.15
R_2O_3	0.95
SiO_2	0.08
	99.91
Deduct O = 2F	.90
	99.01

Earlier analyses by Schrauf (1873, p. 137-138), Larsen and Gonyer (1937, p. 562, for "dakeite"), and Novacek (1939, p. 319) did not report the presence of fluorine in the mineral.

In recent laboratory experiments, Hurlbut (1954, p. 906) noted that, when artificially dehydrated, schroeckingerite lost 6 H_2O, the crystals became cloudy, and the fluorescence of the dehydrated schroeckingerite was less brilliant. The color variation from greenish yellow to yellow for schroeckingerite in the Lost Creek area possibly may be caused by partial dehydration of some of the occurrences. Data, however, are not available to prove whether such dehydration takes place in nature.

Schroeckingerite contains about 27 percent uranium. Despite its high uranium content the mineral is only weakly radioactive. Radiometric and chemical analyses were made by the U. S. Geological Survey on a hand-picked concentrate of schroeckingerite from the Lost Creek locality. It was estimated that the concentrate contained only about 1 percent impurities. The results showed 11.0 percent equivalent uranium and 24.5 percent uranium. The lower equivalent uranium content indicates a disequilibrium relation in which the mineral has a relative deficiency in radium. Much of the schroeckingerite has formed so recently that uranium and its disintegration products have not attained radioactive equilibrium. This relationship between equivalent uranium and uranium is shown graphically (pl. 22) for the samples from schroeckingerite deposits in U. S. Geological Survey trenches.

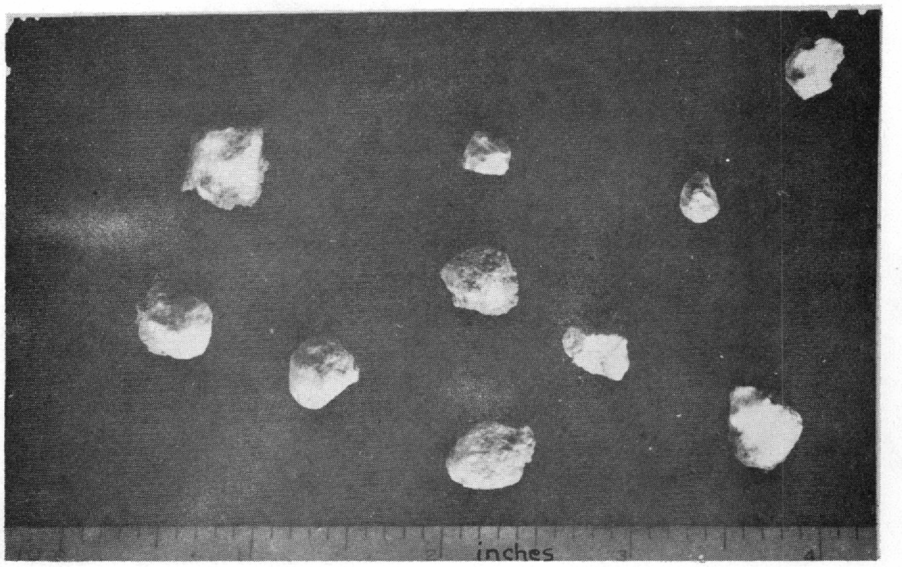
In the Lost Creek area schroeckingerite occurs as rounded to ellipsoidal pellets, as very small flaky crystals coating sand grains, as small tabular masses along bedding planes in shale and along shrinkage cracks, and with silica, carbonate, and/or gypsum in encrustations and small veinlets. It is also found as minute grains in the white efflorescent salts of surface encrustations.

The concretionary (pellet) form, in which schroeckingerite occurs as clusters or aggregates of micaceous plates, is most common in the Lost Creek area. Typical pellets and typical pellet-bearing rocks are illustrated in plate 23. Individual pellets range in diameter from about 0.01 inch to 1.5 inches; the most common size is 0.2 inch. Commonly the pellets contain tiny crystals of gypsum interleaved with the flakes of schroeckingerite.

Schroeckingerite, the only uranium mineral which has been identified in the Lost Creek area, is commonly associated with white to flesh-colored fine-grained gypsum; less commonly, it is associated with opal and carbonate materials. The fine-grained gypsum occurs as irregular masses (pl. 23 C), disseminations, and veinlets (pl. 23 D) in the host rock. No base metals were observed in the schroeckingerite deposits, although pyrite, presumably of sedimentary origin, was found in the same general area; the pyrite occurs as a few concretionary masses in siltstone in the Cathedral Bluffs tongue.

The gypsum and the pellets of schroeckingerite probably form by displacement of the materials of the host rock, although some replacement might be a factor. No detailed petrographic studies of the schroeckingerite-bearing rocks were made, because the mineral is so friable and soluble that it is extremely difficult to retain original textures in a thin-section.

A



B

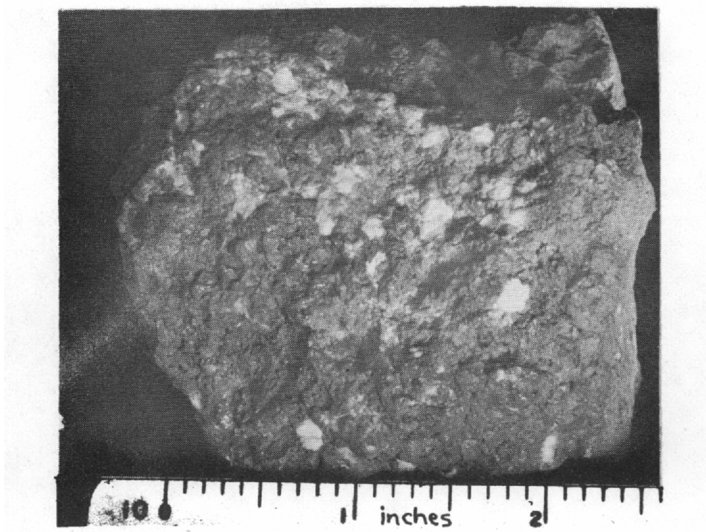
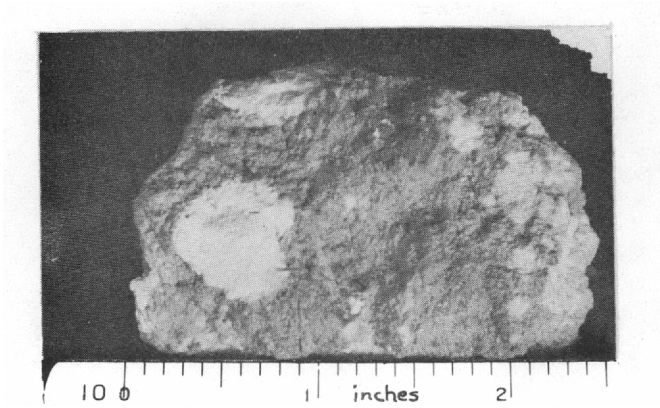


Plate 23. Schroeckingerite, Lost Creek deposits, Sweetwater County, Wyoming.

A. Typical schroeckingerite pellets (natural size).

B. Typical schroeckingerite-bearing rock (natural size). The rock is green sandy siltstone; the light-colored spots are mostly schroeckingerite, with minor gypsum.

C



D

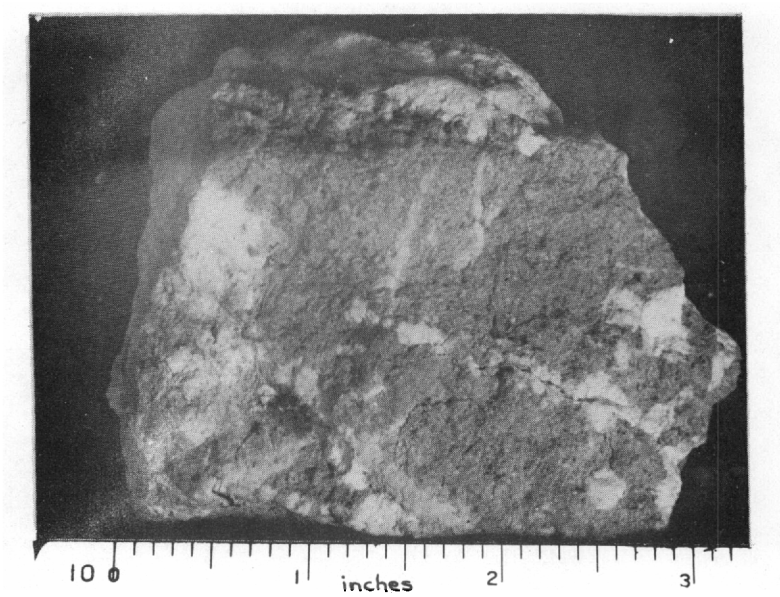


Plate 23. Schroekingerite, Lost Creek deposits, Sweetwater County, Wyoming (cont.).

C. Brown-gray silty sandstone (natural size). The large rounded pellet at the left and another at the upper left are schroeckingerite. Dull white material at right side of specimen is gypsum.

D. Brown-gray sandy siltstone (natural size). The specimen is cut by numerous gypsum veinlets. Schroeckingerite pellets are at left center, right center, and bottom center.

Additional data on the mineralogy of rocks from the Lost Creek area have been included in a report by Wyant and others (1951, p. 54-59).

Solution and redeposition

Observation of natural occurrences and laboratory syntheses demonstrate that schroeckingerite is dissolved and redeposited by natural surface and ground waters. Wyant and others (1951, p. 56) reported that individual crystals and pellets of schroeckingerite, that were exposed in dumps of exploratory trenches, dissolved during the winter season, and, in the dry season, reprecipitated as thin efflorescent coatings. Similar examples of solution and redeposition as efflorescent coatings have been observed along the cut-bank of Lost Creek east of the cabin (Schroeckingerite Manor, pl. 5). The writers of the present report observed very fine crystals having the typical fluorescent color of schroeckingerite in the yellow-white efflorescent crust that formed along the water line in the south end of the northern half of Trench 8 and in the north end of Trench 7. This efflorescent material crystallized from the water in the trenches.

Guillotte (1945) performed an experiment that illustrated that schroeckingerite pellets can form in a short time. He pulverized schroeckingerite pellets in shale and mixed a slurry of this material with water until all the schroeckingerite had dissolved. After the mud had dried, he found that it contained schroeckingerite pellets similar to those that were in the original rock specimens.

An interesting series of experiments were also performed recently by Wayne Mountjoy, U. S. Geological Survey, using a sample of pulverized schroeckingerite-bearing rock (0.092 percent uranium) and simulated Lost

Creek water. These tests were performed as part of research with Harold Masursky, U. S. Geological Survey, on enrichment of coal by uranium from aqueous solutions. Mountjoy and Masursky (oral communications, March 1955) found that 83 percent of the uranium in the rock sample was leached by successive leachings with 7 one-liter portions of the unheated water. The simulated water was made up to conform to the analyzed components of the naturally-occurring Lost Creek water.

Origin

Deposition of the schroeckingerite

The schroeckingerite deposits in the Lost Creek area are epigenetic in character; that is, their deposition is later than the deposition of the rocks in which they are found and, in fact, is continuing at the present time. The schroeckingerite deposits are believed to form by a simple process of crystallization from uraniferous waters. The depositional process is thought to be similar to the process by which "caliche" deposits of calcium carbonate, borax, and other similar materials are formed at or near the surface in other arid and semi-arid regions of the world. In the Lost Creek area the immediate source of the uranium in the schroeckingerite is the uraniferous ground water. The schroeckingerite apparently forms by evaporation of capillary water in the zone between the water level and the surface of the ground in those parts of the area where the ground water is relatively near the surface. In those parts of the area where the ground water level is now considerably below the deposits, upward fluctuation of the water level in Pleistocene or Recent geologic time probably accounted for the deposits. Downward-percolating surface waters also contribute to the process by a certain amount of solution and redeposition of the schroeckingerite.

The exact time in geologic history when deposition of the schroeckingerite in the Lost Creek area started is not known. The present distribution suggests that it started after the folding and erosion of Eocene rocks. It might be presumed that deposition of schroeckingerite started about the same time that faulting occurred in the area or slightly thereafter--that is, in Miocene or post-Miocene time. The fact that the mineral is easily dissolved and redeposited, however, prohibits exact dating of the initial deposition.

The evidence for the "caliche" type of deposition lies mainly in the present distribution of the schroeckingerite deposits. The known deposits are all within 14 feet of the present ground surface, and most of them occur at depths ranging from 2 to 8 feet. It is possible that deeper deposits of schroeckingerite may occur, but existing data suggest that the ground water level is the lower limit of deposition. Within this near-surface zone the deposits commonly cross lithologic boundaries and faults in the northward-dipping Eocene strata and lie subparallel to the surface. Some of the deposits occur in the surficial Quaternary material and some overlap the unconformity at the base of the Quaternary deposits. This pattern of distribution is consistent with a simple epigenetic process of formation by evaporation.

The fact that most of the richest deposits occur in siltstones or silty claystones indicates the manner of depositon. The physical nature of sedimentary rocks of silt size probably makes these rocks more susceptible to capillary action than sedimentary rocks of coarser size or sedimentary rocks like highly indurated shale. Water is probably drawn into and retained longer by the silty beds, thereby allowing slow crystallization and the accumulation of abundant concretionary pellets of schroeckingerite. The deposits in the sandstone beds, on the other hand, are generally of lower grade and the schroeckingerite tends to coat the grains rather than to form large discrete pellets.

The uranium content of schroeckingerite is higher than the equivalent uranium percentage, as shown in the graph of analytical results from trench samples (pl. 22). This disequilibrium relation is explained by the fact that the schroeckingerite deposits are continually changing by processes of solution and redeposition. Apparently none of the schroeckingerite has remained unaffected long enough for the disintegration products of uranium to reach radioactive equilibrium with the uranium. Most of the uranium that goes into solution is redeposited essentially within the limits of the mineralized area, because no schroeckingerite deposits have been found downstream along the Lost Creek drainage.

Source of the uranium.

The ground water is the immediate source of the uranium in the schroeckingerite deposits, but the source from which the ground water obtained the uranium has not been established by direct evidence in the form of drill-cuttings or exposures. Presently available geologic data are entirely from the near-surface portion of the Lost Creek area and are sufficient only to provide indirect evidence for the source of the uranium. The following list of general geologic facts and relations must be explained by any acceptable genetic hypothesis as to the source of the uranium:--

(1) The area of schroeckingerite mineralization is relatively restricted. That is, there are numerous similar topographic, stratigraphic, and structural settings in the Great Divide Basin; yet, the large accumulation of schroeckingerite occurs in this one relatively small part of the Great Divide Basin.

(2) The schroeckingerite deposits occur in an area characterized by faulting. Although individual schroeckingerite deposits do not appear to be related to individual faults, the mineralized area lies partly within and partly north of the Cyclone Rim zone of faulting (pl. 4). Other long fault structures are also located in the Lost Creek area (pl. 2). The fault system in the Lost Creek area is probably part of a major regional fault system that trends northwesterly over a distance of 75 miles.

(3) Every other known occurrence of schroeckingerite is either related directly to some more "primary" type of uranium deposit or is in an area in which other uranium deposits are known to occur.

In the following paragraphs the authors present their hypothesis for the source of the uranium in the schroeckingerite deposits. This is followed by a discussion of other genetic hypotheses and the conclusions.

Preferred hypothesis.--The authors believe that the Lost Creek area contains unexposed deposits of uranium minerals from which ground water obtains uranium and deposits it near the surface as schroeckingerite. The authors believe that these hypothetical source deposits are relatively high in grade compared to the schroeckingerite deposits and probably contain pitchblende, uraninite, or other so-called "primary" uranium minerals. These source deposits may be located at depth in the general area of the schroeckingerite deposits or they may be located laterally from the area of schroeckingerite deposition along or near one or more of the faults in the area. Furthermore, the deposits may be one of two general types.

(1) Hydrothermal vein deposits.

(2) Deposits that occur in sedimentary rocks and that are of uncertain origin. Such deposits may have stratigraphic or structural control, or possibly both types of control. Their origin may have been related directly or indirectly to hydrothermal activity at depth or it may be unrelated to hydrothermal activity. A complex history of solution and redeposition may have preceded the final concentration of the uranium in high-grade deposits.

Three general sequences of events are considered equally probable in explaining the genetic history of the uranium in the Lost Creek schroeckingerite deposits:

(1) The uranium may have been introduced into the area at depth as hydrothermal vein deposits along one or more of the many faults in the area. Subsequently ground water has been obtaining uranium from the vein minerals and has been redepositing it as schroeckingerite near the surface. Upward movement of the uraniferous solutions may be controlled in part by stratigraphic features and in part by structural features. The source veins, therefore, may not be located directly beneath the schroeckingerite deposits, but they are believed to be in the same general area, not 10 or 20 miles distant.

(2) The ultimate source of the uranium may have been hydrothermal in character but the uranium may have gone through a more complicated history prior to its deposition as schroeckingerite. The Tertiary hydrothermal activity that is recorded by veins and other deposits in much of the western United States may have produced distinct veins only at great depths in areas of thick

sedimentary cover like the Great Divide Basin. Part or all of the uraniferous portion of this hydrothermal material may have migrated upward considerable distances from the material that was deposited in veins. Or, if all of the uranium was deposited in the veins, subsequent movements of ground water during various orogenic and erosional cycles may have leached the uranium from the veins. In either process the upward migrating uranium then may have been redeposited in one or more intermediate stages at levels somewhat closer to the surface. Deposits of these intermediate stages may be concentrated along faults or along favorable stratigraphic horizons near faults in the Lost Creek area. The subsequent deposition of schroeckingerite represents the final step in the upward migration of the uranium.

(3) The uranium may have gone through a much more complex history. For example, uranium may have been leached from a large low-grade source or from a number of high-grade sources in pre-Cretaceous time at some distance from the present site of the schroeckingerite deposits. Subsequent events in geologic history may have caused leaching and redeposition of the uranium in one or more stages, possibly continuing well into Tertiary time. The result of such processes could be deposits of relatively high-grade material distributed along favorable stratigraphic horizons over a wide area or along more restricted structural or stratigraphic planes in certain favorable areas. However complex the history of the uranium may have been, it is likely that one of the last stages in the sequence was a group of high-grade

deposits located in the general Lost Creek area. The removal of uranium from such deposits and redeposition near the surface as schroeckingerite represents a continuation of the migration.

The sequences of events, outlined above, cover a wide range of geologic possibilities but they all result in 2 major features: (1) unexposed uranium deposits of relatively high grade; (2) location of these deposits in the Lost Creek area. The authors believe that these 2 features are necessary factors to explain the known geologic facts and relations.

Indirect evidence in favor of the high-grade source deposits in the Lost Creek area is given by the relatively restricted area of occurrence of the schroeckingerite. If low-grade rocks had been the source, they necessarily would have a wide areal extent in order to supply the total uranium for the large accumulation of schroeckingerite. Such low-grade rocks are abundant and widespread in the Tertiary section throughout the Great Divide Basin, but schroeckingerite deposits have not been found elsewhere in the Great Divide Basin in geologic settings similar to those at Lost Creek. It does not seem likely that leaching of widespread rocks of low uranium content could produce schroeckingerite in one area but not in other areas having the same geologic conditions.

The authors believe that the coexistence of schroeckingerite and faulting in the Lost Creek area is a geological condition favorable to the presence of the hypothetical source deposits, because many uranium deposits in other areas are related to structural controls. Individual schroeckingerite deposits do not seem to be related to individual faults in the Lost Creek area, although this is only to be expected when the solubility of the mineral is taken into consideration. The present distribution of the deposits is partly the result of continuing solution and redeposition, so that individual deposits cross many lithologic and structural planes. But the overall relationship of the area of schroeckingerite mineralization to the Cyclone Rim zone of faulting and to the other faults in the Lost Creek area suggest that fault structures played a part in the genesis of the deposits. The proximity of the area of schroeckingerite mineralization to the intersection of northwesterly and northeasterly faults (pls. 2 and 4) is similar to the locations of mineral deposits in many classic localities. Also, the probability that the Lost Creek fault system is part of a very long regional fault system suggests additional similarities to many other classic types of mineral deposits along similar major structural features.

In many other uranium districts in the western United States schroeckingerite is one of a group of secondary uranium minerals that is often a "guide" to ore. In fact, most of the other occurrences of schroeckingerite known to the authors are either related directly to a deposit of other uranium minerals or the genetic relations can be inferred by the presence of other uranium deposits in the same general area of occurrence. The authors have summarized in table 2 the available data on known occurrences of schroeckingerite. There is no necessity for the Lost Creek deposits to conform genetically to any of the other known occurrences, but the authors believe that the geologic relations at the other occurrences merit careful consideration. The evidence from the other localities favors a relatively high-grade source of uranium.

The hydrothermal deposits at Marysvale, Utah, and in the Cochetopa district, Colorado (table 2) are especially interesting because schroeckingerite occurs near the surface in both places along fault structures which contain pitchblende at depth. At Marysvale, Stugard and others (1952, fig. 14) found a zoning of uranium minerals from the surface downward: (1) schroeckingerite near the surface; (2) uranophane, autunite, and torbernite; (3) sooty pitchblende with autunite and torbernite; and (4) pitchblende in hydrothermal veins, below the lower limit of water table fluctuation. The structural pattern at Marysvale is illustrated by Stugard and others as a near-surface fracture zone grading downward to a recognizable vein structure with primary mineralization. Thornburg (1955, p. 56) notes that schroeckingerite and autunite were found near the surface along a fault in the Cochetopa district. Drill holes along the fault structure disclosed pitchblende-bearing veins and stringers at depth along the fault.

The structural relations at Lost Creek are similar in some respects to those in the Marysvale and Cochetopa areas, although the country rocks are different. It is true that the nearest exposed examples of Tertiary igneous activity, other than tuffaceous sediments, are the extrusive and intrusive alkalic rocks of the Leucite Hills, about 40 miles southwest of the Lost Creek area. But the authors believe that hydrothermal veins cannot be discarded as one of the possible sources on the basis of no surface exposures of hydrothermal or igneous activity. Veins may very well exist along the favorable fault structures at depth.

The geologic setting at Lost Creek is also similar in some respects to many of the other deposits listed in table 2. In most of the known occurrences schroeckingerite is a "fringe" type of deposit or an effloresence, with the source of the uranium from nearby deposits of other uranium minerals. The setting of sedimentary rocks at Lost Creek suggests that the source deposits may be similar to some of those on the Colorado Plateaus. For example, schroeckingerite in the McCoy-Flattop area is a near-surface deposit in mudstone; carnotite deposits occur in the same area. The genesis of the uranium, uranium-vanadium, and uranium-copper deposits of the Colorado Plateaus has been the subject of much controversy, but evidence, both factual and theoretical, seems to be increasing in support of the hydrothermal concept of origin. Age determinations by Stieff and others (1953), for example, have indicated that uraninite from these deposits is Late Cretaceous or younger in age, whereas the enclosing rocks of many of the deposits are older. Because hydrothermal origin is regarded as a distinct possibility for many of the deposits in such a dominantly sedimentary area as the Colorado Plateaus, such as origin cannot be disregarded for the uranium in the Lost Creek area.

Certain similarities also exist between the geologic setting at Lost Creek and the geology of other uranium areas in Wyoming. Many of these are in Tertiary sediments and in areas characterized by faults, although the work in many of these areas is so new that the detailed genetic history cannot be evaluated yet. The Crooks Gap uranium area in Fremont County, about 20 miles northeast of the Lost Creek area, contains a prominent northwesterly-trending fault zone, that is shown in the vicinity of Crooks Mountain and Green Mountain on the Geologic Map of Wyoming (Love and others, 1955). J. G. Stephens (1954, p. 120, 122; and oral communication, 1955) has noted that uranophane is the principal uranium mineral in deposits in arkosic sandstone in the lower part of the Wasatch formation in the Crooks Gap district. He notes that uraninite and coffinite also have been identified in these deposits. Grutt (1955, p. 107) reports that autunite occurs as the principal uranium mineral near a large thrust fault in the northern part of the Crooks Gap area and that considerable faulting is evident in the area of uranophane deposits south of the thrust fault. Farther north in Fremont County is the Gas Hills uranium district, where faults of Pliocene(?) or more recent age occur in the same area as uranium deposits in the Eocene Wind River formation (H.D. Zeller, oral communication, 1955). Vine and Prichard (1954) have described uranium occurrences near Baggs in the Poison Basin area of southern Wyoming. They found schroeckingerite and uranophane in deposits in the Browns Park formation of probable Miocene age. Grutt (1955, p. 108) also noted that preliminary drilling in the Baggs area has suggested that some of the uranium has been localized along fractures or fault trends as well as along the bedding. It is interesting to note that Bradley (1945) has illustrated an east-west trending fault zone that extends across the southern part of the Washakie Basin in the vicinity of Baggs.

The similarities in geologic setting suggest that the hypothetical source deposits in the Lost Creek area may duplicate the mineralogy and character of one or the other of the uranium districts in Wyoming. Thus, the source of the uranium may very well be unexposed deposits containing uranophane and uraninite, similar to those in the nearby Crooks Gap area. In the Lost Creek area the occurrence of schroeckingerite and the environment of faulted Tertiary sedimentary rocks may be considered geologic criteria favorable to the presence of unexposed high-grade source deposits. The possible location of the hypothetical deposits in the Lost Creek area is discussed in the chapter on suggestions for prospecting.

Other hypotheses.--Other hypotheses that might explain the source of the uranium in the Lost Creek schroeckingerite deposits are concerned either with derivation of the uranium from uraniferous coal, or from other source materials of low grade, or with deposition of the schroeckingerite from lake or stream waters. These hypotheses are discussed below:

(1) As a result of an earlier examination of the Lost Creek area, Wyant and others (1951, p. 128) arrived at the same conclusion for the manner of schroeckingerite deposition as the writers of the present report--namely, crystallization from ground-water or surface-water solutions. The earlier field work, however, suggested that the uranium was derived (1951, p. 132) from buried uraniferous lignite_/. New research data have appeared since

_/ The "lignite" in the Red Desert area is now known to be subbituminous coal.

the time the earlier field work was done. Breger and Deul (1952, p. 5) have reported that uranium is held in uraniferous lignite from South Dakota as an organo-uranium compound or complex, soluble at a pH of less than 2.18. Breger and others, (1953, p. 4) have found that uranium in subbituminous coal from the Red Desert is also associated with the organic constituents of the coal. If it can be assumed that the Red Desert uraniferous coal is similar to the South Dakota lignite with respect to solubility of uranium, then leaching of uranium from Red Desert coal would be possible only under highly acidic conditions. Such acidic conditions do not appear likely in the subsurface area at Lost Creek because most of the ground water today has a pH of about 8.

In view of the newer research data, the authors of the present report conclude that uraniferous coal, in the subsurface area beneath the schroeckingerite deposits, is less likely as the source of the uranium than was previously supposed.

(2) Another group of hypotheses explains the origin of the uranium by leaching from widespread sedimentary rocks or volcanic rocks of low uranium content. Slaughter and Nelson (1946, p. 35-37) noted that moderately radioactive clays and shales are widespread in the Red Desert and suggested that these radioactive sedimentary rocks are the direct source of the uranium in the schroeckingerite. Bell (1954, p. 112) cited the schroeckingerite occurrences of the Red Desert as an example of uraniferous caliche-type deposits which are formed in semi-arid regions where small amounts of ground and surface waters leach the soluble uranium compounds from slightly uraniferous formations exposed at the surface or lying at shallower depths. The idea of a widespread source, of course, could be applied equally well to the Eocene rocks in which most of the schroeckingerite occurs, to slightly older Tertiary rocks underlying

the area, or to younger Tertiary or Quaternary beds that now overlie, or that once were overlying, the present host rocks of the schroeckingerite.

Other authors have postulated that widespread overlying rocks were the source of the uranium in coal and other deposits. Denson and others (1952, p. 5) proposed an epigenetic hypothesis to explain the origin of uranium in coal and lignite of the Rocky Mountain region. They believe that leaching of overlying rocks of volcanic origin adds uranium to the ground water and that the uranium may be deposited immediately below the overlying rocks or may be moved considerable distances before being deposited "by adsorption on phosphatic, carbonaceous, or clayey beds". Love (1952, p. 17) also applied this same hypothesis to uranium deposits that occur in Wasatch sedimentary rocks in the Pumpkin Buttes area of Wyoming. Masursky and Pipiringos (1953, p. 16) concluded that downward and lateral movement of uranium from a widespread overlying source is indicated in the Red Desert by the widespread relation of coal of relatively high uranium content with permeable zones and with topographic and stratigraphic highs. Masursky and others (1953, fig. 11) pictured the source as Miocene sandstone and conglomerate, from which downward-percolating waters carried the uranium to "receptor" coal beds.

The writers of the present report believe that the general ideas expressed by Slaughter and Nelson, Bell, Denson, Love, and others are inadequate if they are applied to the Lost Creek schroeckingerite deposits because their hypotheses do not explain the fact that schroeckingerite is localized in a relatively small part of the Red Desert and the Great Divide Basin. It is certainly true, for example, that tuffaceous rocks are abundant and widespread. Examples are the Miocene tuffaceous sandstones and tuffaceous beds in the Bridger formation north of the Lost Creek schroeckingerite area. Also, bentonitic beds of volcanic origin occur in the Green River rocks and some are located within the area of schroeckingerite mineralization. If such rocks were the source of the uranium in the schroeckingerite, it is very difficult to explain the absence of schroeckingerite elsewhere in the Great Divide Basin where essentially the same geologic conditions exist. The authors conclude that leaching of widespread low-grade rocks is not a satisfactory explanation of the schroeckingerite.

(3) Another group of hypotheses are concerned with deposition of the schroeckingerite from lake or stream waters. Dake (1938, p. 23) stated that it was possible that the "dakeite" (schroeckingerite) was brought in by waters of a lake or stream flowing into the lake, possibly from an origin in granite Hills in the distance. Wyant and others (1951, p. 131-132) noted, as one of several hypotheses, that uranium derived from surrounding basement

rocks may have accumulated in Eocene Green River lakes and that the schroeckingerite may have precipitated in the near-shore muds when the lake evaporated. The same idea could apply also to younger lakes or streams. Beroni and McKeown (1952, p. 35) noted that arkosic Miocene(?) sedimentary rocks in the vicinity of Green Mountain, 20 miles north of the schroeckingerite deposits, contain appreciable radioactivity and that it is possible that the radioactive material in the soil and lignites south of the area may have been derived from these sedimentary rocks.

The writers of the present report believe that none of these hypotheses dealing with lake or stream deposition explain the localization of the schroeckingerite deposits in a relatively restricted area in the Great Divide Basin. Wyant and others (1951, p. 132) raised similar objections to this type of hypothesis. If, for example, the headwaters of Lost Creek obtained uranium from uranium deposits or uraniferous sediments in the Crooks Gap district near Green Mountain, 20 miles northeast of the schroeckingerite deposits, then uranium minerals including schroeckingerite probably should be found elsewhere along the Lost Creek drainage. The fact that uranium minerals are absent elsewhere along the drainage and the fact that the schroeckingerite deposits are all east of Lost Creek, rather than extending along the creek, are evidences against the source having been in the distant uranium deposits at Crooks Gap. If deposition in the near-shore parts of Eocene lakes is assumed, it is extremely difficult to explain the lack of schroeckingerite in many other exposures of near-shore Eocene beds. Even if the schroeckingerite had been precipitated as a near shore feature of a Green River lake in this one locality alone, it is very difficult to understand how there would be any remaining evidence. If Pleistocene lakes are assumed to have been the sites of deposition, then many other occurrences should have been found in the Great Divide Basin.

Conclusions.--The authors conclude that the most likely source of the uranium in the schroeckingerite is in relatively high-grade concealed uranium deposits located in the Lost Creek area. These hypothetical source deposits may be of hydrothermal origin, either directly of indirectly, or they may be structurally and/or stratigraphically controlled deposits of uncertain origin.

Reserves

The schroeckingerite deposits of the Lost Creek area constitute a large reserve of uraniferous material, but the majority of samples contain less than 0.050 percent uranium. The deposits are distributed irregularly near the surface in an area totalling about 13,000 feet in length and 3,000 feet in maximum width (pl. 4). The thickness of the main zone containing schroeckingerite deposits is 6 feet and the average thickness of individual deposits is 1.5 feet. Individual deposits containing irregular areas barren of schroeckingerite are as much as 80 feet wide and 390 feet long.

The ready solubility of schroeckingerite is a factor favorable to the potential economic use of the deposits, but the low grade of the deposits has been detrimental to commercial development.

In addition to the schroeckingerite deposits, the Lost Creek area may contain unexposed uranium deposits of relatively high grade. Data pertaining to these hypothetical deposits are included in the discussion on source of the uranium and in the chapter on suggestions for prospecting.

Other radioactive materials

Types

Radioactive materials other than schroeckingerite have also been found in the near-surface portion of the Lost Creek area. These materials seem to be of two general types: (1) material having a higher percentage of uranium than equivalent uranium; (2) material having a lower percentage of uranium than equivalent uranium. No uranium minerals have been identified in any of these materials, and the highest uranium content in samples of these types is only 0.039 percent.

In the area known to contain schroeckingerite deposits there are numerous occurrences of material having abnormal amounts of uranium but no schroeckingerite. In most of these occurrences, the percentage of uranium is higher than the percentage of equivalent uranium. Some of the occurrences of this type are very close to known schroeckingerite deposits but contain no schroeckingerite. For example, in Trench 5 (pl. 12, section B'-C') horizontal channel sample DS-H-288 was taken in clayey siltstone of the Cathedral Bluffs tongue 3/4 foot above a schroeckingerite deposit; the sample contains 0.016 percent equivalent uranium and 0.029

percent uranium. Similar anomalous amounts of uranium were found in channel samples above some to the schroeckingerite deposits in Trench 7 (pl. 14, section B-C). The occurrences of this type of material are not restricted to the area above schroeckingerite deposits. For example, in Trench 3 (pl. 10, section A'-B') sample DS-H-428 was taken in brown shale of the Tipton tongue 3 feet below a schroeckingerite deposit; it contains 0.009 percent equivalent uranium and 0.024 percent uranium. Other examples of this type of uraniferous material occur in the general vicinity of schroeckingerite deposits but not directly above or below such deposits. In Trench 8 (pl. 15, section E'-F') sample DS-H-654 in clayey siltstone contains 0.006 percent equivalent uranium and 0.011 percent uranium; it was taken 15 feet from the nearest exposure of schroeckingerite. Claystone at 12-14 feet in drill hole B-13 (Appendix D) near Trench 1 contains 0.015 percent equivalent uranium and 0.023 percent uranium; no schroeckingerite was cut by the drill hole.

Less common in the general area of schroeckingerite deposits are the occurrences of material having no schroeckingerite but higher equivalent uranium than uranium. In Trench 5 (pl. 12, section C'-D') sample DS-H-343 in sandy siltstone of the Cathedral Bluffs tongue contains 0.016 percent equivalent uranium but only 0.009 percent uranium. Some of the iron-stained contacts between adjacent beds are slightly radioactive but the uranium content is very low.

The site for Trench 13 (pl. 4) was selected on the basis of an airborne anomaly reported to occur in the general area (H. Masursky and N. M. Denson, oral communications, 1952). This trench is located southeast of the known area of schroeckingerite mineralization and contains no schroeckingerite deposits. The Trench 13 area, however, contains considerable amounts of iron-cemented sandstone as pebbles in float distributed widely over the surface of the ground (pl. 7). Samples of the float contain 0.005 to 0.008 percent equivalent uranium, but only 0.002 to 0.004 percent uranium. The iron-cemented sandstone in place forms the basal contact of the upper lenticular extension of the Tipton tongue. Even though the radioactivity of the samples is not particularly high, the presence of so much surficial material having slightly abnormal radioactivity probably causes an appreciable mass effect that would explain the anomaly detected by airborne equipment.

Origin

The uranium in many of the occurrences of other radioactive materials in the general schroeckingerite area was probably deposited in the same manner as the schroeckingerite. Many of these occurrences are similar to the schroeckingerite in having a higher percentage of uranium than equivalent uranium. Also, much of this material is either at the same general level as the schroeckingerite deposits or is above and below the schroeckingerite deposits. It seems likely that some of these occurrences may represent the sites of former schroeckingerite deposits which have been dissolved and redeposited elsewhere, leaving part of the uranium behind. In other places, the anomalous occurrences may represent the sites of incipient mineralization by schroeckingerite.

The iron-cemented sandstone float in the Trench 13 area and some of the iron-stained contacts between adjacent beds in other parts of the Lost Creek area are slightly radioactive, but the grade is very low in all occurrences of this type. Many other iron-cemented sandstones and iron-stained bedding planes in the various trenches are essentially non-radioactive. The explanation for abnormal radioactivity in some, but not all, of the iron-cemented rocks is not known.

The deposition of the iron in the various iron-stained zones and along iron-stained bedding planes may have been partly an original sedimentary or diagenetic feature. Or in some or all places the iron may represent a much later deposition of ferrous hydroxide from the ground water. The auger drilling indicated that some of the iron-stained zones persist to as much as 35 feet below the present ground level. If the iron was deposited from ground water, the water level must have been much lower in the past in order to allow the requisite oxidation. Presumably, such a lower water table existed, at least during dry stages of the Pleistocene epoch. The fact that some iron-stained zones and contacts are radioactive whereas others are barren suggests that the formation of the iron oxides was separate and distinct from the uranium deposition. Considerably more work, especially deep drilling, would be necessary to establish the exact relations of the iron-stained zones to the uranium mineralization.

Uraniferous water

General features of water in the Lost Creek area

Lost Creek is one of the few streams in the Great Divide Basin where water is permanently flowing. Lost Creek is intermittent over most of its course, permanently flowing in appreciable amounts only for about 3 miles in the vicinity of the schroeckingerite deposits. The stream begins to flow a short distance upstream from the point where a syncline crosses Lost Creek (pl. 2). It flows steadily to about 1 mile below the schroeckingerite deposits. In Osborne Draw (pls. 2 and 4) there is a permanent pond and several marshy areas. At the mouth of Osborne Draw is a spring which flows throughout the year. There are several springs in the western part of the area, along a large fault. The rest of the area is dry except for seasonal runoff.

Ground water was encountered in several of the trenches and in many of the drill holes in the exploration area. The depth to water ranged from a few feet to 46 feet. Several of the deeper drill holes penetrated a layer of water-saturated rocks at shallow depths, then penetrated a thick layer of dry rocks and reached more water-saturated rocks at depths of about 30 to 40 feet. Most of the water at shallow depths may represent perched water tables, but their extent is not known. Drill holes were too scattered to determine the effect of Lost Creek on the water table. Depth relations, however, indicate that Lost Creek in the schroeckingerite area is supplied by rising ground water in the form of seeps and springs, and has no close relationship with the ground water table.

Water samples

During the course of field work in the Lost Creek area, 141 water samples were taken for analysis (table 3). Forty-one of the samples were given a complete analysis for the common constituents of ground water. The samples were taken in order to classify the ground water in the Lost Creek area as to type and to attempt to correlate the origin of the water-soluble schroeckingerite deposits with the type and origin of the water. Table 3 shows the results of the analyses of the 141 water samples.

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.

Sample number	Location	Date	Partial composition of water in parts per million: Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	Radium gm/l.	Sludge: % U	Sludge: wt. gms.	pH
DS-W-1	Lost Creek 0.5 miles upstream from cabin (on Lost Creek in schroeckingerite area)	Oct., 1952	---	---	---	10.0	201.	260	13.8	0.52	3.7	0.160	1×10^{-12}	---	---	8.39
DS-W-2	Lost Creek 1.0 miles upstream from cabin	do.	---	---	---	7.3	186	198	15.7	.24	3.9	.032	1×10^{-12}	---	---	8.58
DS-W-3	Lost Creek 2.3 miles upstream from cabin	do.	---	---	---	9.0	178	142	18.2	.19	1.8	.028	4×10^{-12}	---	---	8.66
DS-W-4	Soda Lake, south edge	do.	---	---	---	22.6	292	50,600	7600.0	.09	3.5	.110	2×10^{-12}	---	---	8.41
DS-W-5	Lost Creek 4.8 miles NNE of Soda Lake	do.	---	---	---	38.3	517	441	58.0	1.82	2.3	.014	2×10^{-12}	---	---	8.19
DS-W-6	Crooks Creek at bridge in Crooks Gap	do.	---	---	---	10.0	155	29	4.4	.38	2.3	.016	2×10^{-12}	---	---	8.41
DS-W-7	Stock pond (spring) 7.4 miles NW of cabin	do.	---	---	---	3.7	162	162	6.2	.72	3.0	.020	3×10^{-12}	---	---	8.32
DS-W-8	Pickett Lake, south side	do.	---	---	---	183.0	1,020	134	114.0	3.39	3.2	.020	---	---	---	9.28
DS-W-9	Pond in Osborne Draw, 300 yards N. of cabin	do.	---	---	---	4.3	143	251	34.9	.86	1.4	.410	3×10^{-12}	---	---	8.39
DS-W-10	Lost Creek 1.2 miles downstream from cabin	do.	---	---	---	5.7	223	328	18.7	.48	2.8	.046	3×10^{-12}	---	---	8.53
DS-W-11	Lost Creek by cabin	do.	---	---	---	9.0	201	269	15.7	.62	1.9	.056	2×10^{-12}	---	---	8.57
DS-W-12	Spring 100 yds. N. of cabin	do.	---	---	---	1.7	160	90	9.2	.72	1.8	.190	3×10^{-12}	---	---	8.33
DS-W-13	Water well 3.5 miles south of cabin	do.	48	80	4	6.0	164	187	1.87	.25	61	.090	---	---	---	8.0
DS-W-14	Lost Creek at Eagles Nest Crossing	do.	61	310	7	3.7	260	813	4.01	.44	2.7	.150	---	---	---	8.1
DS-W-15	Auger hole ES-24	do.	95	270	20	2.7	179	921	2.49	.35	32	.080	---	0.0006	4.88	7.8
DS-W-16	do. ES-25	do.	41	310	11	<1.0	191	665	4.13	.44	18	.030	---	.0006	1.36	7.7
DS-W-17	do. ES-34	do.	39	400	9	<1.0	179	870	6.41	.30	7.4	.080	---	.0009	1.97	7.8
DS-W-18	do. ES-29	do.	19	230	5	<1.0	142	429	1.86	.30	5.2	.120	---	---	---	7.9
DS-W-19	do. ES-32	do.	35	140	7	<1.0	148	291	2.20	.30	5.2	.080	---	.0011	1.56	7.9

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.--Continued

Sample number	Location	Date	Partial composition of water in parts per million: Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	Radium gm/l.	Sludge: % U	Sludge: wt. gms.	pH
DS-W-20	Auger hole ES-39	Oct., 1952	---	---	---	<1.0	869	68	13.30	0.79	2.8	0.016	---	0.0010	1.65	7.7
DS-W-21	do. ES-91	do.	---	---	---	11.0	423	7,100	119.00	3.94	---	5.800	$< 10^{-12}$	.0036	1.35	8.0
DS-W-22	do. ES-101	do.	16	340	7	13.0	385	396	8.15	1.13	18.0	.023	---	.0021	1.28	8.0
DS-W-23	do. ES-105	do.	49	100	11	<1.0	184	166	1.76	.59	21.0	.24	---	.0025	1.50	7.2
DS-W-24	do. ES-111	do.	28	170	5	6.7	217	238	4.35	.74	3.4	.76	---	.0024	.69	8.1
DS-W-25	do. ES-16	do.	32	200	6	<1.0	161	231	11.20	.20	3.9	.21	---	---	---	8.1
DS-W-26	do. ES-18	do.	36	75	6	3.3	224	77	.93	.30	5.0	.32	---	.0009	.98	8.3
DS-W-27	do. ES-86	do.	35	120	10	<1.0	437	38	2.09	.44	1.6	.08	---	.0031	2.31	7.6
DS-W-28	do. ES-90	do.	41	480	6	20.0	635	573	9.43	2.86	2.6	.44	---	.0017	5.33	8.2
DS-W-29	do. ES-12	do.	40	180	7	8.3	272	220	3.68	<.05	6.2	.52	---	.0011	2.44	8.3
DS-W-30	do. ES-115	do.	49	300	9	<1.0	314	547	2.99	.69	11.0	.25	---	.0025	6.57	7.8
DS-W-31	do. ES-117	do.	22	83	4	5.3	160	89	.92	.59	3.9	.30	---	.0010	1.36	8.2
DS-W-32	Bucket hole 363	do.	19	200	16	3.3	373	167	2.17	.30	16.0	.20	---	.0014	5.86	8.4
DS-W-33	do. 356	do.	150	380	20	<1.0	502	1,184	4.42	.35	11.0	.14	---	.0008	10.81	7.5
DS-W-34	do. 305	do.	76	400	8	<1.0	179	965	2.42	.15	38.0	.78	---	.0050	.54	7.6
DS-W-35	do. 308	do.	89	2,500	20	<1.0	264	6,387	52.70	.44	2.6	7.30	$< 10^{-12}$	.0080	1.09	7.9
DS-W-36	do. 311	do.	160	500	14	<1.0	230	119	20.90	.25	6.3	3.20	---	.0070	.54	8.1
DS-W-37	Pool, trench 7, at 25 ft.	do.	---	---	---	10.0	343	5,548	88.00	5.42	1.4	8.00	$< 10^{-12}$	---	---	8.4
DS-W-38	do. 7, at 140 ft.	do.	29	500	6	10.0	188	940	10.10	2.32	2.8	2.00	---	---	---	8.4
DS-W-39	do. 7, at 635 ft.	do.	36	150	5	<1.0	154	258	3.07	.64	8.8	.60	---	---	---	8.1
DS-W-40	do. 7, at 700 ft.	do.	35	1,100	9	16.0	226	2,110	12.70	4.93	1.4	3.00	---	---	---	8.4
DS-W-41	do. 7, at 1190 ft.	do.	110	6,500	33	<1.0	455	11,569	194.00	6.26	2.4	6.80	---	---	---	8.1
DS-W-42	do. 7, at 1370 ft.	do.	58	1,600	9	1.7	251	3,253	39.30	5.37	.86	1.80	---	---	---	8.2
DS-W-43	do. 7, at 1570 ft.	do.	17	920	5	16.0	284	1,261	25.40	4.63	.66	1.70	$< 10^{-12}$	---	---	8.6

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.--Continued

Sample number	Location	Date	Partial composition of water in parts per million: Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	Radium gm/l.	Sludge: % U	wt. gms.	pH
DS-W-44	Pool, trench 8, at 1410 ft.	Oct., 1952	24	185	6	<1.0	142	167	2.94	1.04	17.00	0.12	---	---	---	7.7
DS-W-45	do. 8, at 1670 ft.	do.	48	400	11	< 1.0	70	3,317	10.10	.74	30.00	.56	---	---	---	8.1
DS-W-46	do. 8, at 1880 ft.	do.	46	400	6	<1.0	161	842	9.80	.64	9.4	.60	---	---	---	8.1
DS-W-47	do. 8, at 2060 ft.	do.	46	400	5.5	<1.0	159	845	9.33	.69	6.6	.60	---	---	---	8.2
DS-W-48	do. 8, at 2100 ft.	do.	55	480	7.5	<1.0	156	1,067	11.20	.69	5.2	.98	---	0.0015	0.38	8.0
DS-W-49	do. 8, at 2200 ft.	do.	31	290	7	<1.0	146	524	5.37	.49	5.5	.41	---	---	---	8.0
DS-W-50	do. 8, at 2310 ft.	do.	78	6,100	15	22.0	187	12,212	32.80	4.93	2.1	2.60	$<10^{-12}$	---	---	8.2
DS-W-51	SK well	do.	11	85	6	2.0	136	53	.84	.39	5.3	.020	---	---	---	8.4
DS-W-52	Crooked Neck Pete Larsen well	do.	25	220	9	<1.0	201	364	1.66	.59	2.1	.016	---	---	---	7.7
RW-1142	SK well	1953	8	14	1	0	56	24	.2	.2	.8	.002	---	---	---	7.15
RW-1143	Spring 100 yds. N. of cabin	do.	19	20	2	3.3	78	59	2.2	.4	4.7	.180	---	---	---	8.12
RW-1144	Lost Creek near cabin	do.	24	45	1	3.3	87	141	4.4	.3	31.0	.023	---	---	---	8.10
RW-1145	Lost Creek 2.3 miles upstream from cabin	do.	18	33	2	0.8	91	105	6.9	.6	28.0	.027	---	---	---	8.18
BH-1	Bucket hole 6	Nov., 1951	---	---	---	2.0	180	169	19.1	.6	---	.52	---	---	---	8.02
BH-43	do. 64	Dec., 1951	---	---	---	1.3	185	122	12.6	.5	---	.44	---	---	---	7.99
BH-307	do. 60	do.	---	---	---	8.3	219	767	86.0	1.3	---	1.30	---	---	---	8.46
BH-309	do. 62	do.	---	---	---	<1.0	253	1,799	234.0	.5	---	5.20	---	---	---	7.84
BH-312	do. 66	do.	---	---	---	<1.0	174	127	15.3	.4	---	.32	---	---	---	7.98
BH-326	do. 41	do.	---	---	---	<1.0	237	248	38.3	1.0	---	.80	---	---	---	8.00
BH-328	do. 43	do.	---	---	---	9.0	204	185	24.7	.8	---	.64	---	---	---	8.39
BH-330	do. 45	do.	---	---	---	2.0	146	114	12.9	.3	---	.36	---	---	---	8.15
BH-331	do. 47	do.	---	---	---	3.3	173	111	9.6	.4	---	.40	---	---	---	8.18
BH-333	do. 49	do.	---	---	---	7.3	215	162	39.7	.4	---	.44	---	---	---	8.20
BH-346	do. 23	do.	---	---	---	6.9	172	187	18.7	.5	---	.44	---	---	---	8.21

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.--Continued

Sample number	Location	Date	Partial composition of water in parts per million: Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	Radium gm/l.	Sludge: % U	wt. gms.	pH
BH-348	Bucket hole 25	Dec., 1951	---	---	---	9.3	423	2,911	252.0	2.6	---	6.40	---	---	---	8.20
BH-350	do. 27	do.	---	---	---	3.7	166	183	20.9	0.6	---	0.52	---	---	---	8.09
BH-351	do. 29	do.	---	---	---	4.0	165	121	10.4	.5	---	.76	---	---	---	8.22
BH-353	do. 31	do.	---	---	---	3.3	168	391	82.1	.8	---	.56	---	---	---	8.13
BH-367	do. 2	Nov., 1951	---	---	---	5.0	177	473	22.4	1.3	---	.68	---	---	---	8.22
BH-369	do. 4	do.	---	---	---	4.0	160	196	11.8	.4	---	.36	---	---	---	8.10
BH-372	do. 8	do.	---	---	---	4.0	196	249	38.2	1.1	---	.68	---	---	---	8.17
BH-374	do. 10	Dec., 1951	---	---	---	<1.0	138	1,379	31.3	1.6	---	.60	---	---	---	7.80
DS-81	Auger hole ES-81	Oct., 1951	---	---	---	8.3	299	---	101.0	---	---	1.9	---	0.004	14.7	---
DS-82-384	do. 82	do.	---	---	---	10.1	302	1,140	394.0	2.34	---	2.1	---	.004	16.7	8.34
DS-83-385	do. 83	do.	---	---	---	15.4	302	---	62.4	---	---	1.2	---	.003	9.79	---
DS-84-386	do. 84	do.	---	---	---	4.3	250	400	17.7	4.68	---	.48	---	.002	10.6	8.21
DS-86-387	do. 86	do.	---	---	---	2.5	189	98.6	73.9	.38	---	.40	---	.003	12.9	8.22
DS-87-388	do. 87	do.	---	---	---	6.8	196	428	57.7	1.87	---	.36	---	.003	3.70	8.28
DS-88-389	do. 88	do.	---	---	---	6.8	199	382	38.3	1.12	---	.24	---	.003	3.59	8.20
DS-90-390	do. 90	do.	---	---	---	9.7	276	521	81.7	1.40	---	.68	---	.003	7.76	8.10
DS-91-391	do. 91	do.	---	---	---	15.1	270	3,390	668.0	1.22	---	4.80	---	.004	5.93	8.10
DS-92-392	do. 92	do.	---	---	---	<1.8	165	536	78.2	1.12	---	.84	---	.003	5.43	8.04
DS-93-393	do. 93	do.	---	---	---	17.2	356	4,120	1,580.0	1.22	---	10.80	---	.005	7.91	8.00
DS-94-394	do. 94	do.	---	---	---	7.9	240	1,260	188.0	.84	---	2.8	---	.003	34.8	8.08
DS-96-395	do. 96	do.	---	---	---	3.6	203	231	17.8	1.03	---	.48	---	.003	8.07	8.27
DS-99-396	do. 99	do.	---	---	---	5.7	170	290	16.8	.56	---	.36	---	.002	6.82	8.43
DS-100-397	do. 100	do.	---	---	---	<1.8	184	161	45.2	2.06	---	.36	---	.007	9.96	---
DS-101-398	do. 101	do.	---	---	---	5.4	238	433	64.3	1.97	---	.76	---	.003	12.4	8.32
DS-103-399	do. 103	do.	---	---	---	8.3	290	339	56.9	1.50	---	.80	---	.003	38.0	8.46

