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GRANITE LASH DISTRICT HENRY MOUNTAINS AREA, UTAH June, 1945 AUG 2.7 1987 U.S. GOVERNMENT DOCUMENTS NONDEPOSITORY ARTHUR LAKES LIBRARY A. H. Coleman, Leonid Bry HURADO SCHOOL OF MINES and J. W. Mill CESSIECTION CHARGED IS

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UNION MINES DEVELOPMENT CORPORATION

Report on

**GRAND JUNCTION FIELD OFFICE** 

GRAND JUNCTION, COLORADO

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Union Mines Dev. Corp. Grand Junction, Colo.

Mr. Robert H. Ridgway 18th Floor - 50 E. 42nd Street New York City 17 June 22, 1945

Letter of Submittal Granite Wash District Henry Mountains Area, Utah

Dear Er. Ridgway:

Attached is a report and set of maps covering the Granite Wash District, Henry Mountains Area, Wayne County, Utah.

This district was mapped, studied, and a report written by A. H. Coleman. Coleman's report was considered inadequate and it was revised and rewritten by Leonid Bryner, who acted as Coleman's assistant during the course of the survey. Bryner was assisted by J. W. Hill in estimating the ore reserves of the district. Hill is familiar with the deposits of the locality from his work with U. S. Vanadium Corp. and Metals Reserve Company.

The type of mineralization is rather limited in size and nabit of occurrence and is widely dispersed. An inferred reserve of about 10,000 tons has been calculated. There is insufficient positive or indicated ore to warrant setting up calculations.

The district habit of ore occurrence is not uncommon in the Colorado Plateau vanadium-SOM region. This type of deposit is only amenable to small scale operations such as exploitation by individual entrepeneur miners during periods of high prices.

Respectfully submitted.

Benj. N. Webber

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INTRODUCTION OFCLASSIFIED

## Location and Accessibility

The Granite Wash District lies along the east flank of the Henry Mountains, in Wayne and Garfield Counties, Utah (see Index Map, Fig. 1). From about 5 miles south of Hanksville it extends south approximately 22 miles to North Wash where it connects with the Trachyte District which is described in a report by A. M. Mastrovich, dated December, 1943. The average width of the mapped area between Hanksville and North Wash is about 2 miles, a distance corresponding to that between the east and west limits of the Morrison outcrop.

Green River is the nearest base for supplies and the nearest railway shipping point. It is on the main line of the Denver and Rio Grande Western Railway, between Salt Lake City and Grand Junction, Colorado, Via U. S. Highway No. 50, Green River is 111 miles west from Grand Junction and 188 miles southeast from Salt Lake City. Up until February 28, 1944 vanadium ore was being accepted at the Metals Reserve stockpile at Thompsons, 27 miles east of Green River on U. S. Highway No. 50.

Hanksville has a post office but no store. It is accessible from Green River by 62 miles of dirt road (State Highway No. 24). From Hanksville southward, a dirt road parallels the eastern margin of the Morrison outcrop to the Trachyte ranch.

During winter and during periods of torrential rains in summer, the roads south from Green River may be impassable for a week at a time. Between Green River and Manksville, Iron Wash and the Muddy River especially are likely to offer difficulties after heavy rains. Since the road from Manksville to Trachyte crosses the drainage from the Henry Mountains, it may also be rendered temporarily impassable by floods. However, whenever dry weather prevails, heavy trucks may be driven over these roads.

Although the mineralized area is, on the average, not more than 3,000 ft. in an airline from the Hanksville-Trachyte road, it is very poorly served by branches from this road. There are 3 or 4 such branches, but they are barely passable in a one-half ton pickup truck.

## Field Methods

The field work was done by Party No. 1 of the Union Lines Development Corporation. The personnel of this party consisted of A. H. Coleman, party chief, Loonid Bryner, Louis Moyd, and G. W. Hassler, Jr.

A tent camp was established four miles up Granite Wash from the Hanksville-Trachyte road, on the homestead of Cornelius and Riter Ekker. The advantages of this campsite consisted in a good spring, a location fairly central to the district, and accessibility by road.

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Since no suitable base map was available, a triangulation system on the scale of 1 in. = 2000 ft. was laid out by means of a telescopic alidade. Triangulation was carried north from the baseline used by A. H. Hastrovich and party in mapping the Trachyte District. In the course of mapping, the following section corners were tied in:

SW. corner Sec. 7, T. 31 S., R. 12 E. SW. corner Sec. 3, T. 31 S., R. 11 E. SW. corner Sec. 19, T. 29 S., R. 11 E. SW. corner Sec. 21, T. 30 S., R. 11 E.

Contacts between formations, mineralized showings, main drainage, and roads were mapped by Brunton, locations being obtained by intersection iron points in the triangulation system.

Prospecting was accomplished on foot, along the Salt Wash outcrop. Usually two men worked together at this, walking abreast. It was often necessary to traverse a certain length of rim two or three times in order to prospect it completely.

Forty-four columnar sections on a scale of 1 in. = 40 ft. were taken at intervals throughout the district. This was usually done by members of the party individually, leveling up from the lower contact by Brunton and compensating for the dip of the beds by setting it off on the clinometer. The purpose of these columns was to show the variations in thickness and lithology of the Salt Wash member of the Morrison formation.

Ten profile sections, on a scale of 1 in. = 1000 ft.. were made. This was done by Brunton-tape traverse along straight lines roughly normal to the trend of the outcrops. It required two to three men working together.

The mineralized outcrops were numbered and described in the course of mapping and prospecting.

## General Jurpose of Survey

A small amount of high-grade ore is known to have been mined and shipped from the district as early as the first World War.

It was the purpose of the present survey to ovaluate what was left of these resources, and to find any ore that may have been overlooked. There was also the broader purpose of observing and recording information of regional importance concerning the stratigraphy, structure, sedimentation, and general geology of the Salt Wash gember of the Morrison formation.

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#### Acknowledgements

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Cornelius and Riter Ekker of Hanksville profferred information on the district and allowed the party use of their homestead for a campsite.

Ted Ekker acted as wrangler during the two weeks it was necessary to use horses, and Darys Ekker spent a day with the party in order to insure that all the known ore showings were seen. Both were compensated for their services.

Mrs. Maxfield of Hanksville greatly helped party morale with her cooking.

The microscopic work on Column No. 47 was done by Carl H. Broedel of Union Mines Development Corp., and his findings are imbodied in the discussion of Salt Wash stratigraphy.

#### GEOGRAPHY

### Physiography

The physiography of the district reflects its main structural feature; namely, a series of relatively conformable, flat-lying, sedimentary beds tilted up on the west by the Henry Mountains intrusive.

Corresponding to the east margin of the Morrison, Summerville, and Curtis outcrops, where these sediments dip from 1/2 to 2½ degrees west, is a deeply indented escarpment, 100 to 500 ft. high. Here the Summerville usually forms a cliff, as do the thicker sandstone beds of the Balt mash member of the Morrison formation, especially where it immediately overlies the Summerville formation.

Erosion remnants of the Summerville and Entrada along the base of this escarpment give rise to the picturesque rock forms known as "stone-babies" and "Demoiselles".

Deep embayments occur in this escarpment where drainage from the Henry Mountains crosses it. The drainage gives rise to headwalls in the stream channels, especially where they traverse the massive beds of the Salt Mash sandstone.

From Granite Wash southward, the western margin of the Salt Mash and the underlying Summerville and Curtis are upturned to an angle of about 14 degrees, thus forming a hogback, the steep side of which faces the Henry Mountains. Here also the Summerville usually forms a cliff, and this cliff commonly continues up into the Salt Mash.

Eastward drainage from the Henry Mountains breaches this hogback, but in most cases the streams first have been deflected

along its base to points where the hogback arches out farthest east, the breaches occurring at such points.

The terrain between the east and west margins of the Salt Wash roughly corresponds to the dip-slope of that member, being relatively flat except for the arroyos which dissect it and an occasional butte, often capped with alluvium. Through this part of their course, the gradient of these arroyos is fairly even.

The vicinity north of Granite Wash differs from that to the south in the absence of the nogback. This difference may be due to a lack of upturning of strata in comparison to the area south of Granite Wash.

## Topography

The Index Map (Fig. 1) is based on a sectional aeronautical chart published by the U.S. Coast and Geodetic Survey. This chart is the only published large-scale map of the area showing topography available.

Taken as a whole, the district has a gentle slope from west to east and an abrupt slope along those two margins.

The most southerly triangulation point on the crest of the hogback has an elevation of 5,857 ft., while about 6 miles north of there, where the crest ends, its elevation is 5,901 ft. At the east margin, the top of the escarpment near the south end of the district has an elevation of 5,159 ft. while 18 miles north of there this escarpment shows an elevation of 4,506 ft.

At the east margin, where the strata break off abruptly in a bluff, the relief between the toe and top of the bluff varies between 100 and 500 ft. and probably averages about 300 ft.

The maximum relief between the crest and toe of the hogback is about 500 ft.

Elevations were obtained by vertical angle shots to known points in the Trachyte District.

## Mater Resources

There are no permanent streams in the district. Bull Creek, Granite Wash, and North Wash may carry a small flow up through the first part of August. However, the duration of flow varies greatly as it depends on the melting snow in the Henry Mountains.

Eumerous springs in the district supply up to 10 gallons per minute each. These springs generally occur near the SummervilleSalt Vash or Salt Wash-Brushy Basin contacts.

Poison Spring is the only one that has been improved by the U.S. Grazing Service, a storage tank and water box for stock water having been installed. From the standpoint of quantity and quality, the spring in Granite Wash at the campsite appears to be the best in the district.

The water rights on Bull Creek are owned by the Fairview Ranch.

Butler Wash, about a mile from where it emerges from the Salt Wash rim, has been diverted and dammed to form a small reservoir for serving stock. It contained water through the beginning of July, 1944, but was subsiding rapidly at that time.

A small reservoir was found about half a mile north of the branch leading from the Trachyte-Hanksville road to Poison Spring. It was dry during June and July, 1944, except for short periods following summer rains.

### Vegetation

Sage brush of the "white" variety is very common throughout the district. There is enough bunch grass to afford grazing for a few horses and cattle in all seasons.

The canyons contain isolated stands of cottonwood. Pinon and juniper begin to appear at the east margin of the district, increasing toward the west as the elevation increases, yet never attaining enough abundance to be classified as forest.

Timber can be secured at Sawmill Basin, about 10 miles southwest of the Fairview Banch. Here, pine and aspen is available for mine props. Sawmill Basin is readily accessible by truck or car over a road built by the CCC.

## <u>Climata</u>

The climate may best be described as arid. Annual rainfall averages around 9 in. and is fairly evenly distributed among the seasons. Light snowfalls occur in winter, and in summer precipitation usually takes the form of heavy, very local showers that last for short periods.

Summer days commonly bring temperatures of  $90^{\circ}$  F. or more. The daily average variation of temperature is on the order of  $40^{\circ}$  F.

## GEOLOGIC RELATIONS

## Areal Distribution of Cartographic Units

#### Entrada Formation

On the west margin of the district the Entrada sandstone of Jurassic age outcrops along the base of the Salt Wash hogback. Here it is exposed continuously from the south boundary of the map (Utah-hm-7) to the point on the northeast flank of Bull Mountain where the hogback terminates.

Along the east margin there is a corresponding exposure of Entrada that disappears about 4,000 ft. south of where Butler Wash crosses the Hanksville-Trachyte road. About 33 miles north of there the Entrada emerges again for a distance of about 1 mile. There are only two more exposures of it, besides the foregoing; namely, about 1,000 ft. of outcrop 1/2 mile south of Granite Wash, and about 1 mile of outcrop just east of Station 28, at the north end of the south sheet (Utah-hm-7).

The thickness of this formation is indeterminate because its lower contact is covered.

## Curtis Formation

The Curtis formation overlies the Entrada and outcrops just above it. Its outcrop has the same north limits as the Entrada, but pinches out toward the south, disappearing about 2/3 of a mile south of Butler Wash on the east rim, and on the west rim near where Granite Wash breaches the Morrison hogback. On the west rim the Curtis is exposed in its total thickness. On the east rim the Curtis is continuously exposed except for about 2 miles near its north extremity, and 2 miles near its south extremity where alluvium covers it. In places along this rim where the Entrada is covered, alluvium also obscures the base of the Curtis.

## Summerville Formation

The Summerville formation overlies the Entrada and Curtis, where the latter is present, and is exposed continuously along the west rim in the steep face of the Morrison hogback. All along this hogback its total thickness shows, but in the outcrops along the east rim, its base is covered with alluvium for a total of about 4 miles.

#### Corrison Formation

The Salt Wash member of the Morrison formation overlies the Entrada, Curtis, and Summerville, and shows continuously along the east and west rims of the district. Its outcrop also occupies a large portion of the area between the east and west rims. Outliers of the Brushy Basin member of the Morrison formation and alluvium occupy the rest of this area. North of Granite Wash, the overlying Brushy Basin to the west limits the Salt Wash exposures in that direction. In the south half of the district, erosion has eliminated the top of the Brushy

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Basin. However, in the north half, where the Brushy Basin is capped in a few places by small outliers of Dakota sandstone, its total thickness is exposed.

## Dakota Formation

The Dakota sandstone, of Cretaceous age, has a very limited distribution. It occurs only in the north part of the district where it forms a rim in three small buttes and a cap rock in four others.

## Stratigraphy

## JURASSIC SYSTEM - SAN RAFAEL GROUP

## Entrada Pormation

The thickness of this sandstone is indeterminate because the lower contact is not exposed in the district. However, according to Baker<sup>1</sup>, the Entrada about 25 miles northeast of the Henry Mountains, on the Creen River desert, is about 450 ft. thick, while at the Circle Cliffs, according to the same authority, the Entrada is about 1,050 ft. thick. Interpolation between the thicknesses at these two areas indicates a thickness of about 750 ft. in the district covered by the present report.

The Entrada as exposed within the district varies from a reddish-brown mudstone to a fine-grained sandstone, with some interbedded gray-white to cream-white beds. These lighter beds are more resistant to weathering than are the reddish beds. The formation contains some thin shale seams of limited extent.

Erosion weathers the formation into fantastic columns and bosses. It forms the valley floor at the base of the rims. A marked local angular unconformity was noted between the Entrada and Curtis formations:

## Curtis Pormation

This formation varies from 30 to 35 ft. in thicknoss except in the southern portions of the district where it pinches out rather suddenly. It consists of fine-grained, thin-bedded, glauconitic shale and shaly sandstone. Its color is grayishgreen, and slight cross-bedding is locally evident. It is

<sup>1</sup>Baker, A.A., et al, Correlation of the Jurassic Formations: U.S.G.S. Prof. Faper 183, Plate 4, 1936. non-resistant to erosion and forms slopes. Some gypsum was noted, with chalcedony replacing some of the gypsum.