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.--Continued

Sample number	Location	Date	Partial composition of water in parts per million: Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	Radium gm/l.	Sludge: % U	Sludge: wt. gms.	pH
DS-104-400	Auger hole ES-104	Oct. 1951	---	---	---	10.1	300	199	31.4	0.94	---	0.68	---	0.002	59.6	8.57
DS-105-401	do. 105	do.	---	---	---	<1.8	151	152	13.2	.66	---	.20	---	.003	3.47	8.03
DS-106-402	do. 106	do.	---	---	---	2.9	162	139	12.2	.66	---	.32	---	.003	6.23	8.15
DS-108-403	do. 108	do.	---	---	---	25.8	329	---	131.0	---	---	.40	---	.005	39.40	---
DS-109-404	do. 109	do.	---	---	---	18.7	320	---	30.8	---	---	.84	---	.004	11.50	---
DS-110-405	do. 110	do.	---	---	---	3.2	177	129	12.2	.66	---	.68	---	.003	2.50	8.20
DS-111-406	do. 111	do.	---	---	---	4.7	210	200	29.1	.47	---	.48	---	.003	1.43	8.39
DS-112-407	do. 112	do.	---	---	---	2.5	218	118	7.1	.28	---	.40	---	.003	16.60	8.25
DS-113-408	do. 113	Nov. 1951	---	---	---	<1.8	201	140	22.5	.75	---	.36	---	.004	14.90	7.99
DS-114-409	do. 114	do.	---	---	---	7.2	208	355	29.9	.47	---	.96	---	.004	6.46	8.38
DS-115-410	do. 115	do.	---	---	---	<1.8	250	248	35.7	.47	---	.36	---	.003	18.20	8.10
DS-116-411	do. 116	do.	---	---	---	4.3	223	704	39.7	.75	---	2.00	---	.005	17.80	7.94
DS-117-412	do. 117	do.	---	---	---	3.6	170	115	9.1	.28	---	.36	---	.003	8.31	8.12
DS- 12-413	do. 12	do.	---	---	---	3.6	167	231	24.3	.38	---	.36	---	.001	5.31	8.10
DS-20-288	do. 20	July 1951	---	---	---	4.0	153.7	86.7	13.1	.70	---	.209	---	.006	.65	---
DS-35-289	do. 35	Aug. 1951	---	---	---	4.0	114.9	197.1	15.4	.28	---	.002	---	.001	.39	---
DS-25-290	do. 25	July 1951	---	---	---	2.5	99.7	436.5	22.6	.52	---	.004	---	.002	.78	---
DS-34-291	do. 34	Aug. 1951	---	---	---	5.0	143.1	835.6	56.9	.19	---	.112	---	.002	.23	---
DS-33-292	do. 33	do.	---	---	---	5.4	208.1	273.1	15.9	.42	---	.011	---	.001	.36	---
DS-29-293	do. 29	July 1951	---	---	---	5.4	130.7	420.6	17.7	.37	---	.028	---	.002	.10	---
DS-30-294	do. 30	Aug. 1951	---	---	---	2.9	119.0	288.1	21.3	.47	---	.034	---	.002	.33	---
DS-32-295	do. 32	do.	---	---	---	6.1	131.8	284.4	21.9	.33	---	.112	---	.002	.38	---
DS-24-296	do. 24	do.	---	---	---	4.7	171.2	618.1	13.5	.19	---	.005	---	.001	.81	---
DS-39-297	do. 39	do.	---	---	---	5.0	198.2	256.6	13.1	.33	---	.019	---	.001	1.67	---
DS-19-310	do. 19	July 1951	---	---	---	12.9	199.7	776.9	122.9	.47	---	1.600	---	.003	.64	---

Table 3.--Results of the analysis of water samples taken in the Lost Creek area, Sweetwater County, Wyoming.--Continued

Sample number	Location	Date	Partial composition of water in parts per million										Radium	Sludge		pH
			Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	gm/l.	% U	wt. gms.	
DS-15-311	Auger hole ES-15	July 1951	---	---	---	23.3	682.6	4,188.2	1,861.3	7.69	---	32.0	---	0.011	0.07	---
DS-16-312	do. 16	do.	---	---	---	5.0	135.4	218.1	65.3	.28	---	.340	---	.003	.19	---
DS-17-313	do. 17	do.	---	---	---	4.0	165.7	71.2	12.1	.33	---	.168	---	---	.25	---
DS-18-314	do. 18	do.	---	---	---	9.0	167.2	90.2	13.1	.70	---	.052	---	.002	.14	---
DS- 2-199	Auger hole ES-2	Nov. 1950	---	---	---	11.1	144.2	998.0	22.6	---	---	.66	---	---	---	7.85
DS- 3-200	do. 3	do.	---	---	---	18.5	190.3	932.0	30.8	---	---	.42	---	---	---	8.35
DS- 4-201	do. 4	do.	---	---	---	18.5	134.0	2,035.0	31.2	---	---	.60	---	---	---	8.00
DS- 5-202	do. 5	do.	---	---	---	6.6	162.1	893.0	16.4	---	---	.48	---	---	---	8.00
DS- 6-203	do. 6	do.	---	---	---	8.7	135.9	800.0	15.2	---	---	.48	---	---	---	8.20
DS- 7-204	do. 7	do.	---	---	---	10.0	123.8	1,844.0	28.7	---	---	.50	---	---	---	7.90
DS- 8-205	do. 8	Dec. 1950	---	---	---	10.6	126.0	751.0	19.5	---	---	.14	---	---	---	8.00
DS- 9-206	do. 9	do.	---	---	---	7.4	134.5	823.0	19.9	---	---	.04	---	---	---	7.90
DS-10-207	do. 10	do.	---	---	---	9.2	138.0	6,521.0	78.3	---	---	.88	---	---	---	8.10
DS-12-208	do. 12	do.	---	---	---	14.5	100.5	2,566.0	35.9	---	---	.07	---	---	---	8.00
DW-102-296	Pond at mouth of Lost Creek	---	---	---	---	2.0	70	103	19	---	---	.0	---	---	---	---
DW- 85-264	Spring 100 yds. N. of cabin	May. 1949	---	---	---	7.0	83	127	20	---	---	.440	---	---	---	---
WNS-10-14	do.	July 1949	---	---	---	6.0	136	78	20	---	---	.010	---	---	---	---
WNS-22-30	do.	October 1949	---	---	---	---	---	---	---	---	---	.130	---	---	---	---
DW-85-265	Lost Creek near cabin	---	---	---	---	17	114	54	5	---	---	.0[illegible]	---	---	---	---
WNS-3-3	Chain Lake	---	---	---	---	242	2,147	1,956	1,960	---	---	.030	---	---	---	---
WNS-7-9	Sourdough draw No. 1 Reservoir	---	---	---	---	0	102	28	68	---	---	.010	---	---	---	---
WNS-9-13	Pit 14	---	---	---	---	34	486	6,590	40	---	---	46.000	---	---	---	---
WNS-17-25	Water well 3.5 miles south of cabin	---	---	---	---	---	---	---	---	---	---	.030	---	---	---	---
WNS-21-29	PB spring 23 miles NW of cabin	---	---	---	---	---	---	---	---	---	---	.010	---	---	---	---

The analysis of water samples from the Lost Creek area indicated that the water has a composition typical of semi-arid and arid regions, but with abnormal amounts of uranium, fluorine, and nitrate. The uranium content of all samples ranges from 0.002 to 46 parts per million, with an average content of about 1.4 parts per million. The uranium content of surface water samples ranges from 0.014 to 0.440 parts per million. The samples with the highest uranium content came from drill holes and prospect pits where the water was close to or in contact with schroeckingerite bodies. The fluorine content of surface water samples in the Lost Creek area and surrounding areas ranges from 0.09 to 3.39 parts per million, and of ground water samples ranges from <0.05 to 6.26 parts per million. The nitrate content of surface water samples ranges from 1.4 to 31.0 parts per million, and of ground water samples ranges from 0.66 to 61 parts per million.

Interpretation of water analyses

In the interpretation of the water samples from the Lost Creek area, an attempt was made to determine whether or not the waters were entirely meteoric in origin or if there could have been addition of hydrothermal or juvenile water. This was done by classifying the waters according to their chemical values, or reaction capacities, and comparing them with similar classifications of waters from other areas, and with waters of known or suspected juvenile additions.

Ground waters are chiefly solutions of bicarbonates, sulfates, and chlorides of the alkaline earths and the alkalies. The waters commonly contain some silicon, iron, and aluminum, but these constituents are usually assumed to occur in the colloid state as oxides, and not to be in chemical equilibrium with the constituent ions. The most abundant cation constituents are usually two alkaline earths, calcium and magnesium, and two alkalies, sodium and potassium. The most common anion constituents are the weak acid bicarbonate, and the two strong acids, sulfate and chloride. For the graphic methods used in this paper, the waters are treated substantially as though they contained only three cation constituents (Ca, Na, K) and three anion constituents (HCO_3, SO_4, Cl).

The reaction capacities of the Lost Creek waters were derived by translating the physical weights, the amounts in parts per million, of the constituents into their chemical values in the solution, expressed as equivalents per million and derived by the following formula:

$$\text{Equivalents per million} = \text{parts per million} \times \frac{\text{valence}}{\text{atomic weight}}$$

(Piper, 1944, p. 915)

The reaction capacity of the constituents of water is their equivalents per million expressed as a percentage of the sum of the equivalents for all the constituents. In substantially all natural waters the cations are in chemical equilibrium with the anions, and if the concentrations of the several dissolved constituents are measured in terms of percentage of reacting value, the subtotals of the cations and the anions should each be 50 percent of the whole.

The statement of a water analysis in terms of ratios, by reacting values of each radicle to the sum of all the radicles, is a basic chemical characterization of the water solution. This system of study allows the various constituents to be listed and studied in terms of the reacting value of each constituent and of each group of like constituents. The reacting values of the physical amounts of constituents determines the chemical characteristics of the water studied. These characteristics are often written in terms of salinity or alkalinity, and are derived as indicated in the following diagram:

Bases	Acids	
	Strong acids (Cl, SO_4)	Weak acids (CO_3, HCO_3)
Alkalies (Na, K)	Primary salinity	Primary alkalinity
Alkaline earths (Ca, Mg)	Secondary salinity	Secondary alkalinity
Metals (H, Fe)	Tertiary salinity	Tertiary alkalinity

Plate 24 shows the chemical values from the water analyses plotted as single points according to conventional trilinear coordinates (Piper, 1944, p. 917). In the triangular field at the lower left the percentage reacting values of the three cations (Ca, Na, K) are plotted as a single point. The three anion groups (HCO_3, SO_4, Cl) are plotted in a similar manner in the triangular field at the lower right. The central diamond shaped field is used to show the overall chemical character of the water by a third single point plotting, which is at the intersection of rays projected from the points in the two triangles. The position of the point in the diamond shaped field indicates the relative composition of a water in terms of cation-anion pairs that correspond to the four vertices of the field. These three trilinear plottings show the essential chemical character of a water according to the relative concentration of its constituents, but not according to the absolute concentrations.

Most of the Lost Creek analyses have a salinity that exceeds 50 percent. The specimens that have the largest amounts of uranium have a primary salinity in excess of 80 percent, due almost exclusively to the sulfate ion. The highest uranium values occur where the composition of the water matches closely the composition of Glauber's salt ($NaSO_4$).

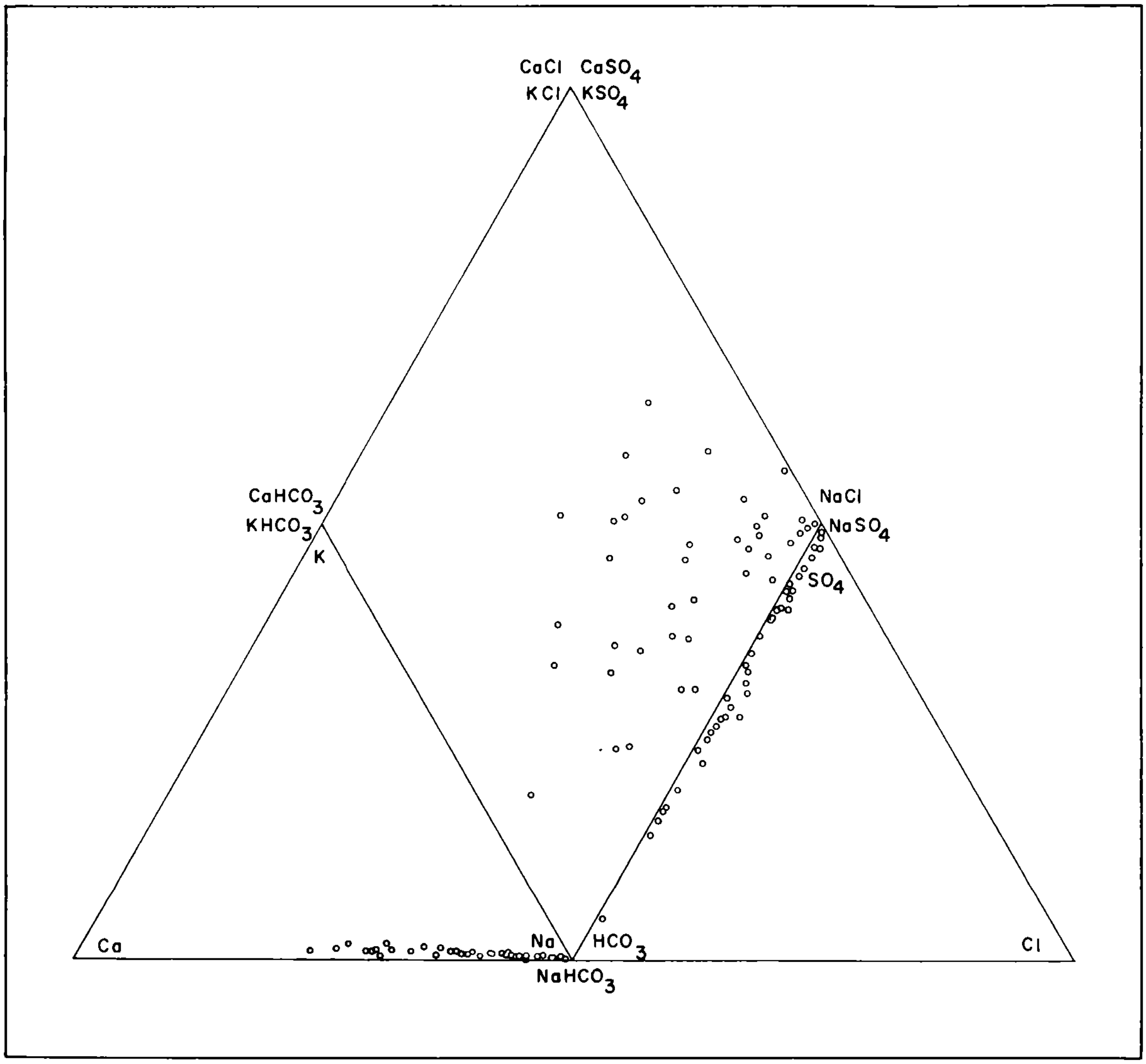


PLATE 24.-TRILINEAR DIAGRAM SHOWING CHEMICAL CHARACTER OF WATER SAMPLES FROM THE LOST CREEK AREA

Table 4 shows a listing of some averages of water analyses from different types of localities in the Lost Creek area compared with some averages of water analyses from other areas. Plate 25 shows the trilinear plot of the chemical values of these analyses. This comparison shows graphically the similarities and dissimilarities of the water from several environments in the Lost Creek area, from similar environments in Montana, and from waters of known volcanic and juvenile associations.

Table 5 shows seasonal and yearly variations in the composition of the water in the Lost Creek area. Analytical data are incomplete, but the table shows that the amounts of the various constituents are subject to wide variation from year to year and from season to season.

Conclusions

The general composition of the waters of the Lost Creek area with the exception of abnormal amounts of uranium, fluorine, and nitrate, matches closely the character and composition of ground waters in other arid regions of similar geology. The data are inconclusive as to the ultimate origin of the water. The waters may be entirely meteoric, with the major constituents, except uranium, derived from the normal soils and bedrocks of the region. Certain features of the composition, on the other hand, including abnormally high concentrations of fluorine, nitrate, and uranium, suggest a possible addition of juvenile or hydrothermal water to the meteoric waters. However, other areas, notably West Texas, also have abnormal amounts of fluorine, but have no direct evidence for the addition of juvenile or hydrothermal waters. Most water analyses in the United States show a low relative concentration of nitrate, whereas most

Table 4. Analyses of water samples from the Lost Creek area, compared with analyses of water from other areas.

	Number of specimens		Partial composition of water, in parts per million								pH
			Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	
1. Waters from auger holes, bucket holes, and trenches, Lost Creek area	35	Max.	160	6,500	33	22.0	869	12,212	194.0	6.26	8.6
		Min.	16	75	5	< 1.0	70	38	.92	< .05	7.2
		Avg.	52	823	9.3	< 4.8	274	1,875	20.8	<1.55	8.25
2. Waters from wells in the Red Desert area	4	Max.	48	220	9	6.0	201	364	1.87	.59	8.4
		Min.	8	14	1	< 1.0	56	24	.20	.20	7.15
		Avg.	23	100	5	< 2.0	139	157	1.13	.36	7.8
3. Surface waters from the Red Desert area	15	Max.	61	310	7	183.0	1,020	813	144.0	3.39	9.28
		Min.	18	20	1	.8	78	29	2.2	.19	8.10
		Avg.	30.5	102	3	19.5	244	228	23.1	.84	8.41
4. Waters from the Fort Union formation in Montana (Riffenburg, 1925)	---	Max.	336	920		---	2,152	2,440	306	---	---
		Min.	4.0	8.0		---	63	2.6	1.0	---	---
		Avg.	54	286		---	666	316	33	---	---
5. Waters from surficial deposits in Montana and North Dakota (Riffenburg, 1925)	142	Max.	500	880		---	883	1,600	472	---	---
		Min.	15	4.0		---	95	12	1.0	---	---
		Avg.	124	140		---	412	382	58	---	---
6. Waters from Steamboat Springs, Nevada (Brannock, and others, 1948, p. 221)	4	Max.	23	707	81	104	419	131	949	2.2	8.6
		Min.	3.9	602	56	20	191	105	747	1.6	7.7
		Avg.	12.9	645	66.6	62	305	118	836	1.9	8.2
7. Some thermal waters of volcanic association (White and Brannock, 1950, p. 569)	7	Max.	338	1,389	108	173	1,891	1,984	921	22	9.5
		Min.	2	48	30	0	0	21	5	2.1	2
		Avg.	61.3	478	57	39	452	628	386	11.7	6.2

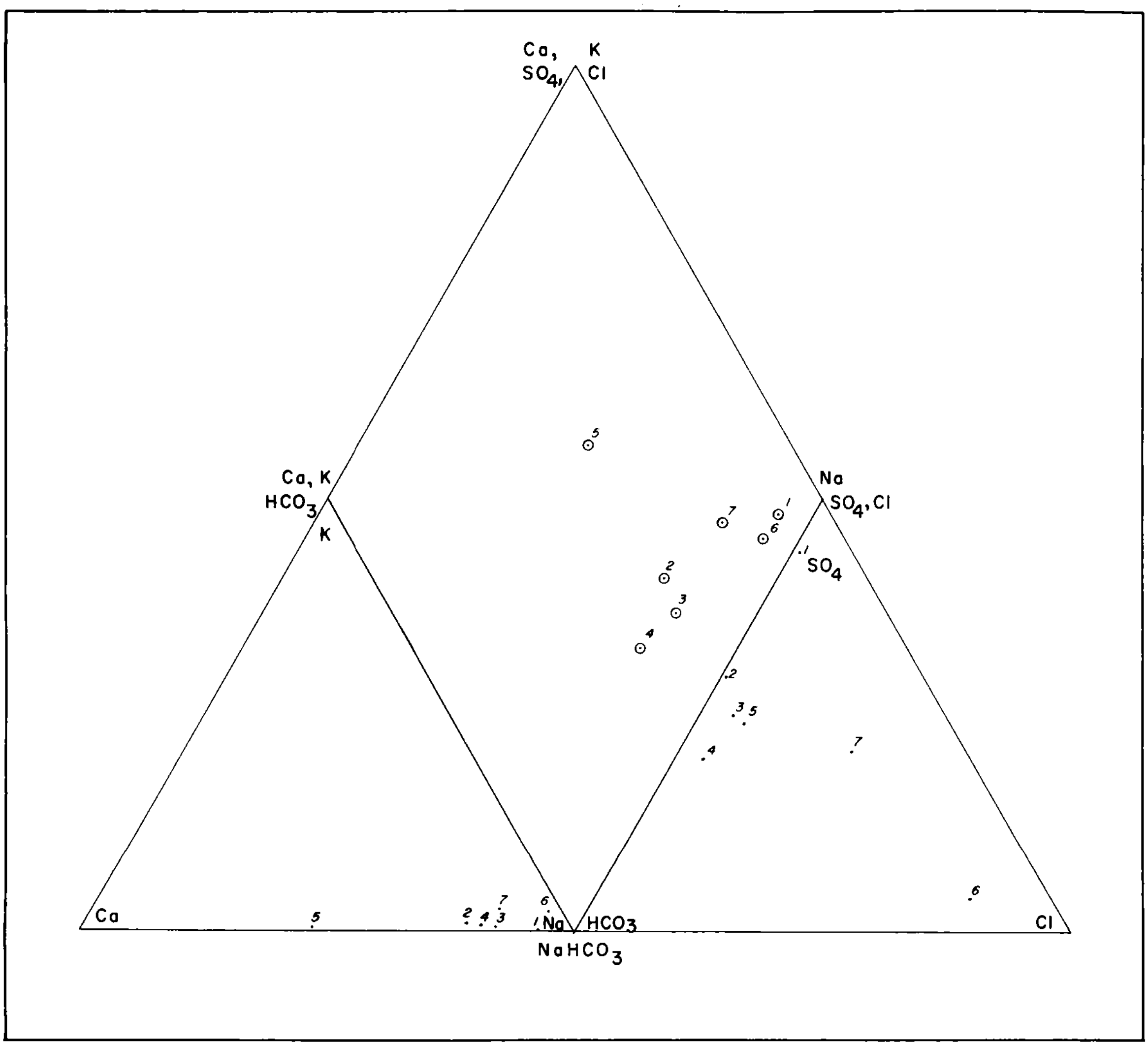


PLATE 25.—TRILINEAR DIAGRAM COMPARING WATER ANALYSES IN THE LOST CREEK AREA WITH WATER ANALYSES FROM OTHER AREAS

Table 5. Comparison of water samples taken from the same location at different times, Lost Creek area.

Sample number	Location and date		Ca	Na	K	CO_3	HCO_3	SO_4	Cl	F	NO_3	U	R	pH
			Partial composition of water, in parts per million											
DW-85-264	Spring in schroeckingerite area near cabin	5/49	---	---	---	7	83	127	20	---	---	0.440	---	---
WNS-10-14	do.	7/49	---	---	---	6	136	78	20	---	---	.010	---	---
WNS-22-30	do.	10/49	---	---	---	---	---	---	---	---	---	.130	---	---
DS-W-12	do.	10/52	---	---	---	1.7	160	90	9.2	0.72	1.8	.190	3×10^{-12}	8.33
RW-1143	do.	10/53	19	20	2	3.3	78	59	2.2	.4	4.7	.180	---	8.12
DW-85-265	Lost Creek near cabin	1949	---	---	---	17	114	54	5	---	---	0	---	---
DS-W-11	do.	1952	---	---	---	9.0	201	269	15.7	.62	1.9	.056	2×10^{-12}	8.57
RW-1144	do.	1953	24	45	1	3.3	87	141	4.4	.3	31	.023	---	8.10
DS-W-3	Lost Creek 2.3 mi. upstream from cabin	1952	---	---	---	9.0	178	142	18.2	.19	1.8	.028	4×10^{-12}	8.66
RW-1145	do.	1953	18	33	2	.8	91	105	6.9	.6	28	.027	---	8.18
WNS-17-25	Water well 3.5 mi. S. of cabin	1949	---	---	---	---	---	---	---	---	---	---	---	---
DS-W-13	do.	1952	48	80	4	6.0	164	187	1.87	.25	61.0	.090	---	8.0
DS-W-51	SK well	1952	11	85	6	2.0	136	53	.84	.39	5.3	.020	---	8.4
RW-1142	do.	1953	8	14	1	0	56	24	.2	.2	.8	.002	---	7.15

waters that are probably in part juvenile have abnormally high relative concentrations of nitrate. (White and Brannock, 1950, p. 568-570; Peale, 1886; Gooch and Whitfield, 1888, Clarke, 1914; Stearns and others, 1937). In a playa basin terrane, however, a high relative concentration of nitrate might be expected through the leaching of the small amounts of nitrate from volcanic rocks and its concentration by evaporation in the closed basin. The high uranium content may be due to a hydrothermal addition, or if the waters are entirely meteoric in character, the uranium may have been derived from a uraniferous source rock or deposit.

Whatever the exact source of the waters may be, it is not likely that the uranium was obtained from the present host rocks, the overlying soils, or widespread low-grade sources since schroeckingerite deposition has not occurred in other places in the Great Divide Basin where lithologic, topographic, and hydrographic conditions, and the water composition, excepting the uranium, are virtually the same. Field evidence concerning the solution and redeposition of schroeckingerite in the Lost Creek area and the laboratory evidence of high uranium content of the waters indicate that water plays a direct part in the formation of the schroeckingerite deposits. The immediate source of the uranium in the schroeckingerite deposits is the uraniferous ground water.

The writers feel that a more careful and complete study of the ground water in the Lost Creek area would be helpful in finding additional uranium deposits. The source of the flowing water in Lost Creek, whether it is artesian springs or water table, and the direction of movement of the subsurface water may indicate the location of high-grade source deposits.

SUGGESTIONS FOR PROSPECTING

Schroeckingerite

The area containing known deposits of schroeckingerite is shown on plate 4. The distribution of deposits within the mineralized area is incompletely known. It is possible, also, that additional deposits may lie outside the arbitrary boundary line shown on the map. As a possible aid to future prospecting, exploration, or development work, the experiences of the writers in identifying schroeckingerite and in searching for it are summarized below.

Pellets of schroeckingerite, 0.05 inch or more in size, can be identified easily by the characteristic brilliant yellow-green fluorescence and by the appearance in natural light. Smaller pellets and the finer grained types of schroeckingerite are more difficult to distinguish in the field from fluorescent opal, which also has a yellowish color under the ultra violet lamp. Small amounts of schroeckingerite associated with fluorescent opal and with some types of fluorescent carbonate give the false impression that the fluorescent material is all schroeckingerite. The difficulties in identification are especially pronounced when the material under inspection is in the form of drill cuttings, because the mixing in drill holes commonly breaks the fluorescent material into very fine grains. Microscope study is often necessary to distinguish some of the very fine grained types of fluorescent material, but the writers also found the following techniques useful for rapid identification. Fine specks of fluorescent material of uncertain identify can be rubbed between the fingers. If the specks are schroeckingerite, they will smear easily on the fingers and the entire smear will retain a brilliant yellow-green fluorescence. If, however, the specks are not schroeckingerite, they either will not smear at all, as with hard opal coatings on sand grains, or if they do smear, the fluorescent color of the smeared material will diminish in intensity to a dull yellow color. A hand lens can be used to check the identification by fluorescence, and an added check should also be made with a Geiger counter. Although the radioactivity of schroeckingerite is low, nevertheless it is an aid to identification.

The most useful tool for geologic work in connection with schroeckingerite is the ultra violet lamp. The lamp can be used at night, for example, in marking out the extent of individual blocks of mineralized ground in exploratory trenches or pits. The lamp can also be used advantageously in a portable dark box for examining drill cuttings during daylight drilling operations.

Experience has shown that the Geiger-Mueller counter and the scintillation counter are of little value for prospecting for schroeckingerite if the deposits lie below about 1 foot of overburden. The radioactivity of the schroeckingerite is relatively so low, in comparison with uranium minerals that are closer to radioactive equilibrium, that its presence can be detected with counting devices only in exposures practically at the surface of the ground.

Prospecting for schroeckingerite deposits in the Lost Creek area is difficult without the aid of exploratory work. Methods that have been used in the area include test-pitting, bulldozing, trenching, auger drilling, and other types of drilling. Of all these methods, trenching gives the most information about the size and shape of the deposits and also provides good exposures for sampling. The other methods, however, can be used very advantageously in determining the presence or absence of schroeckingerite and in marking out details of distribution between trenches.

A limited amount of prospecting can be done without the aid of exploratory methods. Some of the known schroeckingerite deposits lie very close to the surface either where the overburden is thin or where the deposits are partially or wholly within the Quaternary sands and silts. Such deposits are often indicated by efflorescent salts that occur at the surface of the ground. Where such salts overlie schroeckingerite deposits they have a definite pale yellow-green fluorescence. Where such surficial salts are not underlain by schroeckingerite and are not downslope from schroeckingerite deposits, the color under the ultra-violet lamp is merely a white reflection. Night prospecting should be done with caution because the Red Desert has abundant opal-encrusted pebbles that fluoresce yellow or yellow-green.

The known schroeckingerite deposits lie in and near the Cyclone Rim zone of faulting, and the mineralization is generally the richest in siltstone or claystone beds. These geologic associations might aid in further prospecting. Additional exploration work within or near the Cyclone Rim zone might disclose additional deposits of schroeckingerite. The exploration through 1952, however, disclosed no schroeckingerite west of Lost Creek and none as far southeast as Trench 13 (pl. 4). In addition to the immediate vicinity of the Cyclone Rim zone, other possible areas for prospecting include some of the drainages in the area--for example, along Osborne Draw (pl. 4) and eastward along that drainage.

Hypothetical deposits

The writers believe that the schroeckingerite mineralization in the Lost Creek area can be considered a clue to more important uranium deposits. The presence of large amounts of schroeckingerite in this area is difficult to reconcile as a unique occurrence involving no other uranium deposits in the immediate vicinity. In many other uraniferous districts in the western states schroeckingerite occurs as one of a suite of secondary uranium minerals which are often indicators of high-grade ore at depth. The writers have concluded from available geologic data that the uranium in the Lost Creek schroeckingerite deposits was derived from unexposed uranium deposits of relatively high grade. Although these source deposits are hypothetical, the writers believe that their existence must be proved or disproved before the economic and scientific aspects of the Lost Creek area can be evaluated fully. The following suggestions, therefore, are included as possible guides to ore.

Three general areas in the vicinity of Lost Creek can be considered geologically favorable to the presence of the hypothetical source deposits:

(1) First, the known area of schroeckingerite mineralization (pl. 4) is a logical place to explore at depth for source deposits. The fact that this area lies partly within and partly north of the Cyclone Rim zone of faulting may be especially significant, because uranium deposits in many other districts are associated with faults or other structural controls. Although drilling in the area encountered no deposits except those of schroeckingerite and other low-grade types of radioactive material, the

maximum depth of the drill holes was only 51 feet. Even in some of these shallow holes, gamma-ray logging disclosed unexplained radioactive anomalies. Additional drilling to greater depths in the area of schroeckingerite mineralization could be based partly on the complex fault pattern in the Cyclone Rim zone. The areas between faults and the area north of the zone of faulting should also be considered favorable, however, because the hypothetical deposits might be controlled partly by stratigraphic factors.

(2) A second large area that is geologically favorable lies southeast, east, and northeast of the known area of schroeckingerite mineralization. The surface drainage into much of the area mineralized by schroeckingerite is from these directions, and it might be assumed that ground water movements, at least in part, also may be directed into the schroeckingerite area from these directions. Deeper drilling in these directions, both within the Cyclone Rim zone of faulting and in the area north of the zone, could also be considered in any future exploration program.

(3) A third large area includes the intersections of major fault trends. The geologic map (pl. 2) shows that the long northeasterly-trending faults intersect both the Cyclone Rim zone of faulting and the major curving fault on the north limb of the syncline. By comparison with plate 4, it will be noted that the area of schroeckingerite mineralization lies very close to the intersections of the long northeasterly and northwesterly faults. Such a location is similar to the structural associations

of many types of ore deposits. It may be considered geologically favorable, therefore, to drill the various major fault intersections in this vicinity. Drilling also might be considered along the faults away from the intersections. The attitudes of most of the major faults shown on plate 2 are not known. Planning of specific sites and holes probably would require preliminary surface work, partly exploratory, in order to determine the attitude and character of the faults.

In the above comments no suggestions have been made for depth of drill holes because data are too limited to suggest specific depths. Certainly, such depths should exceed the maximum of 51 feet in exploration through 1952, and, conceivably, holes 250 feet, 500 feet, and even 1,000 feet or more in depth should be considered. The deeper holes could be spotted for faults and fault intersections, for example, whereas shallower holes could be laid out in a grid pattern to test the schroeckingerite area, the Cylone Rim zone, and the area to the north of the zone. Gamma-ray logging of all holes would be a necessary part of any exploration in order to detect the presence of deposits near to but not cut by the drill holes.

A special study involving the detailed pattern of ground water movements in the Lost Creek area also might offer some clues. Such a study would be especially valuable if it could determine the path of uranium-bearing solutions into the Lost Creek schroeckingerite area.

Another supplementary study that conceivably might be of value involves geophysical techniques in searching for concealed ore deposits. However, the complex intertonguing of shale and sandstone in the area might pose technical difficulties for some geophysical methods.

If concealed high-grade uranium deposits are eventually found in the Lost Creek area and if these deposits are associated with fault structures, then it would be logical to prospect on a structural basis beyond the limits of the Lost Creek area. As mentioned in the chapter on structure, the fault system in the Lost Creek area is probably part of a major regional fault system trending northwesterly for a distance of about 75 miles. Prospecting and exploration could be extended both to the northwest and to the southeast of the Lost Creek area. It is also conceivable that northeasterly fault structures in the Lost Creek area may extend northeast towards the Crooks Gap uranium district; such structures could also be investigated by exploration.

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USGS - TEI-302

Part II

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GEOLOGY OF THE LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

Part II. Reserves

by D. M. Sheridan, J. T. Collier, and C. H. Maxwell

ABSTRACT

The Lost Creek schroeckingerite deposits in northern Sweetwater County, Wyoming were explored during parts of 1950, 1951, and 1952 by the U. S. Geological Survey on behalf of the Atomic Energy Commission. Exploratory methods included trenching, auger-drilling, and bucket-drilling. Inferred reserves were calculated mainly from data from the exploratory trenches, but data from drill holes aided in blocking out the mineralized area.

The total inferred reserves of schroeckingerite-bearing material in the schroeckingerite deposits of the Lost Creek area are about 150,000 tons of rock containing 0.027 percent uranium, or about 40 tons of uranium. Of this total amount, about 2 tons of uranium are contained in 4 groups of closely related schroeckingerite deposits, each group containing over 200 pounds of uranium. Each of the remaining individual schroeckingerite deposits and groups of closely related schroeckingerite deposits exposed in the trenches contains less than 200 pounds of uranium.

Beneath a strippable overburden, 2 feet in average thickness, in the mineralized area is a zone, 6 feet thick, that contains most of the schroeckingerite deposits. This zone contains a total of about 5,400,000 tons of rock with an average grade of 0.004 percent uranium, or about

200 tons of uranium. This reserve includes the 40 tons of uranium in the schroeckingerite deposits; the remainder of the uranium is disseminated through the host rock, which has an average grade of 0.003 percent uranium.

No production has been recorded from the Lost Creek schroeckingerite deposits to date, but the deposits can be considered a potential economic source of uranium. The fact that the mineral is readily soluble suggests that it might be possible to produce a shippable concentrate cheaply by large-scale methods. Suggested processes include (1) leaching of mined schroeckingerite-bearing material using recycling circuits of naturally-occurring water in the Lost Creek area, and (2) natural evaporation of the resulting uranium-bearing solutions in large evaporating ponds.

The presently available geologic data are favorable to the presence of concealed uranium deposits in the Lost Creek area. The writers of this report believe that these hypothetical deposits are relatively high in grade compared to the schroeckingerite deposits and that they are the source of the uranium in the schroeckingerite. Until the presence of such deposits is either established or disproved, the Lost Creek area cannot be evaluated as a uranium district solely on the basis of its near-surface schroeckingerite deposits.

INTRODUCTION

The Lost Creek schroeckingerite deposits in northern Sweetwater County, Wyoming were explored by the U. S. Geological Survey during parts of 1950, 1951, and 1952. The exploration and geologic investigations leading to this final report were done on behalf of the Atomic Energy Commission. The exploratory methods included trenching, auger-drilling, and bucket-drilling. Detailed descriptions of the general geology, uranium deposits, and methods of exploration are given in Part I of this report. Also given in Part I are a discussion of the origin and suggestions to prospectors.

Part II of this report contains only the data on reserves and the conclusions and recommendations. The exploration area containing the schroeckingerite deposits is shown on plate 27. Also tabulated on plate 27 are the data on reserves and a summary of the data on grade. The inferred reserves were calculated mainly from data from the exploratory trenches, but data from drill holes aided in blocking out the mineralized area. The uranium analyses of trench samples, upon which the reserve calculations are based, are given in Part I on the detailed sections of trenches 1-12 (pl. 8-19).

Except for minor revisions in the data and in the terminology, the reserves cited in this report for the near-surface portion of the Lost Creek area are essentially the same as those reported previously by Sheridan, Collier, and Maxwell (1953, p. 21-22).

RESERVES

The average grade of the schroeckingerite deposits in the Lost Creek area is 0.027 percent uranium. The total inferred reserve of uranium in the schroeckingerite deposits is 42 tons. Most of the known schroeckingerite deposits occur in a zone, 6 feet thick, lying below overburden that averages 2 feet in thickness. This main zone contains an additional 180 tons of uranium, but this amount is disseminated in the host rock which averages only 0.003 percent in uranium content. Detailed summaries of reserves and of data on grade are given at the end of this chapter, following the discussion of calculation of reserves.

Calculation of reserves

Basis for calculations

The detailed calculation of inferred reserves of uranium in the near-surface portion of the Lost Creek area was based on the following geologic facts:

(1) U. S. Geological Survey trenches 1-12 (pls. 8-19, part I) exposed schroeckingerite deposits and host rock which were mapped in detail and sampled extensively for grade.

(2) Some of the old trenches, bulldozed cuts, and pits in parts of the areas between trenches (pl. 27) also contain schroeckingerite deposits.

(3) Some of the U. S. Geological Survey jeep auger holes and some of the contractual bucket-holes also cut schroeckingerite deposits.

(4) A few natural exposures of schroeckingerite occur near Lost Creek.

(5) All of the known schroeckingerite deposits are east of Lost Creek.

(6) Although schroeckingerite was found to depths of 14 feet in drill holes, most of the deposits lie within 10 feet of the surface; the major zone of occurrence is a zone, 6 feet thick, lying beneath overburden averaging 2 feet in thickness.

The boundary of the area used for reserve calculations was drawn so as to include the known schroeckingerite deposits in exposures of all kinds (pl. 27). Although additional schroeckingerite deposits may lie outside this approximate boundary, the presently available data suggest that the majority of the deposits lie within the boundary. The area included within this boundary is about ½ square mile in extent and is shaped like 2 elongate lenses joined near the western end. The northern part of the area is 8,800 feet in length, and the southern part of the area is 10,000 feet in length. Near the west central part of the area, the width is as much as 3,000 feet but tonguelike extensions taper to the northwest and to the southeast.

The U. S. Geological Survey trenches are considered to be representative cross-sections of the area known to contain schroeckingerite deposits, because the distribution of schroeckingerite deposits in other exposures and in drill holes is similar to the distribution in the trenches. The trenches were spaced at wide intervals because the exploration was designed mainly to obtain basic data essential to reserve calculations for a large amount of territory. The data from this type of work are sufficient only to calculate inferred reserves. Calculation of indicated or measured reserves would have been possible only by doing excavation more on the order of development work; such work was not considered practicable for an exploratory investigation.

The exposures in the U. S. Geological Survey trenches offered the best method of obtaining accurate data for detailed reserve calculations because the sampling was more accurate and because the samples can be tied in with accurate cross-sectional areas of the schroeckingerite deposits (pls. 8-19, part I). On the other hand, drill samples were frequently contaminated by sloughing of material from the upper part of the holes and the drilling did not permit accurate determination of thickness or cross-sectional area of deposits. Consequently, the data from the U. S. Geological Survey trenches was used almost exclusively in the detailed calculations involving tonnage and grade. The sampling and mapping methods are explained in detail in part I, and the method of reserve calculations is summarized below.

Method of calculation of reserves

Data from U. S. Geological Survey trenches 1-12 served as the main basis for calculation of reserves:

(1) Tracings of the original field sheets from the trench mapping (scale 1:120) were used as bases for planimetering the schroeckingerite deposits.

(2) The sample numbers, cross-sectional areas of face-cut samples in schroeckingerite deposits, lengths of channel samples in schroeckingerite deposits and host rocks, and analytical data are recorded on the sections in their proper locations and are shown on the illustrations of trenches 1-12 (pls. 8-19 Part I). Plate 8A is retained at its original scale but the others have been photo-reduced to a scale of 1:240.

(3) Typical schroeckingerite-bearing material from Trench 2 was taken for subsequent testing by the U. S. Bureau of Mines. The specific gravity of this material indicated that the average ratio is 15 cubic feet per ton of rock. This figure was used in all the tonnage calculations.

The calculation of inferred reserves of near-surface uraniferous material in the Lost Creek area was divided into 3 classes: Classes A, B, and C, (tabulated on pl. 27). Classes A and B, which pertain to schroeckingerite deposits alone, illustrate the type of material that might be obtained by selective mining. The Class A inferred reserves portray known groups of schroeckingerite deposits which conform to an arbitrary cutoff figure of 200 pounds of uranium per group. The Class B inferred reserves include the uranium in all of the schroeckingerite deposits, regardless of the size or uranium content of individual deposits or groups of deposits. Class C inferred reserves pertain to the uranium both in the schroeckingerite deposits and in the host rock in the main mineralized zone. The Class C reserves were calculated in order to illustrate the type of material that might be obtained by a large scale stripping and bulk-mining operation.

The methods of calculation are subdivided according to classes of reserves.

Method for Class A inferred reserves.--An arbitrary cut-off of a minimum of 200 pounds of uranium was selected as the basis for Class A reserves. Data on the cross-sectional areas of schroeckingerite deposits in the trenches are complete, but data on the third dimension (length) of the deposits are incomplete. Therefore, a study of all exploratory data, including data from old pre-Survey trenches and pits, was used in obtaining a reasonable means of estimating the lengths of deposits. The available data suggest that the ratio of cross-sectional areas of schroeckingerite deposits to lengths is: 0.29 square foot of exposed area in trench per foot of strike distance of each deposit. The combined geologic data suggest also that some of the individual exposures of schroeckingerite deposits in the trenches are probably connected along strike as irregular branches of larger deposits. Individual deposits were considered as belonging to the same "group", when the distance separating them is not greater than 5 feet.

In order to obtain the volume of rock in any single deposit or group of closely related deposits, the formula of a cone was used for projecting in each direction away from the trench; the cross-sectional area exposed in the trench was assumed to be the maximum cross-sectional area of each deposit. The formula for the volume of a single deposit or group of deposits is then approximated by:

$$V = 1/3\ Ah + 1/3\ A'h' + \tfrac{1}{2}L(A + A')$$

where A and A' are areas of deposits on each wall of the trench, h and h' are the projected lengths in each direction from the trench, and L = 4 feet, width of trench.

Projected lengths were calculated on the basis of the ratio, where:

$$h = \frac{A}{0.29\ \text{sq.ft./ft.}} \qquad h' = \frac{A'}{0.29\ \text{sq. ft./ft.}}$$

Thus, the pounds of uranium in a single group of closely related deposits was calculated by the formula:

$$\text{Uranium (lbs.)} = \frac{1/3\ A\dfrac{A}{0.29} + 1/3A'\dfrac{A}{0.29} + 2(A+A')}{15\ \text{cu ft/ton}} \times \text{ave.grade} \times 2000$$

The average grade was obtained by using area as a weighting factor for each analysis. Thus, for a group of analyses representing a deposit or group of closely related deposits:

$$\text{Average grade} = \frac{\text{Sum of (area x percent uranium)}}{\text{total exposed area}}$$

Using these criteria and formulas, 4 groups of schroeckingerite deposits exposed in U. S. Geological Survey trenches were inferred as Class A reserves. Their locations and the reserve data pertaining to them are indicated on plate 27.

Method for Class B inferred reserves.--The Class B inferred reserves were calculated to include the uranium in all the schroeckingerite deposits with no arbitrary cutoff as to size or uranium content; these reserves (pl. 27) include the smaller figure reported as Class A inferred reserves.

The boundary of the area known to contain schroeckingerite deposits was drawn (pl. 4, part I; pl. 27, part II) from combined data from all exploratory openings and natural exposures. Inferences as to the lengths of individual deposits were not needed in calculating the Class B reserves, because the U. S. Geological Survey trenches are considered to be representative, accurate cross-sections of the area known to contain schroeckingerite deposits. The average cross-sectional area of schroeckingerite deposits exposed in each trench and the weighted average of the uranium contents of the schroeckingerite deposits in each trench were used as factors in calculating the reserves. The trenches are the dividing lines between each of the 16 blocks shown on plate 27.

The area of each sample taken from schroeckingerite deposits was used as a weighting factor to obtain average grade. Thus:

$$\text{average grade of deposits in a trench} = \frac{\text{Sum of (area x uranium percentage)}}{\text{total area of samples}}$$

In Trench 1, where much of the initial sampling in schroeckingerite deposits was done by the channel method, the lengths of channel samples were used as weighting factors, and then the average percentages for individual deposits were weighted according to areas to obtain the average grade of deposits exposed in Trench 1. Analytical values for face-cut samples (Appendix E, Part I) were substituted for channel sample data where applicable. In all the other trenches, areas were used for weighting the averages for individual deposits.

The volume of schroeckingerite deposits in each of the individual blocks shown on plate 27 was calculated by averaging the cross-sectional areas of deposits in adjacent trenches and multiplying by the distance between trenches. This method was used for all blocks except those at the ends or margins of the mineralized area; in these few instances the volume of schroeckingerite deposits in the nearest trench (over a width of 4 feet) was projected on the basis of surface area of the block.

An example of the final calculations for Block 11, between Trench 1 and Trench 2, illustrates the general method:

$$\text{Vol. schroeck. deposits} = \frac{\text{Ave. area deposits Tr. 1} + \text{Ave. area deposits Tr. 2}}{2}\ \text{length}$$

$$= \frac{238.8 + 404.6}{2}\ (1000)$$

$$= 321{,}700 \text{ cubic feet}$$

$$\text{Tons uranium} = \frac{\text{Vol. schroeck. deposits}}{15 \text{ cu. ft./ton}} \times \frac{\text{average percent uranium}}{100}$$

$$= \frac{321{,}700}{15} \times .00022$$

$= 4.718$, or 4.7 tons uranium in Block 11 in schroeckingerite deposits

<u>Method for Class C inferred reserves.</u>--The Class C inferred reserves were calculated to include both the uranium in the schroeckingerite deposits and the uranium in the host rocks in the main mineralized zone in the area known to contain schroeckingerite deposits. The reserves cited on plate 27 for Class C include the figures cited for Class B.

The main mineralized zone is 6 feet thick and it lies below overburden averaging 2 feet in thickness. For ease of calculation, it was necessary to assume that all of the schroeckingerite deposits mapped in the trenches lie in this zone. It was impractical to recalculate and replanimeter the basic data, because the thickness of the overburden varies considerably. Therefore, although some of the deposits shown on plates 8-19 (Part I) lie slightly above or below the strict limits of the zone (2 to 8 feet below the surface), they were simply considered as being within the zone to simplify the calculations. Also, because the topographic variation is rather small, volumes were calculated by simple geometric means where possible. Actually, the volumes of rock considered in these calculations are so large that the errors introduced by initial assumptions are practially negligible.

The method of calculating the Class C inferred reserves was essentially the same as that used for the Class B inferred reserves, except that the area of the entire zone, 6 feet in thickness, along each trench was used as the basic factor. The average cross-sectional area of the total of schroeckingerite deposits exposed in each trench had already been calculated under Class B; for each trench, this figure for schroeckingerite deposits was subtracted from the total zonal area, and the resulting area of host rock was multiplied by the average grade of the host rock in the trench. The average grade of the host rock in each trench was calculated by weighting the analyses of channel samples against their lengths. Combined data for host rock and for schroeckingerite deposits in the mineralized zone were then applied to volumes and tonnages per block. The resulting data are shown as Class C reserves on Plate 27, tabulated and located according to the same block system as the Class B inferred reserves.

Summary of inferred reserves

The inferred reserves of uranium in the near-surface portion of the Lost Creek area are tabulated in three classes on plate 27: Class A, Class B, and Class C.

Class A inferred reserves consist of about 5,100 tons of schroeckingerite-bearing material having an average grade of 0.037 percent uranium---(1.9 tons) of uranium. These reserves are represented by 4 groups of closely related schroeckingerite deposits that were exposed in the exploratory trenches, each group containing over 200 pounds of uranium. The locations of the 4 groups are indicated on plate 27 by symbols A-1 through A-4. Available data indicate that less than 200 pounds of uranium are contained in each of the other individual deposits and in each of the other groups of closely related depsoits exposed in the trenches.

Class B inferred reserves consist of all the known and inferred schroeckingerite deposits in the mineralized area with no limiting factor applied as a cutoff for the minimum amount of uranium in each deposit or in each group of closely related deposits. A total of 154,370 tons of schroeckingerite-bearing material has an average grade of 0.027 percent uranium, or 42 tons of uranium (This amount includes the 1.9 tons of uranium contained in the Class A reserves). The Class B inferred reserves are tabulated on plate 27 in 16 blocks, which are keyed to the block numbers indicated in the mineralized area on the accompanying map. Thus, block 1 is shown at the northwestern end of the area and block 16 is shown at the southeastern end. The trenches constitute dividing lines between blocks. Block 10, lying between Trench 5 and Trench 1, contains the largest reserve of uranium in schroeckingerite deposits of any of the blocks---about 12 tons of uranium. The schroeckingerite deposits in Block 9, which lies between Trench 5 and the western margin of the mineralized area, have the highest average grade --- 0.057 percent uranium. Schroeckingerite deposits in block 16, southeast of Trench 12, have the lowest average grade of any of those cited under Class B reserves --- 0.012 percent uranium.

Class C inferred reserves consist of the schroeckingerite deposits and the enclosing host rock in a zone, 6 feet thick, lying below overburden, averaging 2 feet in thickness, in the mineralized area. This zone contains most of the known schroeckingerite deposits. The Class C inferred reserves consist of 5,406,700 tons of rock with an average of 0.004 percent uranium, or about 225 tons of uranium. This amount includes the 42 tons of uranium in the schroeckingerite deposits cited as Class B inferred reserves. The remaining 180 tons of uranium is disseminated in the host rock which has an average grade of 0.003 percent uranium. The Class C reserves are tabulated and illustrated on plate 27 according to the same block system as the Class B reserves.

The three classes of inferred reserves calculated for the Lost Creek area include only the near-surface uraniferous material. Hypothetical concealed uranium deposits of relatively high grade are believed to be the source of the uranium in the schroeckingerite. If the genetic hypothesis preferred by the writers proves to be valid, these source deposits may constitute an important reserve of uranium.

Summary of data on grade

In addition to the tables of reserves, plate 27 also contains a table of data on grade for schroeckingerite deposits and host rock in trenches 1-12. Individual samples from schroeckingerite deposits range in uranium content from 0.001 to 0.260 percent. The average grade of known schrockingerite deposits in all the trenches, using the area represented by each sample as a weighting factor, is 0.026 percent uranium. When the figures are recalculated on the basis of the tonnages represented by each block, as in the table of Class B reserves, the average grade is actually 0.027 percent uranium. The highest average grade for schrockingerite deposits per trench is 0.050 percent uranium in Trench 5. The lowest average grade for schroeckingerite deposits per trench is in Trench 12 --- 0.012 percent uranium.

A total of 6,497.1 feet of channel samples were taken for grade in the host rock which encloses the schroeckingerite deposits. These samples range in uranium content from 0.000 to 0.039 percent. The average grade of the sampled host rock is 0.003 percent uranium. The average grade of the host rock per individual trench ranges from 0.002 to 0.005 percent uranium.

The average grade of both the host rock and the included schroeckingerite deposits in a zone 6 feet thick lying beneath the overburden is 0.004 percent uranium.

METALLURGICAL AND CHEMICAL TESTING

L. F. Rader, Jr. of the U. S. Geological Survey reported (1952) 81 to 96 percent of the uranium in schroeckingerite-bearing material from the Lost Creek area was extracted by 4 different leach solutions

(5 percent solutions)--nitric acid, sulfuric acid, sodium carbonate, and ammonium carbonate. Although these tests were performed on a laboratory scale, they illustrated the relative ease with which uranium can be leached from schroeckingerite-bearing material.

A 1000-pound sample of schroeckingerite-bearing material from a typical deposit in Trench 2 was submitted to the Metallurgical Division, U. S. Bureau of Mines, Salt Lake City, for metallurgical testing. The sample assayed 0.025 percent U_3O_8. In progress report USBM-43, A. E. Back (1952) reported on the metallurgical testing. In cold 2-percent sodium carbonate solution 55 percent of the uranium was soluble; in hot 5 percent solution, 74 percent was soluble. Leaching of the material with 200 pounds of H_2SO_4 per ton for 24 hours at room temperature extracted 82 percent of the uranium. The results showed that the uranium was put into solution rather easily. However, Back reported that separation of the liquid from the solids was a serious problem, and that processing of the whole ore with acid or carbonate did not appear feasible.

An interesting series of chemical tests were performed recently by Wayne Mountjoy, Denver Trace Elements Laboratory, U. S. Geological Survey; these tests were performed as part of research with Harold Masursky, U. S. Geological Survey, on enrichment of coal by uranium from aqueous solution. Mountjoy and Masursky (oral communication, March 1955) found that 83 percent of the uranium in a sample of pulverized schroeckingerite-bearing rock from the Lost Creek area was leached by successive leachings using 7 one-liter portions of unheated, simulated Lost Creek water. The original rock sample contained 0.092 percent uranium and the simulated water was made up to conform to the analyzed composition and pH of naturally-occurring Lost Creek water. Leachates from the schroeckingerite-bearing rock were evaporated to dryness and the residues contained as much as 4 percent uranium. In additional tests, the leachate (750 ml.) from the schroeckingerite-bearing rock was passed through 100 grams of crushed coal in a 72 hour period. The results of this experiment showed that 97 percent of the uranium in the leachate was taken up by the coal and resulted in a grade of 0.091 percent uranium in the coal (about 0.5 percent uranium in the ash). By using less coal and a longer time in the leachate, the coal was upgraded to as much as 1.8 percent uranium.

CONCLUSIONS AND RECOMMENDATIONS

Schroeckingerite

The schroeckingerite deposits at the Lost Creek area are the largest known deposits of this mineral. Although no production has been recorded from the Lost Creek deposits to date, they constitute a large reserve of low-grade uraniferous material that might be considered a potential economic source of uranium.

All of the chemical and metallurgical testing that has been done to date has shown that the schroeckingerite can be put into solution very easily. The field evidence of the natural solubility of schroeckingerite in the local waters and the substantiating laboratory evidence by Mountjoy and Masursky suggest that it might be possible to up-grade the material by cheap processes right in the Lost Creek area. For example, it might be possible to leach a protore consisting of bulk-mined material in the Lost Creek area using naturally occurring waters. Such a process might utilize recycling of the leach solutions. Cheap methods of breaking the rocks could be used and grinding probably wouldn't be necessary. Large evaporating ponds could be used in conjunction with the leaching process to produce a first-stage by natural evaporation. Such a concentrate would consist of redeposited schroeckingerite along with the fine rock material (clays) carried along in suspension in the leach solution. It is not known whether pilot testing has been done on methods such as these.

The work by Mountjoy and Masursky also suggests that crushed coal might be used as a beneficiation agent.

In addition to methods involving bulk-mining and large-scale treatment, some production might be accomplished by selective mining of schroeckingerite deposits. Such mining, however, would probably require considerable development work to minimize dilution of the product; also, if the grade were too low, the product might have to be concentrated by some cheap method before it could be shipped.

Hypothetical concealed deposits

The writers of this report believe that the source of the uranium in the schroeckingerite and in the uraniferous ground waters of the Lost Creek area is in unexposed uranium deposits of relatively high grade. If this genetic hypothesis is valid, the area should be considered potentially important for its concealed deposits. Although such deposits are not the only possible source of the uranium in the schroeckingerite, the writers believe that the geologic conditions are very favorable for the hypothetical relatively-high grade deposits. Unless the presence of such deposits is disproved, the Lost Creek area cannot be evaluated as a uranium district solely on the basis of its near-surface schroeckingerite deposits.

In producing uranium districts elsewhere in the western states the amount of schroeckingerite is rather small in comparison to the amount of uranium minerals in the source deposits. Therefore, if the large amounts of schroeckingerite in the Lost Creek area can be considered a clue to the size of the hypothetical uranium deposits, these source deposits might be a very large potential source of uranium.

The writers have summarized a number of geologic factors pertaining to schroeckingerite and hypothetical source deposits in Part I of this report (see Origin, and Suggestions to Prospectors). In the event that the Lost Creek area is ever explored again, either by private industry or by one of the government agencies, it is recommended that the geologic data in the present report by supplemented by data from other rapidly developing uranium districts in Wyoming. By so doing, it might be possible to conduct a successful exploration of the area at depth, using a number of favorable guides.

UNPUBLISHED REPORTS

Back, A. E., Letter to P. L. Merritt, July 17, 1952, enclosing pages 18 and 19 of Progress Report USBM-43 summarizing preliminary tests by U. S. Bureau of Mines on schroeckingerite-bearing material from Lost Creek.

Rader, L. F., Jr., 1952, Report No. TDC-1532, Denver Trace Elements laboratory, U. S. Geological Survey.

Sheridan, D. M., Collier, J. T., and Maxwell, C. H., 1953, Lost Creek, Wyoming, in Search for and geology of radioactive deposits, semiannual progress report--classified data, December 1, 1952 to May 31, 1953: U. S. Geol. Survey Trace Elements Inv. Rept. 331, p. 21-22.

APPENDIX A

OWNERSHIP

Conflicting mining claims covering the area underlain by known schroeckingerite deposits at Lost Creek were held by at least 2 groups of people during the time this report was in preparation. The original placer mining claims on the deposits are owned by the late Mrs. Minnie McCormick and eight associates -- John A. McCormick, Louis A. McCormick, Mrs. Mabel A. McVae, Mrs. Emma J. Eversole, Mrs. Laura E. A. McCargar, Kleber H. Hadsell, Tom W. Whelan, and C. A. Brimmer. The McCormick group's claims were leased in January 1948 to Uranium Inc., of Denver, Colorado, whose members include Walter Byron, K. W. Robinson, R. D. Charlton, and Robert Swanson. A group of placer claims conflicting with those held by the McCormick group were posted in 1952 by J. Lael Simmons, June V. Simmons, Nels Landeen, Charlotte Borreson, Shirley Arnold, Charles M. Hepworth, Deline Hepworth, and Wilford Arnold. At least two other groups of people own placer claims in the vicinity of the Lost Creek deposits:

(1) R. D. Rudolph, S. H. Rudolph, Jr., C. R. Rudolph, E. A. Rudolph, Tenna Thoeming, Mary Wakeman, B. H. Thoeming, and E. E. Wakeman.

(2) William C. Duncan, Allen J. Livingston, Effie Livingston, Helen Duncan, Arthur Skelton, Mary Skelton, Calla D. Zumwalt, and J. H. Zumwalt.

APPENDIX B

SUPPLEMENTARY DATA ON METHODS AND RESULTS OF EXPLORATION

The Lost Creek area was explored intermittently by the U. S. Geological Survey during the years 1950, 1951, and 1952. This exploratory work and the related geologic studies, both in the field and in the office, were done on behalf of the Atomic Energy Commission. The major objective of the work was to investigate the economic geology of the schroeckingerite deposits. Because much of the Lost Creek area is covered by Quaternary overburden, natural exposures of Tertiary bedrock and of schroeckingerite deposits are sparse. Consequently, the detailed geologic and economic data presented in this report could not have been accumulated without the help of exploratory methods.

The base of operations during the U. S. Geological Survey exploratory work was "Schroeckingerite Manor" cabin owned by Kleber Hadsell of Rawlins, Wyo., and generously loaned to Survey personnel for living quarters.

The exploration included excavation of 13 trenches and drilling of 199 shallow holes. The total length of trenches was 16,460 feet. The maximum depth of drill holes was 51 feet. The locations of all drill holes and trenches excavated by the Survey are indicated on the detailed maps (pl. 5, 6, and 7); detailed sections of both walls of the exploratory trenches are illustrated on plates 8-21. Much of the data resulting from this exploration has been incorporated in the discussions of stratigraphy, structure, and uranium deposits.

The purpose of this section of the report is to describe the methods of exploration and the geologic work in connection with the exploration and to summarize the data and results that are not included elsewhere in this report. Logs of the drill holes are listed in Appendices C and D, and a comparison of 2 types of trench samples for grade of the schroeckingerite deposits is given in Appendix E.

Drilling

Drilling by the U. S. Geological Survey in the Lost Creek area consisted of two types: --- jeep auger-drilling and contractual bucket-drilling. A total of 129 jeep auger-holes and 70 bucket-holes were drilled and logged. The maximum depth was 51 feet. Detailed logs of the jeep auger holes are given in Appendix C; detailed logs of bucket holes are given in Appendix D.

Jeep auger-drilling

The initial exploratory work at the Lost Creek area was carried out with a government-owned, jeep-mounted auger drill, equipped with augers 4 3/8 inches in diameter. In November-December 1950, 13 holes totalling 397 feet were drilled to depths of 9 to 51 feet. In July-November, 1951, 116 holes totalling 2,349 feet were drilled to depths of 6 to 50 feet. The positions of all the holes are indicated on the detailed maps of the exploration area (pls. 5 and 6). The auger-holes were drilled along ten main lines bearing N. 30° E. to N. 44° E.(that is, in a direction more or less perpendicular to the average strike of Tertiary beds in the exploration area and also perpendicular to the general trend of the Cyclone Rim zone of faulting). Distances between the main lines of auger-holes range from 500 to 3,000 feet, lengths of lines of holes range from 200 to 3,150 feet, and distances between adjacent auger-holes range from 2 feet to 163 feet. A few holes were drilled at various points between and beyond the main lines of holes.

The technique employed during the initial drilling in 1950 was as follows. Samples for analysis were collected at 2-foot intervals except where changes in lithology made different intervals preferable or where drilling difficulties required sampling intervals. Each sample for analysis consisted of the entire amount of rock reserved from the interval being drilled, except for small sample splits removed for lithologic collections. Samples of dry rock above the water table were collected by spinning the auger without raising or lowering the position of the bit after the drill had cut through the desired interval; the rock cuttings travelled up the spiral auger and were collected on a flat steel plate. Drilling below the water table required pulling the rods between each sampling-run so that they could be stripped clean of the adhering muck. The very cold and windy weather made this part of the task extremely difficult. In general, the drilling below the water table required sample intervals larger than 2 feet in order to save time and to insure better recovery. Lithologic logs were made during the drilling of each hole, and small representative samples of lithologic units were collected. Water samples were collected from each hole that extended below the water table. Gamma-ray logs were made for each hole with a Beckman Geiger-Mueller counter, model MX-5, to which a 2-foot sausage probe was connected by 50 feet of cable. Following each day's drilling, the rock samples collected for analysis were examined at night with an ultraviolet lamp (Mineralight, wave length 2540 A) and with a Geiger-Mueller counter; the gamma-ray radioactivity and estimates of the schroeckingerite content were recorded. A total of 208 samples for analysis were obtained during the 1950 auger-drilling.

The procedure followed during the initial auger-drilling was found to be fairly satisfactory, but experience showed that contamination of individual samples was practically unavoidable. Although the augers were cleaned carefully and frequently, the caving of loose rock in the holes, the mixing of drill cuttings as they travelled up the auger-spiral, and the sloughing of wet or loose rock off the auger back into the hole whenever the drill stem had to be pulled were at least 3 causes for contamination. Use of casing techniques were considered, but the idea was abandoned because the time consumed and the cost would have been excessive. Therefore, the initial auger-drilling indicated that the method was perfectly satisfactory for qualitative testing to determine the presence or absence of schroeckingerite, but that quantitative sampling for tonnage and grade could not be done satisfactorily with the jeep-mounted auger in the types of rock present in the Lost Creek area.

The methods employed in drilling the jeep auger-holes in 1951 were essentially the same as in 1950, except that the drill-cuttings were examined directly at the drill-site with an ultra-violet lamp. A dark box mounted in the back of a truck provided suitable darkness for the fluorescence tests. Geiger-Mueller counter readings were also obtained from the drill-cuttings directly at the drill site. A complete set of all drill-cuttings was not taken for analysis in 1951; only representative samples were taken of material that contained schroeckingerite or that showed abnormal, unexplored radioactivity. Representative water samples were obtained and gamma-ray logs of the holes were recorded, as in 1950. Detailed lithologic logs (Appendix C) were made of all drill holes except seven holes that were drilled for the purpose of selecting one of the trench sites. The 1951 drilling provided additional data for laying out the plans for the remainder of the exploratory work.

Contractual drilling

A government contract for exploratory 8-inch auger-drilling was started in November 1951 as a substitute for part of the original trenching proposals. The contractual auger-drilling was laid out on a 100-foot grid pattern. The first few weeks of the drilling program were taken up by experimentation to find suitable methods for obtaining clean representative samples, because the drilling was supposed to provide accurate data for the grade and tonnage of the schroeckingerite deposits. But the auger-drilling had to be abandoned because no methods were found to obtain samples which were both representative and uncontaminated. Bucket-drilling (8-inch) was substituted for the auger-drilling; clean representative samples were obtained when precautions were taken to clean the bucket thoroughly between each sample interval. Seventy bucket holes were drilled under this contract to depths of 8 to 46 feet. The locations of the bucket holes are shown on the inset map on plate 5.

The geological methods used during the bucket-drilling were similar to those used during the jeep auger-drilling. Representative cuts from each bucket load of drill-cuttings were examined at the drill site with a Geiger-Mueller counter and in a dark box with an ultra-violet lamp. Detailed lithologic logs were recorded, together with data on fluorescence and radioactivity (Appendix D). A large Jones splitter was used to cut representative samples for analysis from the cuttings from 2-foot intervals. The bucket-holes were also gamma-ray logged.

Extremely cold, windy weather proved to be a great hindrance to the speed and efficiency of the exploratory drilling. Therefore, the bucket-drilling was suspended on December 21, 1951 with the presumption that it would be resumed after the return of clement weather. But the drilling never was resumed because the trenching method proved far superior for the types of results needed in the Lost Creek area. The necessity for constant cleaning of the bucket during the drilling was very time-consuming and was a disadvantage both to the contractor and to the government. The geologic and economic information provided by the drilling was decidedly inferior to the very detailed information provided by the trenching. Consequently, the drilling contract was terminated in April 1952 with no penalty to the government and to the contractor.

Results of drilling

The compilation of data from the jeep auger drilling of holes ES-1 through ES-129 is given in Appendix C. The compilation of data from contractual drilling of bucket drill holes B-1 through B-70 is given in Appendix D. The locations of all the holes are indicated on plates 5 and 6. Appendices C and D include the lithologic logs, data on samples, gamma ray logs, and remarks. The percentages of uranium and equivalent uranium in samples of the drill cuttings were determined by the Denver Trace Elements Laboratory, U. S. Geological Survey.

The rock types recorded in the lithologic logs in Appendices C and D represent megascopic field determinations. For example, the distinction between clay, silt, and fine sand was made by commonly used field methods, including rubbing between the fingers, presence or absence of grit between the teeth, and reference to standard samples of grain sizes. No laboratory size analyses were on any of the Lost Creek drill samples. The description of rock colors used in the logs also represents terms designated in the field. During the beginning phase of the exploratory work an attempt was made to use standard rock color charts. The practice was soon abandoned because its use was impractical in the extreme weather conditions to devote time to correlation of the many variations in pastel colors of rocks in the area.

The Jeep auger drilling provided useful preliminary information pertaining to the distribution of schroeckingerite and the character of the bedrock. Data from the holes aided in determining the sites for trenches and in plotting the approximate boundaries of the area containing schroeckingerite deposits. Schroeckingerite was found in 21 of the jeep auger holes and in 31 of the bucket holes. The positions of the schroeckingerite-bearing holes are indicated by solid black dots on plates 5 and 6; holes containing no schroeckingerite are indicated by open circles. The inset map on plate 5 shows the locations of bucket holes and auger holes in the vicinity of Trench 1.

The greatest depth of schroeckingerite observed in any of the drill holes was 14 feet (B-16, Appendix D). Traces of schroeckingerite found at greater depths in other holes were the result of contamination by material from the upper parts of the holes. In general, most of the schroeckingerite was found in the main zone of occurrence, 2 to 8 feet below the surface of the ground.

The uranium content of analyzed samples from the drilling program ranges from 0.001 to 0.063 percent; the highest analysis was for schroeckingerite-bearing sandy siltstone from a depth of 2 to 4 feet in Jeep auger hole ES-5 (Appendix C). As explained in the descriptions of the drilling, the sampling techniques were not as accurate as techniques followed in the trenches. The drill hole sampling, in most cases, could not be limited strictly to the vertical extent of individual deposits. Hence, the analytical data from the drilling should be considered inferior to the more accurate sample data from the trenches.

In some instances the drilling provided specific information useful to the plotting of concealed faults, and concealed lithologic boundaries. Thus, for example, the line of holes from ES-40 at the northeast to ES-23 at the southwest (pl. 6, in area between trench 6 and trench 3) aided in plotting the contact between the Tipton tongue of the Green River formation and the overlying Cathedral Bluffs tongue of the Wasatch formation. This same line of holes aided in extending several fault contacts.

Of interest, also, is the water level in some of the drill holes (Appendices C and D). For example, the line of auger holes along trench 1 shows an irregular trend for the water level. Hole ES-8, farthest north along trench 1 (pl. 5, inset) had the water level at 16.5 feet. Going southward toward Lost Creek the depths to water are: 19 feet at ES-10, 12 feet at ES-7, 16.2 feet at ES-6, 14 feet at ES-3, 14.7 feet at ES-5, 14 feet at ES-2, and below 23 feet (not reached) at ES-11. Topographic variation is so minor in this area that it cannot be the whole cause of variation in depths to the water level. In some of the bucket holes drilled in the same vicinity, moist layers of rock were encountered in upper parts of the holes, then perfectly dry rock was drilled, and finally the main water level was reached. These data suggest that the Lost Creek area may contain a series of perched water tables. The level, or levels, of water present in any one specific part of the area depends on the attitude and lithology of the bedrock and the character of complex fault relations.

The gamma-ray logs of some of the drill holes indicated anomalous radioactivity. Examples are indicated in the logs (Appendix C) of Jeep auger holes ES-3, -32, -40, -43, -44, -64, -73, -88, -94, -100, -120, -123, -124, -126, -128, and -129; of these examples, only hole ES-3 contained schroeckingerite. In hole ES-3, the gamma ray log showed readings of 4 to 8 mr hr (milliroentgens per hour) at 10 to 18 feet and analysis of cuttings from 9 to 19 feet ranged in percent equivalent uranium from 0.004 to 0.007. In comparison, the gamma ray log in the schroeckingerite-bearing part of hole ES-3, 1 - 6 feet, showed readings of only 1.1 to 1.9 mr hr and the percent equivalent uranium of cuttings ranged from 0.006 to 0.010. The anomalous radioactivity at 10 to 18 feet is not explained by the slight radioactivity of the cuttings. In holes containing no schroeckingerite similar relations were noted. Thus, hole ES-128 had gamma-ray readings of 6.5 to 9 mr hr at 6 to 12 feet, but a sample at 7 to 12 feet contained only 0.003 percent equivalent uranium and no uranium. Hole ES-32 had readings of 7 - 20 mr hr at 8 - 12 feet, but readings averaged only about 1 mr hr above and below the anomalously high part of the hole. Careful checks were made by repeating the logging of some of the holes to determine if instrumental behavior had caused the anomalies, but duplication of the results indicated that the anomalies are valid. It is true that the readings are only relative, but even when a possible error of 30 percent is considered in changing scales on the Geiger counter, the anomalous readings are still 4 to 5 times higher than the average background readings in the holes. The cause for these anomalies is not known. Suggested possibilities include the presence of radon or the presence of unexposed uranium deposits in the immediate vicinity of the drill holes. No facilities for checking radon were available at the time the drilling was done. In some instances, the anomalies might be caused partly by abnormal amounts of equivalent uranium. Thus, in hole ES-88, the gamma-ray log showed readings of 8 - 12.5 mr hr at 3 - 15 feet, and one analysis at 0.5 - 5 feet had 0.008 percent equivalent uranium. However, the gamma-ray log in ES-2 at 2 - 4 feet showed only 1.6 mr hr, yet the schroeckingerite-bearing material at that depth contained 0.021 percent equivalent uranium. Obviously, the slight abnormality of equivalent uranium in cuttings of hole ES-88 is not enough to be the only cause for the anomalous gamma-ray readings.

Other types of anomalies in the drill holes have been noted, whereby material containing no schroeckingerite contains abnormal amounts of uranium. Thus, in hole B-40 (Appendix D), for example, the cuttings at 6 - 8 feet contain 0.012 percent equivalent uranium and 0.016 percent uranium. Similar examples are indicated in holes B-4, B-10, B-13, B-33, B-48, and B-58. Other examples of this type of anomaly are described in the subchapter on other radioactive materials. In these occurrences the percentage of uranium is generally higher than the percentage of equivalent uranium. This similarity to the disequilibrium status of schroeckingerite-bearing rock suggests that the deposition of the uranium may have been similar to the deposition of schroeckingerite. Even though the anomalous occurrences of uranium contain no identified uranium mineral, they possibly may represent the sites of incipient mineralization by schroeckingerite or the sites of former schroeckingerite deposits.

Water samples from drill holes were analyzed and the results are included in Table 3 of this report.

Trenching

Exploratory trenching by the U. S. Geological Survey in the Lost Creek area was done under several government contracts. A total of 16,460 lineal feet of trenching was done in 13 trenches. The trenches were 4 feet wide and averaged about 8 feet in depth. Excavation was done by means of a backhoe machine.

Description of work

The first government contract for exploratory trenching at the Lost Creek area was started on December 5, 1951 and was completed on February 1, 1952. Six trenches, totalling 6,129 feet in length, were excavated; the locations of trenches 1-6 are shown on plates 4, 5, and 6. The trenches ranged in length from 685 feet to 1,414.5 feet, and the distances between adjacent trenches ranged from 1,000 feet to 1,700 feet. The bearings of the trenches were N. 30° E. to N. $43\frac{1}{2}$° E., i.e., in a direction perpendicular to the average strike of the Tertiary beds in the area and also perpendicular to the trend of the Cyclone Rim zone of faulting. The trenches were 4 feet wide, had essentially vertical walls, and averaged about 8 feet in depth. About 400 feet of Trench 1 was widened and then an additional 2 to 5 feet was excavated over a 4-foot width in order to check the mineralization near the water level. The first 6 trenches were backfilled late in January 1952, with the exception of 550 feet of Trench 3 which had drifted full with snow; the snow-filled portion of Trench 3 was left until July 1952 for mapping and sampling.

The second phase of contractural trenching was started in July 1952. Seven trenches, totalling 10,331 feet in length, were excavated by a backhoe machine during July and August; the locations of trenches 7-13 are shown on plates 4, 5, and 6. The trenches ranged in length from 500 to 2,653.5 feet, and bearings of trenches were N. 29°-30° E. The trenches were 4 feet wide, had essentially vertical walls, and averaged between 7 and 8 feet in depth. The distances between adjacent trenches in the main exploration area (including those excavated by the government earlier) ranged from 1,000 feet to 2,050 feet. The final trench, Trench 13, was excavated about 18,000 feet southeast of Trench 12 (pl. 4). All seven trenches and the open part of Trench 3 were then backfilled in November 1952. The backfilling was necessary to prevent injury to livestock.

The total length of all trenches excavated at the Lost Creek area by the government is 16,460 feet. Both walls of this entire length of trenching and of an additional 150 feet of "wide-cut" in Trench 1 were mapped in detail (scale 1:120), so that the total length of detailed trench sections is 33,220 feet (plates 8 through 20).

In the few places where cemented sandstone or compact claystone caused difficulties, the trenches were left shallow to prevent the time and cost of blasting. Perhaps the most difficult excavation was the deepening of Trench 1, because freezing of muck at the lower levels caused the work to be slow and tedious. Very little difficulty was experienced with caving of trench walls and the geologic work was done without the necessity of timbering.

A casing of muck, ranging in thickness from a fraction of an inch to as much as 5 inches, was left on the walls of the trenches by the action of the backhoe machine. This casing had to be scraped away with shovels and axes by the geologists and samplers in order to provide a clean surface for mapping and sampling. The walls of all the trenches were cleaned in this manner. The cleaning process proved especially difficult in winter because the casing was often frozen tightly to the trench walls. During the work in the first 6 trenches it was also necessary to shovel snow periodically from one side of the trench to the other in order to map and sample.

Throughout the trenching program, the detailed work was done in 2 stages. The cleaned trench walls were examined at night with an ultra-violet lamp and the outlines of the schroeckingerite deposits were marked with carbon black from a carbide lamp. During daylight hours the lithology, structure, and schroeckingerite deposits were mapped in detail by tape and level methods, and extensive sampling for grade was carried out.

The initial sampling in Trench 1 was done by conventional channel methods in schroeckingerite deposits, host rock, and overburden. Experience showed, however, that extreme care had to be taken to select representative sites for such channel samples in schroeckingerite deposits (see Appendix E). The distribution of pellets of schroeckingerite is so variable within individual deposits that evenly spaced channel samples can misrepresent the true grade (i.e., a channel could miss most of the pellets or it could include abnormal concentrations of pellets). Therefore the method of sampling the schroeckingerite deposits was changed to the face-cut method for the remainder of Trench 1 and for the rest of the trenches. The face-cut method involved taking a $\frac{1}{2}$-inch layer of the entire face of each deposit; large deposits were divided into sections to permit ease of handling of the samples. The samples of schroeckingerite deposits were taken on both walls of each trench. Sampling of the host rock was continued by the channelling method. Traverses were made in the trenches with a Geiger-Mueller counter and samples were taken in areas which had not been covered by other sampling and which showed abnormal radioactivity.

A total of 2,024 samples for analysis were obtained from the trenches. Additional small samples were taken for a representative lithologic collection.

Results of trenching

Exploratory trenching proved to be the most useful means of exploration in the Lost Creek area. Data from the trenches provided most of the detailed information on the geologic features of the area.

The original mapping of the walls of the trenches was done at a scale of 1:120 feet and all geologic features were recorded in detail. As in the drilling, the designation of rock names and colors was done by simple megascopic methods in the field. Extreme weather conditions and the short time available for much of the work in the trenches made the use of color charts impractical for the main purposes of the investigation. The original field sheets for trenches 1-13 were then compiled in the office and the geology was simplified so that the detailed sections could be reduced to a scale of 1:240 for printing (pl. 8 and pls. 9-20). The assay sections of Trench 1, however, are rather complicated and are printed at the original scale of 1:120 (pl. 8A).

The detailed geologic and assay sections of the trenches (pl. 8-20) give a representative idea of the location, distribution, cross-sectional size and shape, and uranium content of the schroeckingerite deposits in the Lost Creek area. The generalized locations of the schroeckingerite deposits in the trenches are also indicated by "x" symbols on the detailed maps (pl. 5 and 6).

The locations and data for samples from schroeckingerite deposits and the host rock in the trenches are recorded on plates 8A-20 according to sample numbers. For channel samples the length is given in feet; for face-cut samples the area of the sample is given in square feet. The percentages of uranium and of equivalent uranium were determined by the

Denver Trace Elements Laboratory, U. S. Geological Survey. Because the cleaned surfaces of the trench walls permitted accurate sampling techniques and because this sampling was conducted with direct reference to the size and shape of the exposed schroeckingerite deposits, the trench samples represent a considerably more accurate and more significant study of the uranium content than the drilling samples.

The geologic data acquired in the trenches proved useful in a number of ways. For example, the original field sheets were used to compile some of the detailed stratigraphic sections; these stratigraphic sections are included in the chapter on stratigraphy in the descriptions of the Hiawatha member and Cathedral Bluffs tongue of the Wasatch formation and the Tipton tongue of the Green River formation. The detailed data also aided considerably in plotting the positions of geologic contacts and faults (pl. 5, 6, and 7) which are concealed in most of the area by the Quaternary surficial material. For example, the data on faults and major contacts exposed in Trench 3 (pl. 10) were combined with drill hole data and photo-geologic interpretation to produce part of the detailed information shown on plate 6. The detailed trench sections (pl. 8-20) also give a representative idea of the thickness and distribution of the overburden and a representative idea of the lithology and structure in the underlying Eocene sediments.

Most of the detailed data concerning lithology, stratigraphy, structure, and schroeckingerite deposits that were obtained in the trenches are included in the discussions in preceding chapters of this report.

Comparison of visual estimates and chemical analyses

During the exploratory drilling and trenching in the Lost Creek area field observations of drill-cuttings and of trench walls at night with ultraviolet lamps commonly indicated a percentage of schroeckingerite higher (generally by a factor of 2 to 10) than the schroeckingerite content indicated by chemical analyses. For example, the average of estimates by 3 geologists was 1 percent schroeckingerite for a sample of drill cuttings from a depth of 3-4 feet in jeep auger-hole ES-2. Since pure schroeckingerite contains about 27 percent uranium, the drill sample theoretically should have contained about 0.270 percent uranium; the chemical analysis, however, indicated that it contains only 0.049 percent uranium. Because the visual estimates of all the geologists who worked on the project were in reasonable agreement and because the method of visual estimation was checked carefully against scheelite charts and a chart of measured areas, a considerable amount of additional work was done to check the possible reasons for discrepancy between visual estimates of schroeckingerite content and the actual uranium content shown by chemical analysis.

A kodachrome transparency was taken at a typical schroeckingerite deposit in Trench 5 at night, using ultra-violet lamps for illumination. R. E. Erickson of the U. S. Geological Survey later made a Rosiwal analysis of the slide in the Denver laboratory. His results indicated that the the brilliant yellow-green pellets shown in the slide comprise about 2.5 percent of the photographed area. Theoretically the samples taken from this area should have contained 0.6 percent uranium. Instead, chemical analyses of samples from this same area ranged in uranium content from 0.010 percent to 0.086 percent. The discrepancy between the uranium calculated from observational estimates and the uranium from chemical analysis differs, in this instance, by a factor ranging from 7 to 60.

Four types of error were considered as possible reasons for the discrepancies between visual estimates and chemical analyses: (1) errors in preparation of samples; (2) errors in analyses; (3) errors in estimation of the schroeckingerite content; and (4) errors caused by presence of material other than schroeckingerite in the pellets. In an effort to solve the problems, the geologists of the project cooperated with L. F. Rader, A. G. King, and others of the U. S. Geological Survey laboratories.

The methods of sample preparation were checked by preparing samples by hand using a buckboard and agate mortar, and comparing the analyses with splits of the same samples prepared by the usual grinding machinery. With one exception, probably the result of an uneven original split, the resulting analyses agreed very closely. The results of these tests have been tabulated by Radar (1951) and are also included in the report by Wyant, Sharp, and Sheridan (1951, table 31). Rader (1952a) reported that careful checks with ultraviolet lamps and with chemical analyses indicated that no uranium was left in the grinding mill after the usual cleaning with compressed air. Sample sacks that arrived at the laboratory in a wet, frozen condition from the Lost Creek area were checked to determine if part of the schroeckingerite had dissolved and deposited as uranium salts in the cloth of the sacks; the results (Rader, 1952b) indicated that only a negligible amount of uranium was lost to the sacks. Therefore, the various types of tests indicated that the methods of sample handling and preparation were not the cause of the discrepancies.

Radar (1952c) reported that a series of careful checks were made on the methods of chemical analysis of schroeckingerite-bearing samples. Tests with various methods of putting the samples into solution showed little or no difference in the resulting analyses. Also, volumetric methods of analysis checked the fluorimetric methods of analysis. Because sample pulps are heated to burn off organic material prior to fusion, it was considered possible that the samples might lose a volatile uranium fluoride compound during this process, because schroeckingerite contains fluorine. However, this method was checked very carefully, and the results showed no definite trend that would indicate loss of uranium as a volatile fluoride. Rader (1952c) concluded that there can be no significant error in the analytical work done by the laboratory by the regular fluorimetric method.

Mineralogic studies by A. G. King (1952) indicated that pellets of schroeckingerite contain considerable pore space; specific gravity tests suggested that this pore space might cause an error of estimation by a factor of about 2. King suggested also that the major part of the error in visual estimation might be due to optical illusion because the mineral is extremely fluorescent. Additional microscope work by Sheridan, Maxwell, and others indicated that tiny grains of gypsum are often interleaved with the flakes of schroeckingerite in the pellets.

As a result of this series of investigations, it was concluded that methods of sample preparation and sample analysis were probably not the cause of the discrepancies between visual estimates and analyses. The Rosiwal analysis of the color slide indicated that visual estimates of the percentage of pellets in schroeckingerite-bearing material were not in error. However, the mineralogic tests suggested that not all of the material in the pellets is actually schroeckingerite. Instead, pore spaces in the pellets, the orientation of flat micaceous plates of the schroeckingerite, the presence of gypsum and other mineral matter in individual pellets of schroeckingerite, and the brilliance and probable dispersion of the fluorescence are factors which tend to make the visual estimates too high for the actual percentage of schroeckingerite in the rocks.

Comparison of exploration costs

The total contractual costs for drilling at Lost Creek amounted to \$1,694,00. This total includes the cost of building roads to drill sites and the cost of delay time. A total of 1,212 lineal feet bucket-holes were drilled. This amounted to a cost of \$1.39 per lineal foot. Actually, if more holes had been drilled the unit cost probably would have been closer to the actual contract drilling price, which was \$0.75 per lineal foot.

The total contractual cost for all trenches, including the backfilling, levelling, road-building, movement of equipment, delays, and the widening and deepening of Trench 1, was \$16,173.71. A total of 16,460 feet of trenching was done. This amounted to a cost of \$0.98 per lineal foot. The cost per cubic yard of material excavated was \$0.74.

A less apparent cost is that of sample analysis. An area 7,000 feet in length had been laid out under the drilling program on a 100-foot grid pattern. If this drilling had been carried to completion, seven hundred holes and 3,500 sample analyses would have been required. The same area was covered more economically and more efficiently by 6 trenches and only 1,273 sample analyses.

Appendix C. DRILL LOGS OF JEEP-AUGER HOLES ES-1 THROUGH ES-129, LOST CREEK AREA.

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-1										
Quaternary alluvium and colluvium										
sand brown	0-2	0-2	—	—	0.006	0.005	—	—	—	
Wasatch fm., Cathedral Bluffs tongue										
Claystone, gray green, sandy	2-3	2-3	.07-.12	.10	.028	.059	—	—	—	Contains schroeckingerite
Sandstone, brown, argillaceous	3-4.5	3-4.5	.05-.12	.08	.018	.033	—	—	—	from 2 to 4.5 feet
Siltstone, green and brown	4.5-6	4.5-6	.01-.06	.03	.005	.005	—	—	—	
Sandstone, green	6-7.5	6-7.5	.01-.06	.03	.004	.003	—	—	—	
Claystone, brown	7.5-9	7.5-9	.01-.07	.03	.005	.003	—	—	—	
ES-2										
Quaternary alluvium and colluvium										
sand, brown	0-2	0-2	.01-.08	.03	.007	.008	0-2	1.4-1.9	1.7	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, gray, green and brown		2-3	00-.08	.03	.006	.007				Contains schroeckingerite
Argillaceous	2-4	3-4	.05-.10	.07	.021	.049	2-4	1.5-1.8	1.6	from 1 to 5.5 feet
Sandstone, gray, green		4-5.5	.00-.07	.03	.005	.007				
Silty	4-6	5.5-6	.00-.05	.02	.004	.004	4-6	1.1-1.5	1.2	
Siltstone and claystone		6-7	.01-.08	.03	.006	.004				
Gray, green, and brown, silty	6-8	7-8	.01-.07	.03	.006	.005	6-8	1.6-1.9	1.8	
Siltstone, gray and green		8-9	.00-.07	.03	.005	.003				
and brown, Argillaceous		9-10	.01-.06	.03	.005	.003				
	8-13	10-11	.01-.05	.03	.005	.003				
		11-12	.00-.07	.03	.004	.003	10-12	1.4-1.8	1.6	
		12-13	.00-.05	.03	.004	.003	12-14	1.2-1.6	1.5	
Claystone, green gray,		13-15	.00-.05	.02	.004	.003	14-16	1.1-1.6	1.4	Water table at 14 feet
silty and sandy	13-19	15-17	—	—	.004	.004	16-18	1.3-1.8	1.6	
		17-19	—	—	.005	.004	18-20	1.2-1.6	1.4	
Siltstone, red-brown, and		19-21	—	—	.004	.003	20-22	1.1-1.5	1.4	
sandstone, gray green,										
Argillaceous	19-23	21-23	—	—	.005	.002	22-24	1.2-1.7	1.4	
Sandstone, gray,		23-25	—	—	.004	.003	24-26	1.0-1.5	1.3	
pebbly	23-28	25-28	—	—	.004	.003	26-28	1.0-1.5	1.3	
Sandstone, gray green,		28-29	—	—	.005	.005	28-32	1.2-1.6	1.3	
silty	28-33	29-33	—	—	.003	.002				
		33-38	—	—	.005	.003	34-38	1.1-1.5	1.3	
Claystone, gray green and		38-39	—	—	.007	.007				
brown, silty and sandy	33-43	39-41	—	—	.004	.004	38-40	1.1-1.6	1.4	
		41-43	—	—	.004	.003				
		41.5-43	—	—	.005	.005				
Sandstone, brown-white	43-49	43-49	—	—	.004	.003				
Claystone, brown, sandy	49-51	49-51	—	—	.004	.003				

Appendix C (page 2)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-3										
Quaternary alluvium and colluvium										
sand, gray green	0-1									
Wasatch fm., Cathedral Bluffs tongue										
Claystone, brown, sandy	1-2.5	0-2	.01-.07	.03	0.006	0.010	0-2	1.3-1.7	1.5	Contains schroeckingerite
		2-3	.02-.11	.05	.010	.019				from 1 to 6 feet.
Sandstone, gray green, and		3-4	.01-.06	.02	.006	.011	2-4	1.1-1.5	1.3	
brown, argillaceous,		4-6	.01-.11	.05	.007	.007	4-6	1.5-1.9	1.7	
silty and pebbly	2.5-9	6-8	.01-.07	.03	.004	.002	6-8	1.0-1.4	1.3	
		8-9	.01-.06	.03	.004	.003	8-10	1.5-1.9	1.6	
		9-11	.01-.07	.04	.005	.004				
Claystone, gray, green and		11-12	.01-.09	.04	.007	.006	10-12	6.-8.	7.0	Anomalous radioactivity
brown, silty and sandy	9-15	12-14	.01-.07	.03	.005	.002	12-14	5.-7.	6.0	on Gamma-ray log from
		14-15	—	—	.007	.002	14-16	5.-7.	6.8	10 to 18 feet. Water table
Sandstone, gray green		15-19	—	—	.004	.001	16-18	4.-6.	5.0	at 14 feet
argillaceous, silty	15-19	17.5-19	—	—	.005	.002				
Siltstone, gray, green, and										
brown, sandy	19-23	19-23	—	—	.005	.002				
Claystone, gray, green, sandy	23-25	23-25	—	—	.004	.003				

Appendix C (page 3)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-4										
Quaternary alluvium and colluvium										
sand, brown, coarse, pebbly	0-2	0-2	.00-.07	.03	.004	.001	0-2	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs										
tongue										
		2-4	.01-.06	.03	.004	.003	2-4	1.0-1.3	1.1	
Sandstone, buff, gray green,		4-4.5	.00-.07	.03	.004	.002				
brown and white, silty	2-8	4.5-6	.01-.07	.03	.004	.002	4-6	.7-1.0	.8	
		6-7	.00-.06	.03	.003	.003				
		7-8	.01-.06	.03	.003	.003	6-8	.6-1.0	.8	
Siltstone, red brown and		8-10	.01-.07	.03	.004	.004	8-10	.8-1.2	.9	
Gray, argillaceous, and sandy	8-13	10-12	.00-.07	.03	.005	.007	10-12	1.0-1.3	1.2	
		12-14	.02-.09	.04	.005	.005	12-14	1.1-1.4	1.2	
Sandstone, brown gray white		14-14.5	.01-.09	.04	.003	.003				
argillaceous, silty	13-16	14.5-16	.00-.05	.03	.003	.002	14-16	.8-1.2	1.0	
		16-18	.00-.08	.03	.004	.002	16-18	1.0-1.4	1.1	
		18-20	.00-.05	.03	.003	.001	18-20	.8-1.3	1.0	
		20-22	.01-.07	.03	.003	.002	20-22	.8-1.3	1.0	
Siltstone, gray green and		22-24	—	—	.003	.002	22-24	.8-1.2	1.0	Water table at 22.5 feet.
brown argillaceous and sandy	16-30	24-24.5	—	—	.003	.002				
		24.5-26.5	—	—	.003	.001	24-26	.9-1.3	1.1	
		26.5-28	—	—	.003	.002	26-28	.7-1.1	.9	
		28-29	—	—	.002	.002				
		29-30	—	—	.003	.001	28-30	.7-1.0	.9	
		30-32	—	—	.002	.001	30-32	.6-1.0	.8	
		32-33	—	—	.003	.001				
Sandstone, brown, gray		33-34	—	—	.003	.001	32-34	.7-1.1	.9	
white and green, silty		29-34	—	—	.002	.001				
and pebbly	30-46	34-37	—	—	.004	.001	34-36	.8-1.2	1.0	
		37-39	—	—	.003	.001	36-38	.9-1.4	1.1	
		39-44	—	—	.003	.001				
Siltstone and claystone, brown										
grey	46-48	44-45	—	—	.004	.001				
Sandstone, brown, gray, green,										
silty	48-50	45-50	—	—	.004	.002				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-5										
Quaternary alluvium and colluvium										
Sand, brown silty	0-1	0-2	.02-.10	.05	0.011	0.015	0-2	1.5-2.0	1.8	Contains schroeckingerite
Wasatch fm., Cathedral Bluffs										from 1 to 6 feet.
tongue										
Siltstone, gray green, sandy	1-4	2-4	.07-.20	.12	.036	.063	2-4	9-11	10	
Sandstone, brown gray,										
argillaceous	4-5	4-6	.01-.07	.04	.007	.010	4-6	7-9	8	
Claystone, gray, green, brown,										
sandy	5-7	6-7	.01-.08	.03	.006	.003	6-8	6-9	8	
Sandstone, gray white, pebbly	7-8	7-9	.00-.06	.03	.005	.004	8-10	9-12	10	
Siltstone, gray, green, brown,		9-11	.00-.06	.03	.004	.002	10-12	8-11	9	
argillaceous, sandy	8-15	11-13	.01-.07	.03	.004	.001	12-14	4-7	5	
		13-15	—	—	.004	.001	14-16	5-7	6	Water table at 14.7 feet.
Claystone, green gray, sandy	15-16	15-17	—	—	.004	.002	16-18	5-7	6	
Siltstone, green, gray, and		17-20	—	—	.004	.002	18-20	5-7	6	
brown, argillaceous, sandy	16-21	20-21	—	—	.004	.002				
ES-6										
Quaternary alluvium and colluvium										
Sand, brown, clayey	0-1	0-1	.01-.07	.03	.004	.005				
Wasatch fm., Cathedral Bluffs										
tongue										
		1-2	.00-.06	.03	.002	.002	0-2	.7-1.1	.9	
Sandstone, gray, brown, green		2-3	.00-.06	.03	.003	.002				
and white, argillaceous and										
silty	1-8	3-4	.00-.06	.04	.004	.004	2-4	.8-1.2	1.0	
		4-6	.00-.08	.04	.004	.003	4-6	.9-1.4	1.1	
		6-8	.01-.07	.03	.003	.001	6-8	.8-1.3	1.0	
Siltstone, gray green, sandy	8-12	8-10	.00-.06	.04	.004	.002	8-10	1.4-1.8	1.6	
		10-12	.00-.06	.04	.004	.001	12-14	1.5-2.0	1.8	
Claystone, green, gray, silty	12-15	12-14	.01-.07	.04	.005	.004	14-16	5-7	6	
		14-15	.00-.06	.04	.006	.006	16-18	5-7	6	
		15-17	—	—	.005	.003	18-20	4-6	5	Water table at 16.2 feet.
Sandstone, gray, pebbly	17-18	17-21	—	—	.004	.002	20-22	1.0-1.3	1.1	
Siltstone, green, gray, and										
brown, sandy	18-21	21-24	—	—	.006	.005	22-24	1.1-1.6	1.4	
Siltstone, sandstone, and										
claystone, thin-bedded,		24-29	—	—	.004	.002	24-26	1.5-2.0	1.7	
green gray and brown	21-34						26-28	5-6	5.5	
		29-33	—	—	.004	.004	28-30	1.4-1.8	1.6	
							29-31	1.3-1.8	1.5	
		33-34	—	—	.004	.002				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
KS-7										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1									
clay, brown, sandy silty	1-2.5	0-3	.01-.08	.03	0.005	0.004	0-2	.7-1.2	.9	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff white, silty	2.5-4						2-4	.9-1.3	1.1	
Claystone, brown red, silty, sandy	4-5	3-5	.01-.07	.03	.005	.005	4-6	1.1-1.5	1.3	
Sandstone, gray white		5-7	.01-.07	.03	.003	.001	6-8	.6-1.0	.8	
silty	5-9	7-9	.00-.06	.03	.003	.001	8-10	.6-1.0	.8	
Sandstone, buff and gray white,		9-11	.00-.06	.03	.003	.001	10-12	.5-.9	.7	
pebbly, traces of red-brown		11-13	.00-.07	.03	.003	.001	12-14	.6-1.0	.8	Water table at 12 feet.
silt at 12 feet and 18 feet	9-19	13-16	—	—	.002	.001	14-16	.5-.9	.7	
		16-19	—	—	.002	.001	16-18	.6-1.0	.7	
		19-24	—	—	.006	.001	18-20	.6-1.0	.8	
							20-24	.9-1.3	1.1	
		24-28	—	—	.002	.001	24-26	.9-1.3	1.0	
							26-28	.7-1.2	1.0	
		28-30	—	—	.004	.001	28-30	1.1-1.6	1.3	
Siltstone, sandstone, and claystone, thin-bedded, gray,		30-35	—	—	.003	.001	30-32	.8-1.2	1.0	
							32-34	.6-1.1	.8	
							33-35	.7-1.2	.9	
green, brown, red	19-41	35-36.5	—	—	.005	.002				
		36.5-38	—	—	.005	.002				
		38-40	—	—	.004	.002				
		40-41	—	—	.006	.002				
		41-44	—	—	.004	.004				
Siltstone, bluish gray green,		44-45	—	—	.004	.002				
argillaceous and sandy	41-50	45-46	—	—	.001	.001				
		46-50	—	—	.003	.002				
KS-8										
Quaternary alluvium and colluvium										
Sand, brown and buff, silty, pebbly	0-2	0-2	00-.06	.03	.004	.000	0-2	.8-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue		2-4	.00-.07	.03	.004	.000	2-4	.8-1.2	1.0	
		4-6	.00-.08	.04	.005	.002	4-6	1.0-1.4	1.1	
		6-8	.01-.07	.04	.005	.001	6-8	1.1-1.6	1.3	
Siltstone, buff gray, sandy		8-10	.01-.08	.04	.004	.000	8-10	.9-1.4	1.1	
with thin brown and gray	2-22	10-12	.01-.08	.04	.002	.000	10-12	.8-1.2	1.0	
sandy clay seams		12-14	.01-.06	.03	.003	.000	12-14	.8-1.2	1.0	
		14-15	.01-.07	.04	.003	.000	14-16	1.0-1.4	1.2	
		15-17	.01-.08	.04	.003	.000	16-18	.8-1.3	1.0	Water table at 16.5 feet.
		17-22	—	—	.005	.000	18-20	1.0-1.4	1.2	

Appendix C (page 6)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
KS-9										
Quaternary alluvium and colluvium										
Sand, brown, pebbly	0-2	0-2	.00-.06	.03	0.004	0.000	0-2	.8-1.2	.9	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.06	.03	.003	.000	2-4	.8-1.2	1.0	
		4-6	.00-.06	.03	.003	.000	4-6	.8-1.2	1.0	
		6-8	.00-.06	.03	.003	.000	6-8	.8-1.2	1.0	
		8-10	.01-.05	.02	.004	.000	8-10	.8-1.2	1.0	
Sandstone, buff white, silty,		10-12	.01-.06	.03	.003	.000	10-12	.8-1.1	1.0	
pebbly	2-22	12-14	.00-.05	.02	.003	.000	12-14	.8-1.1	.9	
		14-16	.00-.06	.03	.002	.000	14-16	.8-1.2	1.0	
		16-18	.00-.06	.03	.003	.000	16-18	1.0-1.4	1.2	
		18-20	.01-.06	.03	.004	.000	18-20	1.0-1.4	1.2	
		20-22	.00-.08	.04	.003	.000	20-22	1.1-1.6	1.3	
Siltstone, buff, gray white,		22-24	.00-.07	.03	.004	.001	22-24	1.1-1.6	1.3	
sandy	22-27	24-26	.00-.06	.03	.003	.000	24-26	1.0-1.5	1.3	
Sandstone, buff white, silty	27-29	26-29	.00-.08	.04	.004	.000	25-27	.9-1.4	1.1	Water table at 27 feet
KS-10										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-2	0-2	.00-.06	.03	.005	.002	0-2	.9-1.4	1.0	
Sand, buff brown, silty clayey	2-3									
Wasatch fm., Cathedral Bluffs tongue										
claystone, brown red, silty	3-4	2-4	.00-.08	.04	.007	.005	2-4	1.3-1.9	1.5	
		4-6	.01-.09	.04	.007	.004	4-6	1.4-1.9	1.7	
		6-8	.00-.14	.06	.007	.006	6-8	1.3-1.8	1.5	
Siltstone, brown-gray and green		8-11	.00-.07	.04	.004	.001	8-10	1.3-1.8	1.5	
gray, some claystone and sand-	4-20	11-13	—	—	.004	.001	10-12	1.2-1.7	1.4	
stone		13-15	—	—	.004	.001	12-14	1.2-1.6	1.4	
		15-19	—	—	.004	.001	16-18	1.1-1.6	1.4	Water table at 19 feet.
Sandstone, brown, gray, white silty	20-24	19-24	—	—	.003	.000	18-20	1.2-1.7	1.4	
KS-11										
Quaternary alluvium and colluvium										
sand and silt, brown and buff	0-8	0-2	—	—	.002	.000	0-2	.6-1.0	.8	
		2-4	—	—	.002	.000	2-4	.7-1.0	.8	
		4-6	—	—	.003	.000	4-6	.6-1.0	.8	
		6-8	—	—	.002	.000	6-8	.7-1.1	.8	
Undifferentiated Green River fm.,										
Tipton tongue and Wasatch fm.,										
Hiawatha member		8-10	—	—	.002	.001	8-10	.7-1.2	.9	
Claystone, brown, silty, hard		10-12	—	—	.002	.001	10-12	.7-1.2	.9	
platy	8-18	12-14	—	—	.003	.000	12-14	.7-1.1	.9	
		14-19	—	—	.003	.000	14-16	.7-1.2	1.0	
Siltstone and claystone, gray		19-21	—	—	.003	.000	16-18	.9-1.3	1.1	
green and brown	18-23	21-23	—	—	.003	.000				

Appendix C (page 7)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-12										
Quaternary alluvium and colluvium										
Sand, buff brown, silty	0-3	0-2	—	—	0.003	0.000	0-2	.8-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, gray green brown		2-4	—	—	.004	.003	2-4	.9-1.4	1.2	
sandy	3-6	4-6	—	—	.005	.004	4-6	1.0-1.4	1.2	
Claystone, maroon, brown, and		6-8	—	—	.005	.003	6-8	.8-1.3	1.0	
green gray, silty	6-10	8-10	—	—	.004	.001	8-10	1.2-1.6	1.3	
		10-12	—	—	.004	.001	10-12	1.2-1.7	1.4	
		12-14	—	—	.004	.001	12-14	1.2-1.9	1.5	
Siltstone, gray green, argil-		14-16	—	—	.005	.002	14-16	1.4-1.9	1.6	
laceous; some clay seams.	10-23	16-18	—	—	.004	.001	16-18	1.4-1.9	1.6	
		18-20	—	—	.005	.001	18-20	1.2-1.7	1.4	
		20-23	—	—	.004	.001	20-22	1.0-1.6	1.3	
Claystone, gray, green, brown, silty.	23-25	23-25	—	—	.004	.000	21-23	1.0-1.5	1.3	Water table at 23 feet.
ES-13										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-2	0-2	—	—	.003	.000	0-2	.9-1.2	1.0	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	—	—	.003	.000	2-4	.8-1.4	1.0	
		4-6	—	—	.003	.000	4-6	.8-1.3	1.1	
		6-8	—	—	.003	.000	6-8	1.5-2.0	1.7	
Sandstone, buff white, silty,		8-10	—	—	.004	.000	8-10	1.0-1.3	1.1	
pebbly	2-19	10-12	—	—	.003	.000	10-12	.9-1.3	1.1	
		12-14	—	—	.004	.000	12-14	1.0-1.4	1.2	
		14-16	—	—	.004	.000	14-16	1.5-1.9	1.6	
		16-18	—	—	.005	.001	16-18	.9-1.4	1.1	
							18-20	.9-1.4	1.1	
Siltstone, gray brown, sandy;		18-22	—	—	.003	.000	20-22	.8-1.5	1.1	
and sandstone, gray, silty	19-24	22-24	—	—	.003	.000	22-24	.9-1.4	1.1	
							24-26	.8-1.4	1.2	
Sandstone, gray buff, silty, pebbly	24-32	24-29	—	—	.004	.000	26-28	.9-1.4	1.1	
Claystone, maroon and gray-							28-30	.7-1.3	1.1	
green	32-33	29-34	—	—	.003	.000	30-32	1.1-1.5	1.2	Hole abandoned at 35 feet
							32-34	1.1-1.6	1.3	
Siltstone, gray buff, sandy	33-35	34-35	—	—	.004	.000				without striking water