## Summerville Formation

This formation varies in thickness from 109 to 160 ft. It consists of thinly bedded, reddish-brown and grayish-white Eudstonetor very fine-grained sandstone. Included are large quantities of bedded gypsum as well as secondary veinlets of gypsum cutting across bedding planes. Quantities of chert and chalcedony are also present. The formation is notable for its even, well-defined bedding, and for the fact that most of these beds are under one foot thick. Although soft and non-resistant to prosion, it is protected by the relatively resistant capping of the Salt Wash sandstone, thus forming striking vertical cliffs. The contact between Summerville and Salt Wash is gradational.

#### JURASSIC SYSTEM--MORRISON FORMATION

#### Salt Wash momber

The importance of this member consists in the fact that it is the locale for all the known ore in the district.

Where the Salt Wash is exposed in a bluff or cliff it appears as a series of irregular, discontinuous sandstone beds interbedded with marcon to gravish-green mudstones. Limestone Interbedded with shale and sandstone occurs throughout the base of the member up to about 70 ft. above the lower contact. But through the rest of the member, sandstone predominates over other rock and also forms the most striking outcrops. Individual beds 40 ft. thick are common and will often make a sheer cliff. Some of these beds attain a thickness of 75 ft., and some are less than 1 ft. thick. Pale gray and pale tan are common colors of the weathered surface. Lensing will often change the thickness of a bed by as much as a foot in a distance of 3 feet. Widespread and complex cross-bedding is another characteristic, cross-bedding being the rule rather than the exception. The top and bottom of the sandstone beds are usually clearly defined by overlying and underlying mudstones, but within the sandstone itself, the cross-bedding and horizons marked by changes in grain size are usually rather obscure. This is apparently the result of poor sorting during deposition. where the original surface of contact with overlying or underlying mudstone is exposed, this surface commonly will be found undulating and bumpy. The basal surface sometimes exhibits a natwork of sudcrack casts.

Epecimens were taken from various horizons of the Salt Wash in Column No. 47. A pulverized portion of each specimen was examined microscopically at a power of 45x, using both reflected and transmitted light. There were 33 specimens in all, covering a stratigraphic range of 346 ft. The results of this examination are summarized below.

Except in the lower 40 ft. of the column, where linestone, shale, and gypsum are common, the visible exposures are essentially of sandstone. It is a quartz sandstone in which the estimated grain diameter varies from 1/32 mm. to 2 mm. The grains are sub-angular to sub-rounded, and seldom well-sorted. The only other grains that approach quartz in abundance are of chert.

The two chief cements appear to be calcium carbonate and clay. They are usually associated with each other and the carbonate seems to predominate slightly.

Secondary silica, barite, and limonite also occur as cements, widespread in small amounts, but rarely present in any quantity.

Accessory minerals are not abundant and consist mostly of resistant minerals, such as tourmaline and zircon, which may survive several cycles of sedimentation.

What is called mudstone in this report has been described as shale or as siltstone in some other reports. It seldom has the platy parting of typical shale. In some places it may grade into a typical siltstone, if grain size is the criterion for distinguishing between siltstone and mudstone. This distinction was not attempted in the field.

In the Balt Wash of the district, mudstons is second in abundance to sandstone. Its position in cliffs of sandstone is usually marked by a groove. Where it is interbedded with sandstone beds of about the same thickness as itself, a slope usually results. Its thickness is as irregular as that of the sandstones and it is even less continuous. Though its usual thickness appears to be between 1 and 3 ft., in some cases it will reach 10 ft. The beds, however, are by no means uniform from top to bottom. Shaly and limy phases are common, and changes of hue occur longitudinally as well as vertically.

The basal phase of the Galt Wash differs distinctly from the overlying portions. However, the contact of this basal portion with the overlying beds is gradational. From the columns taken throughout the district, the average thickness of this basal phase is about 50 ft., but reaches as high as 75 ft. It is characterized by sandstone, shale, and limestone in about equal quantities and in beds averaging about 1 ft. in thickness. Lenses and beds of gypsum are common also. In general, the series is slope-forming, though a 5- to 10-ft. cliff often occurs at the base. This feature may be due more to the sapping action of the underlying, soft Summerville than to any extra softmess of this portion. The common color of this basal portion is pale gray with a faint greenish cast. Nost of the limestone in the Salt Wash occurs here, but occasionally a thin, isolated bed will be found higher up in the series. In such cases it is usually associated with the mulstones. Beds within the Salt Wash seldom show any correlation from column to column.

A comparison of columnar sections shows that along the east margin of the district the Salt Wash decreases from 340 ft. at a point 13 miles south of Butler Wash to a thickness of 210 ft. at a point about 16 miles north of there. Along the west margin, the thickness decreases from 447 ft. at a point about 7 miles above the southern boundary of the district to 220 ft. at a point 7 miles farther north. Other columns bear out these trends. The direction of maximum decrease in thickness is somewhere west of north. A columnar section (No. 46) taken north of the district, 13 miles due west of Hanksville on the Hanksville-Notom road, showed a Salt Wash thickness of only 30 ft., mainly gypsum.

#### Brushy Basin member

Where the section is completely exposed, the thickness varies between 210 and 313 ft. The lower 60 to 70 ft. is a rusty to dark-brown, medium- to coarse-grained sandstone with some grit in evidence. It also contains interbedded conglomerate with pebbles up to 1 in. in diameter. In this conglomerate there is some local cross-bedding. The remaining upper portion of the member consists of dark pink, reddish-brown, grayish-white and greenish-gray shales and mudstones. Interbedded with these shales and mudstones are occasional thin beds (less than 2 ft. thick) of sandstone that is fine- to medium-grained and shows local cross-bedding. Quantities of chalcedony were noted. The upper portion of the Brushy Basin, where shales predominate, weathers to characteristic "Bad Land".

Only four complete sections were obtained and these were distributed over a north-south span of 7 miles, in the northern part of the district.

## CRETACEOUS SYSTEM

#### Dakota Formation

In the northern part of the district where the section is completely exposed, the Dakota was found to be 30 ft. in thickness. It was not studied in detail. A 4- to 6-ft. coal seam about 10 ft. below its upper contact was noted.

## Jancos Formation

This formation was not exposed in its entirety. It was observed only to the extent of noting a basal sandstone unit containing abundant "oyster" beds.

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### Structure

The sedimentary beds in the east part of the district dip gently westward toward the Henry Mountains. This dip, which appears to be regional, varies from 1/2 to 2½ degrees. The strike is generally NW-SE., although local E.-W. strikes were noted. Along the base of the Henry Mountains, the effect of the Henry Mountain intrusive appears in the upturning of the sediments, the dip being toward the east and reaching a maximum of 34 degrees. The result of these two opposite dips is a syncline having a wide, gently-dipping east limb and a narrow, relatively steep west limb. In the north part of the district where the Salt Wash outcrop veers away from the Henry Mountains, the west limb fades out and the structure becomes a homocline with a gentle westerly dip.

During the uplift, a section of sediments, including all the local formations from the Entrada through the Mancos, was broken away and left on the higher flanks of the Henry Mountains. The thin strip of Salt Wash that remains there was prospected but not mapped as only one ore showing (No. 1) was found there, and it seemed a relatively unimportant one.

## District Habit of Ore Occurrence

The average length of mineralized outerop is 30 ft. and its thickness as seen in the face averages less than 1 ft. Mineralization almost invariably consists of silicified, carnotite-stained logs or vegetal matter, surrounded by vanadiferous sandstone and shale; it is confined to the Salt Wash member of the Morrison formation.

## ORE DEPOSITS

## History and Production

"Near Trachyte Creek the Standard Chemical Company has done a large amount of development work, and in 1914 shipped considerable ore."2 Probably some of this ore came from the district under consideration, as it is known to have produced ore that early.

Thirty-one of the thirty-three outcrops described in this report, namely the ones lying along the east rim of the Salt Wash outcrop where it parallels the Hanksville-Trachyte road, were located by Cornelius Ekker et al of Grand Junction. It has since been reported that the claims covering these outcrops have been sold to the Canadian Radium and Uranium Corp. of New York. In addition, all open ground between these outcrops

<sup>2</sup>Butler, B.S. et al, Ore Deposits of Utah: U.S.G.S. Prof. Paper 111, p. 630, 1920. from Butler to North Wash has been located, regardless of ore showings, by the same concern, under the group name of "Congress." This latter location is reported to comprise some 65 claims.

## Mineralization

Mineralization occurs in sandstone or sandy shale surrounding fragments or logs of silicified fossil wood which in turn shows mineralization in the form of a yellow or greenish-yellow stain. The mineralized sanistone is gray to dark gray, because of the presence of a vanadiferous clay, and sometimes is imprognated with yellow and greenish-yellow specks. The yellow mineral is probably carnotite, and the greenish-yellow is likely to be pintadoite, a secondary form of vanadium.

The fossil wood, in some cases, has been found to be impregnated with gypsum (outcrop No. 25); it often has a carbonaceous appearance.

The sandstone immediately surrounding the ore usually has a rusty tint, due to the presence of limonite. The vanadifarous sandstone often contains shale partings of a dark hue that suggests good values in vanadium and SOQ.

Mineralization was found at the following stratigraphic heights above the base of the Salt Wash: 50, 180 to 210, 230 to 235 ft.

Outcrops in the same immediate vicinity--that is, within about 200 ft. of each other--appear to occupy practically the same horizon. Outcrop No. 1 was the only one differing markedly in this respect, its stratigraphic position being only 50 ft. above the base of the Salt Wash. This showing, however, is 4 miles or more from any other showing in the district (see also under "Structure" above).

## Description of Occurrences

A total of 33 mineralized outcrops were noted and located on the map. With the exception of outcrop Nos 1, 32, and 33, all of them lie in a narrow strip between Butler Mash and North Wash. No. 1 is in that portion of the Salt Wash that lies high on the east flank of the Henry Mountains.

The following is a description of individual occurrences: Location bearings are magnetic throughout these descriptions. Outcrop No. 1

Located S. 45° W., 18,000 ft. from Sta. 3. Outerop is 8.0 ft. long with an average thickness of 0.2 ft. It is 50 ft. above the base of the Salt Wash. The outerop is vanadiferous sandstone with a fair showing of carnotite. It appears to contain much carbonaceous material. There is a small open cut on the outerop. Not sampled.

Located N. 572° N., 1000 ft. from Sta. 7M. Outcrop is 30 ft. long with a thickness of up to 2.0 ft. It is 200 ft. above the base of the Salt Eash. The outcrop is vanadiferous sandstone with fragments of silicified, carnotite-stained wood. Worked by open-cut. Not sampled.

### Outcrop No. 3

Located N. 43 W., 1200 ft. from Sta. 7M. Outcrop is 30 ft. long, with an average thickness of 1.0 ft. It is 200 ft. above the base of the Salt Wash. The outcrop is vanadiferous sandstone with carnotite-stained, silicified wood fragments. Not sampled.

### Outerop No. 4

Located N. 9° W., 2700 ft. from Sta. 7M. Outcrop is 60 ft. long, with average thickness of 0.5 ft. It is 230 ft. above the base of the Salt Wash. The outcrop consists of silicified logs and fragments, stained with carnotite. The surrounding sandstone is vanadiferous. The outcrop was worked by open-cut. Sample No. 1050 (1708) was taken here by cutting a 0.5-ft. channel across the bed. The results of this sample were as follows: 0.12% SOQ and 1.10% V205; 0.09% SOQ by electroscope.

## Outerop No. 5

Located N. 0°, 3400 ft. from Sta. 7M. Outcrop consists of 5 showings as follows: length 10.0 ft., thickness 1.5 ft.; length 15.0 ft., thickness 3.0 ft.; length 20.0 ft., thickness 2.0 ft.; length 15.0 ft., thickness 2.0 ft.; length 20.0 ft., thickness 1.5 ft. The outcrop is 230 ft. above the base of the Salt Wash. The outcrop consists of silicified wood, stained with carnotite. The surrounding sandstone is vanadiferous. Worked by open-cut. Poor outerop. Not sampled.

## Outerop No. 6

Located N. 2110 N., 3400 ft. from Sta. 7M. Outerop consists of 3 showings as follows: Length 10.0 ft., thickness 0.5 ft.; length 5.0 ft., thickness up to 0.75 ft.; length 10.0 ft., thickness up to 0.75 ft. The outcrop is 230 ft. above the base of the Salt Wash. Outcrop consists of vanadiferous sandstone with traces of carnotite. Poor showing. Not sampled.

#### Outerop No. 7

Located N. 3° E., 3800 ft. from Sta. 7N. Outerop is 4.0 ft. long, with average thickness of 0.3 ft. It is 200 ft. above the base of the Salt Wash. Outerop consists of carnotite-stained, silicified logs. Surrounding sandstone is vanadiferous. Worked by open cut. Not sampled.

Located N. 102° E., 4050 ft. from Sta. 7M. Outcrop consists of a thin surface area, 12 by 7 ft., of vanadiferous, carnotitestained, sandstone and shale. It is 200 ft. above the base of the Salt Wash. Poor showing. Not sampled.

## Outerop No. 9

Located N. 7° E., 4050 ft. from Sta. 7M. Outcrop is a silicified log, 4.0 ft. long and 1.5 ft. in diam., faintly stained with carnotite. It is 200 ft. above the base of the Salt Wash. Not sampled.

## Outerop No. 10

Located N.  $10\frac{10}{2}$  E., 4950 ft. from Sta. 7M. Outcrop consists of an area 3 ft. sq. of loose, carnotite-stained, silicified wood fragments. It is 200 ft. above the base of the Salt Wash. Not sampled.

## Outerop No. 11

Located N., 6900 ft. from Sta. 7M. Outerop consists of a silicified log, 10.0 ft. long, and stained with carnotite. Surrounding sandstone is vanadiferous and shows traces of carnotite. The outerop is 203 ft. above the base of the Salt Wash. Norked by open cut. Not sampled.

## Outerop No. 12

Located N. 3° E., 7125 ft. from Sta. 7M. Outcrop is a carnotite-stained, silicified log. One hundred ft. west and 120 ft. east of this point, there is some more carnotitestained, silicified wood. Outcrop is 203 ft. above the base of the Salt Wash. Not sampled.