Appendix C (page 8)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading mr/Hr Range	Ave.	
ES-14										
Quaternary alluvium and colluvium										
Sand, brown gray, silty, pebbly	0-3	0-3	.00-.05	.03	—	—	0-2	.7-1.1	.9	
Wasatch fm., Cathedral Bluffs tongue							2-4	1.1-1.6	1.4	Contains schroeckingerite
Claystone, brown, sandy	3-5	3-5	.01-.13	.08	0.025	0.045	4-6	1.0-1.3	1.2	
							6-8	.6-1.0	.8	at 3 to 5 feet.
Sandstone, green gray, silty	5-16	5-12	.01-.06	.03	—	—	8-10	.5-1.0	.7	Water table at 12 feet.
Sandstone, gray white and brown, silty	16-19	—	—	—	—	—				
Sandstone, gray, white	19-26	—	—	—	—	—				
Siltstone, pale green gray, sandy	26-29	—	—	—	—	—				
Claystone, maroon, brown, dark gray, sandy	29-30	—	—	—	—	—				
Sandstone, green and brown white	30-44	—	—	—	—	—				
Claystone, green, gray, sandy	44-47	—	—	—	—	—				Iron-stained at 44 feet.
Sandstone, gray white	47-49	—	—	—	—	—				
Claystone, gray to gray green	49-50	—	—	—	—	—				
ES-15										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-3	0-3	.00-.05	.03	—	—	0-2	.6-.9	.7	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, green white, silty	3-4.5	3-4.5	.01-.06	.03	—	—	2-4	.6-1.0	.8	
Claystone, brown, sandy	4.5-5	4.5-5	.01-.08	.04	.007	.007	4-6	1.1-1.5	1.3	Contains schroeckingerite
Sandstone, gray green, silty	5-6.5	5-6.5	.00-.05	.03	—	—	6-8	1.0-1.4	1.2	at 4.5 to 9 feet.
Claystone, gray green, sandy	6.5-9	6.5-9	.00-.05	.03	—	—	8-10	.8-1.2	1.0	
Sandstone, green-white, silty	9-10	9-10	.00-.05	.03	—	—				
Siltstone, maroon-brown, argillaceous	10-11	10-11	.00-.05	.02	—	—	10-12	.8-1.3	1.0	
Siltstone, gray, green; brown		11-15	.00-.05	.02	—	—	12-14	.8-1.3	1.0	
sand bed in center ½ foot	11-17	15-17	.01-.06	.03	—	—	14-16	.9-1.3	1.0	
Siltstone, gray-brown, argillaceous	17-18	17-18	.01-.06	.03	.004	.004	16-18	.8-1.3	1.1	Iron-stained
Siltstone, green gray, argillaceous	18-24	18-21	.01-.06	.03	—	—	18-20	1.0-1.4	1.1	Water table at 22 feet.
Claystone, buff, gray, green,							20-22	.9-1.3	1.1	
sandy, silty	24-27	21-24	.01-.06	.03	—	—	22-24	.7-1.2	.9	
							24-26	.8-1.1	.9	
Sandstone, green white, silty	27-30	—	—	—	—	—	26-28	.7-1.1	.9	
							28-30	.6-1.1	.8	
Siltstone, brown gray, sandy,		—	—	—	—	—	30-32	.5-1.0	.7	
pebbly sand in center 1½ ft.	30-34	—	—	—	—	—	32-34	.5-.9	.7	
Siltstone, gray green brown, argillaceous	34-43	—	—	—	—	—	34-36	.7-1.0	.8	
Sandstone, green gray, silty	43-44	—	—	—	—	—	—	—	—	
Siltstone, gray green, sandy	44-49	—	—	—	—	—	—	—	—	
Sandstone, green gray brown, silty	49-50	—	—	—	—	—	—	—	—	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-16										
Quaternary alluvium and colluvium										
Sand, buff brown, silty pebbly	0-3.5	0-5.5	.00-.05	.02	—	—	0-2	.6-1.0	.8	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff gray, silty;							2-4	.7-1.1	.9	
maroon clay in center ½ ft.	3.5-7	5.5-7	.00-.04	.02	—	—	4.6	.5-.8	.6	
Claystone, gray, brown, silty,							6-8	.7-1.1	.8	
sandy	7-9	7-7.2	.00-.04	.03	—	—	8-10	.7-1.0	.8	Iron-stained at 7 and 8½ feet.
Sandstone, buff, gray and							10-12	.5-.9	.7	
reddish silty	9-13.5	7.2-9	.00-.05	.03	—	—	12-14	.5-.9	.7	Iron-stained at 9-9½ feet.
							14-16	.6-.9	.7	
Siltstone and claystone,		9-9.5	.00-.04	.02	—	—	16-18	.4-.9	.6	
							18-20	.5-1.0	.7	
brown, gray, sandy	13.5-25	9.5-17	.00-.05	.03	—	—	20-22	.7-1.0	.8	Water table at 15 feet.
							22-24	.5-.8	.6	
Claystone, gray, sandy	25-27.5	—	—	—	—	—	24-26	.5-.9	.7	
Sandstone, buff gray, silty,										
pebbly	27.5-33						26-28	.6-1.0	.8	
Claystone, brown, sandy	33-34									
Sandstone, buff gray, pebbly	34-36									
Claystone, brown, sandy	36-37									
Siltstone, blue gray, sandy,										
pebbly	37-39									
Sandstone, brown gray, silty	39-45									
Sandstone, gray white, pebbly	45-46									
Sandstone, green white, silty	46-50									
ES-17										
Quaternary alluvium and colluvium										
Sand, buff, pebbly	0-5	0-5	.00-.05	.02	—	—	0-2	.6-1.0	.8	
Wasatch fm., Cathedral Bluffs										
tongue							2-4	.6-1.0	.8	
Sandstone, yellow buff, pebbly	5-6	5-6	.00-.05	.03	—	—	4-6	.6-.9	.7	
Sandstone, brown, pebbly	6-7	6-7	.00-.05	.03	—	—	6-8	1.0-1.3	1.2	
Siltstone, gray buff, silty	7-8	7-8	.00-.06	.03	—	—	8-10	.7-1.1	.9	
Sandstone, maroon brown,										
argillaceous	8-9	8-9	.00-.06	.03	—	—	10-12	.6-.9	.7	
							12-14	.7-1.2	.9	
Sandstone, buff, silty, pebbly	9-13	9-12	.00-.05	.03	—	—	14-16	.5-1.0	.7	Water table at 12.5 feet.
Siltstone, gray buff, green							16-18	.5-.8	.6	
yellow, sandy	13-22						18-20	.5-.8	.6	
Siltstone, variegated, argil-							20-22	.5-1.0	.7	
laceous	22-31						22-24	.5-.9	.7	
Sandstone, green white, buff,							24-26	.5-.9	.7	
silty	31-34						26-28	.6-1.0	.7	
							28-30	.6-1.1	.9	
Claystone, blue gray, sandy	34-35						30-32	.7-1.1	.8	Iron-stained bands
Siltstone, buff gray green,										
sandy	35-39						32-34	.6-1.0	.7	Iron-stained sand at 36 feet.
Claystone, blue green, gray,										
sandy	39-42									Iron-stained at top.
Claystone, green black, dark										
gray	42-49									Carbonaceous?
Sandstone, buff, silty	49-50									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-18										
Quaternary alluvium and colluvium										
Silt, buff brown	0-1	0-1	.00-.06	.02	—	—	0-2	.6-.9	.7	
Sand, buff, silty	1-6	1-6	.00-.06	.02	—	—	2-4	.4-.9	.6	
Wasatch fm., Cathedral Bluffs tongue							4-6	.6-1.0	.7	
Claystone, brown gray, sandy	6-9	6-9	.00-.05	.02	—	—	6-8	.5-1.0	.8	
Sandstone, gray brown	9-10	9-10	.00-.05	.02	—	—	8-10	.5-.9	.7	Water table at 10 feet.
							10-12	.4-.8	.6	
Siltstone, brown gray, sandy	10-12						12-14	.5-.8	.6	
							14-16	.4-.8	.6	
Claystone, dark gray green	12-14						16-18	.5-.9	.6	Carbonaceous?
Siltstone, pale gray and gray black, argillaceous	14-19						18-20	.6-1.0	.7	
							20-22	.6-.9	.8	"lime" nodules
Claystone, gray, green, brown, silty	19-28.5						22-24	.5-.9	.7	
							24-26	.6-1.0	.8	
Sandstone, yellow buff, silty, pebbly	28.5-31.5						26-28	.6-.9	.7	
							28-30	.4-.8	.6	
							30-32	.3-.6	.4	
Claystone, gray, sandy	31.5-33						32-34	.4-.7	.5	Iron-stained at 31.5 feet.
Siltstone, gray brown, argillaceous	33-36						34-36	.4-.8	.6	
Sandstone, pale, gray, green, brown, argillaceous	36-41						36-40	.3-.6	.5	
							40-42	.3-.6	.4	
Claystone, blue gray green, sandy	41-50						42-44	.4-.7	.5	
ES-19										
Quaternary alluvium and colluvium										
Sand, buff-brown, silty	0-1.5	0-1.5	.00-.05	.02	—	—				
Sand, brown, pebbly	1.5-4.5	1.5-4.5	.00-.05	.02	—	—	0-4	1.2-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue					—	—				
Siltstone, gray white, sandy	4.5-6	4.5-6	.01-.05	.02	—	—				
Claystone, red brown, sandy	6-7.5	6-7.5	.01-.05	.02	—	—	4-8	1.2-1.7	1.4	
Siltstone, green white	7.5-9	7.5-9	.01-.06	.03	—	—				
Claystone, brown, sandy	9-10.5						8-12	1.3-1.8	1.5	
Sandstone, gray white, silty	10.5-13									
Claystone, gray green, sandy	13-15						12-16	1.2-1.6	1.4	Water table at 14 feet.
Sandstone, brown gray, pebbly	15-16									
Claystone, gray, brown green, silty, sandy	16-17						16-20	.9-1.3	1.1	
Sandstone, gray, white, buff, silty	17-27									
Claystone, gray green, silty	27-29									
Siltstone, gray green, sandy	29-31									
Claystone, gray, green, brown, silty	31-34									
Siltstone, gray green, sandy argillaceous	34-37									
Sandstone, buff, silty	37-40									
Claystone, gray, green, brown, sandy	40-42									
Sandstone, gray-green white silty	42-50									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-20										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1	0-4.5	.00-.06	.03	—	—	0-2	.7-1.1	.9	
Wasatch fm., Cathedral Bluffs							2-4	1.0-1.4	1.2	
tongue		4.5-9	.01-.09	.04	0.004	0.002	4-6	1.2-1.6	1.4	
Siltstone, buff, brown gray							6-8	1.0-1.4	1.2	
white, sandy	1-17.5	9-14	.01-.08	.03	—	—	8-10	1.0-1.3	1.2	
Claystone, gray, green, brown,							10-12	.7-1.0	.8	
silty	17.5-19	14-19	.01-.08	.03	—	—	12-14	.7-1.2	.9	
Siltstone, brown and buff,							14-16	.7-1.0	.8	
very sandy	19-24	19-24	.01-.08	.04	—	—	16-18	.7-1.1	.9	
							18-20	1.0-1.4	1.2	
Sandstone, gray white, silty	24-29	24-29	.00-.05	.02	—	—	20-22	.7-1.0	.9	Anomalous radioactivity at 27 feet.
Claystone, gray green brown,							22-24	.6-1.1	.8	
sandy	29-31						24-26	.7-1.1	.9	Water table at 29.5 feet.
Siltstone, buff gray, green,							26-28	1.6-1.9	1.7	Iron-stained at 33 feet.
brown, sandy	31-35						28-30	.9-1.2	1.0	
Claystone, green, brown gray,							30-32	1.1-1.5	1.3	
sandy	35-38									
Sandstone, gray green white,										
silty	38-40									
Claystone, blue gray, sandy	40-44									Iron-stained at 44 feet.
Sandstone, yellow buff, gray										
white, silty and argillaceous	44-49.5									
Claystone, maroon gray, sandy	49.5-50									
ES-21										
Quaternary alluvium and colluvium										
Sand, buff brown, silty	0-2						0-2	.6-1.0	.7	
Sand, buff-orange, silty										
pebbly	2-3	0-4	.01-.07	.03	—	—	2-4	.6-1.2	.9	
Wasatch fm., Cathedral Bluffs										
tongue										
Sandstone, buff brown white,										
silty	3-5	4-5	.01-.08	.04	—	—	4-6	.9-1.3	1.1	Contains minor schroeck-
Claystone, green gray, silty	5-6	5-6	.01-.09	.04	0.006	0.007	6-8	1.2-1.6	1.3	ingerite at 5 to 6 feet.
Siltstone, green, gray, brown,										
buff, sandy with pebbles at		6-9	.00-.07	.03	—	—	8-10	1.1-1.5	1.2	
							10-12	.8-1.1	.9	
top.	6-14.5	9-14.5	.01-.06	.03	—	—	12-14	.8-1.2	1.0	
Sandstone, brown gray, silty	14.5-17.5	14.5-17.5	.00-.06	.03	—	—	14-16	.7-1.1	.8	
Siltstone, gray white, buff										
sandy	17.5-19	17.5-19	.00-.05	.02	—	—	16-18	1.0-1.3	1.1	
Sandstone, brown gray, silty,										
pebbly	19-23	19-23	.00-.05	.02	—	—				
Claystone, white	23-24									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	REMARKS
ES-22										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1						0-2	.4-.8	.6	
Silt, buff, sandy	1-2.5						2-4	.5-.8	.7	
Silt, gray, argillaceous	2.5-4	0-4	.01-.06	.02	—	—	4-6	.5-1.0	.7	
Green River fm., Tipton tongue							6-8	.6-1.1	.8	
Claystone, brown gray, platy	4-9	4-9	.01-.06	.02	—	—	8-10	.5-.9	.7	
							10-12	.5-.8	.6	
		9-14	.00-.04	.02	—	—	12-14	.5-.9	.7	
							14-16	.4-.8	.6	
Claystone, brown, platy	9-24	14-19	.00-.05	.02	—	—	16-18	.4-.8	.6	
Undifferentiated Green River										
							18-20	.5-.9	.7	
fm., Tipton tongue, and		19-24	.00-.04	.02	—	—	20-22	.6-.9	.7	
Wasatch fm., Hiawatha member							22-24	.7-1.1	.9	
Claystone, gray brown, sandy	24-27	24-27	.01-.06	.03	—	—	24-26	.8-1.2	1.0	Iron-stained sand at top.
							26-28	.8-1.3	1.0	
Siltstone, gray brown, sandy	27-28						28-30	.6-1.0	.8	
Sandstone, gray brown, green										
							30-32	.6-1.0	.8	
white, silty	28-37.5						32-34	.6-1.0	.9	
							34-36	.9-1.2	1.0	
Siltstone, gray brown, sandy	37.5-38.5						36-38	.7-1.0	.8	
Claystone, gray brown, sandy	38.5-39						37-39	.5-.9	.7	
Not recovered	39-44									
ES-23										
Quaternary alluvium and colluvium										
Silt, buff, brown-white,										
sandy, pebbly	0-4	0-4	.00-.05	.02	—	—	0-2	.5-.9	.7	
Undifferentiated Green River fm.,										
Tipton tongue and Wasatch fm.,										
Hiawatha member							2-4	.6-1.0	.8	
Siltstone, green white, brown							4-6	.6-1.1	.8	
buff, gray sandy, thin clay-										
							6-8	.8-1.1	.9	
stone and sandstone.	4-11	4-9	.01-.07	.03	—	—	8-10	.5-.8	.7	
Sandstone, gray, brown white,										
pebbly	11-13						10-12	.4-.7	.6	
Siltstone, brown gray, sandy	13-14	9-14	.00-.04	.02	—	—	12-14	.4-.7	.5	
							14-16	.5-.7	.6	
Sandstone, yellow buff, silty	14-18						16-18	.4-.7	.6	
Siltstone, buff, brown gray,										
sandy, thin claystone and		14-19	.01-.06	.03	—	—	18-20	.6-1.0	.8	
some pebbles	18-21.5	19-21.5	.00-.04	.02	—	—	20-22	.5-.9	.7	
Claystone, brick-red	21.5-24						22-24	.8-1.2	.9	
Sandstone, buff white	24-26	21.5-29	.00-.07	.03	—	—	24-26	.8-1.1	.9	
Sandstone, gray brown, silty	26-28						25-27	.5-.9	.8	
Siltstone, brown	28-29									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-24										
Quaternary alluvium and colluvium										
Silt, buff, gray white, sandy	0-2	0-2	.00-.05	.02	—	—	0-4	.9-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, green white	2-3	2-3	.00-.06	.03	—	—	4-6	.8-1.1	.9	
Claystone, brown green gray, silty	3-5	3-5	.00-.05	.02	—	—				
Siltstone, buff white	5-7.5	5-7.5	.00-.06	.03	—	—	6-16	.7-1.0	.8	
Claystone, brown, gray, silty	7.5-19.5	7.5-19.5	.00-.05	.03	—	—	16-22	.5-.9	.7	
Siltstone, buff, yellow, brown,							22-26	.6-1.0	.8	
sandy, clayey	19.5-23	19.5-24	.00-.05	.02	—	—	26-28	.6-.9	.7	
							28-30	.7-1.1	.9	
Claystone, brown, green, silty	23-26	24-34	.00-.06	.03	—	—	30-32	.7-1.2	1.0	
							32-36	.8-1.2	1.0	
Claystone, green blue gray	26-37.5						36-38	.8-1.1	.9	Iron-stained sand at base.
Sandstone, green white, buff,							38-40	.5-1.0	.7	
silty	37.5-42	34-39	.00-.05	.03	—	—	40-42	.4-.8	.6	
Siltstone, gray green, brown,							42-44	.6-1.0	.8	
sandy	42-47.5						44-46	.6-.9	.7	Water table at 46 feet.
							46-48	.6-1.0	.8	
Claystone, gray green, silty	47.5-50						47-49	.4-.9	.6	
ES-25										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.06	.03	—	—	0-4	.5-.9	.7	
Wasatch fm., Cathedral Bluffs										
tongue							4-6	.6-.9	.7	
Claystone, brown, silty	2-5	2-5	.01-.05	.02	—	—	6-8	.7-1.0	.8	
Siltstone, gray green, buff,										
brown, sandy							8-10	.7-1.1	.9	
minor clay and sand	5-9.5	5-14.5	.00-.05	.02	—	—	10-12	.8-1.2	1.0	
Claystone, gray, green, brown,							12-14	.9-1.2	1.0	
silty	9.5-17.5						14-16	1.0-1.5	1.2	Iron-stained at 15 feet.
Sandstone, brown, gray, white,							16-18	.7-1.1	.9	
very silty	17.5-21	14.5-19	.01-.06	.03	—	—	18-20	.6-.9	.8	
Siltstone, gray brown,										
argillaceous	21-22						20-22	.6-1.0	.7	
Sandstone, brown gray, silty,										
pebbly	22-23.5	19-23.5	.01-.05	.02	—	—	22-24	.5-.9	.7	
Siltstone, blue gray white,							24-26	.6-1.0	.7	
maroon, sandy	23.5-30						26-28	.7-1.1	.9	
Sandstone, gray brown white,							28-30	.6-1.0	.8	
silty	30-34						30-32	.8-1.1	.9	Water table at 32 feet.
							32-34	.6-1.0	.8	
Claystone, blue gray, sandy	34-39						34-36	.7-1.0	.8	
Sandstone, gray brown,							36-40	.8-1.1	.9	
argillaceous	39-40.5						40-42	.7-1.1	.9	
Claystone, blue gray, sandy	40.5-44.5						42-44	.7-1.0	.8	
Sandstone, gray brown white, silty	44.5-47						44-46	.6-1.0	.8	
Claystone, brown gray, green, silty	47-49						46-48	.5-1.1	.7	
Sandstone, brown white, pebbly	49-50									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-26										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-2.5	0-2.5	.00-.05	.02	—	—	—	—	—	
Sand, light brown, silty, pebbly	2.5-4	2.5-4	.00-.05	.02	—	—	—	—	—	
Wasatch fm., Cathedral Bluffs tongue		4-6	.00-.05	.02	—	—	—	—	—	
Sandstone, gray white, buff, silty	4-9	6-9	.00-.05	.03	—	—	—	—	—	Water table at 8 feet.
ES-27										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-1	0-1	.00-.05	.02	—	—	—	—	—	
Sand, light brown, pebbly	1-2	1-2	.00-.05	.02	—	—	—	—	—	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, gray white, silty	2-14	2-14	.00-.06	.03	0.003	0.000	—	—	—	Water table at 10 feet.
ES-28										
Quaternary alluvium and colluvium										
Sand, light-brown, pebbly	0-2	0-2	.00-.05	.02	—	—	—	—	—	
Wasatch fm., Cathedral Bluffs tongue		2-4	.00-.06	.03	—	—	—	—	—	
Claystone, gray green, silty	2-4	4-7	.01-.07	.03	—	—	—	—	—	
Siltstone, gray green, gray brown, argillaceous	4-12.5	7-9	.01-.06	.03	—	—	—	—	—	
		9-12.5	.00-.05	.02	—	—	—	—	—	
Claystone, green gray, silty	12.5-14	12.5-14	.00-.06	.03	—	—	—	—	—	Water table at 14 feet.
ES-29										
Quaternary alluvium and colluvium										
Silt, gray brown, sandy	0-0.5	0-0.5	.00-.04	.02	—	—	0-2	.8-1.1	.9	
Wasatch fm., Cathedral Bluffs tongue		0.5-1	.01-.05	.02	—	—	2-4	1.0-1.4	1.1	
Siltstone, gray, brown, argillaceous	0.5-3	1-3	.00-.05	.02	—	—	4-8	.9-1.3	1.2	
		3-4	.01-.05	.02	—	—	8-10	.9-1.4	1.1	
Claystone, gray, green, silty	3-12	4-12	.00-.06	.03	—	—	10-14	1.2-1.6	1.4	
Siltstone, gray, argillaceous	12-15	12-14	.01-.06	.03	—	—	14-16	1.0-1.4	1.2	
Claystone, light-brown, silty	15-17.5	14-17.5	.00-.05	.02	—	—	16-18	.8-1.1	1.0	Water table at 17.5 feet.
Siltstone, brown gray green argillaceous	17.5-18.5						18-20	.7-1.1	.8	
							20-22	.6-1.0	.8	
Sandstone, gray white, silty	18.5-28.5						22-26	.7-1.0	.8	
Claystone, brown, gray green, silty	28.5-33.5						26-28	.6-1.0	.8	
							28-30	.8-1.2	.9	
Sandstone, buff gray, argillaceous	33.5-35						30-32	1.2-1.6	1.3	
							32-34	1.0-1.3	1.1	
							34-36	.8-1.2	1.0	
Claystone, green gray, sandy	35-36.5						36-38	.6-1.0	.9	Iron-stained at 36.5 feet.
Sandstone, buff gray white, silty	36.5-50						37-39	.4-.9	.7	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-30										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.05	.02	—	—	0-2	.5-.8	.6	
Sand, buff brown, silty	1-4	1-4	.00-.06	.02	—	—	2-4	.4-.9	.6	
Wasatch fm., Cathedral Bluffs tongue		4-9	.01-.07	.03	0.002	0.001	4-8	.4-.8	.6	
Sandstone, gray white, silty, pebbly	4-12.5	9-12.5	.00-.05	.03	—	—	8-10 10-12	.5-.9 .5-.8	.6 .6	
Siltstone, brown, gray, green, argillaceous	12.5-14	12.5-14	.00-.05	.02	—	—	12-14	.6-1.1	.8	
Claystone, brown, green gray	14-15.5	14-14.5	.00-.05	.02	—	—	14-16	.8-1.2	1.0	
Siltstone, gray, green gray	15.5-18	14.5-15.5	.00-.06	.03	—	—	16-18	.6-1.0	.8	Water table at 18 feet.
Sandstone, gray white, silty	18-19	15.5-19	.00-.05	.03	—	—	18-20	.4-.9	.6	
Siltstone, green gray brown, sandy	19-26						20-22 22-24	.6-1.0 .8-1.2	.7 1.0	
Claystone, gray, green, brown, variegated, silty, sandy	26-39						24-26 26-28 28-30 30-32 32-34	.8-1.1 .8-1.2 1.0-1.4 1.2-1.5 1.0-1.4	.9 1.0 1.2 1.3 1.2	Minor anomaly at 30-32 feet.
Siltstone, gray green brown	39-46						34-36	.9-1.2	1.0	
Claystone, brown, sandy	46-47						36-38 38-40	1.0-1.4 .8-1.2	1.2 1.0	
Siltstone, light gray green white, sandy	47-50						40-46 46-48	.7-1.1 .8-1.2	.9 1.0	
ES-31										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.05	.02	—	—				
Silt, buff brown, sandy	1-4.5	1-4.5	.00-.05	.02	—	—	0-4	.7-1.0	.8	
Wasatch fm., Cathedral Bluffs tongue		4.5-9	.01-.06	.03	—	—	4-8	1.0-1.4	1.1	
Siltstone, gray, green brown, argillaceous	4.5-11	9-11	.00-.05	.02	—	—	8-12	1.2-1.7	1.4	
Sandstone, gray, silty	11-13	11-13	.01-.06	.03	—	—	10-14	1.1-1.5	1.3	
Claystone, brown gray, sandy	13-14	13-14	.00-.06	.03	—	—				
ES-32										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.05	.02	—	—	0-4	.8-1.2	1.0	
Sand, light brown, silty, pebbly	1-2.5	1-2.5	.01-.05	.02	—	—	4-8	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue		2.5-4	.00-.05	.02	—	—	8-12	16-20 7-9	18 8	Anomalous radioactivity at 8 to 12 feet
Sandstone, buff white, silty, pebbly	2.5-6.5	4-6.5	.01-.05	.02	—	—	12-16	1.2-1.6	1.4	
Siltstone, gray green, sandy, argillaceous	6.5-12.5	6.5-10.5	.00-.06	.03	—	—	16-20	.8-1.3	1.0	
Sandstone, brown gray, buff, white, silty	12.5-29	10.5-12.5	.01-.05	.03	—	—	20-24 24-28	.8-1.2 .7-1.2	1.0 .9	Water table at 17 feet.
Sandstone, white, pebbly	29-35	12.5-17	.01-.05	.03	—	—	28-32 30-34	.9-1.3 .9-1.3	1.0 1.0	
Sandstone, white, brown white, silty	35-46									
Siltstone, gray green, yellow, white, sandy	46-50									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-33										
Quaternary alluvium and colluvium										
Silt, buff brown, sandy	0-3									
Sand, buff, silty	3-4	0-4	.00-.05	.02	—	—	0-4	.9-1.4	1.0	
Sand, brown, white pebbly	4-7.5									
Wasatch fm., Cathedral Bluffs tongue		4-9	.01-.05	.02	—	—	4-8	.9-1.3	1.0	
Claystone, dark-gray	7.5-9									
Sandstone, brown, gray, buff, in part silty, 1/2 ft.		9-12.5	.00-.05	.02	—	—	8-12	.9-1.3	1.1	
gray clay in center	9-17	12.5-14	.01-.06	.03	—	—	12-16	1.0-1.5	1.2	
Siltstone, gray, brown gray, sandy	17-18	14-15	.01-.06	.03	—	—	16-20	.8-1.3	1.0	
Sandstone, gray white, pebbly	18-37									
Siltstone, gray green buff white, sandy	37-42									
Sandstone, gray white	42-44									
Siltstone, gray brown white, sandy	44-45.5									
Siltstone, gray green, argillaceous	45.5-47									
Sandstone, gray white	47-50									
ES-34										
Quaternary alluvium and colluvium										
Sand, light-brown, pebbly	0-3	0-3	.00-.05	.02	—	—	0-4	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, gray green brown, clayey	3-13						4-8	1.2-1.6	1.4	
Sandstone, brown green, argillaceous	13-14	3-14	.00-.05	.02	—	—	8-12	1.4-1.7	1.5	
Siltstone, brown gray, argillaceous	14-15.5						12-16	1.4-1.8	1.5	
Sandstone, brown gray white, pebbly	15.5-18	14-18	.00-.05	.03	—	—				Water table at 17 feet.
Siltstone, green brown gray, sandy	18-19						16-20	.8-1.2	1.0	
Sandstone, buff white	19-27.5						20-24	.6-1.0	.8	
Siltstone, green gray brown, argillaceous	27.5-29						24-26	.8-1.1	.9	
Sandstone, gray buff white, silty	29-35						25-29	.9-1.3	1.0	
Claystone, blue gray, gray, silty	35-36									
Sandstone, buff gray white, silty, argillaceous	36-42									
Claystone, blue gray, sandy	42-47									
Sandstone, buff gray, argillaceous	47-49									
Claystone, gray, brown, sandy	49-50									

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DRILL LOG		DATA ON SAMPLES						GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	REMARKS
ES-35										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1	0-0.5	.00-.05	.02			0-4	.7-1.1	.9	
Wasatch fm., Cathedral Bluffs tongue		0.5-4	.01-.05	.02			4-8	.7-1.1	.9	
Sandstone, buff gray white, pebbly	1-12.5	4-9	.00-.05	.02			8-12	.7-1.0	.9	
Claystone, gray, green, brown, silty	12.5-16	9-12.5	.00-.04	.02			12-16	.9-1.3	1.1	
Siltstone, brown gray argillaceous, sandy	16-19	12.5-14 14-16	.00-.05 .00-.04	.02 .02			16-20	.9-1.1	1.0	
Sandstone, brown gray, silty	19-26.5	16-22	.00-.05	.02			20-24	.6-1.0	.8	Water table at 22 feet
Siltstone, yellow buff, gray, brown	26.5-28						24-28	.6-1.1	.8	Iron-stained at top
Sandstone, gray white, silty	28-30									
Siltstone, gray, brown, buff, sandy	30-43									
Claystone, maroon brown, silty	43-44.5									
Siltstone, gray white, very sandy	44.5-50									
ES-36										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-4	0-4	.00-.05	.02	—	—	0-4	.8-1.1	.9	
Sand, brown, silty, pebbly	4-5	4-5	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		5-9	.00-.05	.02	—	—	4-8	1.0-1.4	1.2	
Siltstone, gray, green gray, sandy	5-11	9-12.5	.00-.05	.02	—	—	8-12	1.0-1.4	1.2	
Sandstone, brown gray white, silty	11-14	12.5-14	.00-.05	.02	—	—	10-14	1.0-1.4	1.2	
ES-37										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-0.5	.00-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		0.5-1.5	.01-.05	.02	—	—	0-4	.8-1.2	1.0	
Siltstone, gray, brown gray, sandy	1.5-5.5	1.5-7	.00-.05	.02	—	—				
Sandstone, brown gray white, silty	5.5-9.5	7-9	.01-.05	.02	—	—	4-8	.9-1.3	1.1	
Siltstone, gray, brown gray, argillaceous	9.5-10.5	9-9.5 9.5-10.5	.01-.06 .01-.05	.03 .02	— —	— —	8-12	.9-1.3	1.0	
Claystone, gray, brown	10.5-12	10-14	.01-.06	.03	—	—				
Siltstone, green gray brown buff, sandy	12-17	14-15 15-17	.01-.05 .00-.06	.02 .03	— —	— —	12-16	1.1-1.5	1.2	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-38										
Quaternary alluvium and colluvium										
Silt, brown, clayey	0-4									
Silt, gray brown, sandy	4-4.5	0-4	.00-.05	.02	—	—	0-4	1.0-1.5	1.2	
Sand, brown white, pebbly	4.5-7.5									
Wasatch fm., Cathedral Bluffs tongue							4-8	.9-1.2	1.0	
Siltstone, gray brown	7.5-9	4-9	.01-.05	.02	—	—				
Sandstone, brown white	9-11.5						8-12	.9-1.2	1.0	
Sandstone, rusty brown	11.5-12.5	9-13	.00-.05	.02	—	—				
Claystone, brown gray, silty	12.5-13						10-14	.8-1.1	1.0	
Sandstone, gray, silty	13-14									Water table at 13.5 feet.
ES-39										
Quaternary alluvium and colluvium										
Silt, brown	0-1.5									
Clay, gray brown, silty	1.5-4						0-4	1.1-1.4	1.2	
Silt, gray brown	4-7									
Wasatch fm., Cathedral Bluffs tongue							4-8	.9-1.1	1.0	
Siltstone, rusty brown, gray, sandy	7-8.5									
Claystone, gray	8.5-9	0-13.5	.00-.05	.02	—	—	8-12	.8-1.2	1.0	
Siltstone, gray brown	9-13									
Claystone, brown, dark gray	13-16.5						12-16	.9-1.1	1.0	Water table at 15 feet
Sandstone, brown gray, argillaceous	16.5-21.5						15-19	.8-1.1	.9	
Siltstone, light-brown gray, sandy	21.5-23.5									
Sandstone, rusty brown, silty	23.5-24									
ES-40										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-4	0-4	.01-.07	.02	—	—	0-4	1.0-1.5	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown white, silty	4-8						4-8	1.6-1.9	1.7	
Siltstone, buff, brown gray, sandy ½-foot clay at 14		4-15	.01-.06	.02	—	—	8-12	7.-9.	8.	Anomalous radioactivity
feet.	8-17	15-16	.00-.04	.02	—	—	12-16	7.-10.	8.	at 8-16 feet
ES-41										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-3	0-3	.01-.05	.02	—	—				
Sand, light brown, silty	3-4	3-4	.01-.04	.02	—	—	0-4	1.0-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue		4-9	.01-.06	.03	—	—	4-8	1.1-1.5	1.3	
Sandstone, light-brown white gray, pebbly	4-14	9-10	.01-.05	.02	—	—	8-12	1.1-1.4	1.2	
Siltstone, gray buff, sandy	14-16	10-14	.00-.04	.02	—	—	9-13	1.1-1.4	1.2	
Not recovered	16-18	14-16	.01-.06	.03	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-42										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5									
Wasatch fm., Cathedral Bluffs										
tongue		0-7	.00-.05	.02	—	—	0-4	.9-1.3	1.0	
Siltstone, brown white, sandy	1.5-8.5	7-9	.01-.06	.03	—	—	4-8	1.0-1.4	1.1	
Sandstone, buff white, pebbly	8.5-10.5	9-10.5	.01-.05	.02	—	—				
Sandstone, gray	10.5-11.5	10.5-11.5	.01-.04	.02	—	—	8-12	.9-1.4	1.1	
Sandstone, gray white, pebbly	11.5-14	11.5-12	.01-.06	.03	—	—				
Not recovered	14-16.5	12-14	.01-.05	.03	—	—				
ES-43										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-3	0-3	.01-.05	.02	—	—	0-4	1.3-1.7	1.5	
Wasatch fm., Cathedral Bluffs										
tongue										
Siltstone, gray brown	3-5.5	3-5.5	.01-.08	.03	—	—	4-8	7.5-9.5	8.5	Anomalous radioactivity.
Sandstone, gray brown, silty	5.5-6.5	5.5-6	.01-.07	.03	—	—				
Siltstone, gray brown white,		6-10.5	.01-.06	.03	—	—	8-12	8.5-10.5	9.5	
		10.5-11	.01-.04	.02	—	—				
gray green, minor sand	6.5-16.5	11-12.5	.01-.06	.03	—	—	11-15	9-11	10	
		12.5-14.5	.01-.07	.02	—	—				
Sandstone, brown white, silty	16.5-18	14.5-16.5	.01-.06	.02	—	—				
		16.5-18	.01-.08	.03	—	—				
Siltstone, gray brown	18-19									
ES-44										
Quaternary alluvium and colluvium										
Silt, brown to light brown,		0-1.5	.01-.04	.02	—	—				
sandy	0-4	1.5-4	.01-.05	.02	—	—	0-4	1.0-1.5	1.2	
Wasatch fm., Cathedral Bluffs										
tongue		4-5	.00-.07	.03	—	—				
Siltstone, buff gray brown	4-5.5	5-5.5	.01-.06	.03	—	—				
Siltstone and claystone, gray										
green	5.5-9	5.5-9	.02-.09	.04	0.007	0.005	4-8	9.-11.	10	Anomalous radioactivity
Claystone, green gray, silty	9-14	9-14	.01-.08	.03	—	—	8-12	9.-11.	10	
Sandstone, light brown gray,										
silty	14-16.5	14.-16.5	.00-.05	.02	—	—	12-16	1.3-1.7	1.5	
Siltstone, green white	16.5-17.5	16.5-17.5	.01-.05	.02	—	—				
Sandstone, gray brown, silty	17.5-19	17.5-19	.01-.04	.02	—	—	16-18	1.3-1.6	1.4	
Siltstone, brown, gray,		19-21	.01-.07	.03	—	—				
sand and clay	19-24	21-24	.01-.09	.03	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr		eU%	U%	Depth (feet)	Reading Mr/Hr		
			Range	Ave.				Range	Ave.	
ES-45										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1.5	.00-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		1.5-3	.01-.07	.03	—	—				
Siltstone, buff brown, sandy	1-4	3-4	.01-.08	.03	0.006	0.005	0-4	1.2-1.7	1.4	Contains schroeckingerite
Siltstone, brick red	4-5	4-5	.01-.09	.04	.006	.009				at 3 to 5.5 feet.
Claystone, brown	5-5.5	5.-5.5	.01-.08	.04	.009	.011	4-8	1.5-2.0	1.7	
		5.5-9	.01-.06	.03	—	—				
Siltstone, gray brown, sandy	5.5-17.5	9-11	.01-.08	.03	—	—	8-12	1.4-1.8	1.6	
Sandstone, brown gray, pebbly	17.5-18	11-16	.01-.06	.03	—	—	11-15	1.6-2.0	1.7	
Siltstone, gray white, argillaceous	18-19	16-19	.01-.05	.02	—	—				
ES-46										
Quaternary alluvium and colluvium										
Silt, dark-brown, sandy	0-1.5	0-1.5	.00-.04	.02	—	—				
Silt, light-brown, sandy	1.5-2.5	1.5-2.5	.01-.05	.02	—	—	0-4	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs		2.5-5	.01-.08	.03	—	—				
tongue		5-9	.01-.05	.02	—	—	4-8	1.0-1.4	1.2	
Siltstone, buff white, gray,		9-12	.01-.06	.03	—	—				
sandy	2.5-16	12-14.5	.01-.07	.03	—	—	8-12	1.3-1.7	1.5	
Sandstone, gray white, buff, silty	16-19	14-19	.01-.06	.02	—	—	11-15	1.3-1.6	1.4	
ES-47										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.06	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue							0-4	.9-1.4	1.2	
Siltstone, buff brown	1-2.5	1-2.5	.01-.07	.03	—	—	4-8	.8-1.2	.9	
Sandstone, buff gray white, silty	2.5-8	2.5-4	.01-.09	.04	0.002	0.002	8-12	.9-1.3	1.0	
Siltstone, buff, gray, brown, sandy	8-16	4-16	.00-.06	.025	—	—	10-14	1.0-1.3	1.1	
ES-48										
Quaternary alluvium and colluvium										
Silt, brown to light-brown, sandy	0-1.5	0-1.5	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, buff, gray brown, sandy	1.5-8.5	1.5-8.5	.01-.06	.02	—	—				
Sandstone, buff gray, silty	8.5-9.5	8.5-9.5	.01-.05	.02	—	—	0-12	1.0-1.4	1.1	
Siltstone, variegated, argillaceous	9.5-11	9.5-11	.01-.05	.02	—	—				
Siltstone, brown gray	11-11.5	11-11.5	.01-.06	.02	—	—				
Sandstone, gray brown, silty	11.5-12.5	11.5-16	.01-.06	.02	—	—				
Claystone, maroon, gray brown, silty	12.5-15.5	16-18	.01-.05	.02	—	—	12-16	1.3-1.7	1.6	
Siltstone, red brown, gray, green	15.5-19	18-19	.01-.06	.03	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-49										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.06	.03	—	—				
Silt, light-brown	1-3	1-3	.01-.04	.02	—	—	0-4	.9-1.2	1.0	
Green River fm., Tipton tongue							4-8	.9-1.3	1.1	
Claystone, brown, gray brown, platy	3-4	3-4	.01-.06	.03	—	—	8-12	1.0-1.4	1.1	
Siltstone, light-brown	4-5	4-5	.01-.05	.02	—	—	12-16	.8-1.2	1.0	
Claystone, brown, platy	5-19	5-19	.00-.06	.02	—	—	13-17	.9-1.3	1.0	
ES-50										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-3	0-3	.01-.05	.02	—	—				
Silt, brown, argillaceous	3-4	3-4	.00-.04	.02	—	—	0-4	.9-1.3	1.1	
Green River fm., Tipton tongue							4-8	.8-1.3	1.0	
Claystone, brown, platy	4-13	4-13	.01-.05	.02	—	—	8-12	.9-1.3	1.0	
Claystone, rusty brown, sandy	13-14.5	13-14.5	.01-.05	.02	—	—				
Siltstone, gray brown, sandy	14.5-15.5	14.5-15.5	.01-.05	.02	—	—	12-16	1.0-1.5	1.2	
Claystone, green brown gray, platy	15.5-19	15.5-19	.01-.05	.02	—	—				
ES-51										
Quaternary alluvium and colluvium										
Silt, brown, light-brown, sandy	0-2.5	0-2.5	.00-.05	.02	—	—				
Undifferentiated Green River fm., Tipton tongue, and Wasatch fm. Hiawatha member							0-4	.8-1.2	1.0	
Sandstone, light brown, silty	2.5-4	2.5-4	.01-.04	.02	—	—	4-8	.9-1.3	1.1	
Siltstone, light brown gray, sandy	4-14	4-14	.01-.06	.03	—	—	8-12	.8-1.3	1.0	
Sandstone, brown gray, silty	14-15	14-15	.01-.05	.03	—	—	11-15	.9-1.3	1.0	
Claystone, pink, gray, sandy	15-16	15-16	.01-.06	.03	—	—				
Siltstone, gray brown, sandy	16-19	16-19	.01-.04	.02	—	—				
ES-52										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.00-.05	.03	—	—				
Sand, brown, silty	2-4	2-4	.01-.05	.03	—	—	0-4	.8-1.1	.9	
Undifferentiated Green River fm., Tipton tongue, and Wasatch fm., Hiawatha member										
Sandstone, brown white, silty	4-9.5	4-9.5	.01-.05	.02	—	—	4-8	.7-1.2	.9	
Sandstone, yellow, gray	9.5-11.5	9.5-11.5	.00-.04	.02	—	—	8-12	.8-1.3	1.0	
Siltstone, buff brown; argillaceous	11.5-14	11.5-14	.01-.05	.02	—	—				
Not recovered	14-15									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-53										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2.5	0-2.5	.01-.06	.02	—	—				
Silt, light brown, sandy, pebbly	2.5-4	2.5-4	.01-.05	.02	—	—	0-4	.8-1.2	1.0	
Undifferentiated Green River fm., Tipton tongue, and Wasatch fm., Hiawatha member										
Siltstone, buff, brown white, gray, minor claystone and sandstone		4-11.5	.01-.07	.03	—	—	4-8	1.0-1.3	1.1	
	4-13.5	11.5-13.5	.00-.05	.02	—	—	8-12	1.0-1.3	1.1	
Claystone, variegated, silty	13.5-14.5	13.5-14.5	.01-.05	.02	—	—				
Siltstone, gray brown buff, sandy	14.5-19	14.5-19	.01-.06	.02	—	—	12-16	.9-1.3	1.1	
Sandstone, brown gray, silty	19-21	19-21	.01-.05	.02	—	—	16-20	.6-1.1	.8	
Siltstone, light-brown, sandy	21-25	21-25	.01-.05	.02	—	—	20-24	.6-1.0	.8	
Claystone, maroon, brown, red mixed with siltstone, light brown		25-28.5	.00-.06	.03	—	—				
	25-30	28.5-30	.01-.05	.02	—	—	23-27	.8-1.2	.9	
Sandstone, light brown, silty	30-31	30-31	.00-.06	.03	—	—				
Siltstone, brown, sandy	31-34	31-34	.01-.04	.02	—	—				
Not recovered	34-37									
ES-54										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2.5									
Sand, brown, silty	2.5-4	0-4	.01-.05	.02	—	—	0-4	.9-1.4	1.1	
Undifferentiated Green River fm.,										
Tipton tongue, and Wasatch fm.,		4-6	.01-.07	.03	—	—				
Hiawatha member		6.-7.5	.01-.07	.03	0.001	0.002				
Siltstone, buff brown white, sandy	4-9	7.5-10	.01-.06	.03	—	—	4-8	.9-1.3	1.1	
Sandstone, buff, gray white, silty	9-18	10-18	.01-.05	.02	—	—	8-12	.8-1.1	1.0	
Siltstone, yellow brown buff, sandy	18-19	18-19	.01-.06	.02	—	—	12-16	.8-1.1	.9	
ES-55										
Quaternary alluvium and colluvium		0-1	.01-.05	.02	—	—				
Silt, brown, sandy	0-1.5	1-1.5	.01-.07	.02	—	—				
Sand, light brown, pebbly, silty	1.5-4	1.5-3	.01-.05	.02	—	—	0-4	1.0-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, green gray brown, minor sand and clay							4-8	1.5-1.8	1.6	
	4-11.5	3-10	.01-.07	.03	—	—	6-10	1.6-2.0	1.7	
Sandstone, brown gray, silty	11.5-14	10-14	.01-.05	.02	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-56										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1.5	1-3	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		3-4	.01-.07	.03	0.005	0.003	0-4	1.3-1.6	1.5	Contains schroeckingerite
Siltstone, brown gray, sandy	1.5-5	4-5	.01-.07	.03	—	—	4-8	7.-9.	8.5	at 3 to 6.5 feet.
		5-6.5	.01-.08	.03	.006	.005				
Siltstone, green gray, sandy	5-11.5	6.5-13	.01-.06	.03	—	—	8-12	1.4-1.8	1.6	
Sandstone, green gray brown white, silty	11.5-14	13-14	.01-.05	.02	—	—				
ES-57										
Quaternary alluvium and colluvium		0-1.5	.01-.07	.03	—	—				
Silt, brown to light brown, sandy	0-2.5	1.5-2.5	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs		2.5-4	.01-.06	.03	—	—				
tongue		4-5	.01-.09	.03	—	—	0-4	1.1-1.3	1.2	
Siltstone, brown white, gray buff, sandy	2.5-7	5-6.5	.01-.05	.03	—	—				
Sandstone, gray, silty	7-8	6.5-7	.01-.07	.04	.002	.000				
Siltstone, green gray, sandy	8-9	7-9	.01-.05	.03	—	—	4-8	.9-1.3	1.0	
Sandstone, buff, gray, silty	9-11.5	9-10.5	.01-.05	.02	—	—				
Siltstone, gray buff green	11.5-12.5	10.5-11.5	.01-.05	.02	—	—	8-12	1.2-1.5	1.3	
Sandstone, brown gray, silty	12.5-14	11.5-14	.01-.05	.02	—	—				
ES-58										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2.5	0-2.5	.01-.05	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff white, silty	2.5-4.5	2.5-4.5	.01-.06	.03	—	—	0-4	1.1-1.5	1.3	
Siltstone, gray brown white, argillaceous	4.5-8	4.5-8	.01-.07	.03			4-8	1.5-1.8	1.6	
Sandstone, green brown, gray	8-9.5	8-9.5	.01-.05	.03	—	—	8-12	1.3-1.7	1.5	
Siltstone, varicolored	9.5-14	9.5-14	.01-.05	.03	—	—	9.5-13.5	1.5-1.8	1.6	
ES-59										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2	0-2	.01-.06	.02	—	—	0-4	1.1-1.6	1.3	
Wasatch fm., Cathedral Bluffs tongue		2-5	.01-.08	.04	—	—	4-8	1.5-1.8	1.6	
Siltstone, brown white, sandy at base	2-7	5-7	.01-.06	.03	—	—	8-12	1.1-1.5	1.3	
Sandstone, green buff, silty	7-14	7-14	.01-.07	.03	—	—	10-14	1.1-1.5	1.2	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-60										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2.5	0-0.5	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		0.5-2.5	.01-.06	.02	—	—				
Siltstone, brown white, sandy	2.5-4	2.5-5.5	.01-.05	.02	—	—	0-4	.8-1.1	1.0	This may be part of the Quaternary
Sandstone, brown buff white, silty	4-9	5.5-9	.01-.08	.03	—	—	4-8	1.1-1.4	1.2	
Siltstone, green gray	9-12.5	9-10	.01-.06	.02	—	—	8-12	1.7-2.0	1.8	
Claystone, variegated	12.5-14	10-14	.01-.07	.04	—	—	9-13	1.7-2.0	1.9	
ES-61										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-1.5									
Silt, brown white, sandy, pebbly	1.5-4	0-4	.01-.06	.03	—	—	0-4	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, buff brown white, sandy	4-8.5	4-7.5	.01-.06	.03	0.004	0.000	4-8	1.2-1.7	1.4	
Sandstone, gray, buff, yellow		7.5-8.5	.01-.05	.03	—	—	8-12	1.0-1.4	1.2	
white, silty at bottom	8.5-14	8.5-12	.01-.06	.03	—	—	10-14	.8-1.2	1.0	
		12-14	.00-.04	.02	—	—				
ES-62										
Quaternary alluvium and colluvium		0-1.5	.01-.07	.03	—	—				
Silt, light brown, sandy	0-2	1.5-2	.01-.05	.02	—	—				
Sand, brown white, silty	2-3	2-4	.01-.06	.03	—	—	0-4	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff gray brown, silty	3-6.5						4-8	1.0-1.3	1.1	
Siltstone, brown buff, sandy	6.5-7.5	4-14	.01-.05	.02	—	—				
Sandstone, buff gray, light-brown, silty	7.5-13.5						8-12	.9-1.3	1.1	
Siltstone, gray brown	13.5-14						10-14	.9-1.3	1.1	
ES-63										
Quaternary alluvium and colluvium										
Silt, brown, light brown, sandy	0-1.	0-0.5	.00-.04	.02	—	—				
Sand, light brown, silty	1-2.5	0.5-8	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff white, silty	2.5-6.5	8-9	.00-.04	.02	—	—	0-4	.8-1.2	1.0	
Sandstone, brown buff, pebbly	6.5-8	9-11.5	.01-.06	.03	—	—	4-8	.9-1.2	1.0	
Sandstone, buff gray, silty, some pebbles	8-12.5	11.5-12.5	.00-.04	.02	—	—	8-12	1.0-1.4	1.1	
Sandstone, brown, gray, pebbly	12.5-13.5	12.5-13.5	.01-.06	.03	—	—				
Not recovered	13.5-14						10-14	1.0-1.4	1.1	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-64										
Quaternary alluvium and colluvium										
Silt, brown, gray brown, sandy	0-1	0-0.5	.00-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue							0-4	1.3-1.9	1.5	
Siltstone, brown green white, argillaceous	1-6	0.5-9	.01-.07	.035	—	—	4-8	1.1-1.5	1.3	
Claystone, brown gray	6-8						8-12	9.5-12.	11.	Anomalous radioactivity
Sandstone, yellow, buff, white	8-14	9-14	.01-.06	.03	—	—	9-13	9.5-12.	11.	
ES-65										
Quaternary alluvium and colluvium										
Silt, light brown, gray brown, sandy	0-3.5	0-3.5	.01-.06	.03	—	—	0-4	1.1-1.6	1.2	
Wasatch fm., Cathedral Bluffs tongue							4-8	1.3-1.7	1.5	
Siltstone, green gray brown,		3.5-6	.01-.07	.04	—	—	8-12	1.1-1.5	1.3	
sandy except 9-11 feet.	3.5-14	6-14	.01-.06	.03	—	—	9.5-13.5	1.1-1.5	1.3	
ES-66										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2.5	0-0.5	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, green gray white, very sandy	2.5-3.5	0.5-3.5	.01-.07	.03	—	—	0-4	1.4-1.8	1.6	Contains schroeckingerite at 3 to 4.5 feet.
Siltstone, gray green, argillaceous	3.5-4.5	3.5-4	.01-.08	.04	0.006	0.006				
Siltstone, buff gray green, clayey and sandy	4.5-6.5						4-8	8.-9.5	9.	
Claystone, brown gray	6.5-7.5	4-9	.01-.07	.03	—	—				
Siltstone, brown green gray, sandy	7.5-10						8-12	1.3-1.7	1.5	
Sandstone, brown green gray, silty	10-14	9-14	.01-.05	.02	—	—				
ES-67										
Quaternary alluvium and colluvium										
Silt, gray brown, sandy	0-1	0-1	.01-.07	.04	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, light brown, green gray, argillaceous	1-2	1-2	.02-.11	.07	.013	.021	0-4	1.6-2.0	1.7	Contains schroeckingerite at 1 to 4 feet.
Claystone, brown green gray, silty	2-6.5	2-4	.01-.09	.05	—	—				
Claystone, chocolate brown	6.5-7.5	4-6.5	.00-.05	.02	—	—	4-8	1.2-1.6	1.3	
Sandstone, brown buff, pebbly top ½ foot	7.5-11	6.5-11	.01-.06	.03	—	—				
Claystone, green brown gray, silty	11-12.5	11-12.5	.01-.07	.03	—	—	8-12	1.5-1.9	1.7	
Sandstone, buff gray, silty	12.5-14	12.5-14	.01-.05	.02	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-68										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-1.5	0-0.5	.00-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		0.5-1.5	.00-.07	.03	---	---				
Siltstone, brown green gray	1.5-2.5	1.5-2.5	.01-.06	.03	—	—	0-4	1.6-2.0	1.8	Contains schroeckingerite
Claystone, green, gray, silty	2.5-4	2.5-4	.02-.10	.06	0.009	0.009				at 1.5 to 4 feet.
Siltstone, green buff, sandy	4-5	4-5	.01-.08	.04	—	—				
Sandstone, brown gray white, silty at top	5-8.5	5-6.5	.01-.07	.04	—	—	4-8	1.6-1.9	1.7	
Siltstone, buff, sandy	8.5-10	6.5-10	.01-.06	.03	—	—	8-12	1.4-1.8	1.6	
Sandstone, gray, buff, some pebbles	10-14	10-14	.01-.05	.02	—	—				
ES-69										
Quaternary alluvium and colluvium										
Silt, brown, minor sand	0-3									
Silt, light brown, sandy, pebbly	3-4						0-4	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown white	4-5	0-8	.01-.05	.02	—	—	4-8	1.3-1.6	1.4	
Siltstone, light brown, very sandy	5-8									
Siltstone, brown white, argillaceous	8-9	8-10	.01-.06	.03	—	—	8-12	1.7-2.0	1.8	
Sandstone, brown gray white, silty	9-10.5									
Siltstone, brown white, sandy	10.5-12	10-14	.01-.05	.02	—	—				
Siltstone, gray green, argillaceous	12-14									
ES-70										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-4	0-6	.00-.05	.02	—	—	0-4	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue		6-9	.01-.06	.03	—	—	4-8	1.4-1.8	1.6	
Siltstone, buff, light brown white, sandy;		9-12	.01-.09	.04	.004	.002	8-12	1.6-1.9	1.7	
small amounts of claystone	4-14	12-14	.01-.08	.04	—	—	9-13	1.6-1.9	1.7	
ES-71										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-3	0-1	.00-.04	.02	—	—				
Sand, light brown, silty	3-4	1-4	.01-.05	.02	—	—	0-4	.9-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue		4-6	.01-.06	.02	—	—	4-8	1.0-1.4	1.1	
Sandstone, buff brown white	4-10	6-10	.01-.07	.03	—	—	8-12	1.2-1.6	1.3	
Sandstone, buff gray white, pebbly	10-14	10-14	.01-.08	.03	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-72										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2	0-4	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		4-6	.01-.06	.03	—	—	0-4	1.1-1.5	1.2	
Siltstone, buff brown gray white, sandy	2-10.5	6-10	.01-.05	.02	—	—	4-8	1.2-1.5	1.3	
Siltstone, buff brown, argillaceous	10.5-12	10-12	.01-.06	.03	—	—	7-11	1.4-1.7	1.5	
ES-73										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-3	0-1.5	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue		1.5-3	.01-.06	.03	—	—	0-4	1.0-1.3	1.1	
Siltstone, brown buff, green, gray, sandy	3-8.5	3-7.5	.01-.05	.02	—	—	4-8	1.2-1.6	1.4	
Sandstone, light green gray	8.5-9	7.5-9	.01-.07	.03	—	—				
Siltstone, green gray	9-9.5	9-9.5	.01-.06	.02	—	—	8-12	1.5-2.0	1.7	
Claystone, gray green, silty	9.5-10.5	9.5-12	.01-.06	.03	—	—				
Siltstone, gray, brown buff, sandy	10.5-14	12-14	.01-.05	.02	—	—	9-13	8.-10.	8.5	Anomalous radioactivity
ES-74										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-2.5	0-2.5	.01-.06	.03	—	—				
Silt, brown, sandy	2.5-3	2.5-3	.01-.04	.02	—	—	0-4	1.0-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, gray buff brown, silty	3-4.5	3-5.5	.01-.07	.03	—	—				
Siltstone, gray buff, very sandy	4.5-7						4-8	1.3-1.6	1.4	
Sandstone, buff brown, gray, silty	7-8	5.5-11.5	.01-.05	.02	—	—				
Siltstone, gray buff, sandy	8-11.5	11.5-12.5	.01-.08	.03	—	—	8-12	1.2-1.7	1.4	
Sandstone, gray, buff, silty	11.5-14	12.5-14	.01-.06	.02	—	—	9-13	1.1-1.5	1.3	
ES-75										
Quaternary alluvium and colluvium										
Silt, very sandy	0-0.5	0-0.5	.01-.06	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, green gray, brown, silty at base	0.5-5	0.5-5	.01-.05	.03	—	—	0-4	.9-1.4	1.1	
Siltstone, gray brown green, sandy	5-7	5-7	.01-.05	.03	—	—	4-8	1.1-1.5	1.3	
Siltstone, gray brown green	7-10	7-10	.01-.06	.03	—	—				
Siltstone, buff brown, argillaceous	10-12	10-11 11-12	.01-.08 .01-.05	.04 .03	— —	— —	8-12	1.4-1.7	1.5	
Sandstone, gray brown, silty, pebbly	12-14	12-14	.00-.05	.02	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-76										
Quaternary alluvium and colluvium										
Silt, brown, gray white, sandy	0-1	0-1	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		1-1.5	.01-.08	.03	0.005	0.007	0-4	1.0-1.4	1.1	Contains schroeckingerite
Siltstone, buff brown white, sandy	0-2	1.5-2	.01-.07	.04	.007	.009	4-8	.8-1.2	1.0	at 1 to 6 feet.
Green River fm., Tipton tongue							8-12	.9-1.2	1.0	
Claystone, brown, platy	2-14	2-14	.01-.05	.02	—	—	10-14	.9-1.3	1.0	
ES-77										
Quaternary alluvium and colluvium										
Sand, light brown, some clay	0-1	0-1	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Claystone, dark-gray	1-1.5	1-1.5	.01-.05	.02	—	—	0-4	.9-1.3	1.1	
Siltstone, gray, gray brown, argillaceous	1.5-4.5	1.5-4.5	.01-.05	.02	—	—				
Siltstone, gray white, sandy	4.5-6	4.5-6	.01-.06	.03	—	—	4-8	1.3-1.6	1.4	
Claystone, gray, brown, silty	6-9	6-9	.01-.08	.03	—	—	5-9	1.2-1.6	1.4	
ES-78										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-0.5	0-0.5	.01-.06	.03	—	—				
Silt, white, sandy	0.5-2	0.5-2	.00-.06	.03	—	—	0-4	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue							4-8	.9-1.2	1.0	
Sandstone, buff, white	2-4	2-4	.01-.05	.02	—	—	8-12	.9-1.3	1.1	
Sandstone, buff, buff brown, pebbly	4-14	4-14	.00-.07	.02	—	—	9-13	.9-1.3	1.1	
ES-79										
Quaternary alluvium and colluvium										
Silt, brown white, sandy	0-1	0-1	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		1-2	.01-.07	.03	—	—				
Siltstone, buff white, sandy	1-4	2-4	.01-.06	.03	—	—	0-4	1.2-1.5	1.3	
Siltstone, brown gray	4-5	4-5	.01-.07	.03	—	—				
Siltstone, gray white, sandy	5-6.5	5-6.5	.01-.06	.02	—	—				
Siltstone, brown white, argillaceous	6.5-7.5	6.5-7.5	.01-.05	.02	—	—	4-8	1.1-1.4	1.2	
Sandstone, buff gray brown, silty	7.5-10	7.5-10	.00-.05	.02	—	—				
Siltstone, buff brown	10-11.5	10-11.5	.01-.06	.03	—	—	8-12	1.0-1.4	1.2	
Claystone, purple brown, green	11.5-12	11.5-12	.01-.06	.03	—	—				
Sandstone, gray brown	12-14	12-14	.01-.07	.03	—	—	10-14	1.2-1.6	1.3	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU	U	Depth (feet)	Reading Mr/Hr Range	Ave.	REMARKS
ES-80										
Quaternary										
Silt, brown, sandy	0-2.5	0-2.5	.00-.05	.02	—	—				
Sand, light brown, silty, pebbly	2.5-4.5	2.5-4.5	.00-.05	.02	—	—	0-4	.9-1.2	1.0	
Undifferentiated Green River fm., Tipton tongue and Wasatch fm., Hiawatha member										
Sandstone, buff white	4.5-6	4.5-6	.00-.05	.02	—	—	4-8	.9-1.3	1.0	
Siltstone, buff brown, sandy	6-9	6-9	.01-.07	.02	—	—				
Sandstone, gray brown, silty at top	9-10.5	9-10.5	.01-.05	.02	—	—	8-12	.9-1.4	1.1	
Siltstone, buff white, sandy	10.5-13	10.5-13	.01-.06	.02	—	—	9-13	.9-1.2	1.0	
ES-81										
Quaternary										
Silt, brown, sandy	0-0.5	0-0.5	.01-.05	.02	—	—	0-3	1.0-1.4	1.2	
		0.5-2	.01-.07	.03	—	—				
Sand, light brown, pebbly	0.5-4.5	2-5	.01-.06	.03	—	—	3-6	1.2-1.6	1.3	
Wasatch fm., Cathedral Bluffs tongue		5-7	.00-.08	.03	0.005	0.001	6-9	1.1-1.5	1.3	
Sandstone, gray buff	4.5-14	7-14	.01-.05	.02	—	—	7-14	1.1-1.5	1.3	Water table at 9 feet.
ES-82										
Quaternary alluvium and colluvium										
Sand, brown, pebbly	0-1	0-1	.01-.05	.02	—	—	0-3	.9-1.2	1.0	
Sand, buff, pebbly	1-3	1-3	.01-.06	.03	—	—	3-6	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue		3-4	.01-.07	.03	—	—	6-9	1.4-1.7	1.5	
Claystone, buff green gray	3-13.5	4-12.5	.01-.05	.02	—	—	9-12	1.4-1.7	1.5	
Siltstone, buff brown	13.5-14	12.5-14	.01-.06	.03	—	—	10-13	1.4-1.8	1.5	Water table at 13.5 feet.
ES-83										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-0.5	0-0.5	.01-.05	.02	—	—	0-3	1.0-1.2	1.1	
Sand, light brown, pebbly	0.5-5	0.5-5	.01-.07	.03	—	—	3-6	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue		5-8.5	.01-.07	.03	.004	.000	6-9.	1.0-1.3	1.1	
Sandstone, gray white	5-13.5	8.5-13.5	—	—	—	—	8-11	1.0-1.3	1.1	Water table at 10 feet.
ES-84										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1.5	0-1.5	.01-.05	.02	—	—				
Sand, light brown	1.5-4	1.5-2.5	.00-.07	.03	—	—	0-3	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue		2.5-4	.01-.06	.03	—	—				
Sandstone, brown gray	4-6	4-6	.01-.05	.02	—	—	3-6	1.0-1.5	1.1	
Claystone, brown, gray green, silty, sandy	6-8.5	6-8.5	.01-.08	.03	—	—	6-9	1.6-2.0	1.7	Iron-stained at 6 feet.
Claystone, gray green brown	8.5-10.5	8.5-10.5	.01-.07	.03	—	—	9-12	1.6-2.0	1.7	
Claystone, gray green, silty	10.5-16	10.5-16	.01-.06	.03	—	—	12-15	1.5-1.8	1.6	Water table at 17.5 feet.
Siltstone, gray brown green	16-18	16-18	.00-.06	.03	—	—	15-18	8.-10.	9	Anomalous radioactivity
Claystone, buff green, silty	18-19	—	—	—	—	—				