## Outcrop No. 13

Located S. 15<sup>10</sup> E., 1025 ft. from Sta. 7. Outcrop is 15.0 ft. long and 3.0 ft. thick. It is 225 ft. above the base of the Salt Wash. Sutcrop consists of a silicified log, slightly stained with carnotite. Worked by open-cut. Not sampled.

## Outerop No. 14

Located S. 83° E., 400 ft. from Sta. 7. Outcrop consists of a shallow pile of carnotite-stained, silicified wood, covering an area of 12 by 12 ft. It is 203 ft. above the base of the Jalt Mash. Morked by open cut. Not sampled.

Located N. 11° W., 1000 ft. from Sta. 7. Outcrop is 60.0 ft. long, with an average thickness of 0.3 ft. and a maximum thickness of 1.0 ft. It is 235 ft. above the base of the Salt Wash. Outcrop consists of vanadiferous sandstone with some carnotite stain. Worked by open-cut.

Sample No. 1053 (1714) was taken here by cutting a 1.0-ft. channel across the bed. The results of this sample were as follows: 0.16% 309 and 2.68%  $V_205$ ; 0.255% S09 by electroscope.

## Outeron No. 16

Located N. 340 W., 1500 ft. from Sta. 7. Outcrop is 20.0 ft. long with an average thickness of 0.2 ft. and a maximum thickness of 1.0 ft. It is 235 ft. above the base of the Salt Wash. Outcrop consists of vanadiferous, carnotite-stained sandstone with some fragments of carnotite-stained, silicified wood.

Sample No. 1055 (1710) was taken here by cutting a 1.0-ft. channel across the bed. The results of this sample were as follows: 0.44% SOQ and 2.64% V<sub>2</sub>05; 0.33% SOQ by electroscope.

## Outeron No. 17

Located 5. 6° E., 1100 ft. from Sta. 6. Outcrop is 25.0 ft. long and 0.2 ft. thick. It is 210 ft. above the base of the Salt Wash. Outcrop consists of carnotite-stained, silicified log. The surrounding sandstone is vanadiferous and carnotitestained. Norked by open-cut. Not sampled.

## Outerop No. 18

Located S.  $43\frac{10}{5}$  E., 1150 ft. from Sta. 6. Outcrop is 30.0 ft. long with an average thickness of 0.4 ft. and a maximum thickness of 1.0 ft. It is 235 ft. above the base of the Salt Wash. The outcrop consists of vanadiferous sandstone with fragments of carnotite-stained, silicified wood. Sandstone also shows traces of carnotite. Worked by open-cut.

Sample No. 1054 (1711) was taken here by cutting a 1.0-ft. channel across the bed. The results of this sample were as follows: 0.37% SOQ and 3.18% V<sub>2</sub>O<sub>5</sub>; 0.26% SOQ by electroscope.

### Outeron No. 19

Located S. 7<sup>10</sup> W., 800 ft. from Sta. 6. Outcrop is 10.0 ft. long and 0.5 ft. thick. It is 210 ft. above the base of the Salt Wash. Sutcrop is vanadiferous sandstone with a trace of carnotite. Worked by small open-cut. Not sampled.

Located S.  $7\frac{10}{2}$  E., 750 ft. from Sta. 6. An area of vanadiferous float, 20 by 5 ft. May have been storage dump for outcrop No. 19. Not sampled.

### Outerop No. 21

Located 3. 54° E., 900 ft. from Sta. 6. Outcrop is 50 ft. long with an average thickness of 0.2 ft. and a maximum thickness of 0.5 ft. It is 210 ft. above the base of the Salt Wash. Outcrop is vanadiferous sandstone and silicified log. Both sandstone and log show carnotite. Worked by open-cut.

Sample No. 1052 (1713) was taken here by cutting a 0.5-ft. channel across the bed. The results of this sample were as follows: 0.50% SOO, 2.86%  $V_2O_5$ ; 0.36% SOQ by electroscope.

## Outcrop No. 22

Located S., 450 ft. from Sta. 6. Outcrop consists of 150 ft. of discontinuous ore lenses. The maximum thickness is 0.5 ft. It is 185 ft. above the base of the Salt Wash. Outcrop is vanadiferous sandstone with carnotite stain. Several mineralized logs are present. Worked by open-cut. Poor showing. Not sampled.

## Outerop No. 23

Located N. 56° E., 500 ft. from Sta. 6. Outerop consists of 8 small showings extanding over a length of 125 ft. The average thickness is 0.3 ft. It is 210 ft. above the base of the Salt Mash. Outcrop consists of carnotite-stained logs and vanadiferous sandstone. Morked by open-cut. Poor showing. Not sampled.

## Outerop No. 24

Located N. 110° W., 480 ft. from Sta. 6. Dutcrop is 6.0 ft. long and 0.5 ft. thick. It is 210 ft. above the base of the Salt Wash. Dutcrop is of vanadiferous sandstone and shale. Poor showing. Not sampled.

## Outerov No. 25

Located N. 52° W., 2550 ft. from Sta. 6. Outcrop consists of 2 small showings, each 5.0 ft. long and with a maximum thickness of 2.0 ft. It is 200 ft. above the base of the Salt Wash. Outcrop consists of vanadiferous sandstone and silicified wood. Doth are imprognated with carnotite. N. 55° E., 180 ft. from the above point, is a third small and similar showing. Outcrops were worked by open-cuts. Poor showing. Not sampled.

Located N. 58° W., 3300 ft. from Sta. 6. Outcrop is 50.0 ft. long with an average thickness of 2.0 ft. It is 200 ft. above the base of the Salt Wash. Outcrop consists of silicified, carnotite-stained log, surrounded by a halo of vanadiferous sandstone. Worked by open-cut. Poor showing. Not sampled.

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Sec.

#### Outeron No. 27

Located N. 30° E., 320 ft. from Sta. 5. Outerop is 30.0 ft. long, with an average thickness of 0.2 ft. and a maximum thickness of 0.5 ft. It is 200 ft. above the base of the Salt Wash. The outerop consists of vanadiferous sandstone with shale partings. There is a trace of carnotite. Worked by open-cut.

Sample No. 1051 (1712) was taken here by cutting a 0.5-ft. channel across the bad. The results of this sample were as follows: 0.10% SOQ, and 1.12%  $V_2O_5$ ; 0.12% SOQ by electroscope.

## Outerop No. 28

Located N. 65° E., 2000 ft. from Sta. 5. The outcrop is 40 ft. long with an average thickness of 1.0 ft. It is 200 ft. above the base of the Salt Wash. Outcrop is of vanadiferous sandstone with fragments of silicified, carnotite-stained wood. Worked by open-cut. Poor showing. Not sampled.

## Outerop No. 29

Located N. 210 E., 1550 ft. from Sta. 5. Outcrop is a carnotite-stained, silicified log. It is 200 ft. above the base of the Salt Wash. Worked by open-cut. Poor showing. Not sampled.

## Outcrop No. 30

Located H. 35° W., 2000 ft. from Sta. 5. Outcrop is 2.0 ft. long, with an average thickness of 0.5 ft. and a maximum thickness of 1.5 ft. It is 195 ft. above the base of the Salt Wash. Outcrop consists of carnotite-stained, vanadiferous sandstone. Twenty feet vertically below this point is a carnotite-stained, silicified log, practically all mined out. Log was about 20 ft. long and 1 ft. in diameter.

Sample No. 1049 (1709) was taken here by cutting a 1.5-ft. channel across the bed. The results of this sample were as follows: 0.78% SOQ and 4.03% V205; 0.40% SOQ by electroscope.

## Outcrop No. 31

Located N. 27<sup>10</sup> W., 2000 ft. from Sta. 5. Outcrop is 20 ft. long and 0.8 ft. thick. It is 185 ft. above the base of the -13- Not set allow here the

Salt Wash. The outcrop is of vanadiferous sandstone with shale partings. There is a fair showing of carnotite. Worked by open-cut, and 4-ft. adit.

Sample No. 1056 (1715) was taken by cutting a 0.8-ft. channel across the bod. The results of this sample were as follows: 0.44% SOQ and 3.74%  $V_2O_5$ ; 0.30% SOQ by electroscope.

#### Outerop No. 32

Located N. 66° E., 13,850 ft. from Sta. 37. Outcrop consists of fragments of carnotite-stained, silicified wood, scattered over an area 10 by 40 ft. Not sampled.

## Outeron No. 33

Located 5. 73° E., 2800 ft. from Sta. 8. Outcrop is 15 ft. long and 0.3 ft. thick. It is 180 ft. above the base of the Salt Wash. Outcrop is of vanadiferous, carnotite-stained sandstone; evidently an impregnation from a mineralized log which has been mined out. Worked by open-cut. Poor showing; not sampled.

## CONDITIONS AFFECTING MINING

Most of the showings occupy the bench between the brink of the Summerville-Salt Wash cliff and the base of the bluff formed by the lower bed of the Brushy Basin member. This bench varies between an even, almost lovel surface and a steep slope broken by a succession of projecting sandstone beds. The majority of workings thus occupy comparatively flat terrain. A few occur in the steep face of a projecting ledge. The locality would be easily accessible from a road contouring along the bench. In fact, there is such a road, but it is practically impassable in its present condition.

The disposal of tailings should offer no special problem since the Summerville-Salt Wash cliff is close to most of the workings.

Underground mining has not been undertaken here except in one case where a 4-ft. adit was driven. The fact that most of the ore is found in the flats led to its extraction from shallow pits. Where it is exposed in a vertical face, as in at least two cases, mining along a flat stope requiring timber support might be necessary.

Timber and water resources have already been described under the headings "Vegetation" and "Water Resources". However, the deposits so far developed are too small and superficial to have required timbering. If any water was used in mining, it must have been hauled, since none has been developed at the deposits.

### ORE RESERVES

The type of mineralization described under "Ore Occurrences", as well as the limited scattered exploration pits and outcrops, suggest the best classification of the ore reserves of this district to be inferred ore alone.

Therefore, the area between Butler Wash and North Wash containing the ore-bearing outcrops has been designated as inferred ore block No. 1 (see South Area map Utah-hm-7 and -7A). This area includes the workings numbered 2 to 31 inclusive.

This is the only ore reserve block considered in this report. The other three ore exposures, numbers 1, 32, and 33, are isolated occurrences with insignificant reserves.

This block of inferred ore is calculated to contain 11,490 tons of ore assaying 0.354% SOQ and 2.952%  $V_20_5$ . The average width is calculated as 0.39 ft.

The detailed calculations are set forth in Table I, Sheet 1, and summarized in Table II, Sheet 1. The ore block No. 1 is outlined on the supplemental areal map (Utah-hm-7A).

### Method of Calculation

In the standard method of ore reserve calculations, three types of ore are recognized; namely, positive, indicated, and inferred.

The inferred ore in this district is ore for which quantitative estimates are based largely on the geologic character of the deposit and for which there are eight channel samples and detailed measurements of average widths. The estimates are based on an assumed repetition for which there is geologic evidence. The area is limited by the known ore exposures on a definite ore trend in the Salt Wash member (see geologic map UTah-hm-7,  $1^{u} = 2000'$ ).

The ore reserves are usually further classified into three grades of SOU: Grade 1 contains 0.15% or more SOU; Grade 2 contains from 0.08% to 0.15% SOU; and Grade 3 ore contains 0.005% to 0.08% SOU. According to this classification, the ores of this district are Grade 1.

The tonnage was calculated as follows: (1) The total area of the block was determined with a planimeter; (2) The average width is the average of the observed average thicknesses of the ore exposures as described (this average width is not equal to the average width of the samples); (3) The volume of the block is reduced by a factor of mineralization (0.81%) which represents the distribution of the ore within the volume; and (4) The volume was divided by 14, a conversion figure representing the number of cubic feet in one ton of ore in place, thereby arriving at the number of tons of ore in the block (see tonnage calculation for Table I, Sheet 1).

The eight channel samples taken from ore exposures within this block supply representative analytical data that was used to calculate the amount of the SOQ and  $V_2O_5$  products (see Table II, Sheet 1).

The above samples are posted on the supplemental South Areal map (Utah-hm-7A). The following sequence of figures apply: Field number, office number, width in feet and tenths, 3500 electroscopic (B), 3500 chemical, 3700 chemical; the letter (R) designates that chemical analysis was run in the U.S. Vanadium Corp. laboratory, Rifle, Colorado, and the letter (E) that the electroscopic analysis was run in the laboratory of the Grand Junction Field Office.

### Exploration

All the workings, with the exception of Nos. 1, 32, and 33, occur in a zone 18,000 ft. long that has an average width of less than 3,350 ft. The prospect pits and outcrops are scattered throughout this zone.

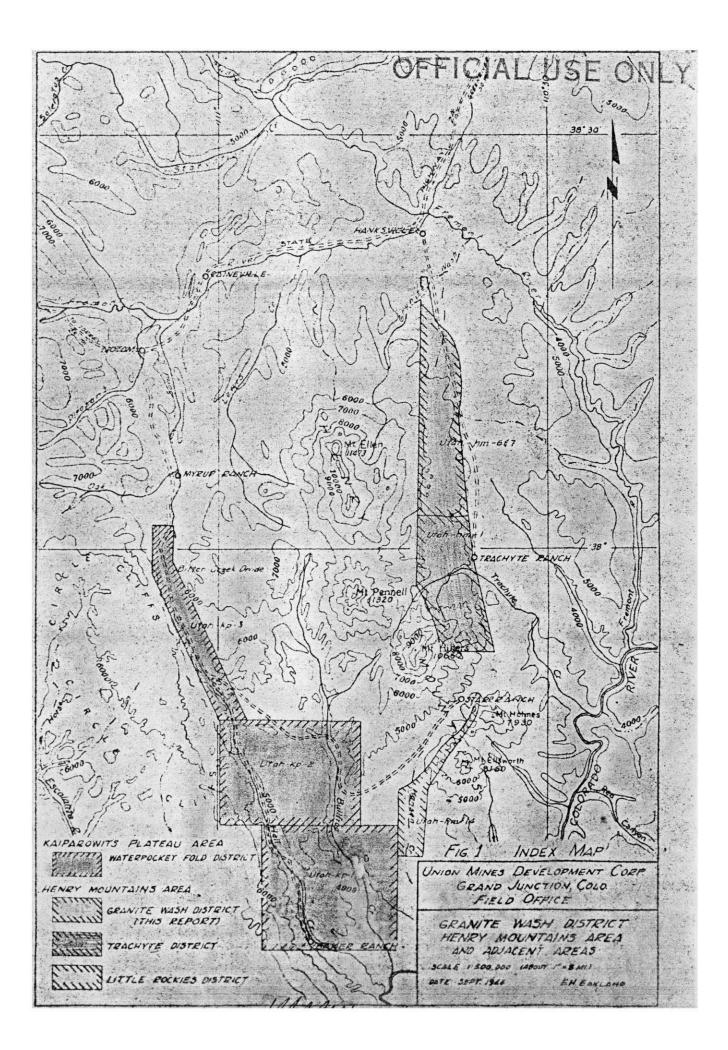
Since many of the exposures are at, or near, the surface of the ground, and as the ore is of Grade 1 quality, a Geiger-Mueller counter reconnaissance survey might yield some results.