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-85										
Quaternary alluvium and colluvium										
Sand, brown	0-0.5									
Sand, light brown, pebbly	0.5-4.5	0-5.5	.00-.06	.03	—	—	0-3	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue							3-6	1.0-1.5	1.3	
Sandstone, gray green brown,		5.5-10	.00-.05	.02	—	—	6-9	1.1-1.4	1.3	
pebbly at top 1 ft.	4.5-14	10-14	.00-.06	.03	—	—	9-12	.8-1.2	1.0	Water table at 10 feet
ES-86										
Quaternary alluvium and colluvium										
Sand, brown to light brown, pebbly	0-2.5	0-1.5	.01-.06	.03	—	—	0-3	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue		1.5-4	.00-.05	.02	—	—	3-6	1.1-1.5	1.2	
Sandstone, buff brown, gray	2.5-11	4-9.5	.01-.05	.02	—	—	6-9	.9-1.4	1.1	
Claystone, green, light brown, silty	11-17	9.5-14	.01-.06	.03	—	—	9-12	1.2-1.5	1.3	
Siltstone, brown, buff, sandy	17-18.5						12-15	1.6-2.0	1.8	Water table at 17 feet.
Sandstone, buff, silty	18.5-19						13-16	1.6-2.0	1.8	
ES-87										
Quaternary alluvium and colluvium										
Sand, brown, light brown, pebbly	0-3						0-3	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, gray brown, sandy	3-7.5	0-9.5	.00-.05	.02	—	—	3-6	1.1-1.5	1.3	
Sandstone, gray, silty	7.5-8.5						6-9	1.3-1.7	1.5	
Siltstone, brown gray	8.5-10.5	9.5-10.5	.01-.06	.03	—	—	9-12	1.4-1.7	1.5	
Claystone, green gray, silty	10.5-13.5	10.5-13.5	.01-.08	.03	—	—	10-13	6.5-9.0	7.5	Water table at 13.5 feet
ES-88										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-0.5	0-0.5	.00-.05	.02	—	—	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		0.5-5	.01-.08	.04	0.008	0.003	3-6	10.5-12.5	11.5	
Claystone, gray, green, brown, silty	0.5-16.5	5-14	.01-.08	.04	—	—	6-9	8.-10.	9.	
							9-12	8.5-10.5	9.	Anomalous radioactivity, 3 to 15 feet.
		14-15	.01-.07	.03	—	—	12-15	9.-11.	10.	
		15-16.5	.00-.08	.04	—	—	15-18	1.2-1.5	1.3	
Sandstone, gray buff	16.5-19	16.5-19	.01-.06	.03	—	—	16-19	1.1-1.5	1.2	Water table at 16.5 feet.
ES-89										
Quaternary alluvium and colluvium										
Silt, light brown, minor clay	0-0.5	0-0.5	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue							0-3	.9-1.3	1.1	
Claystone, light brown, silty	0.5-4	0.5-4	.01-.05	.02	—	—				
Sandstone, green gray, argillaceous	4-5	4-5	.01-.06	.03	—	—	3-6	.9-1.3	1.1	
Sandstone, buff white, pebbly	5-9		—	—			5-8	.8-1.3	1.0	Water table at 5 feet.

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-90										
Quaternary alluvium and colluvium										
Clay, brown, silty	0-3	0-4	.01-.05	.02	—	—	0-3	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Claystone, gray brown	3-8.5	4-8.5	.01-.06	.03	—	—	3-6	1.0-1.3	1.2	Water table at 7 feet
Sandstone, brown white, argillaceous	8.5-9						5-8	1.2-1.6	1.3	
ES-91										
Quaternary alluvium and colluvium		0-0.5	.00-.04	.02	—	—				
Sand, brown, silty, and light brown	0-3.5	0.5-1.5	.00-.07	.03	—	—	0-3	.8-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue		1.5-3.5	.00-.08	.04	—	—				
Claystone, green buff gray, sandy	3.5-4.5	3.5-4.5	.01-.07	.04	—	—				
Siltstone, green buff gray, sandy	4.5-6	4.5-6	.00-.07	.04	0.005	0.002	3-6	1.3-1.7	1.5	
Siltstone, brown gray	6-8	6-7	.02-.08	.05	.016	.024				
		7-8	.02-.10	.06	.010	.015	6-9	1.7-2.0	1.9	Contains schroeckingerite
		8-8.5	.01-.06	.04	.006	.004				at 6 to 9 feet.
Claystone, gray, green, brown	8-10	8.5-9	.01-.08	.04	.006	.004				
		9-10.5	.01-.08	.04	—	—				
		10.5-11.5	.00-.06	.03	.005	.003	9-12	1.3-1.9	1.5	
Claystone, gray, brown, maroon,	10-14.5	11.5-13.5	.01-.05	.02	.004	.000	12-15	1.2-1.7	1.5	
silty		13.5-14.5	.01-.07	.04	—	—	15-18	1.6-1.9	1.8	
Claystone, green, gray brown, silty	14.5-24	14.5-19.5	.01-.06	.03	—	—	17-20	8.-10.	9.	Water table at 21.5 feet.
ES-92										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-1.5	.00-.07	.03	—	—				
Sand, light brown, pebbly	1.5-3.5	1.5-3.5	.01-.07	.03	—	—	0-3	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Claystone, gray green, silty	3.5-5	3.5-5	.01-.07	.03	—	—	3-6	1.2-1.7	1.4	
Siltstone, brown gray, argillaceous	5-7	5-7	.00-.06	.03	—	—	6-9	1.5-1.8	1.6	
Claystone, gray, brown, silty	7-9.5	7-9.5	.00-.06	.03	—	—				
Siltstone, gray brown,		9.5-11	.01-.08	.04	—	—				
argillaceous, sandy	9.5-12	11-12	.00-.06	.03	—	—	9-12	1.5-1.9	1.7	
Sandstone, brown, gray, silty	12-13	12-13	.00-.05	.02	—	—				Water table at 12 feet.
Sandstone, gray	13-14						11-14	1.3-1.7	1.4	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
ES-93										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1.5	0-1.5	.01-.06	.02	—	—				
Clay, light brown, sandy	1.5-2	1.5-2	.01-.07	.04	—	—	0-3	1.1-1.5	1.2	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.07	.04	—	—				
		4-4.5	.00-.08	.04	0.007	0.006				
		4.5-5.5	.01-.12	.06	.019	.030	3-6	1.5-1.9	1.7	Contains schroeckingerite at 4 to 9.5 feet.
Claystone, gray, gray green, silty; brown, sandy at top, very silty at base	2-9.5	5.5-6	.01-.07	.04	.012	.012				
		6-7.5	.01-.07	.04	.006	.004				
		7.5-9	.01-.06	.03	.004	.000	6-9	1.8-2.1	1.9	
		9-9.5	.01-.05	.03	.007	.003				
Siltstone, green gray, argillaceous	9.5-11	9.5-11	.01-.06	.03	—	—				
Siltstone, buff, brown, gray green, sandy	11-14	11-14	.01-.06	.03	—	—	11-14	1.1-1.4	1.2	Water table at 13.5 feet.
ES-94										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-1	.00-.06	.03	—	—				
Sand, light brown, pebbly	1-4.5	1-4	.01-.07	.03	—	—	0-3	1.0-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue		4-4.5	.01-.07	.04	—	—				
Sandstone, buff, white	4.5-6.5	4.5-6.5	.01-.07	.04	—	—	3-6	1.3-1.5	1.4	
Claystone, green gray, silty	6.5-9	6.5-9	.01-.07	.04	—	—	6-9	12.-14.5	13.5	Anomalous radioactivity
Claystone, green gray, brown	9-10	9-10	.02-.10	.06	.007	.003				
Siltstone, green gray	10-12	10-12	.01-.08	.04	.003	.000	9-12	11.-14.	12.	
Sandstone, buff gray, silty	12-14	12-14	.01-.06	.03	—	—	11-14	1.3-1.7	1.4	Water table at 13 feet.
ES-95										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-0.5	0-0.5	.01-.05	.02	—	—	0-3	1.0-1.5	1.2	
Sand, light brown, pebbly	0.5-3.5	0.5-3.5	.01-.08	.03	—	—	3-9	1.1-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue		3.5-5.5	.01-.08	.03	—	—	9-12	1.3-1.6	1.4	
Claystone, green gray, silty	3.5-14	5.5-14	.01-.05	.03	—	—	11-14	1.5-1.9	1.7	
ES-96										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-0.5	0-0.5	.01-.06	.03	—	—				
Sand, light brown, pebbly	0.5-2	0.5-2	.01-.06	.03	—	—	0-3	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.07	.04	—	—				
Claystone, green gray, brown, silty	2-7.5	4-7.5	.01-.06	.03	—	—	3-6	1.4-1.7	1.5	
Siltstone, green gray, sandy	7.5-8.5	7.5-8.5	.01-.05	.02	—	—				
Sandstone, buff brown, silty	8.5-9	8.5-9	.01-.06	.03	—	—	6-9	1.7-1.9	1.8	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-97										
Quaternary alluvium and colluvium		0-0.5	.01-.05	.02	—	—				
Silt, light brown, sandy	0-0.5	0.5-2	.01-.06	.03	—	—	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.09	.04	—	—				
Claystone, green gray, silty	0.5-5	4-5	.02-.07	.03	—	—	2-5	1.5-1.8	1.7	
ES-98										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-0.5						0-3	1.2-1.6	1.3	
Wasatch fm., Cathedral Bluffs										
tongue							3-6	1.5-1.9	1.7	
Claystone, green gray, brown, silty	0.5-7						4-7	1.5-1.8	1.6	
ES-99										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-0.5									
Sand, light brown, pebbly	0.5-1.5						0-3	1.2-1.6	1.3	
Wasatch fm., Cathedral Bluffs										
tongue										
Claystone, green gray, light brown, silty	1.5-7						3-6	1.3-1.9	1.7	
Siltstone, buff brown gray, sandy	7-8.5						5.5-8.5	1.3-1.9	1.7	
ES-100										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-0.5	0-0.5	.00-.08	.03	—	—	0-3	1.2-1.6	1.4	
Sand, light brown, pebbly	0.5-1.5	0.5-1.5	.01-.06	.03	—	—	3-6	1.4-1.7	1.6	
Wasatch fm., Cathedral Bluffs										
tongue		1.5-4	.01-.08	.04	0.008	0.010	6-9	8.-9.5	9.	Anomalous radioactivity
Claystone, green gray, silty	1.5-7	4-7	.01-.08	.03	—	—	9-12	1.3-1.7	1.4	
Siltstone, green gray brown, sandy	7-14.5	7-9	.01-.08	.04	—	—	12-15	1.1-1.5	1.3	
Claystone, buff, gray, sandy	14.5-16.5	9-14	.01-.06	.03	—	—	15-18	1.2-1.6	1.4	Perched water table at 16.5 feet.
Sandstone, buff brown, gray, silty	16.5-19						16-19	1.2-1.6	1.4	Dry material at 18-19 feet.
ES-101										
Quaternary alluvium and colluvium										
Silt, brown	0-0.5	0-3.5	.01-.06	.02	—	—				
Sand, light brown, pebbly	0.5-4	3.5-4	.01-.05	.02	—	—	0-3	1.0-1.4	1.1	
Wasatch fm., Cathedral Bluffs										
tongue										
Sandstone, buff brown, silty	4-6.5	4-7.5	.01-.05	.02	—	—	3-6	1.1-1.6	1.3	
Siltstone, buff gray, sandy	6.5-7.5	7.5-9	.00-.04	.02	—	—	6-9	1.1-1.4	1.2	
Sandstone, buff gray	7.5-14						9-12	.9-1.4	1.1	Water table at 9.2 feet.

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-102										
Quaternary alluvium and colluvium										
Silt, brown	0-0.5	0-0.5	.01-.07	.03	—	—				
Sand, light brown, pebbly	0.5-3.5	0.5-3.5	.01-.06	.03	—	—	0-3	1.0-1.4	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, brown buff, argillaceous	3.5-4	3.5-4	.01-.07	.03	—	—				
Sandstone, buff, silty	4-5.5	4-5.5	.01-.08	.04	—	—	3-6	1.3-1.6	1.4	
Siltstone, red-brown	5.5-7	5.5-7	.01-.08	.04	—	—				
Sandstone, buff gray white	7-14	7-9.5	.01-.06	.03	—	—	6-9	1.3-1.6	1.4	Water table at 9.5 feet.
ES-103										
Quaternary alluvium and colluvium										
Silt, brown	0-1									
Sand, light brown, pebbly	1-1.5	0-1.5	.00-.06	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue							0-3	.9-1.2	1.1	
Sandstone, buff brown, silty	1.5-3.5	1.5-3.5	.01-.07	.03	—	—				
Siltstone, light brown, sandy	3.5-4.5						3-6	1.3-1.8	1.5	
Sandstone, gray buff, silty	4.5-7.5	3.5-7.5	.01-.06	.02	—	—				Water table at 7.5 feet.
Sandstone, buff white	7.5-9						6-9	1.1-1.5	1.3	
ES-104										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1	0-0.5	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		0.5-1	.01-.05	.02	—	—	0-3	.9-1.2	1.1	
Sandstone, brown buff white, pebbly	1-4	1-4	.01-.06	.04	—	—				
Sandstone, light brown, silty	4-4.5	4-4.5	.01-.09	.05	—	—	3-6	1.2-1.6	1.3	
Sandstone, buff gray white	4.5-9	4.5-7	.01-.05	.02	—	—	6-9	1.0-1.2	1.1	Water table at 7 feet.
ES-105										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1	0-1	.01-.05	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue							0-3	.9-1.2	1.1	
Sandstone, buff white, pebbly	1-4	1-4	.01-.08	.04	—	—	3-6	1.3-1.7	1.4	
Siltstone, light brown, argillaceous	4-5	4-5	.02-.07	.05	0.007	0.003	6-9	1.5-1.8	1.6	
Sandstone, green gray, brown white, silty	5-9	5-9	.01-.07	.03	—	—				
		9-11	.01-.07	.04	—	—	9-12	1.4-1.8	1.6	
		11-14	.01-.07	.03	—	—				
Siltstone, variegated, sandy	9-17.5	14-17.5	.01-.07	.04	—	—	12-15	1.4-1.7	1.6	Water table at 17.5 feet.
Sandstone, buff, silty	17.5-19	17.5-19	.01-.06	.03	—	—	13-16	1.6-1.9	1.7	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-106										
Quaternary alluvium and colluvium										
Sand and silt, light brown	0-1	0-1	.01-.05	.03	—	—				
Sand, light brown, pebbly	1-3.5	1-3.5	.01-.07	.03	—	—	0-3	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
		3.5-4	.01-.09	.05	0.014	0.023				
		4-5	.01-.08	.04	.005	.005				Contains schroeckingerite at 3.5 to 6 feet.
Siltstone, gray green, light brown, sandy	3.5-9	5-6	.02-.08	.04	.008	.004	3-6	1.3-1.6	1.4	
		6.-6.5	.02-.06	.03	.005	.002				
		6.5-8.5	.02-.07	.03	—	—	6-9	1.1-1.5	1.2	
Sandstone, brown buff gray, silty	9-15.5	8.5-14	.01-.06	.02	—	—	9-12	1.0-1.3	1.1	
		14-15.5	—	—	.004	.000	12-15	1.2-1.5	1.3	Water table at 15.5 feet.
Siltstone, brown white, white, sandy	15.5-19									
ES-107										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1.5	0-1.5	.01-.05	.02	—	—				
Sand, light brown, pebbly	1.5-2.5	1.5-2.5	.01-.05	.02	—	—	0-3	.9-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown white, pebbly	2.5-4.5	2.5-4.5	.00-.05	.02	—	—	3-6	1.0-1.3	1.1	
Sandstone, light brown, buff gray, white	4.5-10	4.5-10	.01-.06	.02	—	—	6-9	.8-1.0	.9	
Siltstone, buff, argillaceous	10-12									
Claystone, green gray, rusty-brown, silty	12-13									
Sandstone, buff white	13-14									Water table at 13 feet.
ES-108										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-2	0-2	.01-.06	.02	—	—				
Sand, light brown, pebbly	2-4.5	2-4.5	.01-.06	.02	—	—	0-3	.9-1.1	1.0	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, red brown, green white, sandy	4.5-6.5	4.5-6.5	.01-.07	.04	—	—	3-6	1.1-1.5	1.2	
Claystone, maroon, buff, gray, silty	6.5-10.5	6.5-10.5	.01-.05	.02	—	—	6-9	1.5-1.8	1.6	
Siltstone, maroon, gray	10.5-12						7-10	1.4-1.9	1.6	Water table at 11.5 feet.
Claystone, gray, sandy	12-13									
Sandstone, gray green, argillaceous	13-14									

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-109										
Quaternary alluvium and colluvium										
Silt and sand, light brown	0-3	0-3	.01-.05	.02			0-3	1.0-1.2	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown white, pebbly	3-6	3-4	.01-.07	.04	0.005	0.004	3-6	1.1-1.4	1.2	Contains schroeckingerite
Siltstone, green gray, light brown, sandy	6-8	4-6.5	.01-.06	.03	.005	.002	6-9	1.4-1.7	1.5	at 3 to 4 feet.
Sandstone, brown white, silty	8-9	6.5-9	.01-.07	.03						Water table at 8.5 feet.
ES-110										
Quaternary alluvium and colluvium										
Sand, light brown, silty; silt at top	0-3	0-3	.01-.06	.02	—	—	0-3	.8-1.1	.9	
Sand, brown white, pebbly	3-5	3-5	.01-.05	.02	—	—	3-6	1.0-1.2	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, buff, gray green, very sandy	5-6	5-6	.01-.05	.02	—	—				
Sandstone, buff, green	6-8	6-9	.00-.05	.02	—	—	6-9	1.1-1.6	1.3	
Alternating thin beds of silty sandstone and sandy siltstone, light brown gray	8-14						9-12	1.2-1.5	1.3	Water table at 12 feet.
ES-111										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-1.5	.01-.05	.03	—	—				
Sand, light brown	1.5-3.5	1.5-3.5	.01-.05	.02	—	—	0-3	.9-1.2	1.0	
Sand, light brown, pebbly	3.5-5	3.5-5	.00-.08	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, light brown, silty	5-6	5-6	.00-.07	.04	.008	.009	3-6	1.1-1.6	1.3	Contains schroeckingerite
Siltstone, brown gray	6-6.5	6-6.5	.01-.10	.04	.011	.019				at 5 to 8.5 feet.
Sandstone, brown green, silty	6.5-8.5	6.5-7.5	.01-.06	.04	.007	.004	6-9	1.4-1.8	1.6	
Alternating thin beds siltstone and sandstone, brown, green,		7.5-8.5	.01-.05	.03	—	—	9-12	1.1-1.4	1.2	
gray	8.5-15	8.5-9.5	.01-.09	.03	—	—	12-15	1.4-1.7	1.5	
Claystone, rusty brown, silty	15-16	9.5-15	.01-.06	.02	—	—				Water table at 16 feet.
Siltstone, gray green brown, sandy	16-19									
ES-112										
Quaternary alluvium and colluvium										
Silt and sand, light brown	0-2.5	0-2.5	.00-.06	.02	—	—	0-3	.8-1.2	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, gray brown white, pebbly	2.5-5.5	2.5-5.5	.01-.06	.03	—	—	3-6	1.1-1.5	1.3	
Claystone, gray green, silty	5.5-6	5.5-6	.01-.05	.02	—	—				
Siltstone, gray green, light brown, sandy	6-7.5	6-7.5	.01-.05	.02	—	—	6-9	1.4-1.7	1.6	
Siltstone, gray green, light brown, argillaceous	7.5-9	7.5-9	.00-.05	.02	—	—				Water table at 8 feet.

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-113										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-2.5	0-2.5	.01-.05	.02	—	—	0-3	.8-1.2	1.0	
Sand, gray buff, pebbly	2.5-3.5	2.5-3.5	.00-.05	.02	—	—	3-6	1.1-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue							6-9	1.0-1.3	1.1	
Sandstone, gray, buff, white	3.5-18	3.5-18	.01-.05	.02	—	—	9-12	1.0-1.4	1.2	Water table at 15 feet.
Sandstone, gray white, silty	18-19						12-15	.7-1.2	1.0	
ES-114										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-1.5	.01-.06	.02	—	—				
Sand, buff brown, pebbly	1.5-2.5	1.5-2.5	.01-.05	.02	—	—	0-3	1.1-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff, gray, white	2.5-6.5	2.5-6.5	.01-.06	.03	—	—	3-6	1.1-1.4	1.3	
Siltstone, gray brown	6.5-8	6.5-8	.01-.07	.03	—	—	6-9	1.2-1.5	1.3	
Sandstone, gray, silty	8-11.5	8-11.5	.01-.07	.03	—	—	9-12	1.1-1.4	1.2	
Siltstone, gray brown	11.5-13.5	11.5-13.5	.01-.05	.02	—	—	10.5-13.5	1.0-1.3	1.1	
ES-115										
Quaternary alluvium and colluvium										
Silt and clay, brown	0-1	0-1	.00-.05	.02	—	—				
Sand, light brown, pebbly	1-3	1-3	.01-.06	.03	—	—	0-3	.9-1.3	1.0	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, brown gray, argillaceous	3-5.5	3-5.5	.00-.06	.03	—	—	3-6	1.1-1.5	1.3	
Siltstone, brown green	5.5-6.5	5.5-6.5	.01-.07	.04	0.007	0.008				Contains schroeckingerite
Siltstone, green gray	6.5-7.5	6.5-7.5	.01-.07	.04	.007	.006	6-9	1.4-1.7	1.5	at 5.5 to 7.5 feet.
Siltstone, brown green	7.5-8.5	7.5-8.5	.01-.06	.03	.004	.000				
Sandstone, light brown gray, silty	8.5-10.5	8.5-10.5	.01-.06	.03	.004	.000	9-12	1.3-1.6	1.4	
Sandstone, brown buff gray	10.5-13.5	10.5-13.5	.01-.07	.03			10-13	1.1-1.4	1.2	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	REMARKS
ES-116										
Quaternary alluvium and colluvium										
Silt and clay, brown	0-1.5	0-1.5	.00-.07	.03	—	—				
Sand, light brown	1.5-3	1.5-3	.01-.08	.03	—	—	0-3	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, green gray, sandy	3-4	3-6	.00-.07	.03	—	—	3-6	1.1-1.5	1.3	
Sandstone, brown green, silty	4-5	6-7.5	.01-.07	.04	0.005	0.004				Contains schroeckingerite at 6 to 8.5 feet.
Sandstone, gray buff green, minor silt	5-9	7.5-8.5	.00-.06	.03	.004	.000	6-9	1.2-1.6	1.4	
		8.5-9	.01-.07	.04	.006	.003				
Siltstone, buff, brown gray, argillaceous	9-10	9-10	.01-.06	.03	—	—	9-12	1.5-1.8	1.7	
Claystone, gray brown, silty	10-11	10-11	.01-.07	.03	—	—				
Siltstone, gray green, argillaceous	11-14.5	11-14.5	.01-.09	.03	.004	.000	12-15	1.8-2.0	1.9	
Siltstone, gray brown	14.5-16.5	14.5-16.5	.01-.07	.03	—	—				
Siltstone, green gray, argillaceous	16.5-18.5	16.5-18.5	.01-.05	.02	—	—	15-18	1.3-1.5	1.4	Water table at 18.5 feet.
S-117										
Quaternary alluvium and colluvium										
Sand and silt, brown, light brown	0-1	0-1	.01-.05	.02	—	—	0-3	1.1-1.3	1.2	
Sand, light brown, pebbly	1-2	1-2	.00-.06	.03	—	—	3-6	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-10.5	.01-.07	.03	—	—	6-9	.9-1.3	1.1	
Sandstone, buff gray white	2-10.5	10.5-12.5	.01-.08	.04	.004	.000	9-12	1.2-1.5	1.3	
Siltstone, gray green brown, argillaceous	10.5-19	12.5-19	.01-.07	.03	—	—	12-15 13-16	1.4-1.7 1.2-1.6	1.5 1.4	
ES-118										
Quaternary alluvium and colluvium										
Silt and sand, brown, light brown	0-1.5	0-1.5	.00-.06	.03	—	—	0-3	.9-1.2	1.0	
Sand, light brown, pebbly	1.5-3	1.5-4	.00-.05	.02	—	—	3-6	1.1-1.5	1.2	
Wasatch fm., Cathedral Bluffs tongue							6-9	1.0-1.3	1.2	
Sandstone, brown green, gray white	3-13.5	4-13.5	.01-.07	.03	—	—	9-12 10.5-13.5	1.1-1.4 .9-1.1	1.2 1.0	Water table at 13 feet.
ES-119										
Quaternary alluvium and colluvium										
Silt, brown, light brown, sandy	0-3	0-3	.01-.06	.02	—	—	0-3	1.0-1.3	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, brown gray white, sandy	3-5	3-5	.01-.07	.03	—	—	3-6	1.2-1.4	1.3	
Sandstone, light brown, minor pebbles	5-14	5-14	.01-.07	.03	—	—	6-13	1.0-1.4	1.2	

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DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-120										
Quaternary alluvium and colluvium										
Silt, brown, light brown, sandy	0-1	0-1	.01-.06	.02	—	—				
Wasatch fm., Cathedral Bluffs tongue										
Claystone, gray brown, silty	1-2	1-2	.01-.08	.03	—	—	0-3	1.2-1.6	1.4	
Claystone, dark to light gray	2-8.5	2-8.5	.01-.07	.03	—	—	3-6	7.-8.	7.5	Anomalous radioactivity.
Claystone, gray green, silty	8.5-10	8.5-10	.01-.06	.03	—	—	6-9	1.6-1.9	1.7	
Siltstone, green gray brown, sandy	10-12	10-12	.01-.07	.03	—	—	9-12	1.5-1.9	1.7	
Claystone, gray green, silty	12-13.5	12-13.5	.01-.07	.03	—	—				
ES-121										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-3	0-3	.00-.05	.02	—	—	0-3	1.0-1.2	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, buff brown, silty, pebbly	3-5	3-5	.00-.05	.02	—	—	3-6	1.2-1.4	1.3	
Siltstone, gray buff, silty	5-7.5	5-7.5	.00-.06	.03	0.004	0.000	6-9	1.2-1.5	1.3	
Siltstone, green buff, sandy, argillaceous	7.5-10	7.5-10	.00-.08	.04						
Sandstone, gray green, clay-stone lenses	10-12	10-11	.00-.06	.03	—	—				
		11-12	.00-.05	.02	—	—	9-12	1.1-1.5	1.3	
Claystone, green brown, silty	12-14	12-14	.01-.07	.03	—	—	12-15	1.4-1.8	1.6	
Siltstone, gray green brown, argillaceous	14-19	14-15	.00-.08	.04	—	—				
		15-19	.00-.07	.03	—	—	13-16	1.6-1.9	1.7	
ES-122										
Quaternary alluvium and colluvium										
Silt and sand, brown, light brown	0-3	0-3	.00-.05	.02	—	—	0-3	.9-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue							3-6	1.2-1.5	1.3	
Siltstone, light gray brown, very sandy	3-7	3-7	.01-.06	.03	—	—	6-9	1.1-1.6	1.3	
Sandstone, brown buff gray	7-10.5	7-10.5	.01-.07	.03	—	—	9-12	1.0-1.3	1.1	
Sandstone, brown gray, pebbly	10.5-13.5	10.5-13.5	.01-.05	.02	—	—	12-15	1.0-1.4	1.1	
Sandstone, buff brown	13.5-18.5	13.5-18.5	.01-.05	.02	—	—	15-18	1.0-1.4	1.2	
ES-123										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.05	.02	—	—	0-3	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Siltstone, green gray, argil-laceous	2-7	2-7	.00-.06	.03	—	—	3-6	1.2-1.6	1.4	
Claystone, gray green, brown, silty	7-11.5	7-10	.00-.06	.02	—	—	6-9	1.4-1.8	1.5	
		10-11.5	.01-.06	.03	—	—				
Sandstone, green brown, silty	11.5-14	11.5-14	.00-.05	.02	—	—	9-12	7.-9.	7.5	Anomalous radioactivity

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-124										
Quaternary alluvium and colluvium										
Silt, brown, very sandy	0-1	0-1	.01-.06	.03	—	—				
Sand, light brown, pebbly	1-1.5	1-1.5	.01-.06	.03	—	—				
Wasatch fm., Cathedral Bluffs tongue		1.5-2	.01-.07	.03	—	—				
Siltstone, brown green	1.5-3	2-3	.01-.08	.04	0.008	0.010	0-3	1.2-1.4	1.3	Contains schroeckingerite
		3-3.5	.01-.06	.03	.007	.008				
Siltstone, light brown, sandy	3-4	3.5-4	.01-.06	.03	.004	.000	3-6	1.4-1.8	1.5	at 2 to 3.5 feet.
Sandstone, light brown, gray, pebbly	4-9	4-9	.01-.08	.04	—	—	6-12	1.3-1.6	1.4	
Sandstone, buff white	9-13.5	9-17	.01-.06	.03	—	—	12-18	7.5-9.0	8.5	Anomalous radioactivity
Claystone, gray, buff, brown, very silty	13.5-25	20-23.5	.00-.06	.02	—	—	18-21	1.5-1.8	1.6	Water table at 25 feet.
Sandstone, gray white	25-29						21-24	1.7-2.0	1.8	
ES-125										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-2	0-2	.00-.08	.03	—	—	0-3	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs tongue							3-6	.9-1.3	1.1	
Sandstone, brown white	2-6	2-9	.00-.07	.03	—	—	6-9	.9-1.2	1.1	
Sandstone buff white, pebbly	6-14	9-14	.00-.08	.03	—	—	9-12	.9-1.2	1.1	
ES-126										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1	0-1	.00-.07	.03	—	—				
Sand, light brown, silty, pebbly	1-2.5	1-2.5	.01-.07	.04	—	—	0-3	.8-1.1	1.0	
Wasatch fm., Cathedral Bluffs tongue							3-6	.9-1.3	1.1	
Sandstone, buff gray white, pebbly	2.5-16	2.5-16	.01-.08	.03	—	—	6-9	1.0-1.4	1.2	
Sandstone, light brown	16-17.5	16-17.5	.01-.06	.03	—	—	9-12	1.2-1.5	1.3	
Claystone, gray green, very silty	17.5-20	17.5-21.5	.01-.07	.03	—	—	12-15	1.0-1.4	1.2	
Sandstone, light brown, pebbly	20-21.5						15-18	1.5-1.8	1.6	
Not recovered	21.5-24						18-21	8.5-10.5	9.5	Anomalous radioactivity.

Appendix C (page 40)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
ES-127										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-2.5	0-2.5	.00-.07	.02	—	—	0-3	.8-1.2	1.0	
Wasatch fm., Cathedral Bluffs tongue							3-6	1.1-1.5	1.2	
Siltstone, green gray brown, argillaceous	2.5-5.5	2.5-5.5	.01-.08	.04	—	—	6-9	1.2-1.6	1.4	
Claystone, green, gray, brown, silty	5.5-14	5.5-9	.00-.05	.03	—	—				
		9-14	.01-.07	.04	—	—	9-12	1.2-1.6	1.4	
ES-128										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1.5	0-1.5	.01-.08	.04	—	—				
Sand, light brown, pebbly	1.5-2.5	1.5-2.5	.01-.07	.04	—	—	0-3	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, green brown	2.5-3.5	2.5-3.5	.01-.08	.04	—	—	3-6	1.4-1.8	1.6	
Siltstone, red-brown, argillaceous	3.5-4.5	3.5-4.5	.00-.06	.03	—	—	6-9	6.5-8.0	7.5	Anomalous radioactivity.
Claystone, green brown, silty	4.5-12	4.5-7	.01-.06	.03	—	—				
		7-12	.02-.11	.06	0.003	0.000	9-12	7.5-9.0	8.0	
Sandstone, green brown	12-14	12-13	.01-.10	.05	—	—				
		13-14	.00-.06	.03	—	—	12-15	1.2-1.6	1.4	
Sandstone, gray, silty	14-18	14-15	.01-.06	.03	—	—				
Claystone, gray	18-18.5	15-18.5	.01-.08	.04	—	—				
ES-129										
Quaternary alluvium and colluvium										
Silt, brown, sandy, clayey	0-1.5	0-1.5	.01-.09	.03	—	—	0-3	1.3-1.7	1.4	
Wasatch fm., Cathedral Bluffs tongue		1.5-5	.01-.07	.03	—	—				
Siltstone, light brown, sandy, argillaceous	1.5-6	5-6	.01-.08	.04	—	—	3-6	1.6-1.9	1.7	
Sandstone, brown white, silty, pebbly	6-7	6-7	.02-.10	.04	—	—				
Siltstone, gray brown, sandy	7-9	7-8	.01-.08	.03	—	—	6-9	6.5-9.0	7.0	
Sandstone, light brown, silty	9-11	8-10	.01-.08	.04	—	—				
Claystone, green gray, maroon	11-19	10-11	.01-.06	.03	—	—	9-12	7.5-9.0	8.0	Anomalous radioactivity
		11-19	.01-.09	.04	—	—				

Appendix D. DRILL LOGS OF BUCKET HOLES B-1 THROUGH B-70, LOST CREEK AREA.

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-1										
Quaternary Alluvium and Colluvium										
Sand and silt, light brown	0-1.5	0-2	.00-.07	.03	0.006	0.006				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.10	.05	.005	.004				Contains schroeckingerite
Sandstone, brown buff, silty	1.5-5	4-6	.01-.09	.04	.003	.002	0-3	1.5-2.0	1.8	at 2 to 4 feet
Sandstone, buff	5-7	6-8	.01-.08	.04	.003	.001	3-6	1.3-1.9	1.7	
Siltstone, brown green, sandy	7-9	8-10	.00-.07	.03	.004	.000	6-9	1.3-1.8	1.5	
Sandstone, buff, gray white,										
silty	9-10.5	10-12	.01-.09	.04	.004	.000	9-12	1.2-1.8	1.6	
Siltstone, green buff, sandy	10.5-14	12-14	.01-.06	.03	.003	.000				
Sandstone, buff white	14-16	14-16	.00-.08	.04	.004	.000	12-15	1.2-1.6	1.4	Water table at 15 feet
B-2										
Quaternary Alluvium and Colluvium										
Silt and sand, brown to light										
brown	1-1.5	0-2	.00-.06	.03	.003	.000				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.07	.03	.003	.000	0-3	1.0-1.6	1.3	
Sandstone, brown white, gray										
green, silty	1.5-6	4-6	.00-.09	.04	.015	.018	3-6	3.5-4.2	3.9	Anomalous U assay at 4 to 6 feet;
Siltstone, light brown, green,										
sandy	6-9.5	6-8	.00-.08	.04	.005	.004	6-9	3.0-4.0	3.5	Contains schroeckingerite
		8-10	.01-.09	.04	.005	.003				at 7 to 9 feet
Sandstone, gray green, light										
brown, thin		10-12	.01-.09	.04	.004	.002	9-12	1.5-2.0	1.9	
beds of sandy siltstone and										
claystone	9.5-18	12-14	.01-.07	.03	.003	.001				
		14-16	.01-.10	.04	.005	.001	12-15	2.5-3.0	2.8	
		16-18	.01-.07	.04	.004	.001	13-17	1.8-2.2	2.0	Water table at 17.5 feet
B-3										
Quaternary Alluvium and Colluvium										
Silt, light brown	0-1									
Sand, light brown	1-2.5	0-2	.00-.07	.03	.003	.000				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.09	.04	.003	.000	0-3	.9-1.6	1.3	
Sandstone, white, pebbly	2.5-6.5	4-6	.01-.08	.04	.004	.000	3-6	.9-1.6	1.3	Contains schroeckingerite
Siltstone, light brown, sandy	6.5-8	6-8	.01-.10	.05	.006	.007	6-9	1.3-1.6	1.4	at 6 to 8 feet, high assay to
Sandstone, gray white	8-11	8-10	.01-.08	.04	.006	.006	9-12	1.1-1.4	1.2	10 feet
Siltstone, variegated, sandy	11-12.5	10-12	.01-.09	.05	.002	.002	10-13	1.1-1.4	1.2	Water table at 12.5 feet
Sandstone, gray white	12.5-14	12-14	.01-.09	.04	.002	.002				

Appendix D (p. 2)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-4										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	.01-.08	.03	.003	.000				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.09	.04	.008	.008	0-3	2.0-3.0	2.5	Anomalous U assay from
Claystone, brown, gray green,										
silty, sandy	1-5	4-6	.01-.09	.04	.007	.009	3-6	3.0-3.5	3.2	2 to 10 feet. No schroeckingerite
Siltstone, brown green white,										
very sandy	5-8.5	6-8	.01-.06	.04	.004	.003	6-9	2.2-3.0	2.5	recognized.
Sandstone, gray white, silty	8.5-9.5	8-10	.01-.08	.04	.005	.007				
Siltstone, maroon and light										
green	9.5-10.5	10-12	.01-.08	.04	.002	.003	9-12	1.4-2.0	1.6	
Sandstone, light brown, white,										
silty	10.5-13.5	12-14	.01-.07	.03	.003	.000				
Siltstone, brown, green white,										
sandy	13.5-15.5	14-16	.01-.07	.03	.002	.000	12-15	.7-1.1	.9	
Sandstone, white	15.5-16									Water table at 15.5 feet
B-5										
Quaternary alluvium and colluvium										
Silt and clay, brown, sand at										
top	0-1.5	0-2	.00-.06	.03	0.006	0.007				
Wasatch fm., Cathedral Bluffs										
tongue										
Claystone, green gray, sandy	1.5-2.5	2-4	.03-.12	.07	.009	.012	0-3	2.5-3.0	2.8	Contains schroeckingerite
Siltstone, brown green gray,										
sandy	2.5-4.5	4-6	.01-.07	.04	.005	.008	3-6	2.8-3.5	3.0	from 2 to 6 feet, trace
Sandstone, green gray brown	4.5-7.5	6-8	.01-.07	.04	.004	.000	6-9	2.2-3.2	2.8	at 10.5 to 11 feet
Siltstone, brown green, sandy	7.5-11	8-10	.01-.09	.04	.005	.002	9-12	1.5-1.8	1.6	
Sandstone, green gray, silty,										
pebbly	11-13.5	10-12	.01-.10	.04	.003	.002	10-13	1.3-1.6	1.4	
Siltstone, light green gray,										
sandy	13.5-14	12-14	.00-.07	.03	.003	.000				Water table at 14 feet
B-6										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.07	.03	.003	.000				
Wasatch fm., Cathedral Bluffs										
tongue										
Sandstone, brown gray green,										
silty	1.5-3.5	2-4	.01-.09	.04	.004	.002	0-3	1.6-2.0	1.8	
Siltstone, variegated,										
argillaceous	3.5-4.5	4-6	.01-.09	.05	.005	.003	3-6	3.2-3.8	3.5	
Sandstone, white, pebbly	4.5-9	6-8	.00-.08	.04	.002	.002	6-9	1.4-1.8	1.6	
Claystone, brown green, silty	9-10	8-10	.01-.11	.04	.003	.003	9-12	3.0-4.0	3.5	
Siltstone, brown green, sandy										
at top		10-12	.01-.08	.04	.004	.000				
argillaceous	10-17	12-14	.01-.09	.04	.005	.003	12-15	2.8-3.2	3.0	
Sandstone, brown green gray,										
silty		14-16	.01-.08	.04	.004	.000	14-17	1.7-2.0	1.9	
	17-18	16-18	.00-.06	.03	.003	.000				Water table at 17.5 feet

Appendix D. (p. 3)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
B-7										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-1	0-2	.00-.08	.04	.005	.004				
Wasatch fm., Cathedral Bluffs tongue										
Siltstone and sandstone interbedded		2-4	.00-.11	.06	.006	.006	0-3	2.9-3.1	3.0	Contains schroeckingerite
brown, green, buff	1-4.5	4-6	.00-.06	.03	.003	.000	3-6	1.6-1.9	1.8	from 2 to 4 feet. Anomalous
Sandstone, white, pebbly	4.5-10	6-8	.00-.06	.04	.005	.002	6-9	4.5-5.5	5.0	U assay at 8 to 10 feet.
Siltstone, brown green	10.-10.5	8-10	.00-.11	.06	.008	.008				
Claystone, green, brown, maroon, platy	10.5-12.5	10-12	.00-.07	.04	.003	.000	9-12	3.2-3.9	3.5	
		12-14	.01-.10	.04	.004	.000	12-15	1.6-1.9	1.7	
Sandstone, brown buff, white	12.5-18	14-16	.00-.08	.04	.003	.002	14-17	1.1-1.4	1.2	Water table at 17.5 feet.
		16-18	.00-.06	.03	.003	.000				
B-8										
Quaternary alluvium and colluvium										
Sand, light brown, silty, pebbly	0-2	0-2	.01-.07	.04	.003	.000				
Wasatch fm., Cathedral Bluffs tongue		2-4	.00-.10	.06	.006	.011				Contains schroeckingerite
Claystone, green brown, platy	2-4.5	4-6	.00-.10	.06	.008	.006	0-3	1.3-1.7	1.4	from 2 to 8 feet.
		6-8	.00-.08	.05	.003	.002	3-6	3.2-3.8	3.5	
Sandstone, white	4.5-10	8-10	.00-.08	.04	.001	.002	6-9	1.3-1.6	1.4	
Siltstone, gray green brown, sandy	10-12	10-12	.00-.08	.04	.002	.000	9-12	1.2-1.5	1.3	
Sandstone, white, buff	12-16.5	12-14	.00-.07	.03	.002	.000	12-15	.9-1.2	1.0	
Claystone, green, maroon, brown	16.5-17.5	14-16	.00-.07	.03	.002	.000	14-17	1.4-1.7	1.5	
Sandstone, buff white	17.5-18	16-18	.01-.09	.04	.003	.000				Water table at 16 feet.
B-9										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-2	.00-.06	.03	0.003	0.000				
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown green, buff,		2-4	.00-.07	.03	.003	.000	0-3	1.4-1.8	1.6	
some pebbles, silty	1.5-7.5	4-6	.00-.08	.04	.003	.000	3-6	1.2-1.5	1.3	
Siltstone, brown green gray, sandy	7.5-10.5	6-8	.00-.08	.05	.003	.002	6-9	1.1-1.6	1.3	
Sandstone, brown white, silty	10.5-12	8-10	.00-.09	.05	.003	.003	9-12	1.3-1.7	1.4	
Sandstone, brown white	12-13.5	10-12	.00-.09	.05	.002	.000	10-13	.9-1.3	1.1	
Siltstone, brown, green, argillaceous	13.5-14	12-14	.00-.07	.04	.003	.000				Water table at 14 feet.

Appendix D. (p. 4)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
B-10										
Quaternary alluvium and colluvium										
Sand, light brown, silty	0-1									
Sand, light brown, pebbly	1-2.5	0-2	.00-.07	.03	.002	.000	0-3	1.0-1.4	1.2	
Wasatch fm., Cathedral Bluffs tongue										
Claystone, maroon, green brown	2.5-3.5	2-4	.00-.07	.04	.003	.000	3-6	1.6-2.0	1.8	
Sandstone, buff white, silty	3.5-4.5	4-6	.01-.09	.05	.004	.003				
Claystone, gray green, variegated, silty	4.5-9.5	6-8	.00-.09	.05	.007	.007	6-9	3.2-3.8	3.5	Anomalous U assays from
Siltstone, yellow buff, sandy	9.5-10.5	8-10	.00-.06	.03	.004	.005				6 to 14 feet. No visible
Green River fm., Tipton tongue		10-12	.01-.11	.06	.011	.018	9-12	3.0-3.7	3.3	schroeckingerite
		12-14	.00-.07	.04	.005	.010				
		14-16	.00-.07	.03	.003	.000	12-15	1.2-1.5	1.3	
		16-18	.00-.07	.03	.002	.000	15-18	1.0-1.3	1.2	
Claystone, brown, platy	10.5-26	18-20	.00-.07	.03	.002	.000	18-21	1.2-1.6	1.4	
		20-22	.00-.07	.03	.002	.000				
		22-24	.00-.08	.04	.002	.000	21-24	.8-1.1	.9	
		24-26	.00-.06	.04	.002	.000	22-25	.8-1.1	.9	Water table at 26 feet.
B-11										
Quaternary alluvium and colluvium										
Sand, light brown, silty, pebbly	0-2.5	0-2	.00-.07	.04	.001	---	0-3	.8-1.2	1.0	
		2-4	.00-.05	.03	.004	---				
Green River fm., Tipton tongue		4-6	.00-.08	.06	.004	.004	3-6	1.2-1.6	1.4	
		6-8	.00-.07	.04	.004	---				
		8-10	.00-.06	.03	.003	---	6-9	1.3-1.6	1.4	
		10-12	.00-.06	.03	.003	---	9-12	1.0-1.4	1.3	
Claystone, brown, green brown,		12-14	.00-.06	.03	.002	---	12-15	.9-1.4	1.1	
buff; silty										
		14-16	.00-.06	.03	.001	---				
and sandy in places; platy	2.5-20.5	16-18	.00-.06	.03	.002	---	15-18	1.0-1.4	1.3	
		18-20	.00-.06	.03	.002	---				
Sandstone, buff gray, silty	20.5-22	20-22	.00-.06	.03	.002	---	18-21	1.0-1.4	1.2	
		22-24	.00-.07	.04	.002	---	21-24	.9-1.2	1.0	
		24-26	.00-.06	.03	.003	---	24-27	1.3-1.6	1.4	
		26-28	.00-.06	.03	.003	---				
		28-30	.00-.09	.04	.002	---	27-30	1.3-1.7	1.5	
		30-32	.01-.06	.03	.003	---	30-33	1.4-1.8	1.5	
Claystone, brown, platy	22-41	32-34	.01-.08	.04	.002	---	33-36	1.1-1.4	1.3	
		34-36	.01-.08	.04	.003	---				
		36-38	.00-.05	.02	.002	---	36-39	.8-1.2	1.0	
		38-40	.00-.09	.04	.002	---				
Claystone, black brown, carbonaceous (?)	41-42	40-42	.00-.07	.03	.002	---	38-41	.7-1.1	.9	Water table at 41 feet

Appendix D. (p. 5)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-12										
Quaternary alluvium and colluvium		0-2	.01-.08	.04	0.002	---				
Sand, light brown, silty	0-3	2-4	00-.07	.03	.002	---	0-3	.9-1.2	1.1	
		4-6	.01-.08	.04	.003	---				
Green River fm., Tipton tongue		6-8	.01-.07	.03	.003	---	3-6	1.2-1.6	1.3	
Claystone, brown, platy;										
		8-10	.02-.07	.03	.003	---	6-9	1.2-1.6	1.3	
interbedded with thin beds		10-12	.01-.07	.03	.002	---	9-12	1.2-1.6	1.4	
		12-14	00-.05	.02	.002	---	12-15	.8-1.3	1.1	
sandstone and siltstone	3-22	14-16	00-.07	.03	.002	---	15-18	.9-1.3	1.1	
		16-18	.01-.06	.03	.002	---				
Claystone, brown, platy	22-37	18-20	.01-.06	.03	.001	---	18-21	.8-1.3	1.0	
Undifferentiated Green River										
		20-22	.01-.07	.03	.002	---	21-24	1.3-1.6	1.4	
fm., Tipton tongue and		22-24	00-.02	.01	.003	---				
		24-26	.01-.03	.01	.002	---	24-27	.9-1.3	1.1	
Wasatch fm., Hiawatha member		26-28	.01-.03	.02	.001	---				
Siltstone, brown green gray,										
		28-30	.01-.03	.02	.002	---	27-30	1.0-1.3	1.2	
sandy,		30-32	.01-.04	.02	.002	---	30-33	1.1-1.5	1.3	
		32-34	.01-.03	.02	.002	---				
argillaceous	37-41.5	34-36	.01-.04	.02	.001	---	33-36	1.0-1.3	1.1	
Siltstone, variegated, very										
		36-38	.01-.03	.02	.003	---				
argillaceous	41.5-43	38-40	.01-.04	.02	.003	---	36-39	1.3-1.5	1.4	
Sandstone, brown green white,										
		40-42	.01-.03	.02	.003	---				
silty	43-45	42-44	00-.02	.01	.003	---	39-42	1.6-2.0	1.8	
		44-46	00-.03	.02	.003	---				
Siltstone, green white, sandy	45-46						42-45	1.1-1.5	1.2	Water table at 46 feet.
B-13										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-2	0-2	00-.02	.01	.004	---	0-3	.9-1.2	1.1	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	00-.02	.01	.003	---				
Sandstone, buff white, pebbly	2-5	4-6	00-.02	.01	.004	---	3-6	1.4-1.7	1.5	
Sandstone, green, brown, buff,										
gray, silty	5-7.5	6-8	00-.02	.01	.003	---	6-9	1.7-2.0	1.8	
Claystone, green, brown red,										
silty	7.5-11	8-10	00-.02	.01	.007	.005				Anomalous U assays from
Green River fm., Tipton tongue		10-12	00-.03	.01	.007	.008	9-12	4.3-4.6	4.5	8 to 14 feet. No visible
Claystone, brown, green brown										
rusty	11-13	12-14	00-.02	.01	.015	.023	12-15	3.2-3.8	3.5	schroeckingerite
		14-16	00-.02	.01	.004	---	15-18	1.0-1.3	1.1	
Claystone, brown, platy	13-20	16-18	00-.02	.01	.002	---	16-19	1.0-1.3	1.1	
		18-20	00-.02	.01	.002	---				
B-14										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-2	00-.02	.01	.002	---	0-3	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	00-.02	.01	.002	---				
Siltstone, light brown, sandy	1.5-3	4-6	00-.02	.01	.003	---	3-6	.9-1.3	1.1	
Sandstone, white, pebbly	3-7	6-8	00-.03	.02	.003	---	6-9	1.1-1.6	1.4	
Siltstone, light brown, sandy	7-11.5	8-10	00-.02	.01	.003	---	8-11	1.1-1.6	1.4	Water table at 11 feet
Sandstone, white, silty	11.5-12	10-12	00-.02	.01	.003	---				

Appendix D. (p. 6)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
B-15										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.03	.02	.004	.002				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.02	.004	.001	0-3	1.1-1.5	1.3	
Sandstone, buff gray, pebbly	1.5-7	4-6	.01-.04	.02	.003	.001	3-6	1.1-1.5	1.3	
		6-8	.02-.04	.03	.003	---				
Siltstone, gray green; thin		8-10	.01-.04	.02	.004	---	6-9	2.5-3.0	2.7	
sandy layers; Argillaceous	7-14	10-12	.01-.03	.02	.003	---	9-12	1.4-1.7	1.6	
		12-14	.01-.03	.02	.004	---	12-15	1.2-1.6	1.4	
Sandstone, tan, gray green,										
silty pebbly sandstone at		14-16	.01-.04	.03	.003	---	14-17	1.0-1.4	1.1	
15.5-16 ft	14-18	16-18	.01-.03	.02	.003	---				Water table at 17 feet
B-16										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1.5	0-2	.01-.03	.02	0.004	0.005	0-3	1.3-1.7	1.5	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.03-.08	.05	.011	.020				Contains schroeckingerite
Siltstone, gray green brown,										
sandy	1.5-5.5	4-6	.01-.04	.03	.003	.002	3-6	1.4-1.7	1.5	from 1 to 5 feet and traces
Sandstone, green white, silty	5.5-11	6-8	.01-.04	.03	.003	.001	6-9	1.6-1.9	1.8	from 8 to 14 feet
		8-10	.01-.03	.02	.003	.001				
		10-12	.01-.04	.02	.007	.006	9-12	4.8-5.2	5.0	
Claystone, green brown, platy	11-15.5	12-14	.01-.04	.03	.004	.004	12-15	2.9-3.2	3.0	
Sandstone, white	15.5-16	14-16	.01-.04	.03	.003	---				Water table at 15.5 feet
B-17										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	.02-.08	.05	.023	.024	0-3	5.3-5.6	5.5	Contains schroeckingerite
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.04-.09	.06	.012	.012				from 1 to 6.5 feet and traces
Sandstone, gray buff white,										
silty, pebbly	1-8	4-6	.01-.04	.03	.004	.002	3-6	3.0-3.3	3.1	from 6.5 to 11.5 feet.
		6-8	.01-.05	.03	.003	.001	6-9	3.1-3.5	3.3	
Siltstone, brown green, thin										
sandy layers	8-12	8-10	.00-.04	.02	.004	.001	9-12	4.4-5.4	4.8	
		10-12	.01-.05	.03	.006	.002	10-13	3.8-4.2	3.9	
Sandstone, gray white	12-14	12-14	.01-.04	.02	.004	---				Water table at 14 feet
B-18										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-2	0-2	.01-.03	.02	.005	.006	0-3	1.4-1.7	1.5	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.02-.06	.04	.010	.010				Contains schroeckingerite
Sandstone, buff white, pebbly	2-3.5	4-6	.01-.04	.03	.006	.006	3-6	3.0-3.5	3.1	from 2.5 to 6 feet
Siltstone, gray green, sandy	3.5-8	6-8	.01-.03	.02	.004	.002	6-9	1.5-1.9	1.7	
		8-10	.01-.03	.02	.004	.001				
Sandstone, gray green brown,										
silty	8-14	10-12	.01-.03	.02	.004	---	9-12	1.4-1.8	1.6	
		12-14	.01-.03	.02	.003	---	10-13	1.4-1.9	1.6	Water table at 13.5 feet

Appendix D. (p. 7)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-19										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	00-.03	.02	.004	---				
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.02	.004	.003	0-3	1.2-1.7	1.4	
Sandstone, gray white, silty,										
pebbly	1-5	4-6	.01-.04	.02	.006	.007	3-6	1.6-2.0	1.7	Contains schroeckingerite
		6-8	.01-.04	.03	.007	.004	6-9	3.7-4.2	4.0	from 4 to 6.5 feet
		8-10	.01-.03	.02	.005	.003				
Siltstone, brown, gray green,										
sandy; thin argillaceous		10-12	.01-.03	.02	.004	.003	9-12	3.7-4.2	4.0	
and pebbly seams	5-19	12-14	00-.04	.02	.005	.003	12-15	3.0-3.5	3.2	
		14-16	00-.03	.02	.003	---				
		16-18	.01-.03	.02	.004	---	15-18	1.4-1.8	1.6	
		18-20	.01-.03	.02	.003	---	17-20	1.0-1.6	1.3	
Sandstone, brown, green gray,										
silty	19-24	20-22	.00-.03	.02	.004	---				
		22-24	.01-.03	.02	.003					
B-20										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	0.005	0.005	0-3	1.2-1.5	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.005	.003				
		4-6	.01-.03	.02	.004	---	3-6	1.4-1.7	1.5	
Sandstone, light gray green,										
pebbly	2-12	6-8	.01-.03	.02	.004	.003	6-9	1.1-1.7	1.4	
		8-10	.00-.02	.01	.003	.001	8-11	.9-1.3	1.0	
		10-12	.01-.03	.02	.003	.001				Water table at 11 feet
B-21										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2.5	0-2	.01-.03	.02	.004	---	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.02	.004	---				
		4-6	.01-.04	.02	.005	.002	3-6	1.5-2.0	1.7	
Sandstone, gray green, silty,										
some pebbles	2.5-7.5	6-8	.01-.04	.03	.004	.003	6-9	1.7-2.0	1.8	
		8-10	.01-.03	.02	.004	---				
Siltstone, gray green, light										
brown, sandy	7.5-14	10-12	.01-.03	.02	.004	---	9-12	2.7-3.5	3.2	
		12-14	.01-.03	.02	.004	---	10-13	2.5-3.2	3.0	ater table (?) at 14 feet

Appendix D. (p. 8)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-22										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	.005	.003	0-3	1.5-1.8	1.6	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.005	.004				
Sandstone, buff gray, silty	2-6.5	4-6	.02-.06	.04	.009	.008	3-6	2.9-3.2	3.0	Contains schroeckingerite
		6-8	.01-.03	.02	.003	.002	6-9	1.3-1.7	1.4	from 4 to 7 feet
Sandstone, yellow gray, pebbly	6.5-10	8-10	.01-.04	.03	.003	.001				
Sandstone, yellow gray	10-12	10-12	.01-.04	.02	.003	.001	9-12	1.4-1.7	1.5	
Sandstone, gray yellow, pebbly	12-14	12-14	.01-.04	.02	.004	---	10-13	1.2-1.6	1.3	Water table at 14 feet
B-23										
Quaternary alluvium and colluvium										
Silt and sand, brown, light brown	0-2.5	0-2	.01-.03	.02	.002	---	0-3	1.0-1.5	1.3	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.003	---				
Sandstone, light brown green, silty	2.5-5.5	4-6	.01-.03	.02	.003	---	3-6	1.0-1.5	1.2	
Sandstone, green white, pebbly	5.5-7.5	6-8	.01-.03	.02	.004	.004	6-9	1.5-1.9	1.7	Contains schroeckingerite
Siltstone, brown green gray	7.5-10.5	8-10	.01-.04	.03	.007	.007				from 6 to 9 feet
Siltstone, brown buff, argillaceous	10.5-12	10-12	.01-.04	.03	.005	.003	9-12	3.5-4.5	4.0	
Siltstone, light brown, buff	12-15	12-14	.01-.03	.02	.004	---	12-15	2.7-3.2	3.0	
		14-16	.01-.03	.02	.004	.002				
Siltstone, brown green buff, sandy	15-20	16-18	.01-.03	.02	.004	---	15-18	2.8-3.8	3.2	
		18-20	.01-.03	.02	.005	.002	16-19	2.5-3.3	3.0	Water table at 20 feet
B-24										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	.004	---	0-3	2.2-2.8	2.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.005	.003				
Siltstone, green brown gray, very sandy	2-8	4-6	.03-.05	.04	.015	.019	3-6	3.4-3.8	3.6	Contains schroeckingerite
		6-8	.05-.09	.06	.012	.017	6-9	2.8-3.2	2.9	from 5 to 8 feet
Sandstone, green gray, pebbly	8-10	8-10	.01-.04	.03	.004	.001				
Sandstone, gray green, silty	10-14	10-12	.01-.04	.02	.005	.002	9-12	1.5-1.9	1.7	
		12-14	.01-.03	.02	.003	---	10-13	2.0-3.0	2.6	Water table (?) at 14 feet

Appendix D. (p. 9)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr		eU%	U%	Depth (feet)	Reading Mr/Hr		REMARKS
			Range	Ave.				Range	Ave.	
B-25										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	0.003	---	0-3	1.3-1.6	1.5	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.005	0.005				
Siltstone, brown green, sandy	2-3.5	4-6	.01-.03	.02	.004	---	3-6	1.2-1.6	1.4	
Sandstone, green white, pebbly	3.5-6.5	6-8	.01-.03	.02	.005	.003	6-9	1.4-1.7	1.6	
Siltstone, brown green, very										
sandy	6.5-9.5	8-10	.01-.03	.02	.005	.003	8-11	1.2-1.5	1.3	
Sandstone, gray white, pebbly	9.5-12	10-12	00-.02	.01	.004	---				Water table at 12 feet
B-26										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.03	.02	.003	---	0-3	.9-1.3	1.1	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.004	---				
Siltstone, dark brown, sandy	1.5-4	4-6	.01-.04	.03	.005	.003	3-6	1.0-1.4	1.2	
		6-8	.01-.03	.02	.004	---				
Sandstone, yellow,tan, silty	4-12	8-10	.01-.04	.02	.004	.001	6-9	1.1-1.6	1.3	
		10-12	.01-.03	.02	.003	<.001	8-11	.9-1.3	1.0	Water table at 12 feet
B-27										
Quaternary alluvium and colluvium										
Silt, light brown, sandy,										
pebbly	0-2	0-2	.01-.03	.02	.004	---	0-3	1.1-1.4	1.3	
Wasatch fm., Cathedral Bluffs										
tongue										
Sandstone, green gray, silty	2-4	2-4	.01-.03	.02	.005	.003	3-6	1.5-1.9	1.8	
Claystone, olive green, silty,										
sandy	4-6	4-6	.01-.04	.03	.006	.005				
Sandstone, green brown, silty	6-8	6-8	.01-.03	.02	.004	.001	6-9	1.4-1.8	1.7	
Siltstone, light green, sandy	8-10	8-10	.01-.03	.02	.004	---				
Sandstone, light green, silty	10-12	10-12	.01-.03	.02	.004	---	9-12	1.4-1.8	1.6	
Siltstone, brown green, sandy	12-14.5	12-14	.01-.04	.02	.003	---	12-15	3.0-3.4	3.2	
Sandstone, gray green, silty,										
pebbly	14.5-17	14-16	.01-.03	.02	.002	---	14-17	1.5-1.8	1.6	
Siltstone, green gray,										
argillaceous	17-18	16-18	.01-.03	.02	.003	---				Water table at 18 feet
B-28										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-2	0-2	.01-.03	.02	.002	---	0-3	4.0-4.5	4.2	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.02-.05	.03	.008	.007				Contains schroeckingerite
Sandstone, brown, tan, yellow -		4-6	.01-.04	.02	.003	.001	3-6	1.5-1.9	1.7	from 2 to 3.5 feet
tan, silty some pebbles	2-8	6-8	.01-.05	.03	.003	.001	6-9	1.3-1.8	1.6	
Siltstone, gray green, sandy	8-11	8-10	.01-.04	.02	.004	.001				
Claystone, green, gray, silty	11-12.5	10-12	.01-.04	.02	.004	.002	9-12	3.0-3.5	3.3	
Sandstone, gray green, silty	12.5-14	12-14	.01-.05	.03	.003	.001	10-13	2.9-3.2	3.0	Water table at 14 feet

Appendix D. (p. 10)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-29										
Quaternary alluvium and colluvium										
Silt, light brown, sandy	0-1.5	0-2	.01-.03	.02	.004	---	0-3	1.3-1.6	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.03-.06	.05	.006	.009				Contains schroeckingerite
Interbedded thin sandy silt-		4-6	.02-.04	.03	.004	.004	3-6	1.5-1.9	1.6	from 2.5 to 5 feet
stones and silty sandstones,		6-8	.01-.03	.02	.003	.001	6-9	1.3-2.0	1.7	
buff tan, and green gray	1.5-10	8-10	.01-.04	.02	.003	.001				
Sandstone, gray green,										
argillaceous	10-13	10-12	.01-.05	.03	.004	---	9-12	3.2-4.2	3.8	
Claystone, green, gray, brown,		12-14	.01-.04	.02	.006	.003	12-15	3.2-4.0	3.6	
purple, silty and sandy	13-16	14-16	.01-.05	.03	.004	---				Water table at 14 feet
B-30										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.04	.03	0.004	---	0-3	1.2-1.5	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.004	---				
Sandstone, green gray buff,		4-6	.01-.03	.02	.003	0.001	3-6	1.4-1.8	1.5	
silty, pebbly at 3 feet	2-6	6-8	.01-.03	.02	.003	---	6-9	1.0-1.5	1.2	
		8-10	.01-.03	.02	.003	---				
Sandstone, yellow gray, pebbly	6-14	10-12	.01-.03	.02	.003	---	9-12	.9-1.2	1.0	
		12-14	.01-.03	.02	.002	---	12-15	.9-1.3	1.1	
Sandstone, yellow gray, silty	14-16	14-16	.01-.03	.02	.002	---				Water table at 16 feet
B-31										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly at										
base	0-2	0-2	.01-.02	.015	.003	---	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.004	---				
Siltstone, green brown, sandy,		4-6	.01-.04	.02	.005	.004	3-6	2.5-3.2	2.8	
thin beds of sandstone	2-10	6-8	.01-.04	.02	.003	---	6-9	1.1-1.5	1.3	
		8-10	.01-.03	.02	.003	---				
Sandstone, brown green white,										
silty	10-12	10-12	.00-.02	.01	.003	---	9-12	1.2-1.6	1.4	
Siltstone, green brown, sandy	12-14	12-14	.01-.03	.02	.003	---	10-13	1.1-1.5	1.3	Water table at 14 feet
B-32										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	.003	---	0-3	1.1-1.6	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.02	.01	.004	---				
Sandstone, green brown, silty	2-6	4-6	.01-.03	.02	.004	---	3-6	1.3-1.7	1.5	
Sandstone, brown white, pebbly	6-8.5	6-8	.00-.02	.01	.003	.002	6-9	1.5-1.9	1.7	
		8-10	.00-.02	.01	.004	.003				
Sandstone, brown green white,										
very silty	8.5-14	10-12	.01-.03	.02	.003	---	9-12	1.0-1.4	1.2	
		12-14	.01-.04	.03	.003	---	10-13	1.0-1.3	1.1	Water table at 14 feet

Appendix D. (p. 11)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-33										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.04	.02	.004	---	0-3	1.3-1.7	1.5	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.04	.03	.006	.009				Anomalous U assay
Siltstone, green gray, argillaceous	2-5.5	4-6	.01-.04	.03	.006	.007	3-6	1.6-2.0	1.8	No visible schroeckingerite
Siltstone, green brown, sandy	5.5-8	6-8	.01-.04	.03	.004	---	6-9	2.5-3.0	2.7	
Sandstone, light green brown, pebbly	8-10	8-10	.01-.04	.03	.002	.002				
Siltstone, light green, brown, sandy	10-12	10-12	.01-.03	.02	.003	---	9-12	2.2-2.5	2.3	
Sandstone, green brown, some silt	12-15	12-14	.01-.03	.02	.003	---	12-15	1.0-1.3	1.1	
Sandstone, green brown, pebbly	15-18	14-16	.01-.04	.02	.003	---	13-16	1.0-1.4	1.2	Water table at 16 feet
		16-18	---	---	.003	---				
B-34										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.03	.02	0.005	0.006	0-3	1.4-1.8	1.5	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.004	---				
Sandstone, gray green, silty	1.5-4	4-6	.01-.03	.02	.004	---				
Siltstone, gray green, brown, sandy	4-5.5	6-8	.01-.03	.02	.003	---	3-6	1.3-1.6	1.4	
Sandstone, gray, green, silty	5.5-10	8-10	.01-.03	.02	.002	---	6-9	1.3-1.7	1.5	
		10-12	.00-.02	.01	.002	---	9-12	1.5-2.0	1.8	
Siltstone, green brown, very sandy	10-16	12-14	.01-.03	.02	.003	---	12-15	1.6-2.0	1.8	
		14-16	.00-.02	.01	.004	---				Water table at 16 feet
B-35										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	.02-.06	.03	.003	---				
Wasatch fm., Cathedral Bluffs tongue		2-4	.04-.06	.05	.015	.016	0-3	3.9-4.8	4.2	Contains schroeckingerite
Siltstone, green brown, sandy	1-4	4-6	.01-.03	.02	.004	---				from 2 to 4 feet
Sandstone, gray green, pebbly	4-8	6-8	.01-.03	.02	.003	---	3-6	3.5-4.5	3.8	
		8-10	.01-.03	.02	.004	---	6-9	2.4-3.2	2.5	
Sandstone, green gray, silty	8-14.5	10-12	.02-.04	.03	.004	---	9-12	1.5-1.9	1.7	
		12-14	.01-.04	.02	.003	---	10-13	1.5-1.9	1.7	Water table at 13 feet
B-36										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1	0-2	.01-.03	.02	.005	.002	0-3	1.3-1.8	1.5	
Wasatch fm., Cathedral Bluffs tongue		2-4	.02-.04	.03	.006	.005				
Siltstone, buff gray green, very sandy	1-3.5	4-6	.00-.02	.01	.004	---	3-6	1.1-1.6	1.3	
Sandstone, gray green white, pebbly	3.5-10	6-8	.00-.02	.01	.003	---				
		8-10	.01-.03	.02	.004	---	6-9	.7-1.3	1.0	Water table at 10 feet

Appendix D. (p. 12)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
B-37										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-3	0-2	.01-.03	.02	.004	---	0-3	1.1-1.4	1.2	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.004	---				
Sandstone, yellow gray buff,										
silty	3-5	4-6	.01-.03	.02	.004	---	3-6	1.2-1.5	1.3	
Sandstone, yellow gray buff,										
pebbly	5-10	6-8	.01-.04	.03	.005	.003				
		8-10	.01-.03	.02	.004	---	6-9	1.1-1.5	1.3	Water table at 10 feet
B-38										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-2	.00-.02	.01	.005	.003	0-3	2.6-3.1	2.8	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.006	.006				
Siltstone, brown gray, sandy,										
argillaceous	1.5-4	4-6	.01-.03	.02	.006	.007	3-6	2.8-3.2	3.0	Contains schroeckingerite
Sandstone, green gray	4-6	6-8	.01-.03	.02	.009	.009				from 4 to 8 feet
Siltstone, gray brown,										
argillaceous	6-9	8-10	.00-.02	.01	.004	---	6-9	2.5-3.0	2.7	
Siltstone, brown green, very										
sandy	9-12	10-12	.01-.03	.02	.004	---	8-11	1.5-2.0	1.7	Water table at 12 feet
B-39										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	0.003	---	0-3	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.003	---				
Sandstone, buff, green,										
pebbly	2-8	4-6	.01-.04	.03	.003	---	3-6	1.0-1.6	1.3	
		6-8	.01-.04	.03	.004	---	6-9	2.0-2.5	2.2	
Siltstone, dark-brown, green		8-10	.02-.05	.04	.007	0.012				
brown, argillaceous	8-12	10-12	.02-.04	.03	.005	.003	9-12	3.5-4.5	4.0	
Sandstone, buff gray green;										
top half		12-14	.02-.04	.03	.004	---	12-15	2.8-3.2	3.0	
silty, pebbly from 15 to 16										
feet	12-18	14-16	.02-.05	.03	.003	---				
		16-18	.01-.03	.02	.003	---	14-17	1.8-2.2	2.0	Water table at 18 feet

Appendix D. (p. 13)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-40										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.00-.02	.01	.003	---	0-3	1.1-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.04	.03	.004	---				
Siltstone, gray brown, sandy	2-3.5	4-6	.01-.04	.03	.003	---	3-6	1.1-1.6	1.3	
Sandstone, buff white	3.5-9.5	6-8	.01-.03	.02	.012	.016	6-9	1.1-1.5	1.3	Anomalous U assay from 6 to 8 feet. No visible schroeckingerite
		8-10	.01-.03	.02	.004	---				
Siltstone, brown gray, very sandy	9.5-13.5	10-12	.00-.02	.01	.004	---	9-12	1.2-1.6	1.4	
Sandstone, white	13.5-14	12-14	.00-.02	.01	.002	---	10-13	1.3-1.6	1.5	Water table at 14 feet
B-41										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.00-.02	.01	.003	---	0-3	1.2-1.7	1.5	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.04	.03	.006	.006				
Claystone, light brown, gray green, silty	2-5.5	4-6	.01-.04	.03	.006	.005	3-6	2.5-3.0	2.7	
Siltstone, gray green, sandy	5.5-8	6-8	.01-.04	.03	.007	.006	6-9	2.5-3.0	2.7	
Sandstone, gray buff	8-10	8-10	.01-.03	.02	.004	---				
Sandstone, gray buff, silty	10-12	10-12	.01-.03	.02	.005	.002	8-11	1.5-1.9	1.6	Water table at 12 feet
B-42										
Quaternary alluvium and colluvium										
Silt; brown, sandy	0-1.5	0-2	.00-.02	.01	.004	---	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.00-.02	.01	.003	---				
Sandstone, buff, white; thin clay seams	1.5-6.5	4-6	.01-.03	.02	.004	---	3-6	1.2-1.7	1.4	
Claystone, brown red, green gray, silty	6.5-9.5	6-8	.01-.03	.02	.008	.010	6-9	3.0-4.0	3.5	Contains schroeckingerite from 7.5 to 9 feet
		8-10	.01-.05	.04	.013	.021				
		10-12	.01-.04	.03	.004	---	9-12	1.6-2.0	1.7	
Siltstone, brown green, sandy	9.5-16	12-14	.01-.04	.03	.004	---	12-15	1.5-2.0	1.8	
		14-16	.01-.03	.02	.004	---	14-17	1.4-1.8	1.6	
Sandstone, gray green brown, silty	16-18	16-18	.01-.03	.02	.003	---				Water table at 16.5 feet
B-43										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	.01-.03	.02	.005	.004	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.006	.005				
Sandstone, green gray, silty;		4-6	.01-.04	.03	.005	.004	3-6	1.4-1.8	1.6	
thin claystone at top	1-10	6-8	.02-.04	.03	.007	.008				
		8-10	.01-.03	.02	.005	.001	6-9	1.4-1.7	1.6	Water table at 10 feet

Appendix D. (p. 14)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Field Radioactivity Mr/Hr Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Reading Mr/Hr Ave.	
B-44										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1	0-2	.01-.03	.02	0.006	0.005	0-3	1.5-1.9	1.7	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, gray green, silty	1-4	2-4	.01-.03	.02	.004	---				Contains schroeckingerite
Siltstone, brown green, sandy	4-6	4-6	.02-.04	.03	.007	.005	3-6	1.6-1.8	1.7	from 4.5 to 5.5 feet
Sandstone, gray green	6-8	6-8	.01-.04	.03	.003	---	6-9	1.2-1.6	1.3	
Sandstone, gray green, brown, silty	8-9.5	8-10	.00-.02	.01	.003	---				
Siltstone, brown green, sandy	9.5-11.5	10-12	.01-.03	.02	.004	---	8-11	1.6-1.9	1.7	
Sandstone, green white	11.5-12									Water table at 12 feet
B-45										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.02-.04	.03	.005	.004	0-3	.9-1.2	1.1	
Wasatch fm., Cathedral Bluffs tongue										
Sandstone, brown, silty, pebbly	2-3.5	2-4	.01-.03	.02	.007	.010				Contains schroeckingerite
Sandstone, green brown, argillaceous	3.5-4.5	4-6	.02-.04	.03	.007	.005	3-6	1.6-2.0	1.7	from 3.5 to 4.5 feet
		6-8	.02-.04	.03	.006	.002	6-9	3.2-3.7	3.5	
Sandstone, green gray, pebbly	4.5-12	8-10	.02-.05	.04	.004	---	8-11	1.5-1.9	1.7	
		10-12	.01-.03	.02	.004	---				
B-46										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-2	0-2	.01-.04	.03	.003	---	0-3	2.5-3.0	2.8	
Wasatch fm., Cathedral Bluffs tongue		2-4	.06-.11	.08	.012	.027				Contains schroeckingerite
Siltstone, brown green, argillaceous	2-5	4-6	.00-.04	.03	.004	---	3-6	2.0-4.0	3.2	from 2 to 5 feet
		6-8	.00-.04	.03	.003	---				
Sandstone, green brown white, silty	5-12	8-10	.01-.03	.02	.003	---	6-9	1.2-1.6	1.4	
		10-12	.01-.04	.03	.004	---	9-12	1.4-1.8	1.6	
Claystone, brown green gray, silty	12-14	12-14	.01-.03	.02	.004	---	12-15	1.6-2.0	1.8	
Sandstone, gray green, silty	14-16	14-16	.01-.03	.02	.002	---				Water table at 16 feet

Appendix D. (p. 15)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-47										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-2	0-2	.00-.02	.01	.004	---	0-3	1.2-1.5	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.006	---				
Siltstone, gray green brown,										
sandy	2-5	4-6	.01-.03	.02	.004	---	3-6	1.1-1.3	1.2	
		6-8	.00-.02	.01	.003	---	6-9	1.0-1.2	1.1	
		8-10	.01-.03	.02	.002	---				
Sandstone, gray green, silty;		10-12	.00-.02	.01	.004	---	9-12	1.0-1.3	1.1	
thin layers of sandy siltstone	5-16	12-14	.00-.02	.01	.003	---	12-15	1.0-1.3	1.2	
		14-16	.00-.02	.01	.004	---	13-16	1.1-1.6	1.4	Water table at 16 feet
Sandstone, white	16-17.5	16-17.5	.00-.02	.01	.003	---				
B-48										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	.003	---	0-3	1.3-1.7	1.6	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.02	.01	.006	.004				
Sandstone, gray green, tan,										
silty	2-4	4-6	.02-.04	.03	.005	.012	3-6	1.5-1.9	1.6	Anomalous U analysis. No
Siltstone, gray green	4-7	6-8	.01-.04	.03	.006	.007	6-9	2.5-3.0	2.7	visible schroeckingerite
Claystone, gray green, silty	7-9	8-10	.01-.03	.02	.005	.002				
Sandstone, gray green buff,										
silty	9-13	10-12	.01-.03	.02	.004	---	9-12	2.2-2.7	2.5	
Sandstone, gray green tan,										
pebbly	13-16	12-14	.01-.03	.02	.004	---	11-14	1.2-1.5	1.3	
		14-16	.01-.03	.02	.004	---				Water table at 15 feet
B-49										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-2	.01-.03	.02	.005	.003	0-3	.8-1.1	.9	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.004	---				
		4-6	.00-.02	.01	.006	.001	3-6	1.1-1.4	1.2	
Sandstone, brown green gray,		6-8	.00-.02	.01	.003	---	6-9	1.1-1.5	1.2	
silty	1.5-11.5	8-10	.01-.03	.02	.003	---				
Sandstone, white	11.5-13	10-12	.00-.03	.02	.003	---	8.5-11.5	1.1-1.4	1.2	Water table at 12 feet
		12-13	.00-.02	.01	.002	---				
B-50										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-2	0-2	.01-.04	.03	.003	---	0-3	1.2-1.4	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.02	.01	.004	---				
Sandstone, tan, gray green,										
pebbly	2-6	4-6	.01-.03	.02	.003	---	3-6	1.1-1.5	1.3	
		6-8	.01-.03	.02	.003	---	6-9	1.2-1.5	1.4	
Sandstone, buff, gray green,										
silty,		8-10	.01-.05	.03	.003	---				
some pebbles	6-14	10-12	.01-.03	.02	.003	---	9-12	1.3-1.8	1.5	
		12-14	.01-.03	.02	.003	---	10-13	1.2-1.7	1.4	Water table at 14 feet

Appendix D. (p. 16)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-51										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-2	0-2	.00-.02	.01	.003	---	0-3	1.2-1.6	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.005	.007				Contains schroeckingerite
Siltstone, green gray, sandy	2-4.5	4-6	.01-.03	.02	.005	.004	3-6	2.5-3.2	3.0	at 3 to 4 feet
Siltstone, green brown, argillaceous	4.5-7	6-8	.01-.04	.03	.003	---	6-9	1.2-1.6	1.3	
Siltstone, brown, green gray, sandy	7-12	8-10	.01-.03	.02	.004	---				
		10-12	.01-.03	.02	.003	---	9-12	1.4-1.8	1.6	
Claystone, green brown gray, silty	12-14	12-14	.01-.03	.02	.004	---	12-15	1.5-1.7	1.6	
		14-16	.01-.03	.02	.004	---				
Siltstone, green brown, sandy	14-18.5	16-18	.01-.03	.02	.004	---	15-18	1.6-1.9	1.7	
Sandstone, brown green	18.5-20	18-20	.01-.03	.02	.003	---	16-19	1.5-1.8	1.6	Water table at 19 feet
B-52										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-1.5	0-2	.01-.03	.02	0.004	---	0-3	1.1-1.4	1.3	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.003	---				
Sandstone, tan gray, pebbly	1.5-10	4-6	.01-.04	.03	.004	---	3-6	1.4-1.7	1.5	
		6-8	.01-.03	.02	.003	---	6-9	1.2-1.7	1.4	
		8-10	.01-.04	.03	.003	---				
Sandstone, gray green, silty	10-18	10-12	.01-.03	.02	.003	---	9-12	1.1-1.7	1.4	
		12-14	.01-.03	.02	.003	---	12-15	1.0-1.5	1.3	
		14-16	.01-.04	.03	.002	---	14-17	1.0-1.4	1.2	
		16-18	.02-.04	.03	.004	---				
B-53										
Quaternary alluvium and colluvium										
Silt and sand, brown	0-1.5	0-2	.00-.02	.01	.003	---	0-3	1.2-1.7	1.4	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.006	0.010				Contains schroeckingerite
Sandstone, gray green, silty, thin clay seam at base	1.5-8	4-6	.01-.04	.02	.004	---	3-6	2.5-3.0	2.7	from 2.5 to 4 feet
		6-8	.01-.03	.02	.003	---	6-9	1.2-1.6	1.4	
Sandstone, buff gray green, pebbly	8-12	8-10	.02-.05	.03	.003	---				
		10-12	.01-.03	.02	.003	---	9-12	1.1-1.5	1.3	
Sandstone, gray green tan	12-13.5	12-13.5			.003	---				Water table at 13.5 feet

Appendix D. (p. 17)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-54										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-1.5	0-2	.01-.03	.02	.003	---	0-3	1.1-1.5	1.3	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.004	---				
Sandstone, brown green, silty	1.5-3.5	4-6	.01-.03	.02	.004	---	3-6	1.2-1.6	1.4	
Siltstone, gray green, sandy	3.5-7.5	6-8	.01-.03	.02	.003	---	6-9	1.1-1.5	1.2	
Sandstone, gray green	7.5-12	8-10	.01-.03	.02	.003	---	8-11	1.1-1.4	1.2	
		10-12	.01-.03	.02	.003	---				Water table at 11 feet
B-55										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	.004	---	0-3	1.2-1.5	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.02	.009	.012				Contains schroeckingerite
Siltstone, brown green, sandy,										
argillaceous	2-6.5	4-6	.02-.04	.03	.008	.010	3-6	3.5-4.0	3.8	from 4 to 6 feet
Sandstone, gray green, pebbly	6.5-10	6-8	.01-.04	.03	.003	---				
		8-10	.01-.03	.02	.002	---	6-9	1.1-1.6	1.3	Water table at 10 feet
B-56										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-1.5	0-2	.00-.02	.01	.004	---	0-3	1.4-1.8	1.5	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.005	.002				
Sandstone, green gray	1.5-3.5	4-6	.01-.03	.02	.006	.007	3-6	1.6-2.0	1.8	
Sandstone and siltstone, gray		6-8	.00-.02	.01	.005	.007				
green, brown white,										
argillaceous	3.5-10	8-10	.00-.03	.02	.003	---	6-9	1.4-1.8	1.6	Water table at 10 feet
B-57										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2	0-2	.01-.03	.02	0.004	---	0-3	1.4-1.9	1.6	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.02-.05	.04	.008	0.012				Contains schroeckingerite
		4-6	.01-.03	.02	.006	.008	3-6	3.0-3.5	3.3	from 6.5 to 10 feet
		6-8	.03-.06	.05	.021	.008	6-9	3.5-4.0	3.6	
Sandstone, green gray,green,										
brown,		8-10	.01-.04	.03	.006	.007				
buff, silty, argillaceous										
at 5 feet	2-18	10-12	.01-.03	.02	.003	---	9-12	2.6-3.0	2.8	
		12-14	.01-.03	.02	.003	---	12-15	3.8-4.2	4.0	
		14-16	.01-.03	.02	.005	.002				
		16-18	.03-.05	.04	.004	---	15-18	4.0-4.4	4.3	
Siltstone, gray green buff,										
argillaceous	18-19.5	18-20	.01-.04	.03	.004	---	18-21	1.4-1.7	1.6	
Sandstone, gray green, silty	19.5-22	20-22	.01-.03	.02	.004	---				

Appendix D. (p. 18)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-58										
Quaternary alluvium and colluvium										
Sand, brown, silty, clay at base	0-2.5	0-2	.02-.04	.03	.004	---	0-3	1.5-2.0	1.7	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.009	.010				Anomalous U assay from
Sandstone, light brown, silty, argillaceous	2.5-5.5	4-6	.01-.03	.02	.006	.007	3-6	3.0-3.5	3.2	2 to 6 feet. No visible
Sandstone, buff white, pebbly	5.5-7	6-8	.02-.04	.03	.004	---	6-9	2.7-3.2	3.0	schroeckingerite
Siltstone, brown green, sandy	7-8.5	8-10	.01-.03	.02	.004	---				
Sandstone, buff white, pebbly	8.5-12	10-12	.01-.03	.02	.003	---	8-11	1.3-1.9	1.6	Water table at 12 feet
B-59										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-2.5	0-2	.01-.03	.02	.003	---	0-3	1.5-1.8	1.6	
Wasatch fm., Cathedral Bluffs tongue		2-4	.02-.04	.03	.004	---				
Sandstone, brown gray, pebbly	2.5-7	4-6	.02-.04	.03	.004	---	3-6	2.6-2.9	2.7	
Siltstone, brown gray green, argillaceous;		6-8	.02-.05	.04	.010	.022	6-9	3.7-4.0	3.8	Contains schroeckingerite
few thin sandy lenses	7-12	8-10	.02-.04	.03	.012	.014				from 6 to 10 feet
		10-12	.03-.05	.04	.006	.004	9-12	4.8-5.2	5.0	
Siltstone, gray green, sandy	12-14	12-14	.01-.03	.02	.005	.003	12-15	3.4-3.9	3.5	
		14-16	.02-.05	.04	.003	---				
Sandstone, buff, gray green,		16-18	.02-.05	.04	.004	---	15-18	3.0-3.4	3.2	
dark brown at 20 feet, silty	14-24	18-20	.01-.03	.02	.004	---	18-21	3.0-3.4	3.2	
		20-22	.02-.04	.03	.005	.002	20-23	3.0-3.4	3.2	
		22-24	.01-.03	.02	.002	---				Water table at 23.5 feet
B-60										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-2	0-2	.00-.02	.01	.005	.002	0-3	2.8-3.2	3.0	
Wasatch fm., Cathedral Bluffs tongue		2-4	.01-.03	.02	.014	.021				Contains schroeckingerite
Sandstone, gray buff, silty	2-4	4-6	.01-.03	.02	.010	.014	3-6	4.5-5.4	5.0	from 3 to 7 feet
Siltstone, green gray, argillaceous	4-6	6-8	.01-.03	.02	.005	.004	6-9	3.0-3.5	3.3	
Sandstone, green gray brown, silty	6-10	8-10	.01-.03	.02	.003	---				
		10-12	.01-.03	.02	.004	---	9-12	3.5-4.2	3.9	
Siltstone, green gray, sandy, argillaceous	10-16	12-14	.01-.03	.02	.002	---	12-15	3.5-4.0	3.8	
		14-16	.01-.03	.02	.003	---				
Sandstone, green gray, silty	16-20.5	16-18	.00-.02	.01	.002	---	15-18	2.8-3.4	3.0	
		18-20	.01-.03	.02	.003	---	18-21	1.5-1.9	1.7	
Siltstone, gray green brown, sandy	20.5-24	20-22	.00-.02	.01	.003	---				
		22-24	.00-.02	.01	.004	---	20-23	1.5-1.9	1.7	Water table at 23 feet

Appendix D. (p. 19)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
3-61										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.03	.02	0.004	---	0-3	3.0-3.2	3.1	
Sand, brown, pebbly	1.5-2.5									
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.005	0.005	3-6	2.9-3.3	3.0	Contains schroeckingerite
Sandstone, gray green, tan,		4-6	.02-.04	.03	.004	---				from 5 to 7.5 feet
silty, pebbly at bottom of hole	2.5-8	6-8	.01-.04	.03	.009	.013	4-7	2.8-3.3	3.0	Water table at 8 feet
3-62										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-2	0-2	.01-.03	.02	.003	---	0-3	3.0-3.5	3.2	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.010	.014				Contains schroeckingerite
Claystone, gray green brown,										
sandy	2-5	4-6	.01-.03	.02	.007	.005	3-6	4.6-5.3	5.0	from 2.5 to 3 feet and
Siltstone, green gray brown,										
sandy	5-8	6-8	.01-.04	.03	.010	.009	6-9	3.8-4.5	4.2	from 6.5 to 8.5 feet
Sandstone, gray green, silty	8-11	8-10	.01-.04	.03	.003	---	8-11	1.5-1.9	1.7	
Sandstone, green white	11-12	10-12	.01-.03	.02	.004	---				Water table at 12 feet
3-63										
Quaternary alluvium and colluvium										
Sand and silt, brown	0-2	0-2	.01-.03	.02	.006	.008	0-3	1.6-2.0	1.8	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.004	---				Contains schroeckingerite
Sandstone, gray green, silty	2-6	4-6	.01-.05	.03	.003	---	3-6	3.0-3.4	3.1	from 2.5 - 3.5 feet
Sandstone, gray green	6-10.5	6-8	.01-.03	.02	.002	---	6-9	3.0-3.7	3.5	
		8-10	.01-.03	.02	.003	---				
Sandstone, gray green brown,										
silty	10.5-14	10-12	.01-.04	.03	.003	---	9-12	2.5-2.7	2.6	
		12-14	.01-.03	.02	.001	---	10-13	2.3-2.5	2.4	
3-64										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1.5	0-2	.01-.03	.02	.004	---	0-3	2.8-3.1	3.0	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.005	.004				Contains schroeckingerite
Sandstone, light green, silty	1.5-2.5	4-6	.02-.04	.03	.007	.008	3-6	4.3-5.0	4.5	from 3.5 to 5 feet
Claystone, green, gray	2.5-5	6-8	.01-.03	.02	.003	---	6-9	2.2-2.5	2.4	
		8-10	.01-.04	.03	.003	---				
Sandstone, brown green gray,										
silty, thin layers of sandy		10-12	.00-.02	.01	.004	---	9-12	3.2-3.9	3.5	
siltstone	5-16	12-14	.01-.03	.02	.003	---	12-15	1.9-2.3	2.0	
		14-16	.01-.04	.03	.002	---	14-17	1.6-2.1	1.8	
Sandstone, gray green	16-18	16-18	.00-.02	.01	.002	---				Water table at 16.5 feet

Appendix D. (p. 20)

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
B-65										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1	0-2	.01-.03	.02	.003	---	0-3	2.8-3.2	3.0	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.02-.04	.03	.002	---				
Sandstone, gray green white	1-6	4-6	.00-.02	.01	.003	---	3-6	1.9-2.3	2.1	
Sandstone, green brown, silty	6-10	6-8	.01-.03	.02	.003	---	6-9	2.2-2.4	2.3	
		8-10	.01-.04	.02	.003	---				
Sandstone, gray green	10-14	10-12	.01-.03	.02	.003	---	9-12	1.9-2.3	2.0	
		12-14	.01-.03	.02	.002	---	12-15	1.8-2.2	1.9	
Sandstone, brown green, silty	14-16	14-16	.01-.03	.02	.003	---				Water table at 16 feet
B-66										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1.5	0-2	.01-.03	.02	0.003	---	0-3	1.7-2.1	1.9	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.03	.02	.004	---				
Sandstone, buff, silty	1.5-3.5	4-6	.01-.03	.02	.005	0.002	3-6	3.4-3.8	3.6	
Sandstone, gray green, pebbly	3.5-4.5	6-8	.01-.03	.02	.003	---				
Siltstone, green brown, sandy	4.5-7	8-10	.01-.03	.02	.002	---	6-9	1.6-2.1	1.9	
Sandstone, gray green	7-10	10-12	.01-.03	.02	.003	---				
Sandstone, gray, silty	10-12.5	12-14	.01-.03	.02	.002	---	9-12	1.1-1.5	1.3	
Sandstone, light gray, pebbly	12.5-15	14-16	.01-.03	.02	.002	---	12-15	1.2-1.6	1.4	
Sandstone, gray tan, silty	15-18	16-18	.01-.03	.02	.002	---	14-17	1.2-1.6	1.4	
B-67										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1.5	0-2	.01-.03	.02	.004	---	0-3	1.3-1.7	1.5	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.02	.01	.004	---				
Sandstone, brown green buff, silty	1.5-5	4-6	.00-.02	.01	.004	---	3-6	1.3-1.8	1.5	
		6-8	.00-.02	.01	.003	---	6-9	1.3-1.7	1.4	
Sandstone, brown green	5-12	8-10	.00-.02	.01	.003	---				
		10-12	.00-.02	.01	.002	---	9-12	1.3-1.6	1.4	
Sandstone, gray green, silty	12-14	12-14	.01-.03	.02	.003	---	10-13	1.3-1.7	1.4	Water table at 14 feet
B-68										
Quaternary alluvium and colluvium										
Silt, brown, sandy	0-1	0-2	.01-.03	.02	.003	---	0-3	1.2-1.7	1.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.004	---				
		4-6	.01-.03	.02	.004	---	3-6	1.2-1.6	1.4	
		6-8	.01-.03	.02	.002	---	6-9	1.3-1.8	1.5	
Sandstone, tan gray, pebbly	1-14	8-10	.01-.03	.02	.002	---				
		10-12	.01-.03	.02	.002	---	9-12	1.2-1.7	1.4	
		12-14	.01-.04	.03	.003	---	10-13	1.3-1.7	1.5	Water table at 14 feet

DRILL LOG		DATA ON SAMPLES					GAMMA-RAY LOG			REMARKS
Lithology	Depth (feet)	Depth of Sample (feet)	Field Radioactivity Mr/Hr Range	Ave.	eU%	U%	Depth (feet)	Reading Mr/Hr Range	Ave.	
3-69										
Quaternary alluvium and colluvium										
Sand, brown, silty	0-1.5	0-2	.01-.03	.02	.003	---	0-3	2.3-2.5	2.4	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.01-.04	.03	.004	---				
Sandstone, brown white, silty										
at base	1.5-4	4-6	.00-.02	.01	.003	---	3-6	2.6-3.0	2.8	
		6-8	.01-.04	.03	.002	---	6-9	1.5-2.0	1.7	
Sandstone, brown green, white	4-14	8-10	.00-.02	.01	.003	---				
		10-12	.01-.03	.02	.002	---	9-12	1.5-2.0	1.7	
		12-14	.01-.03	.02	.002	---	12-15	1.4-1.8	1.6	
Sandstone, brown green, pebbly	14-15.5	14-16	.01-.03	.02	.003	---				
Siltstone, gray green brown,										
argillaceous	15.5-18	16-18	.01-.03	.02	.002	---	15-18	1.4-1.8	1.7	
Siltstone, gray green, sandy	18-20	18-20	.00-.02	.01	.003	---	18-21	1.4-1.9	1.6	
Sandstone, brown green, silty	20-22	20-22	.00-.02	.01	.002	---				Water table at 22 feet
B-70										
Quaternary alluvium and colluvium										
Sand, brown, silty, pebbly	0-1.5	0-2	.00-.02	.01	.003	---	0-3	1.6-2.2	1.9	
Wasatch fm., Cathedral Bluffs										
tongue		2-4	.00-.02	.01	.003	---				
Sandstone, light brown, pebbly	1.5-3	4-6	.01-.03	.02	.003	---				
Siltstone, brown green, sandy	3-5	6-8	.00-.02	.01	.003	---	3-6	1.5-2.1	1.8	
Sandstone, gray green brown,										
silty	5-11.5	8-10	.01-.03	.02	.003	---	6-9	1.7-2.2	1.9	
Siltstone, brown gray,										
argillaceous	11.5-12.5	10-12	.01-.03	.02	.003	---	9-12	2.8-3.1	3.0	
Sandstone, gray white	12.5-14	12-14	.01-.03	.02	.002	---	10-13	2.7-3.0	2.8	Water table at 13 feet

APPENDIX E

Comparison of channel samples and face-cut samples from representative schroeckingerite deposits in Trench 1

The initial sampling of schroeckingerite deposits in Trench 1 was done by conventional channel methods. It was soon discovered, however, that extreme caution had to be used to obtain fair samples in the deposits by this method. When the channels were spotted according to a visual estimate of positions which seemed to be representative, human error became too much of a factor. The distribution of pellets and grains of schroeckingerite in the deposits is so irregular that evenly spaced channels contained virtually no schroeckingerite, in some instances, and others contained more schroeckingerite than was representative. Therefore, in order to obtain fair samples from the deposits, the method of sampling was changed to the face-cut method, whereby the entire face of each deposit was sampled in one or more individual samples, corresponding to carefully mapped areas. The face-cut method was used for sampling schroeckingerite deposits in the rest of the trenches. However, because distribution of schroeckingerite pellets was not a factor in the sampling of host rock, the channel method was continued for all samples outside of schroeckingerite deposits.