The known habit of distribution of ore deposits in this district is such that the locality is not amenable to exploration by core drilling. Ore in the known workings could be extracted and an exploration plan designed thereafter in the light of any additional geologic data that might be gained.

> A. H. Coleman Leonid Bryneis J. W. Hill

# LIST OF LARGE MAPS TO ACCOMPANY REPORT

Description	Scale	<u>File No.</u> Utah-hm-
Geologic Areal Map, North Area	l in. = 2000 ft.	6
Geologic Areal Map, South Area	l in. = 2000 ft.	7
Supplemental Kap, South Area	l in. = 2000 ft.	7A
Geologic Sections (profiles) Nos. 1 - 10	l in. = 1000 ft.	8
Stratigraphic Columns Nos. 1 - 9; 15 - 17	l in. = 40 ft.	9
18 - 32; 34 - 36	do.	10
10 - 14; 37 - 39	đo₊	11
40 - 45; 47	do.	12
Note: Column Nos. 10 -	14, 33 - 46 not use	d.
Correlation of Profile Sections	1 in. = 40 ft.	13



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Union Mines Development Corp. Grand Junction Field Office Grand Junction, Colo.

Area HENRY MOUNTAINS District GRANITE WASH

Subtitle INFERRED ORE

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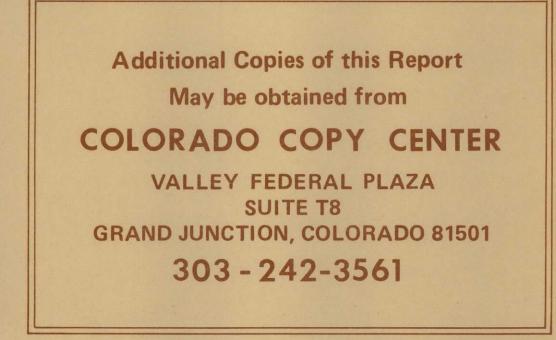
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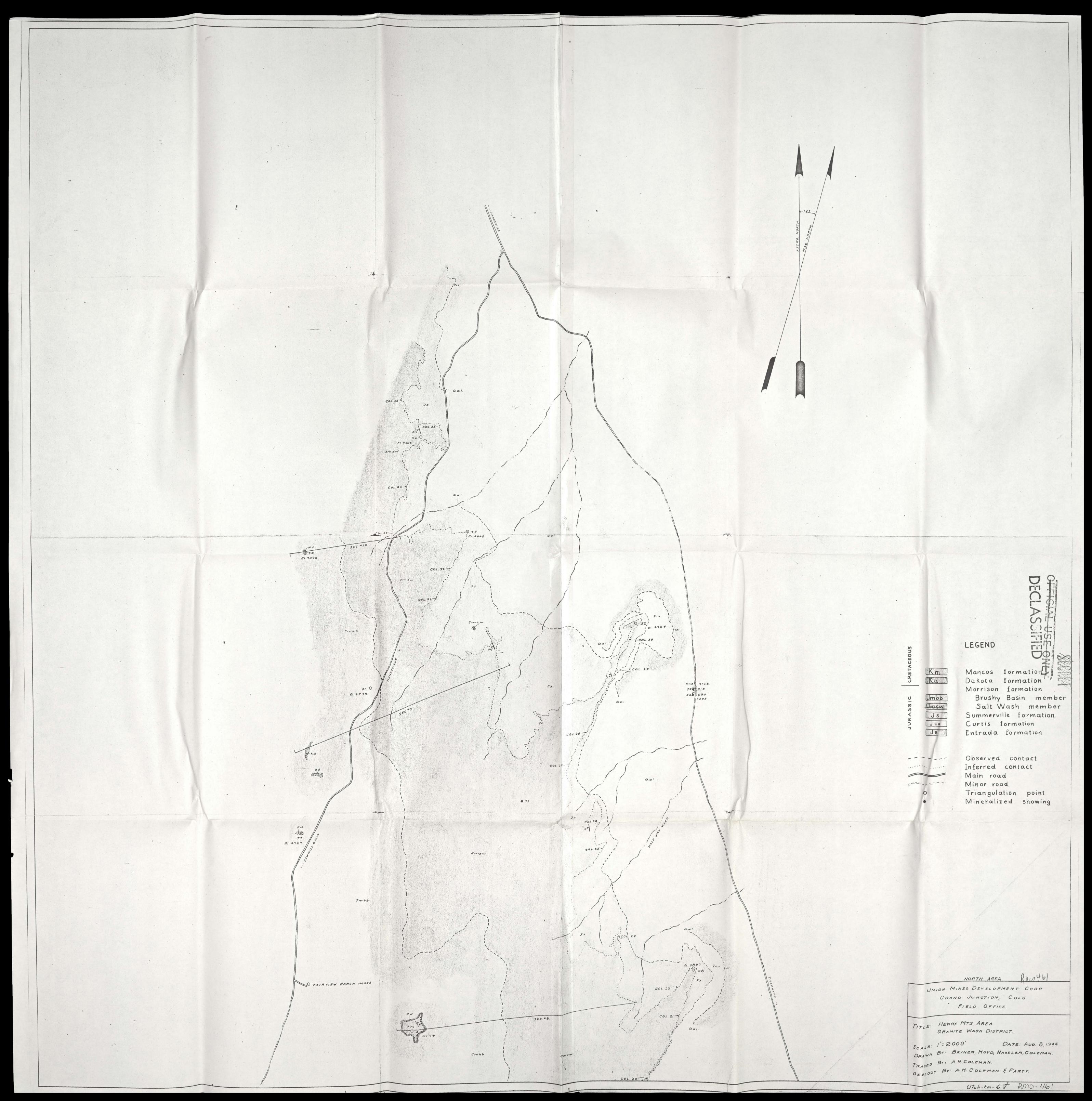
## Descriptions of mineralized outcrops

The following descriptions of mineralized outcrops is taken directly from the Union Mines Development Corporation Reports within the area, and where changed will be noted. Local bearings are magnetic throughout these descriptions. Bearing and distance from stations not included. Outcrop No. 1