As a check comparison, duplicate samples were taken by the face-cut method in some of the deposits in Trench 1 that had already been sampled by the channel method. The comparative results are shown in table 6. Although some of the average uranium contents indicated by channel samples agree fairly closely with the uranium contents of face-cut samples, others are obviously in error, as had been expected. Thus, the deposit represented by face-cut sample DS-G-3 contains 0.024 percent uranium, which is twice as much as indicated by the 2 channel samples, DS-51-63 and DS-51-64. In this case, evenly spaced channel samples failed to cut enough schroeckingerite to be representative of the entire exposure. Face-cut sample DS-G-10 contains only 0.024 percent uranium, whereas the weighted average of 4 channel samples from the same deposit is 0.043 percent uranium. In this instance, spacing of channels resulted in "high-grading" the samples. The comparative tests corroborated the theoretical conclusion that channel samples in the schroeckingerite deposits can give an inaccurate picture of the uranium content.

APPENDIX F

Reconnaisance for radioactivity

A systematic reconnaissance for radioactivity was conducted in the Lost Creek area as part of the geologic investigations of the exploration project. Early in the exploration program it had been found that Geiger counters and other devices were practically valueless in determining the positions of schroeckingerite deposits concealed by a thin cover of Quaternary overburden. Therefore, because the detailed information from trenches and drill holes provided a representative picture of the distribution and radioactivity of the schroeckingerite deposits themselves, the emphasis of the reconnaissance work was placed on the radioactivity of other near-surface materials and on the radioactivity of lithologic and structural features.

During October and November, 1952, several surface traverses were made in the Lost Creek area with a scintillation counter, and the open trenches were traversed with a field Geiger counter. These traverses with the resulting values are shown on plate 26.

The average background count in the Lost Creek area was 0.008 mr/hr (milleroentgens per hour) as read on a scintillation counter. The highest average readings taken were 0.025 mr/hr. Most of the anomolous readings were from 0.012 to 0.016 mr/hr. The highest anomalies were found to be associated with iron-cemented sandstones and concretions in the vicinity of trench 13, and with an iron-stained contact zone between a dull green-gray siltstone and overlying coarse arkosic, pebbly sandstone in the upper part of the Cathedral Bluffs tongue of the Wasatch formation, to the north of the trenched area (Pl. 26). Samples from the iron-stained contact had 0.002 to 0.005 percent equivalent uranium and 0.001 percent and less uranium. The iron-cemented concretions from the trench 13 area had a range of 0.003 to 0.006 percent equivalent uranium and up to 0.003 percent uranium. The traverses near trenches 1 and 3 are near schroeckingerite bodies; where the overburden was preserved there were no anomalies due to the schroeckingerite, but where the schroeckingerite was exposed at the surface the high readings were ignored. The schroeckingerite bodies gave readings of 0.05 to 0.10 mr/hr.

Those traverses which were made in the trenches which had not been backfilled were made with a Nuclear field Geiger counter. As with the surface traverses, the anomalous readings due to schroeckingerite bodies were ignored. The surface traverses are shown with continuous readings along their lengths; the trench traverses show only the spots of anomalous radioactivity not due to schroeckingerite bodies. The trench backgrounds are shown in parenthesis at the bottom of the column of anomalous readings. The schroeckingerite bodies exposed in the trenches gave only slightly higher readings than those on the surface traverses, and varied considerably with the size of the exposed bodies; readings ranged from 0.05 to 0.80 mr/hr.

Appendix G shows a breakdown of the anomalies found in the Lost Creek area according to occurrence. Only about 10 percent of the faults show higher than background radioactivity and faults accounted for only about 10 percent of the total number of anomalies found. The remainder of the anomalies are listed according to lithologic occurrence. Most of them are in the finer grained sediments. About 50 percent of the total anomalies were found in siltstones and claystones, about 30 percent were in iron-cemented concretions and iron-stained areas and about 10 percent were in the sandstones. Looking at the figures involving the total areas checked for radioactivity, about 45 percent of the iron-stained areas and iron cemented concretions were radioactive, only about 2 percent of the claystones and siltstones had higher than background radioactivity, and only about 0.2 percent of the sandstones were above background.

The ratio between the number of anomalies on the surface and the number in the trenches is obviously too high to allow any value to be placed on the statistical figures given. Much of the discrepancy is due to the muffling effect of the overburden. There are probably comparable numbers of surface anomalies in those categories which would be detected if the overburden were not present. Despite this discrepancy in the data, the figures may be of some comparative value.

Appendix G

Radioactivity data exclusive of schroeckingerite, Lost Creek area, Wyoming.

	Iron-stained contacts	Iron-stained shale, claystone and sandstone lens	Iron-cemented sand concretions	Green siltstones and silty-clayey sandstones	Green claystone	Green and maroon variegated claystone	Purple claystone	Red claystone	Brown fissile claystone and shale	Buff and white sandstones	Faults	Faults with CO_3 gouge	Unknown
Anomalies in trenches	3	10	1	17	31	10	3	1	6	11	8	1	0
Anomalies on surface	7	7	14	0	1	0	0	1	0	5	6	0	8
Total anomalies	10	17	15	17	32	10	3	2	6	16	14	1	---
Total checked 1/	46	32	17	1600 2/	1200 2/	120 2/	5	3	220 2/	8130 2/	130	22	---
Percentage total 3/	.4	.3	.1	14.0	10.4	1.0	.04	.02	2.0	70.0	1.2	.2	---
Percent radioactive 4/	22	53	88	1	3	8	60	67	3	.2	10	4	---
Percent total radioactive 5/	6.6	11.3	10.0	11.3	20.6	6.6	2.0	1.3	4.0	10.6	9.3	.6	5.3

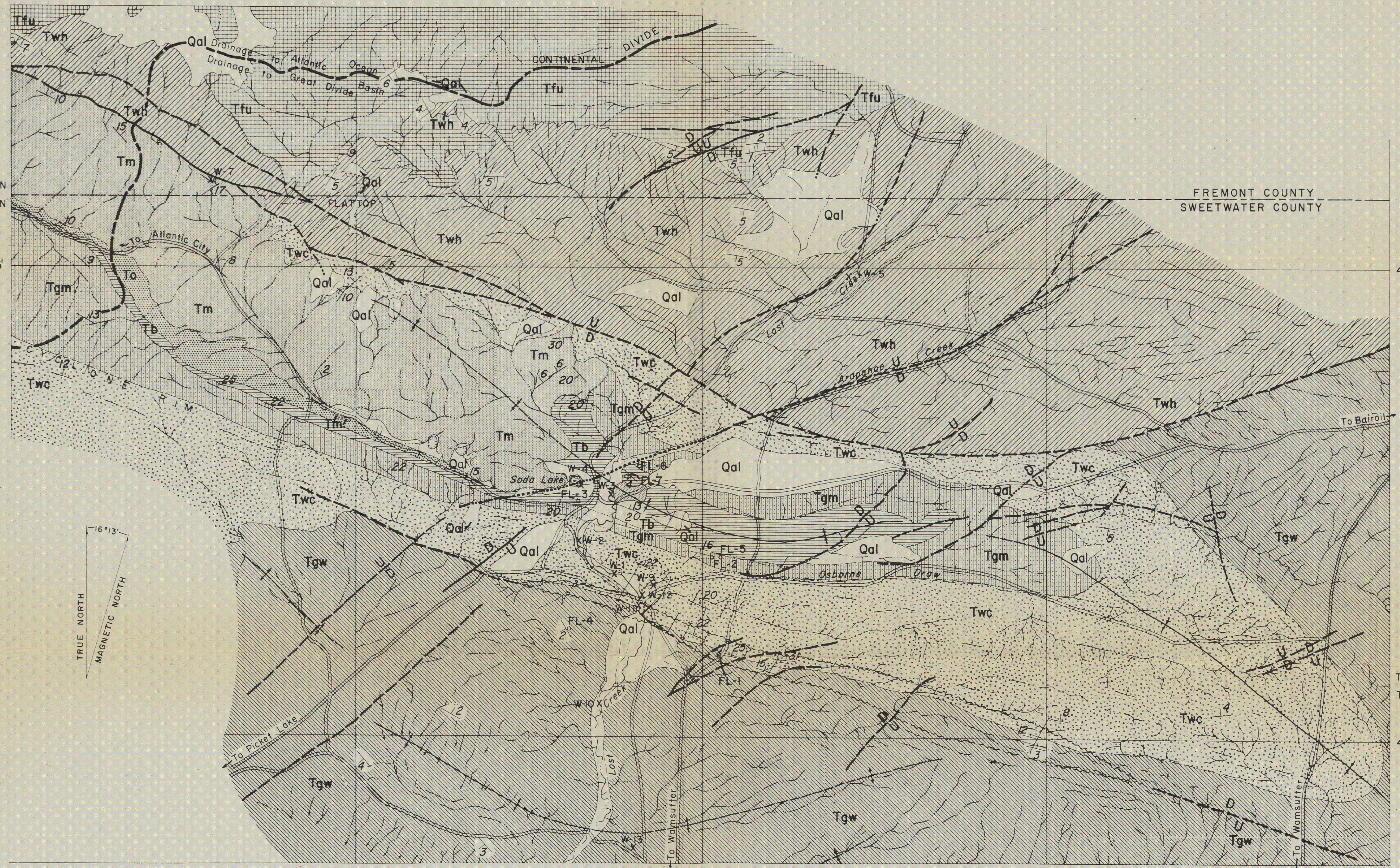
1/ Number of areas checked, both radioactive and non-radioactive

2/ Figures approximate

3/ Number of areas checked in each category divided into total areas checked in all categories

4/ Percent of radioactive areas in each category, i.e.: Total radioactive divided by total checked in each category

5/ Total number of radioactive areas in each category divided by total number of radioactive areas



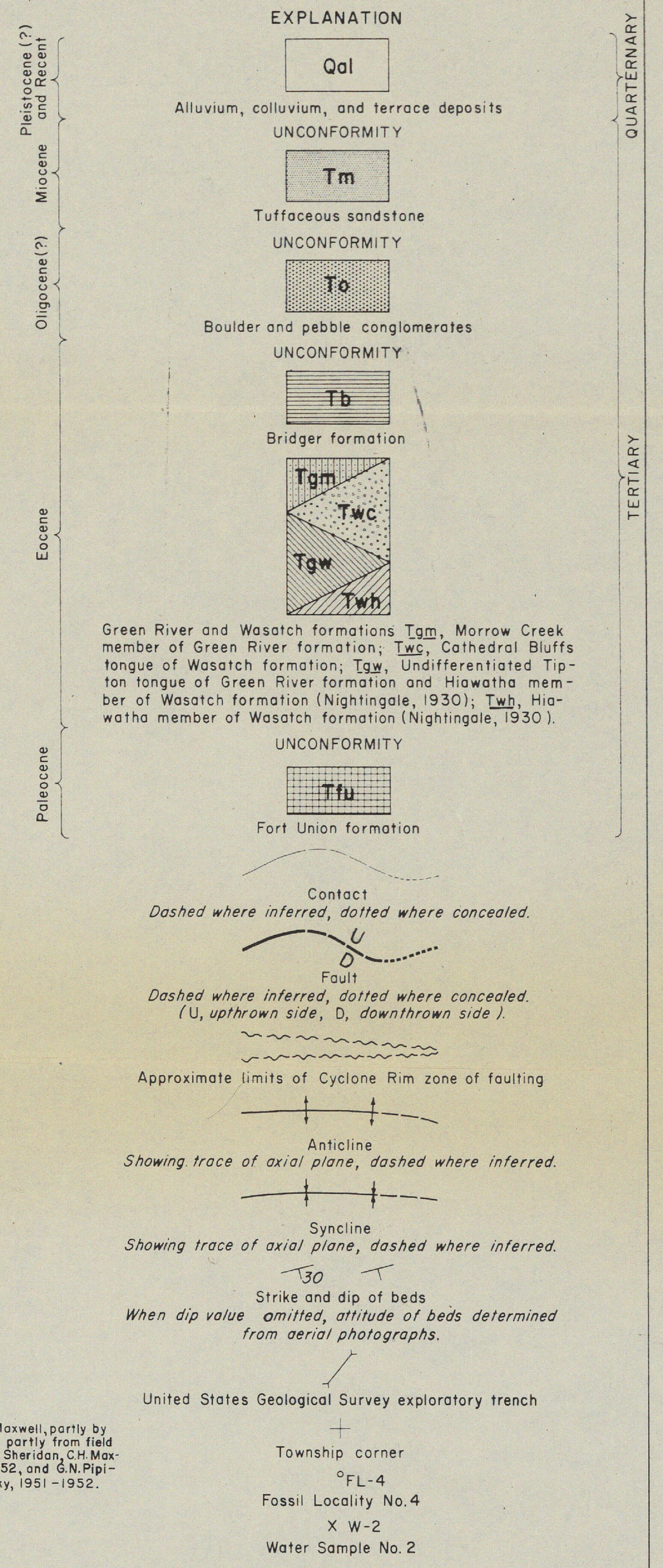


PLATE 2.--AREAL GEOLOGY OF THE LOST CREEK AREA, SWEETWATER AND FREMONT COUNTIES, WYOMING.

0 1 2 3 4 Miles

0 2000 4000 6000 8000 10,000 Feet

Map compiled by C.H.Maxwell, partly by photointerpretation and partly from field data collected by D.M.Sheridan, C.H.Maxwell, and J.T.Collier, 1952, and G.N.Pipiringos and H. Masursky, 1951-1952.

PLATE 4. - GEOLOGIC MAP AND CROSS-SECTIONS OF THE LOST CREEK SCHROECKINGERITE AREA AND VICINITY, SWEETWATER COUNTY, WYOMING

Scale 1:9600
800 400 0 800 1600 2400 3200 4000 Feet
Contour interval 10 feet
Datum is approximate mean sea level

Geology and topography by D.M. Sheridan, C.H. Maxwell, J.T. Collier, and L.R. Page - 1952.

PLATE 5.— DETAILED MAP OF THE EXPLORATION AREA, TRENCHES 1,2,5,6,7,8,9, and 10, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

300 150 0 300 600 900 1200 1500 Feet

Contour interval 5 feet
Datum is approximate mean sea level

Geology and topography by D. G. Wyant, W. N. Sharp, and H. L. Bauer, 1949, and by D. M. Sheridan, C. H. Maxwell, J. T. Collier, and A. W. Rose, 1952.

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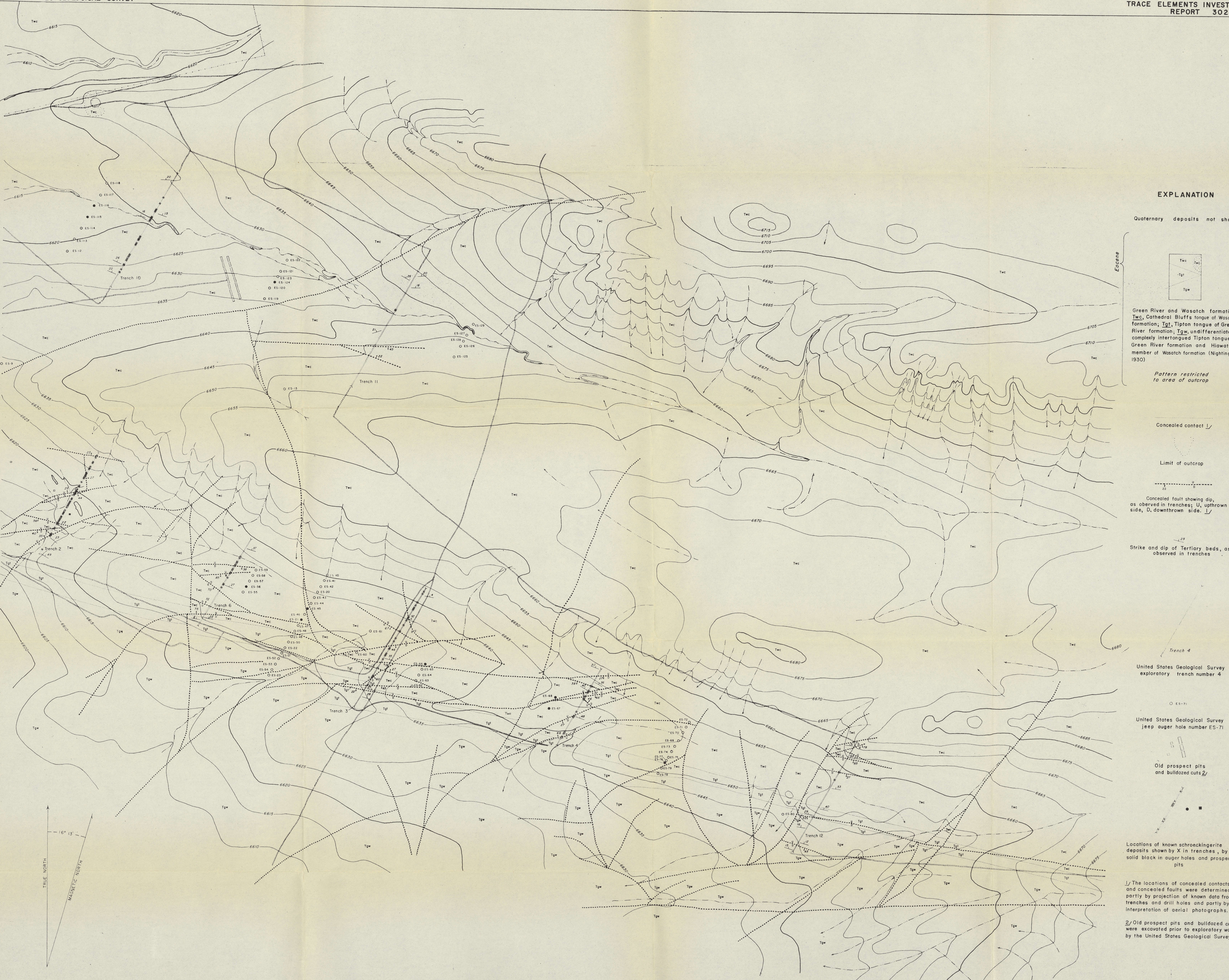


PLATE 6. - DETAILED MAP OF THE EXPLORATION AREA, TRENCHES 2,3,4,6,10,11, and 12, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

300 150 0 300 600 900 1200 1500 Feet

Contour interval 5 feet

Datum is approximate mean sea level

Geology and topography by D. M. Sheridan, C. H. Maxwell, J. T. Collier, and A. W. Rose, 1952

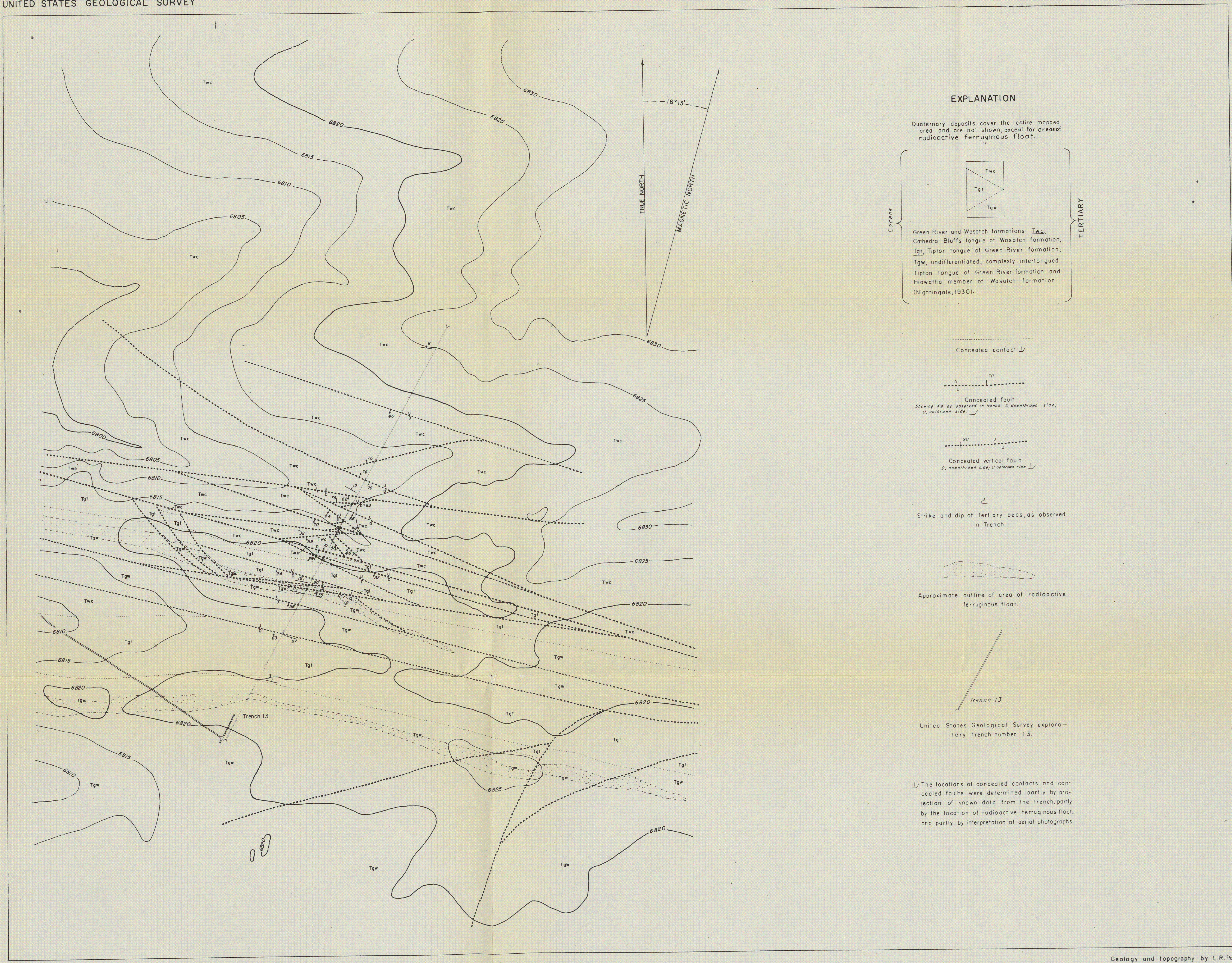


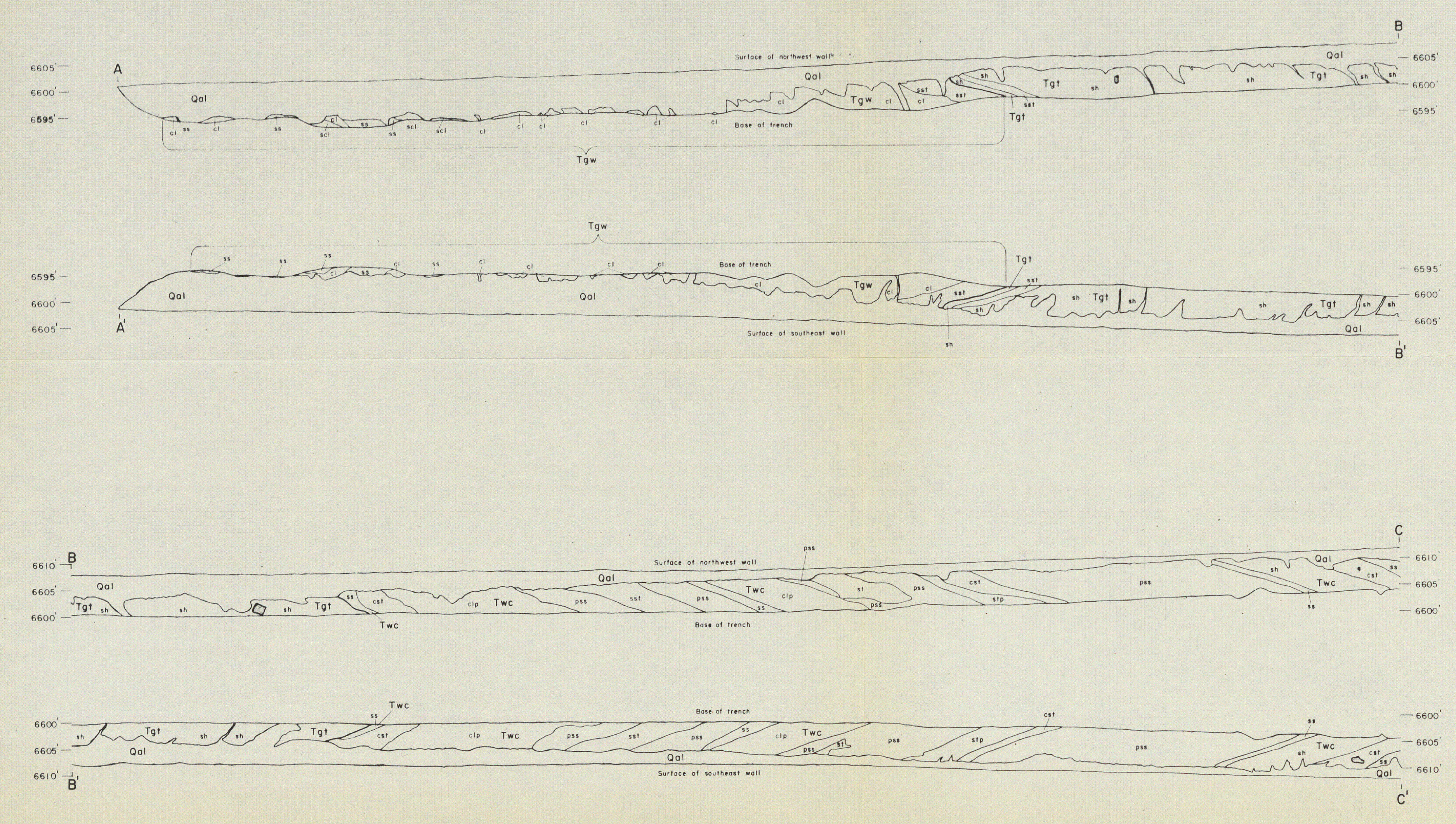
PLATE 7.-DETAILED MAP OF THE VICINITY OF TRENCH 13, LOST CREEK AREA, SWEETWATER COUNTY, WYOMING

Geology and topography by L.R. Page, D.M. Sheridan, C.H. Maxwell, E.P. Beroni, and J.T. Collier, 1952.

300 150 0 300 600 900 1200 1500 Feet

Contour interval 5 feet

Datum is approximate mean sea level



EXPLANATION

QUATERNARY — *Pleistocene(?) and Recent*

Qal — Overburden. Alluvium, colluvium, and terrace deposits

UNCONFORMITY

TERTIARY — *Eocene*

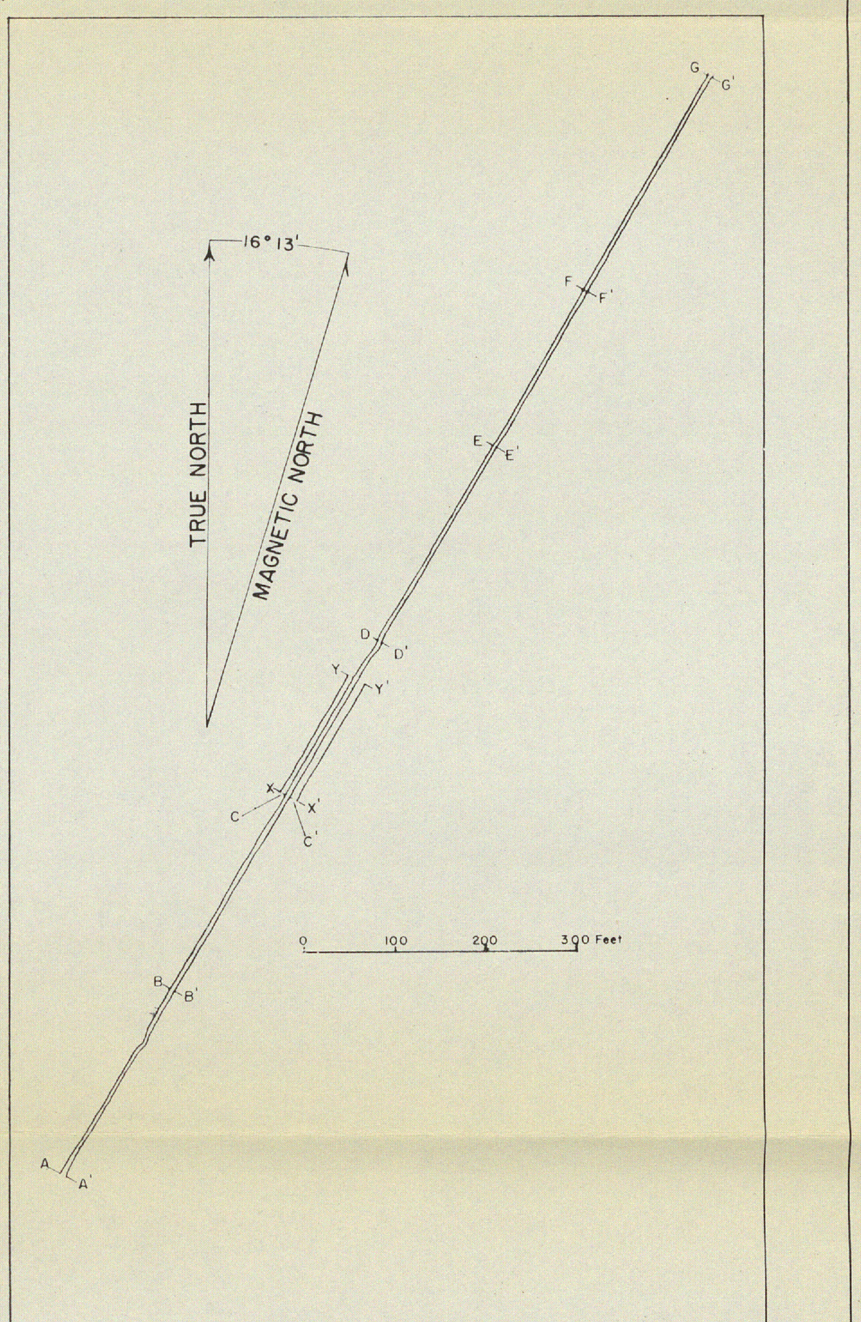
Twc — Cathedral Bluffs tongue of Wasatch formation

Tgt — Tipton tongue of Green River formation

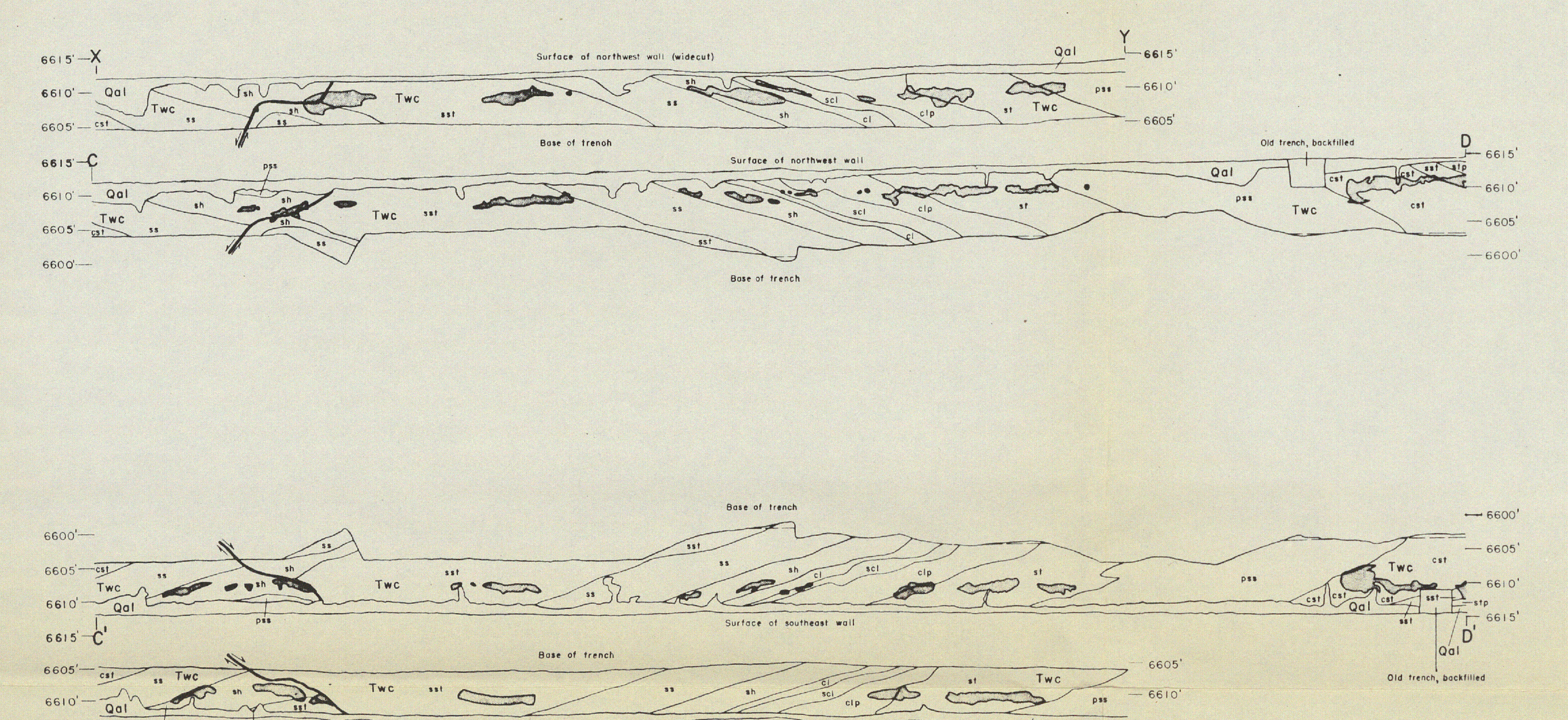
Tgw — Undifferentiated Tipton tongue of Green River formation and Hiawatha member of Wasatch formation (Nightingale, 1930)

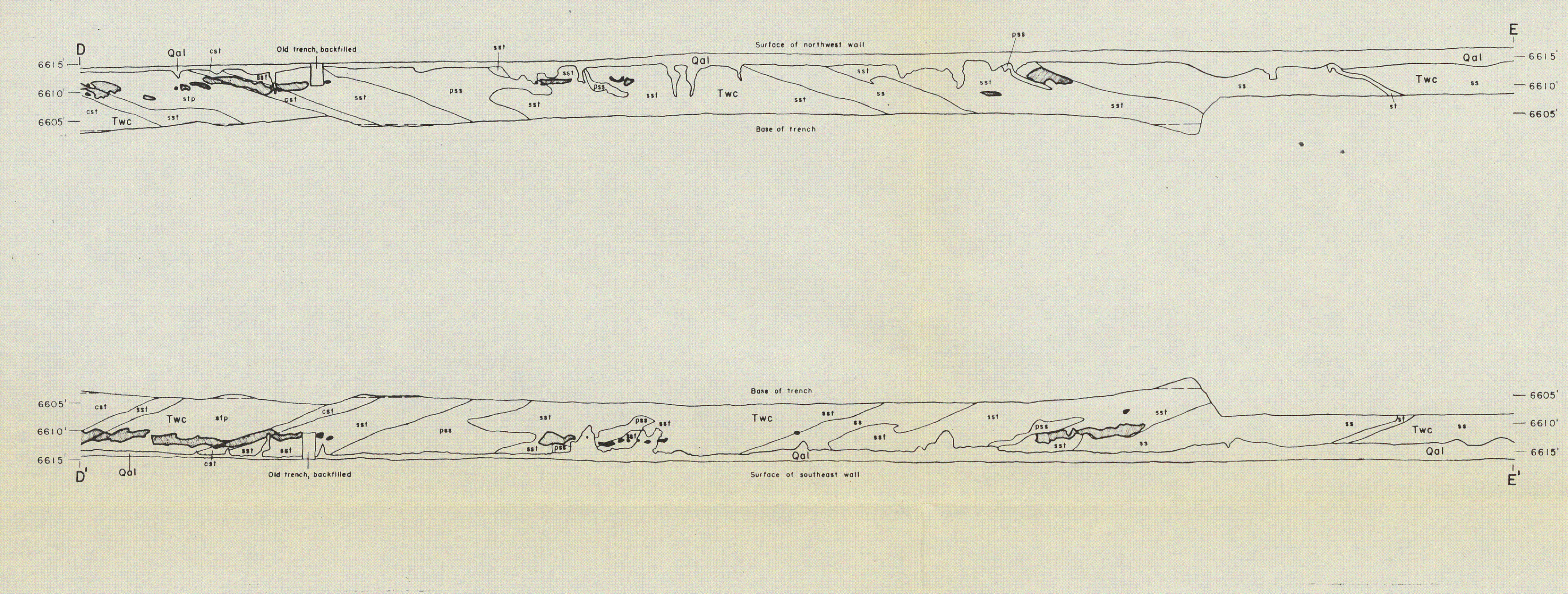
LITHOLOGIC UNITS

Letter symbols are used to designate lithologic units within a Tertiary formation: sh, shale; cl, claystone, massive and blocky, poorly fissile; scl, sandy claystone or clayey sandstone, also interbedded sandstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of claystone and sandstone; clp, interbedded claystone and pebbly sandstone; cst, silty claystone or clayey siltstone, also interbedded siltstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of siltstone and claystone; st, siltstone; sst, sandy siltstone or silty sandstone, also interbedded sandstone and siltstone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of sandstone and siltstone; stp, interbedded siltstone and pebbly sandstone, also pebbly sandstone mottled with irregular lenses of siltstone; ss, sandstone; pss, pebbly sandstone



PLAN OF TRENCH I, SHOWING LOCATION OF SECTIONS





Unconformable contact between Quaternary and Tertiary sediments

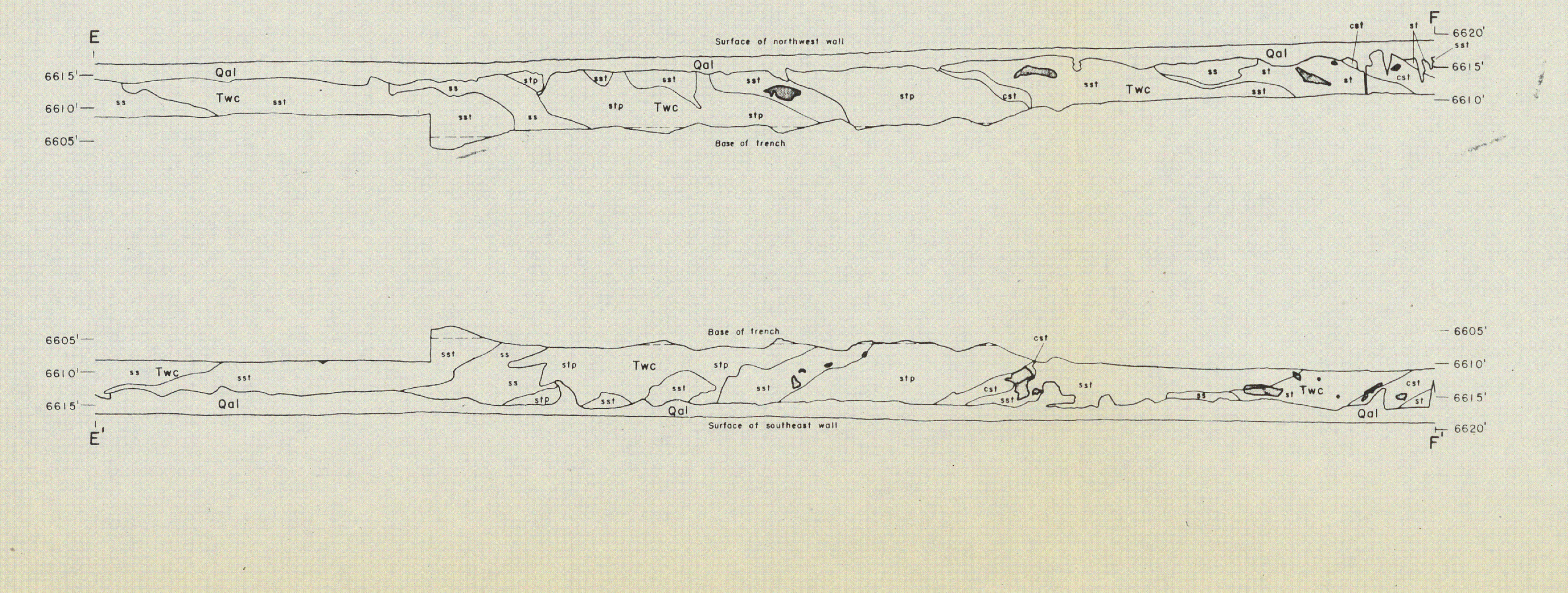
Contact between Tertiary formations

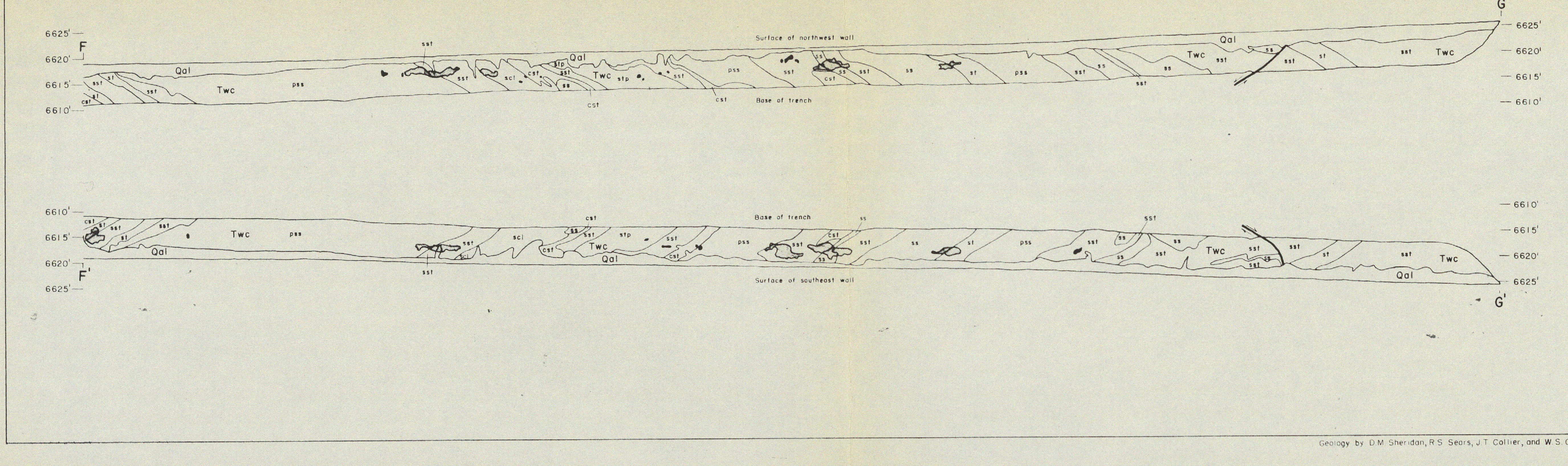
Contact between lithologic units

Fault
Arrows show apparent direction of relative movement

Schroeckingerite deposits
Solid black for small deposits

Water level in trench





Geology by D.M. Sheridan, R.S. Sears, J.T. Collier, and W.S. Cavender, Dec. 1951 - Jan. 1952

PLATE 8.-GEOLOGIC SECTIONS OF TRENCH I, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

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PLATE 8A-ASSAY SECTIONS OF TRENCH I, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

20 10 0 20 40 60 80 Feet

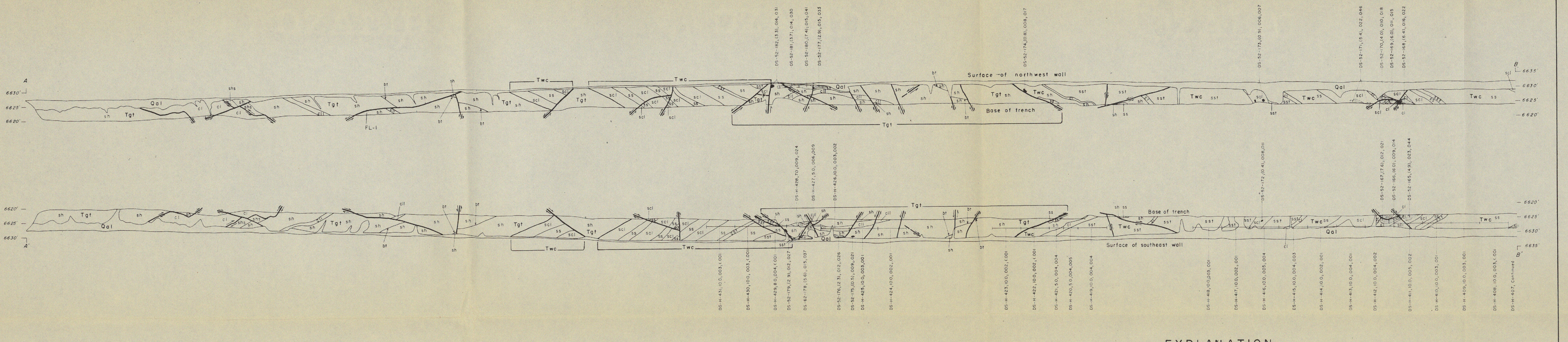
Datum is approximate mean sea level

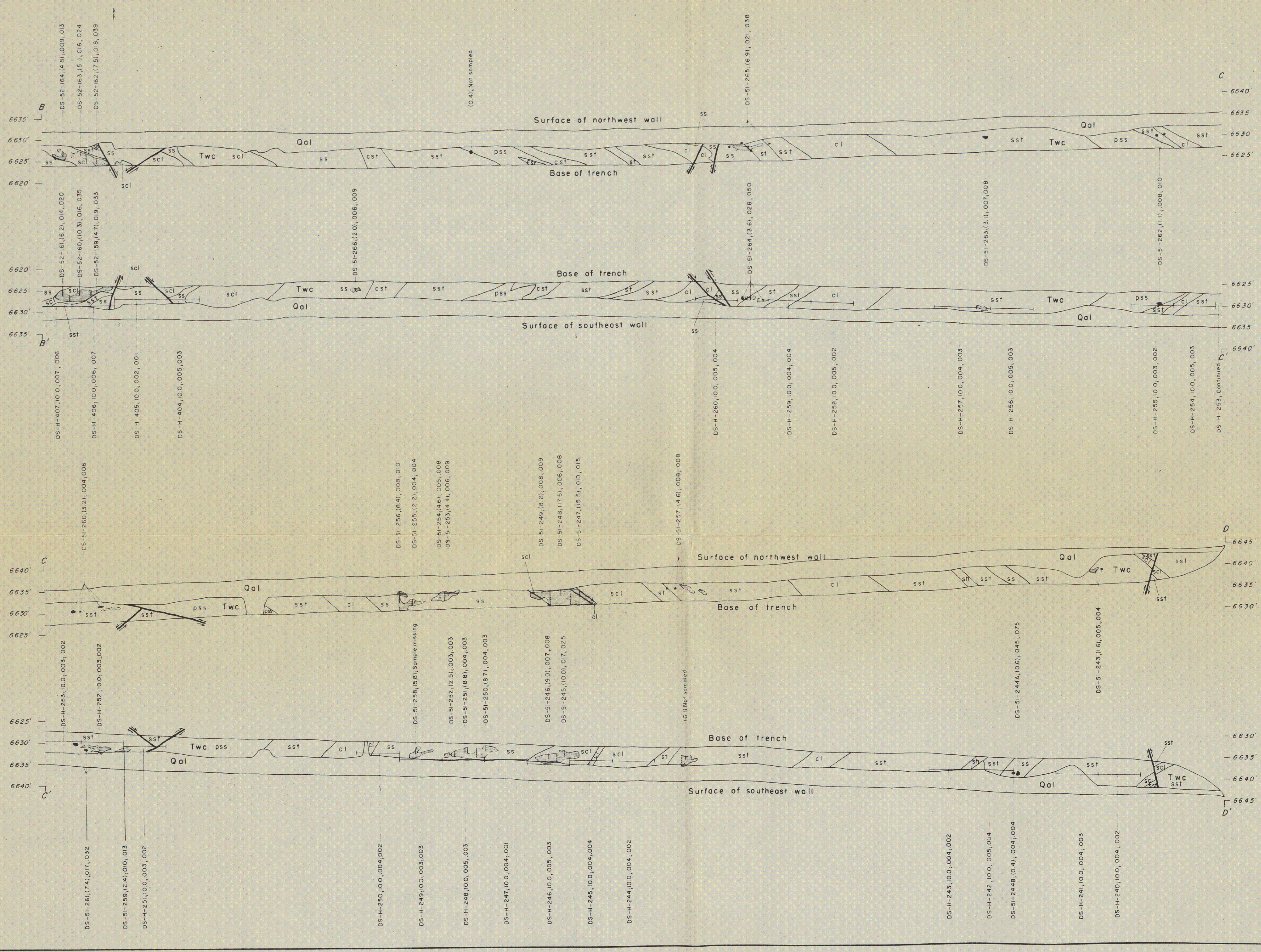
Geology by L.R. Page, D.M. Sheridan, C.T. Pierson, and J.T. Collier, January 1952.

PLATE 9.— GEOLOGIC SECTIONS OF TRENCH 2 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level





EXPLANATION

Pleistocene (?) and Recent — QUATERNARY

Qal
Overburden
Alluvium, colluvium, and terrace deposits

UNCONFORMITY

Eocene — TERTIARY

Twc
Cathedral Bluffs tongue of Wasatch formation

Tgt
Tipton tongue of Green River formation

LITHOLOGIC UNITS

Letter symbols are used to designate lithologic units within a Tertiary formation: sh, shale; bt, bentonite bed (brown waxy claystone, 0.5 inch to 2.5 inches thick); shs, interbedded shale and sandstone, also sandy shale; cl, claystone, massive and blocky, poorly fissile; cll, claystone containing limestone concretions; scl, sandy claystone or clayey sandstone, also interbedded sandstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of claystone and sandstone; cst, silty claystone or clayey siltstone, also interbedded siltstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of siltstone and claystone; st, siltstone; sst, sandy siltstone or silty sandstone, also interbedded sandstone and siltstone when individual beds are less than 1 ft thick, also complexly mottled and interlensed beds of sandstone and siltstone; ss, sandstone; pss, pebbly sandstone.

Unconformable contact between Quaternary and Tertiary sediments

Contact between Tertiary formations

Contact between lithologic units

Fault
Dashed where approximately located
Arrows show apparent direction of relative movement

F
Fault
Direction of relative movement unknown

FL-1
Fossil locality and number

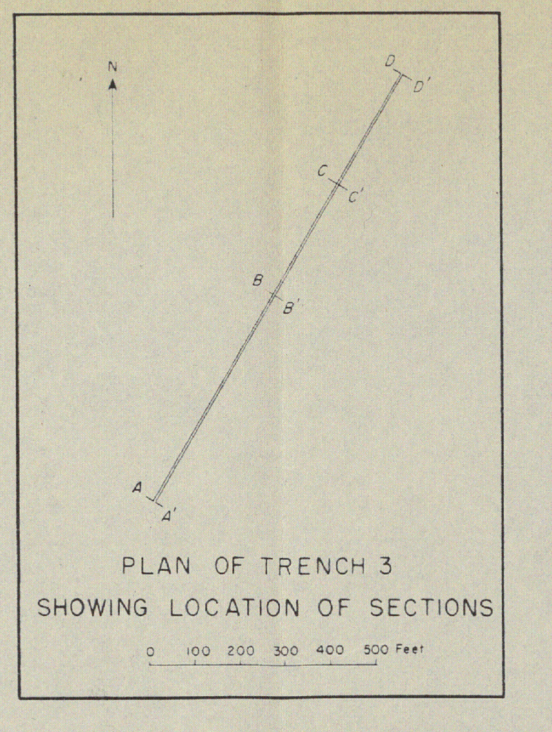
Schroekingerite deposits
Solid black for small deposits

DS-51-246;(9.0);.007,.008
DS-51-245;(10.0);.017;.025

Face-cut samples in schroekingerite deposit: number of sample; (area of sample in square feet); percent equivalent uranium; percent uranium

DS-H-250;10.0;.004;.002

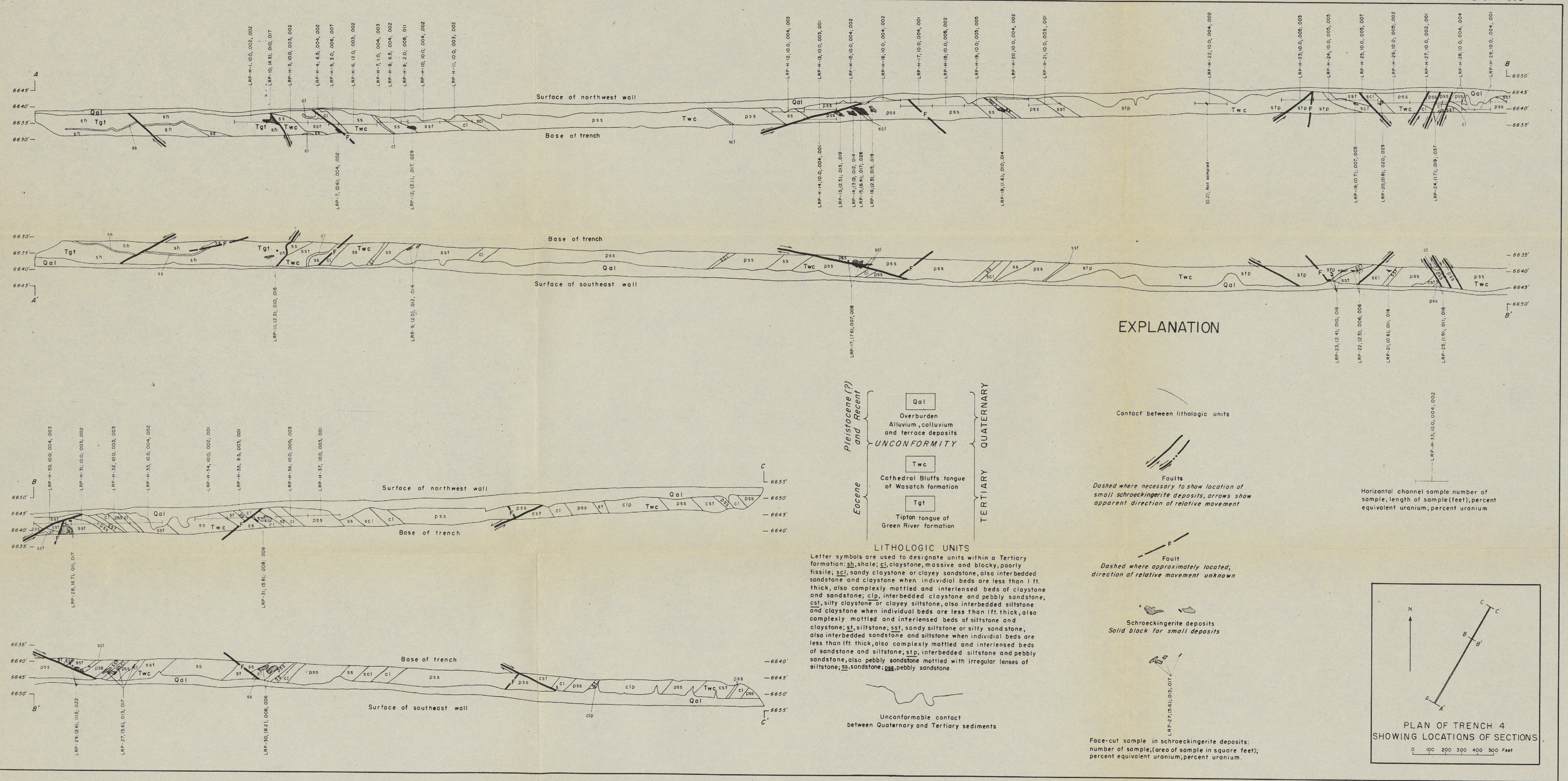
Horizontal channel sample: number of sample; length of sample (feet); percent equivalent uranium; percent uranium



Geology by D.M. Sheridon, J.T. Collier, W.S. Cavender, and R.S. Sears, January 1952, July 1952

PLATE 10—GEOLOGIC SECTIONS OF TRENCH 3 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet
Datum is approximate mean sea level



Geology by L.R. Page, C.T. Pierson, R.S. Sears, W.S. Cavender, and D.M. Sheridan, January 1952

PLATE 11.—GEOLOGIC SECTIONS OF TRENCH 4 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

Geology by D.M. Sheridan, R.S. Sears, W.S. Cavender, and J.T. Collier, January 1952

PLATE 12.—GEOLOGIC SECTIONS OF TRENCH 5 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

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EXPLANATION

Pleistocene(?) and Recent — Qal — Overburden Alluvium, colluvium, and terrace deposits — QUATERNARY

UNCONFORMITY

Eocene — Twc — Cathedral Bluffs tongue of Wasatch formation — TERTIARY

Tgt — Tipton tongue of Green River formation

Contact between Tertiary formations

Contact between lithologic units

Fault
Arrows show apparent direction of relative movement

Fault
Direction of relative movement unknown

LITHOLOGIC UNITS

Letter symbols are used to designate lithologic units within a Tertiary formation: sh, shale; shl, shale containing limestone concretions; shs, interbedded shale and sandstone; cl, claystone, massive and blocky, poorly fissile; scl, sandy claystone or clayey sandstone, also interbedded sandstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of claystone and sandstone; cst, silty claystone or clayey siltstone, also interbedded siltstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of siltstone and claystone; st, siltstone; sst, sandy siltstone or silty sandstone, also interbedded sandstone and siltstone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of sandstone and siltstone; ss, sandstone; pss, pebbly sandstone.

Unconformable contact between Quaternary and Tertiary sediments

Schroeckingerite deposits
Solid black for small deposits

Face-cut samples in schroeckingerite deposits: number of sample; (area of sample in square feet), percent equivalent uranium, percent uranium

PLAN OF TRENCH 6 SHOWING LOCATION OF SECTIONS

Horizontal and slightly inclined channel samples: number of sample; length of sample (feet); percent equivalent uranium; percent uranium

Geology by D. M. Sheridan, R. S. Sears, W. S. Cavender, and J. T. Collier, January 1952

PLATE 13.-GEOLOGIC SECTIONS OF TRENCH 6 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

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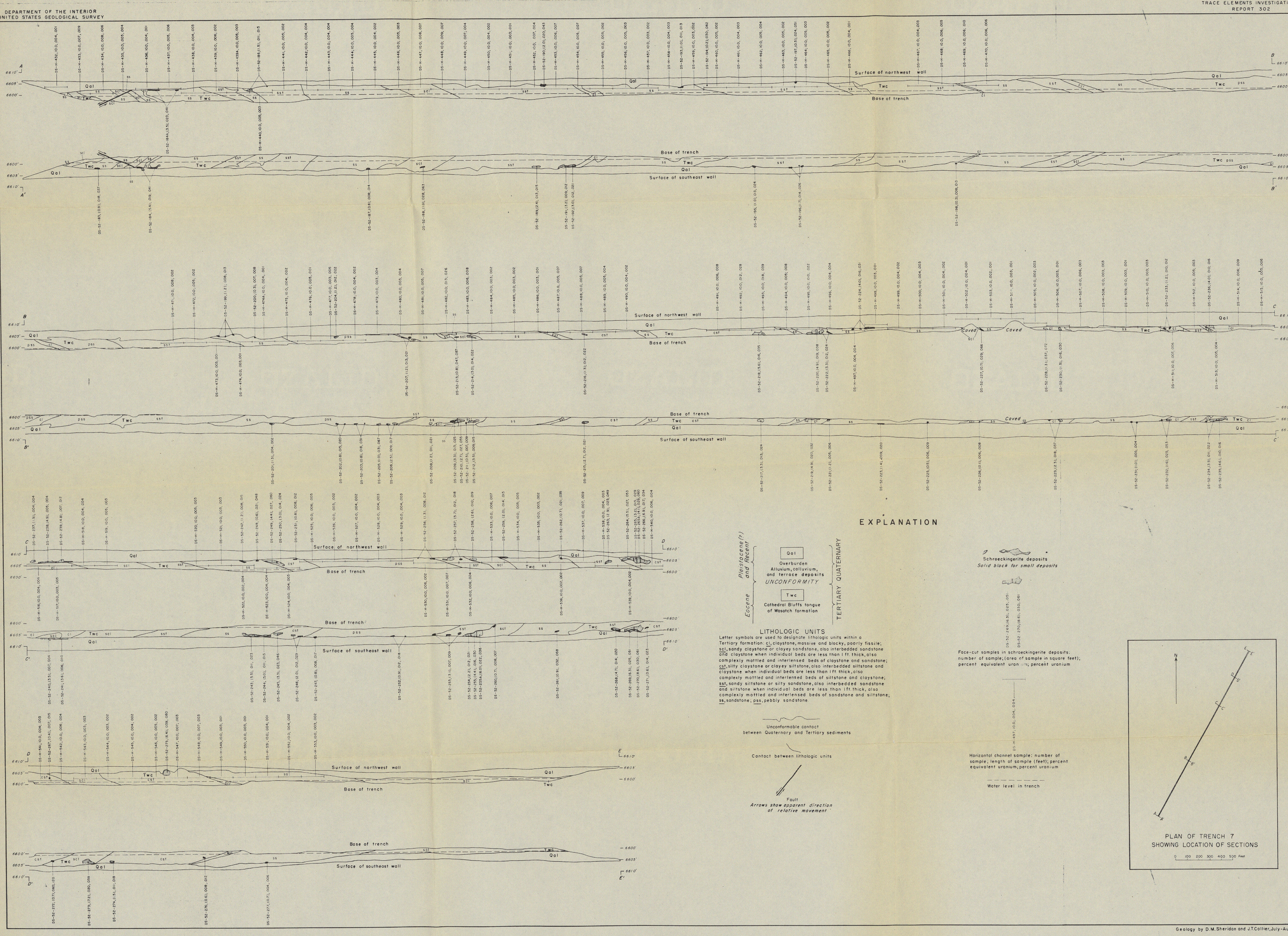

Geology by D.M. Sheridan and J.T. Collier, July-August 1952

PLATE 14— GEOLOGIC SECTIONS OF TRENCH 7 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

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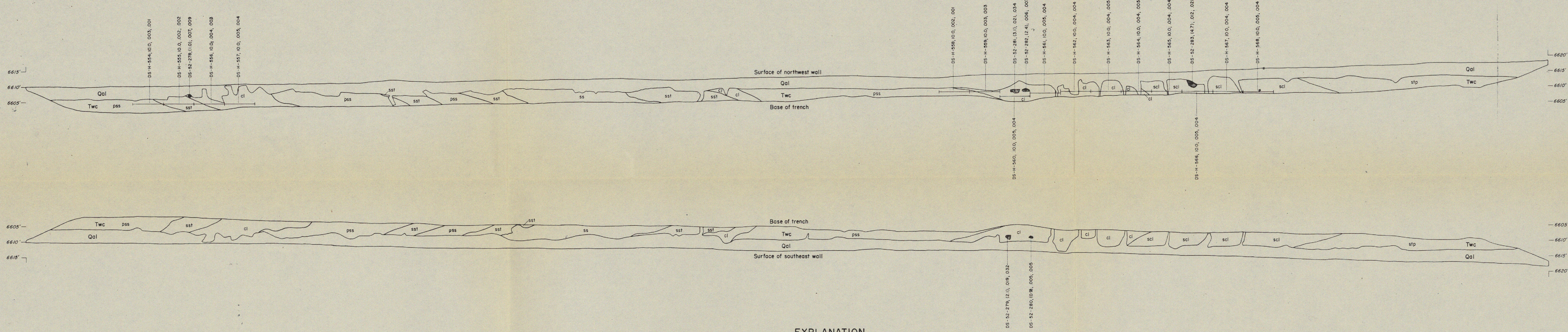
Geology by D. M. Sheridan and J. T. Collier, September 1952

PLATE 15.—GEOLOGIC SECTIONS OF TRENCH 8 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level



EXPLANATION

Qal

Overburden
Alluvium, colluvium, and terrace deposits.

Pleistocene(?) and Recent

UNCONFORMITY

Twc

Cathedral Bluffs tongue of Wasatch formation.

Eocene

QUATERNARY

TERTIARY

LITHOLOGIC UNITS

Letter symbols are used to designate lithologic units within a Tertiary formation: cl, claystone, massive and blocky, poorly fissile; scl, sandy claystone or clayey sandstone, also interbedded sandstone and claystone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of claystone and sandstone; sst, sandy siltstone or silty sandstone, also interbedded sandstone and siltstone when individual beds are less than 1 ft. thick, also complexly mottled and interlensed beds of sandstone and siltstone; stp, interbedded siltstone and pebbly sandstone; ss, sandstone; pss, pebbly sandstone.

Unconformable contact between Quaternary and Tertiary formations

Contact between lithologic units

Schroeckingerite deposits
Solid black for small deposits

DS-52-279, (2.1); .019; .032

Face-cut sample in schroeckingerite deposit: number of sample; (area of sample in square feet); percent equivalent uranium; percent uranium.

DS-H-557, 10.0, .005, .004

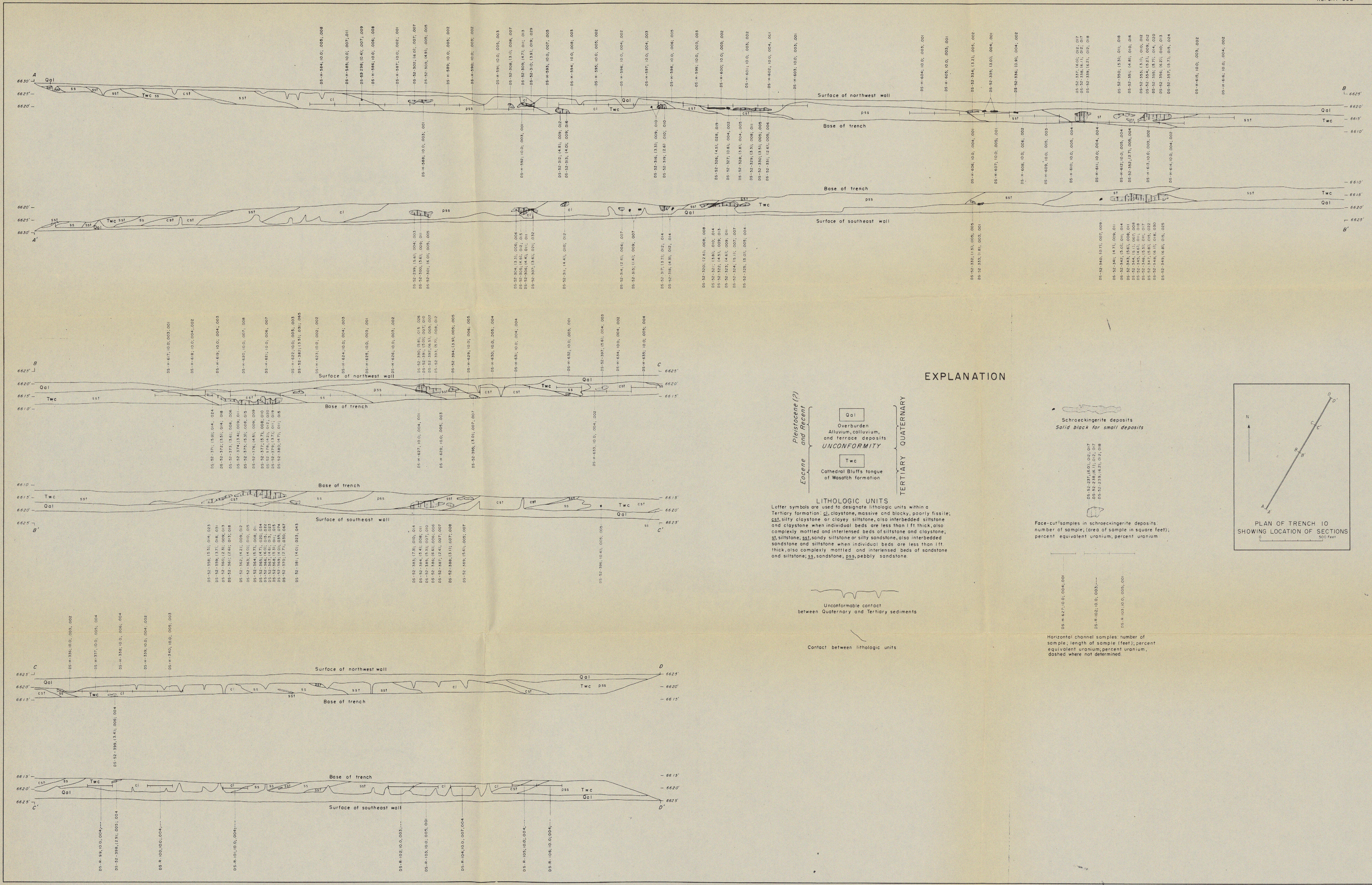
Horizontal channel sample: number of sample; length of sample (feet); percent equivalent uranium; percent uranium

Geology by D. M. Sheridan and J. T. Collier, August 1952.

PLATE 16.—GEOLOGIC SECTIONS OF TRENCH 9 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level



Geology by D.M. Sheridan and J.T. Collier, September 1952

PLATE 17.— GEOLOGIC SECTIONS OF TRENCH 10 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

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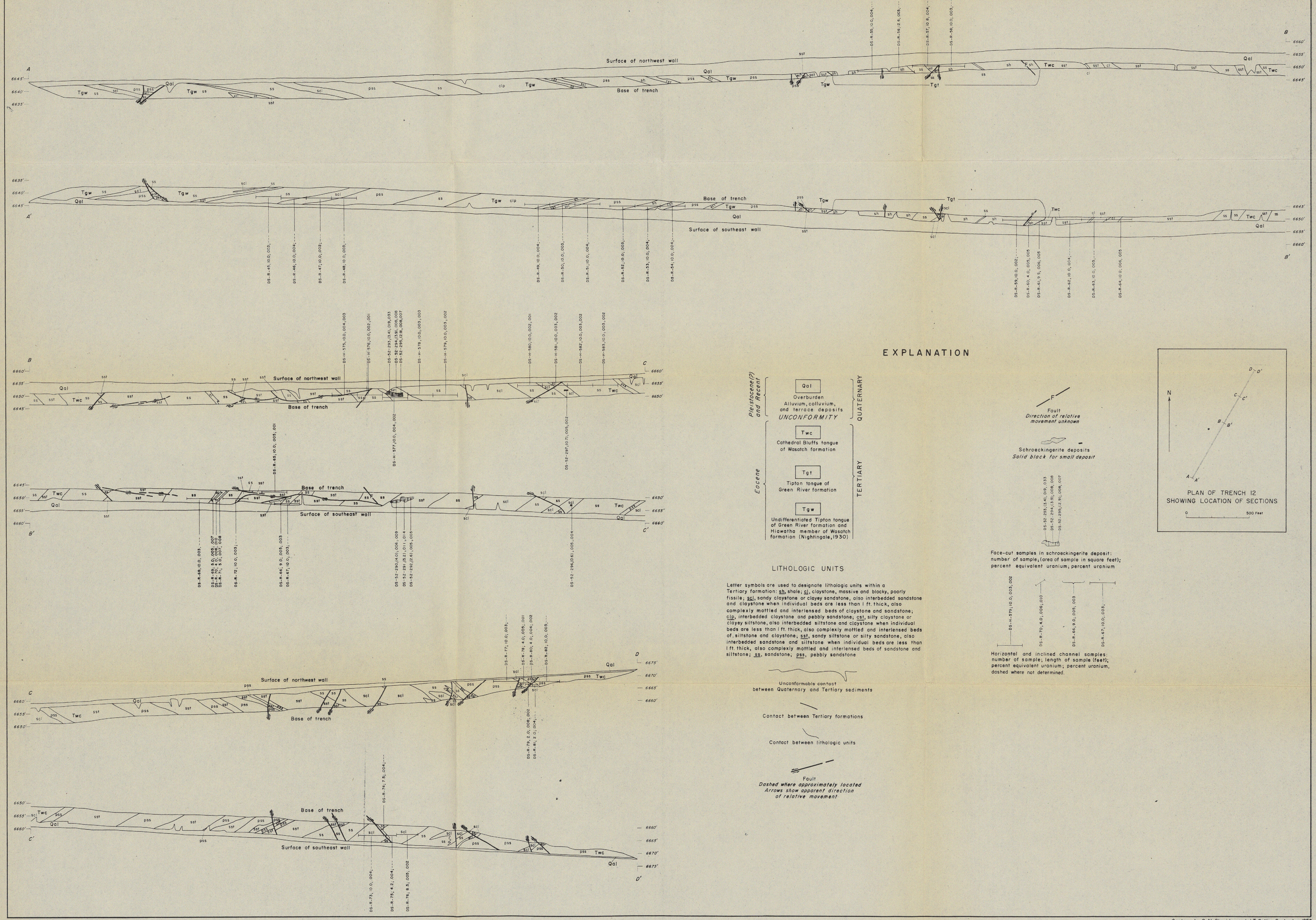
Geology by D.M. Sheridan and J.T. Collier, August 1952

PLATE 18—GEOLOGIC SECTIONS OF TRENCH 11 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level



Geology by D. M. Sheridan and J. T. Collier, September 1952

PLATE 19.—GEOLOGIC SECTIONS OF TRENCH 12 SHOWING ASSAYS, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING.

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

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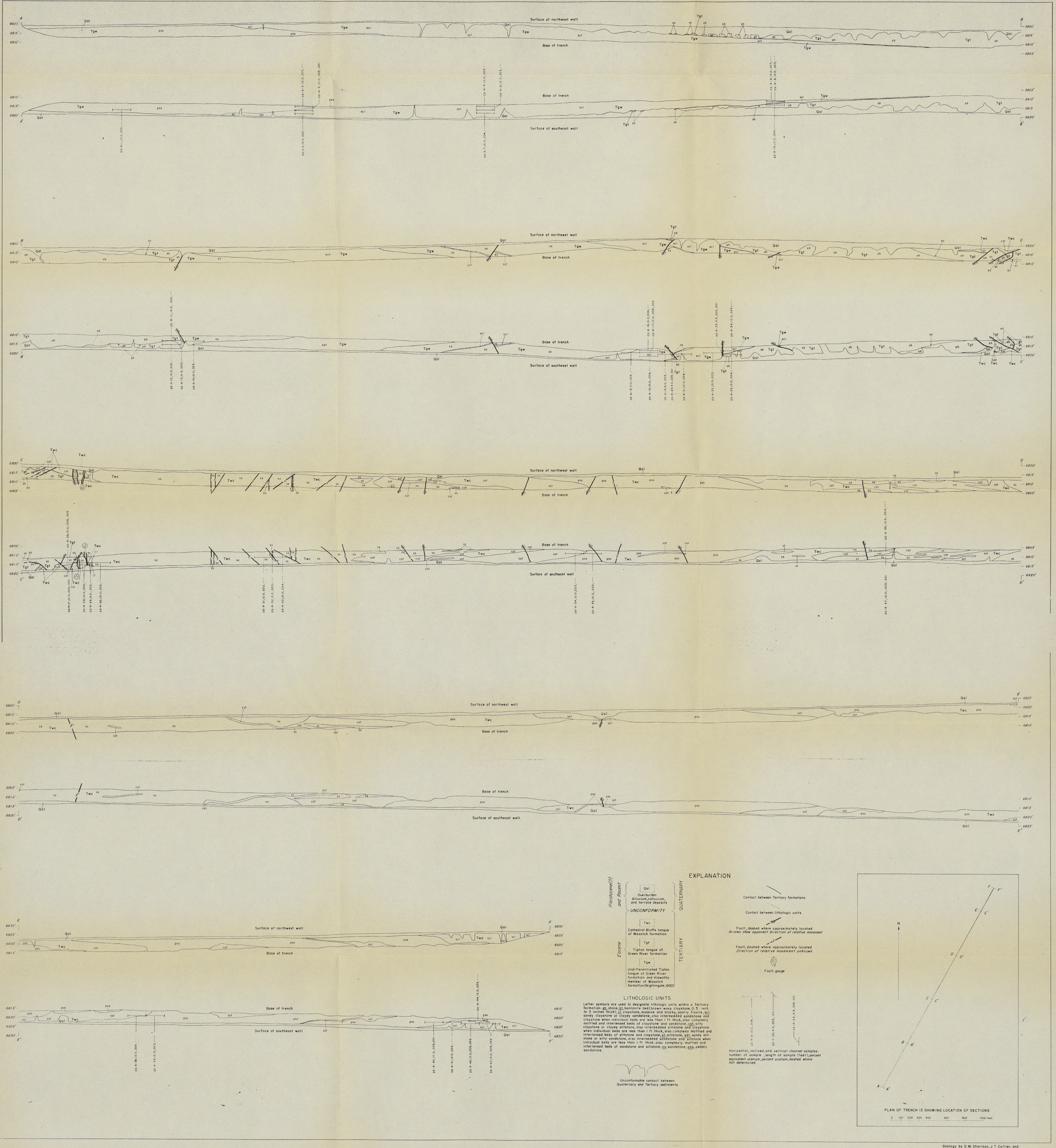

Geology by D. M. Sheridan, J. T. Collier, and L. R. Page, August - September 1952

PLATE 20 - GEOLOGIC SECTIONS OF TRENCH 13 SHOWING ASSAYS, LOST CREEK AREA, SWEETWATER COUNTY, WYOMING

20 10 0 20 40 60 80 Feet

Datum is approximate mean sea level

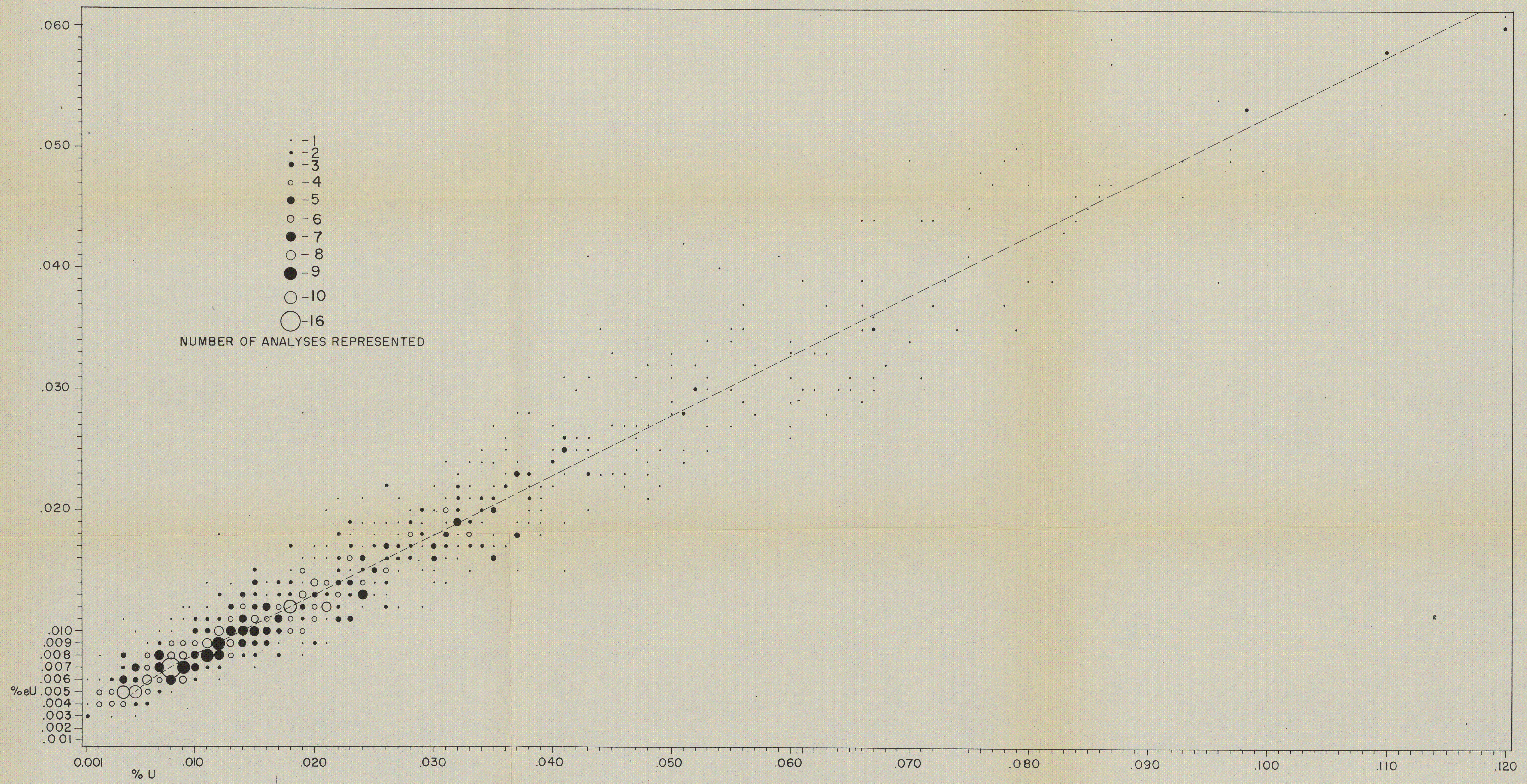

PLATE 22.—GRAPH SHOWING RELATIONSHIP OF EQUIVALENT URANIUM TO URANIUM IN THE LOST CREEK SCHROECKINGERITE DEPOSITS, ANALYSES OF 820 SAMPLES FROM TRENCHES

Table 1.--Paleontologic data, Lost Creek area, Sweetwater County, Wyoming
Identification of fossils by U. S. Geological Survey: fish remains by D.H. Dunkle, algae by Richard Rezak, Mollusks by J.B. Reeside, Jr., ostracods by I.G. Sohn.

Fossil locality number (shown on plate 2)	Stratigraphic section number	Stratigraphic position 1/	Fossils (all reported to be Eocene in age)	Specimen number
FL-1 2/	8	In the uppermost lenticular extension of the Tipton tongue of the Green River formation. It is in brown shale 27 feet below the top of an incomplete section totalling 70.2 feet in exposed thickness. This upper extension of the Tipton tongue is stratigraphically about 150± feet above a lower extension of the tongue.	Mioplosus cf. beani (pl. 22) 3/ Phareodus sp.? 3/ Matted mass of smooth ostracod valves, all flattened; not the same species as that present in collection by G.N. Pipiringos from Tipton tongue 5 miles northeast of Tipton, but difference in species probably due to difference in ecology.	DS-F-1, DS-F-2, DS-F-3, DS-F-6, DS-F-4
FL-2	11	In a well-cemented sandstone bed 32.3 feet below the top of the Morrow Creek member of the Green River formation. This section of the Morrow Creek member is 238.8 feet thick.	Unio shoshonensis White Goniobasis nodulifera Meek	DS-F-7 and DS-F-8
FL-3	---	In the lower part of the Bridger formation. (No stratigraphic section was measured at this fossil locality)	Australorbis spectabilis (Meek)	DS-F-9
FL-4	---	Coquina layer in brown shale in an extension of the Tipton tongue of the Green River formation. This extension of the tongue is about 150± feet stratigraphically below the uppermost lenticular extension of the tongue (see FL-1).	Ostracods--very close in shape and size to Cyprois cf. C. marginata (Strauss) as identified by Swain (1949, p. 177, pl. 32, fig. 14) from the Flagstaff member of the Wasatch formation, 1 mile west of Ephraim, Utah.	DS-F-10 and DS-F-11
FL-5	11	In a limestone bed which is the uppermost bed of the Morrow Creek member of the Green River formation. The limestone bed contains algal structures.	Chlorellopsis coloniata Reis, with thick covering layers of Rivularia-like mats.	DS-F-12
FL-6	---	In a limestone bed which is the uppermost bed of the Morrow Creek member of the Green River formation. The limestone bed contains algal structures and is at the same stratigraphic horizon as the bed containing fossil locality number 5.	Chlorellopsis coloniata Reis, with covering layers of Rivularia-like mats.	DS-F-13
FL-7	---	In a 1-foot bed of pale green-yellow, calcareous claystone in the Bridger formation. Although no stratigraphic section was measured at this locality, the equivalent claystone bed is cited in stratigraphic section 12, 197 feet above the base of the Bridger formation.	Laminated algal structures suggestive of the form-genus Collenia.	DS-F-14

1/ None of the fossils collected for this report is diagnostic for specific locations in the stratigraphic column, except that they all are reported to be Eocene in age. The stratigraphic positions cited in this table represent the positions within the various Eocene units as mapped by the authors of this report.

2/ Location also shown on section A-B of plate 10.

3/ Reported by Dunkle as Green River.

Table 2.--Known occurrences of schroeckingerite

Location	Other uranium minerals	Occurrence and geologic relations	References	Remarks
1. Lost Creek area, Sweetwater County, Wyoming--largest known group of schroeckingerite deposits in the world.	None identified	Rounded to ellipsoidal pellets; also flakes and coatings. In caliche-type, near-surface deposits in Eocene rocks (Cathedral Bluffs tongue of Wasatch formation and Tipton tongue of Green River formation) and in Quaternary overburden. Deposits are in and near the Cyclone Rim zone of faulting.	The present report (see also references cited in chapter on schroeckingerite deposits)	Immediate source of uranium is uraniferous ground water. Writers of present report believe that uranium is coming from unexposed uranium deposits of relatively high grade; these hypothetical source deposits are believed to be in the Lost Creek area.
2. Joachimsthal, Bohemia (Czechoslovakia)--the type locality.	Uraninite	Globular and flaky groups on uraninite. Dana's system of Mineralogy (Palache, Berman, and Frondel, 1946, no. I, p. 614) lists Joachimsthal under hydrothermal Co-Ni-Bi-Ag-As veins, and lists the oxide occurrences there as pitchblende.	Descriptions: v. Schröckinger (1875, p. 66-68); Schrauf (1873, p. 173-178); Novacek (1939, p. 317-323)	---
3. Marysvale area, Piute County, Utah	Uranophane, autunite, torbernite, pitchblende	In a group of secondary uranium minerals in weathered and hydrothermally-altered Tertiary igneous rocks. Occurrences are in weathered zone along faults which contain pitchblende-bearing veins at depth. The schroeckingerite is one of a group of secondary uranium minerals resulting from weathering of hydrothermal vein deposits of pitchblende, quartz, fluorite, pyrite, and sulfides.	D. G. Wyant, F. Stugard, Jr., and E. P. Kaiser (written communication, 1950) H. C. Granger and H. L. Bauer, Jr. (written communication, 1950) Stugard, Wyant, and Gude (1952)	---
4. Hillside mine, Yavapai County, Arizona	With andersonite, swartzite, and bayleyite on 300-foot level. (Note: pitchblende and johannite occur on 400-foot level.)	Schroeckingerite and other secondary uranium minerals occur as coating 1/8 inch thick on gypsum on mine walls on 300-foot level; located in oxidized zone 40 feet above water level. Mine openings are in Cretaceous or early Tertiary vein cutting Precambrian rocks. Vein contains pyrite, arsenopyrite, galena, sphalerite, tetrahedrite, and copper sulfides. Axelrod and others (1951, p. 2) state that source of uranium is unknown but may be in the vein or in small aplite-pegmatite dikes.	Axelrod, Grimaldi, Milton, and Murata (1951, p. 1-22).	---
5. Cochetopa Creek district, northwestern Saguache County, Colorado	Autunite (pitchblende at depth)	Schroeckingerite and other highly-colored secondary uranium minerals occur in hydrothermally-altered zone along a fault cutting Precambrian rocks and the Morrison formation (Jurassic). Pitchblende deposits have been cut by drill hole along the fault. The pitchblende is in hydrothermal deposits, Tertiary in age.	Thornburg (1955)	Presumably the schroeckingerite and other secondary uranium minerals were derived from the pitchblende deposits.
6. Black Cloud Mine, Gold Hill District, Boulder County, Colorado	Pitchblende (?)	Schroeckingerite occurs as pellets on mud-coating on mine walls. Mine is in Tertiary vein cutting Precambrian rocks. It is Au-Ag, galena, sphalerite vein. Dark clay-like material filling fissures in vein may be pitchblende (R.U. King, written communication, 1956).	Schroeckingerite observed by R. H. Campbell (oral communication, 1955). Mine description (R. U. King, written communication, 1956)	Presumably the source of the uranium may be pitchblende in hydrothermal vein.
7. Shinarump No. 1 Uranium Mine, Seven Mile Canyon area, Grand County, Utah	Becquerelite, uraninite	Schroeckingerite occurs with becquerelite along fractures and bedding planes near edges of uraninite deposit nearest the surface. Mine is in basal siltstone of Chinle formation (Triassic). Finch (1954, p. 13) states that the most abundant ore mineral is uraninite and believes the origin of the uranium deposit to be hydrothermal.	Finch (1954)	The schroeckingerite and becquerelite presumably are secondary alteration products derived from the uraninite deposit.
8. Shinarump No. 3 Mine, Seven Mile Canyon area, Grand County, Utah	Uraninite, tyuyamunite, carnotite	Schroeckingerite occurs with other uranium minerals and with copper minerals at contact of Moenkopi and Chinle formations (Triassic). Hurlbut (1954, p. 902) states that the schroeckingerite occurs with gypsum in seams in shale.	Gruner and Gardiner (1952, p. 22-23). Hurlbut (1954, p. 901-907)	Presumably the schroeckingerite is a secondary alteration product derived from copper-uranium deposit.
9. Hideout No. 1 (Tiger) Mine, on Deer Flats, north side of White Canyon, San Juan County, Utah	Bayleyite, pitchblende or uraninite	Schroeckingerite occurs with bayleyite in yellow efflorescent crust in adit less than 100 feet from cliff face. Mine is in a copper-uranium deposit in the Shinarump conglomerate (Triassic). Benson and others (1952, p. 8) favor the hypothesis that the copper-uranium ores of White Canyon area were brought to their present locations by hydrothermal solutions in early Tertiary time.	Stern and Weeks (1952) Benson, Trites, Beroni, and Feeger (1952) A.F. Trites, Jr., and T. L. Finnell (written communication, 1953)	Presumably the schroeckingerite and bayleyite were derived from the copper-uranium deposit.
10. Cane Creek anticline, Moab district, San Juan County, Utah	Andersonite, bayleyite, carnotite, metatyuyamunite, betazippeite	Schroeckingerite occurs with other uranium minerals and copper minerals in deposits in the Chinle formation (Triassic). The deposits are localized along faults on the Cane Creek anticline.	E. N. Hinrichs (oral communication, 1955)	---
11. Colorado No. 1 Mine, Moab district, San Juan County, Utah	Uraninite	Schroeckingerite occurs as coatings on fractures in uraninite deposits in Moss Back member of Chinle formation (Triassic). The schroeckingerite is an alteration product of uraninite.	E. N. Hinrichs (oral communication, 1955)	---
12. Crabapple claim, Green River district, Utah	Pitchblende	Schroeckingerite occurs as an alteration product of pitchblende in deposit in Chinle formation (Triassic). According to W. I. Finch (oral communication, 1955) the deposit is the Colorado Plateau type, contains uranium and minor copper and vanadium, is localized in an ancient stream channel, and is associated with carbonaceous material.	Schroeckingerite occurrence:--Weeks and Thompson (1954, p. 35). Geologic data:--W. I. Finch (oral communication, 1955)	---
13. McCoy-Flattop area, Thompsons district, 15 miles southeast of Thompsons, Grand County, Utah	Carnotite	Schroeckingerite is in a near-surface deposit in mudstone, Carnotite is the principal uranium mineral in nearby deposits in the Thompsons district.	Cannon (1952, p. 748, 751)--botanical studies	Presumably the schroeckingerite is a secondary alteration product derived from nearby carnotite deposits.
14. Parco No. 25 Mine, Yellow Cat group, Thompsons district, Grand County, Utah.	---	Schroeckingerite occurrence listed by Weeks and Thompson (1954, p. 36) but no geologic relations given.	Weeks and Thompson (1954, p. 36)	Presumably the schroeckingerite is a secondary mineral derived from nearby carnotite deposits of the Colorado Plateau type.
15. Trader Smith's claims, 15 miles west of Cisco, Grand County, Utah	---	Schroeckingerite occurrence listed by Gruner and Gardiner (1952, p. 21); no geologic relations given.	Gruner and Gardiner (1952, p. 21)	Presumably the schroeckingerite is a secondary mineral derived from uranium deposits of the Colorado Plateau type.
16. Sevastopol claims, Butler Wash, 15 miles south of Blanding, San Juan County, Utah	---	Do.	Do.	Do.
17. Poison Basin area, Carbon County, Wyoming	Uranophane	Schroeckingerite is the principal uranium mineral in one sample and uranophane is the principal uranium mineral in 3 selected samples. All occurrences are in the Browns Park formation of probable Miocene age.	Vine and Prichard (1954)	---
18. Green Mountain area, Fremont County, Wyoming	---	Schroeckingerite occurs in the Cody shale (upper Cretaceous) along the underside of a thrust fault.	M. H. Bergendahl (oral communication, 1955)	

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Table 6.--Comparison of channel samples and face-cut samples from representative schroeckingerite deposits in Trench 1, Lost Creek schroeckingerite deposits, Sweetwater County, Wyoming

Location of deposit or portion of a deposit (see Plate 8A) 1/	CHANNEL SAMPLES						FACE-CUT SAMPLES			
	Sample number	Equivalent uranium (percent)	Uranium (percent)	Length of sample (feet)	Average for deposit or portion of a deposit: Equivalent uranium 2/ (percent)	Average for deposit or portion of a deposit: Uranium 3/ (percent)	Sample number	Area of sample (square feet)	Equivalent uranium (percent)	Uranium (percent)
Section C'-D'	DS-51-24	0.015	0.019	1.0	0.012	0.022	DS-G-1	6.2	0.012	0.014
	DS-51-25	.010	.024	1.3						
Section C'-D'	DS-51-63	.009	.012	1.5	.010	.012	DS-G-3	4.9	.016	.024
	DS-51-64	.011	.012	1.0						
Section C'-D'	DS-51-65	.013	.022	2.0	.014	.024	DS-G-4	6.2	.017	.025
	DS-51-66	.016	.027	1.8						
Sections C'-D' and D'-E'	DS-51-76	.006	.004	2.8	.011	.014	DS-G-5	10.8	.012	.010
	DS-51-113	.020	.033	1.8						
	DS-51-114	.008	.010	1.5						
Section D'-E'	DS-51-122	.035	.067	1.3	.030	.063	DS-G-6	7.3	.040	.070
	DS-51-123	.026	.060	1.6						
Section D'-E'	DS-51-124	.030	.065	1.5	.038	.077	DS-G-7	7.4	.028	.050
	DS-51-125	.049	.093	1.2						
Section D-E	DS-51-108	.018	.028	1.5	.020	.031	DS-G-8	5.7	.020	.033
	DS-51-109	.021	.032	2.8						
Section D-E	DS-51-110	.022	.038	1.7	.030	.056	DS-G-9	7.5	.026	.041
	DS-51-111	.034	.060	1.5						
	DS-51-112	.039	.082	1.0						
Section E-F	DS-51-159	.035	.055	0.9	.028	.043	DS-G-10	4.0	.025	.024
	DS-51-160	.020	.021	1.0						
	DS-51-161	.019	.023	1.1						
	DS-H-157	.031	.051	4.3						
Section E'-F'	DS-51-207	.007	.010	1.1	.009	.015	DS-G-11	4.2	.012	.013
	DS-51-208	.010	.018	1.7						
Section E'-F'	DS-51-209	.009	.008	1.6	.008	.007	DS-G-12	3.0	.007	.006
	DS-51-210	.006	.005	0.9						
Section E'-F'	DS-51-217	.014	.020	0.8	.014	.020	DS-G-13	1.0	.012	.016
Section F'-G'	DS-51-218	.009	.007	1.6	.012	.018	DS-G-14	6.2	.015	.019
	DS-51-220	.015	.027	2.0						
	DS-51-221	.012	.018	1.0						
Section F-G	DS-51-184	.013	.013	0.9	.010	.011	DS-G-15	5.0	.013	.019
	DS-51-185	.008	.006	1.2						
	DS-51-186	.010	.012	1.4						
	DS-H-189	.010	.011	4.2						
Section F-G	DS-51-201	.018	.033	1.1	.011	.016	DS-G-16	8.0	.014	.015
	DS-51-202	.008	.011	2.1						
	DS-51-203	.011	.015	1.3						
	DS-51-204	.010	.014	0.9						
	DS-H-208	.011	.015	6.0						
Section F'-G'	DS-51-238	.011	.013	1.3	.012	.017	DS-G-17	6.8	.020	.029
	DS-51-240	.013	.019	2.2						
Section F'-G'	DS-51-241	.008	.012	1.5	.008	.012	DS-G-18	4.2	.010	.012
	DS-51-242	.009	.012	1.3						

1/ Locations of deposits or portions of a deposit can be found on plate 8A by reference to channel sample numbers. The corresponding face-cut sample numbers are not indicated on plate 8A.

2/ Average equivalent uranium (percent) was calculated as a weighted average by the formula: $\frac{\text{Total (length x percent equivalent uranium)}}{\text{Total length of samples}}$

3/ Average uranium (percent) was calculated as a weighted average by the formula: $\frac{\text{Total (length x percent uranium)}}{\text{Total length of samples}}$

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PLATE 26.—GEOLOGIC MAP SHOWING RADIOACTIVITY DATA IN THE LOST CREEK AREA, SWEETWATER COUNTY, WYOMING

Scale 1:9600

800 400 0 800 1600 2400 3200 4000 Feet

Contour interval 10 feet
Datum is approximate mean sea level

Geology and topography by D.M. Sheridan, C.H. Maxwell, J.T. Collier, and L.R. Page—1952. Radioactivity data by E.P. Beroni, C.H. Maxwell, and J.W. Collier, 1952.

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SUMMARY OF INFERRED RESERVES

Inferred reserves - Class A 1/

Number of group	Location	Schroeckingerite-bearing material (tons)	Average grade (percent uranium)	Uranium (pounds)
A-1	Trench 10	453.3	0.023	209
A-2	Trench 5	1,753.0	.064	2,244
A-3	Trench 1	888.7	.036	640
A-4	Trench 2	1,967.0	.016	629
TOTALS - - - - -		5,062.0	2/	3,722

1/ Class A inferred reserves are in four groups. Each group of closely related schroeckingerite deposits contains over 200 pounds of uranium.

2/ Average grade of all 4 groups is 0.037 percent uranium.

Inferred reserves - Class B and Class C

	Class B 1/			Class C 2/		
Number of block	Schroeckingerite deposits (tons)	Average grade (percent uranium)	Uranium (tons)	Rock (tons)	Average grade (percent uranium)	Uranium (tons)
Block 1	190	0.021	0.04	61,900	0.004	2.48
2	2,030	.028	.57	398,400	.004	15.94
3	9,650	.032	3.09	667,100	.005	33.36
4	21,910	.020	4.38	656,000	.004	26.24
5	15,180	.016	2.43	312,000	.004	12.48
6	70	.026	.02	2,100	.004	0.08
7	1,960	.031	.61	486,400	.004	19.46
8	760	.031	.24	187,900	.004	7.52
9	12,450	.057	7.10	259,500	.006	15.57
10	29,740	.039	11.60	664,700	.005	33.24
11	21,450	.022	4.72	401,900	.004	16.08
12	19,770	.020	3.95	336,700	.004	13.47
13	7,440	.019	1.41	318,800	.003	9.56
14	8,330	.019	1.58	399,500	.003	11.98
15	3,270	.015	.49	243,700	.003	7.31
16	170	.012	.02	10,000	.002	.20
TOTALS - -	154,370	3/	42.25	5,406,700	4/	224.97

1/ Class B inferred reserves consist of schroeckingerite deposits only, as inferred in Blocks 1-16. These reserves include the smaller amount shown as Class A reserves.

2/ Class C inferred reserves consist of both the host rock and schroeckingerite deposits in a zone 6 feet thick lying below overburden 2 feet thick in Blocks 1-16. These reserves include the amount of uranium shown in Class B reserves.

3/ Average grade of all schroeckingerite deposits in Blocks 1-16 is 0.027 percent uranium (figure is based on tonnage figures).

4/ Average grade of rock in the zone, 6 feet thick, is 0.004 percent uranium.

SUMMARY OF GRADE DATA FOR SCHROECKINGERITE DEPOSITS AND HOST ROCK IN TRENCHES 1-12

	Schroeckingerite deposits			Host rock		
Trench	Total area of schroeckingerite deposits on both walls of trench (square feet)	Range in uranium content - individual samples (percent uranium)	Average grade of schroeckingerite deposits 1/ (percent uranium)	Total length of channel samples (feet)	Range in uranium content - individual samples (percent uranium)	Average grade of the sampled host rock 2/ (percent uranium)
1 3/	613.8	0.001 - 0.260	0.026	1,335.6	0.000 - 0.021	0.003
2	809.2	.002 - .085	.020	798.5	.000 - .012	.003
3	258.6	.003 - .075	.020	470.0	< .001 - .024	.003
4	74.6	.002 - .037	.015	309.5	.001 - .011	.002
5	550.0	.003 - .150	.050	873.5	.000 - .029	.003
6	69.6	.003 - .066	.016	310.0	< .001 - .006	.003
7	244.7	.002 - .120	.031	1,240.0	< .001 - .039	.004
8	47.3	.008 - .071	.029	290.0	.001 - .011	.005
9	14.2	.005 - .034	.021	150.0	.001 - .005	.003
10	432.7	.001 - .074	.015	570.0	.001 - .011	.003
11	22.7	.006 - .033	.026	60.0	.002 - .009	.004
12	23.3	.002 - .033	.012	90.0	.001 - .003	.003
TRENCHES 1-12	3,160.7	0.001 - 0.260	0.026	6,497.1	0.000 - 0.039	0.003

1/ Average grade of schroeckingerite deposits in each trench was computed by a process of weighted averages, using the area represented by each sample as a weighting factor.

2/ Average grade of the sampled host rock in each trench was computed by a process of weighted averages, using the length of each sample as a weighting factor.

3/ Data for Trench 1 include both the main trench and the wide-cut.

PLATE 27—DETAILED MAP OF THE EXPLORATION AREA AND DATA ON RESERVES, LOST CREEK SCHROECKINGERITE DEPOSITS, SWEETWATER COUNTY, WYOMING

300 0 300 600 900 1200 1500 1800 2100 2400 2700 FEET

Contour interval 5 feet
Datum is approximate mean sea level

Data on grade and reserves by D.M. Sheridan, J.T. Collier, and C.H. Maxwell

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