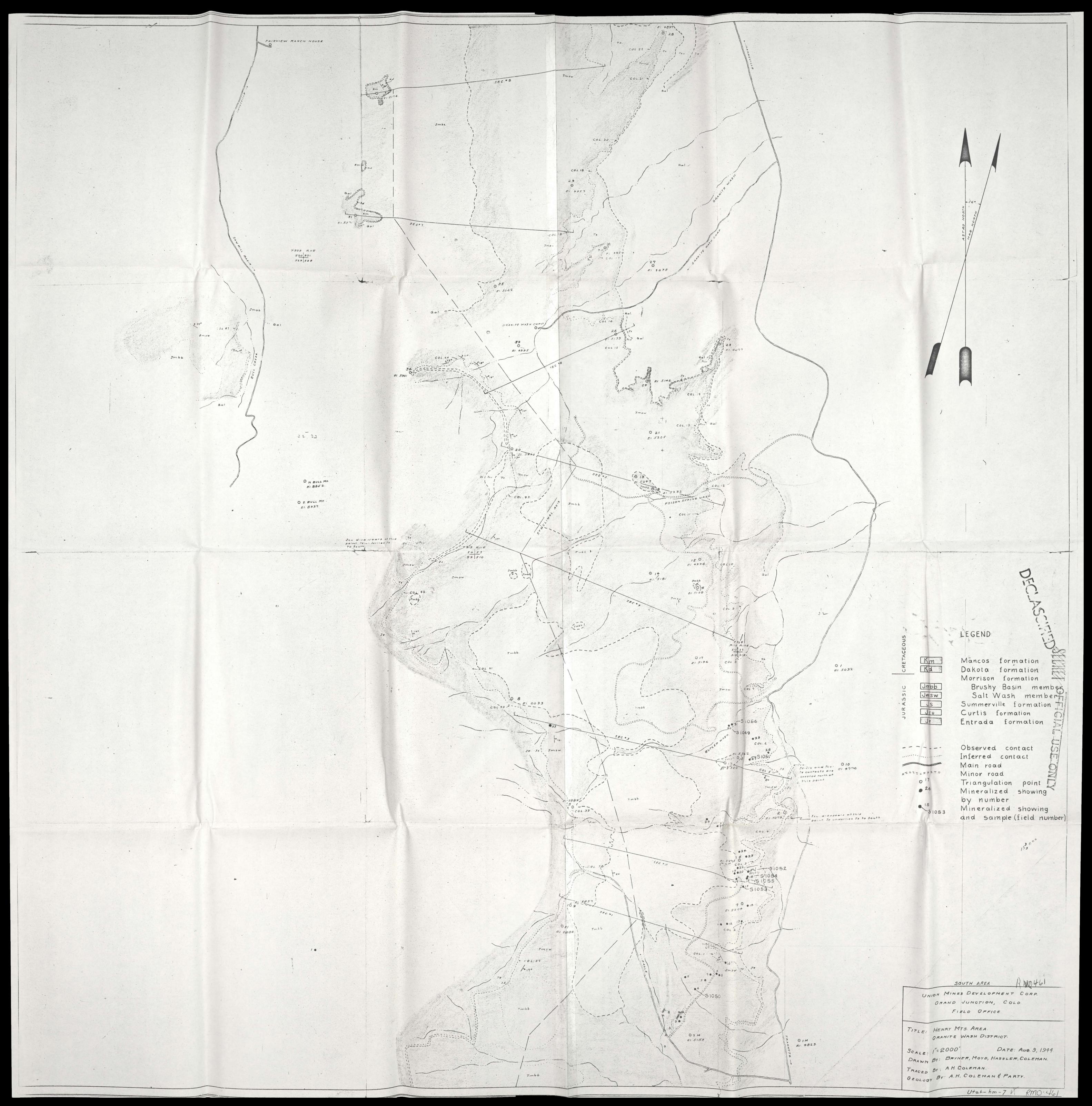
Located S. 45<sup>oW</sup>., 18,000 ft. from Sta. 3. <sup>O</sup>utcrop is 8.0 ft. long with an average thickness of 0.2 ft. It is 50 ft. above the base of the Salt Wash. The outcrop is vanadiferous sandstone with a fair showing of carnotite. <sup>I</sup>t appears to contain much carbonaceous material. There is a snall open cut on the outcrop. Not sampled.

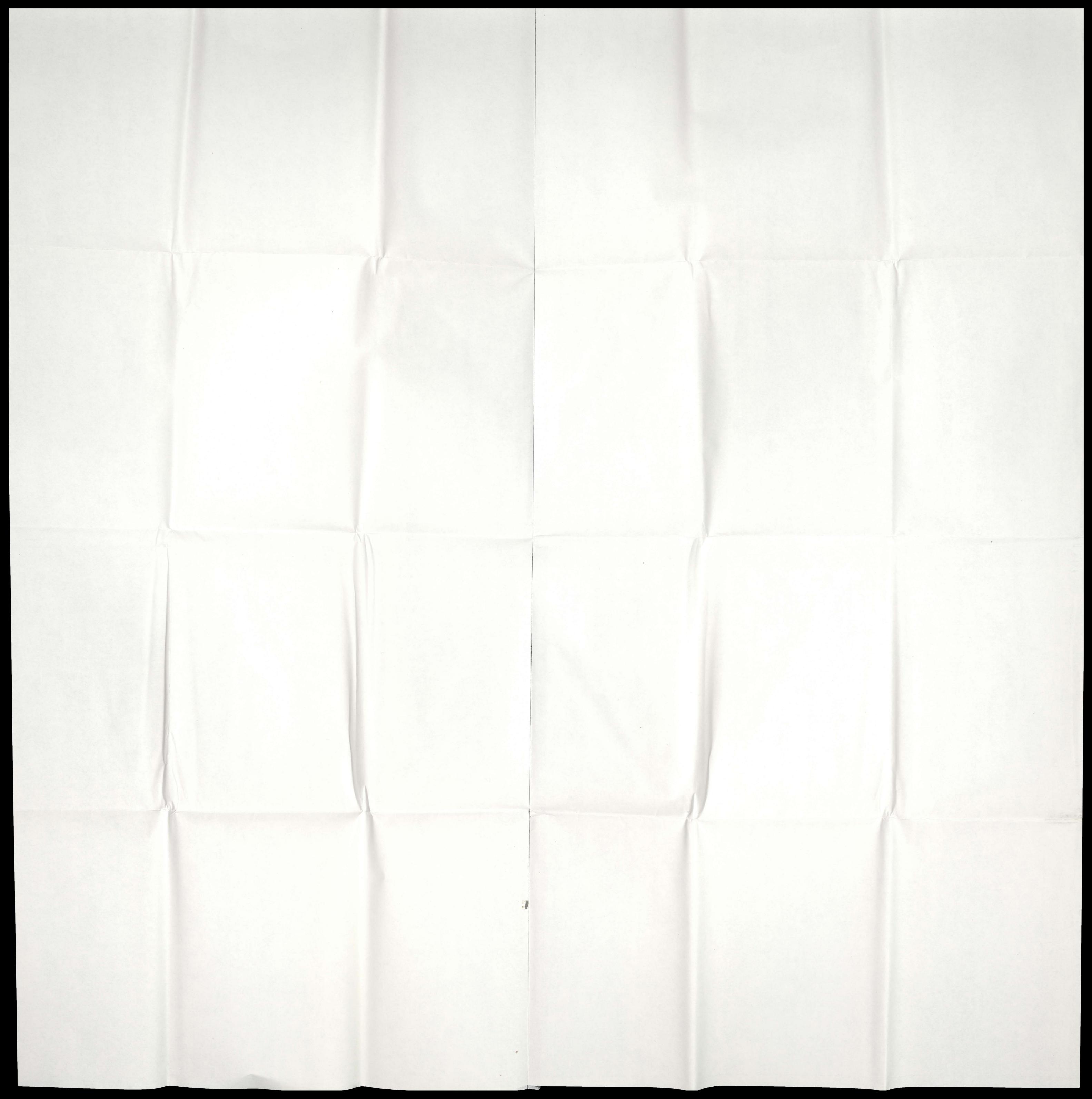


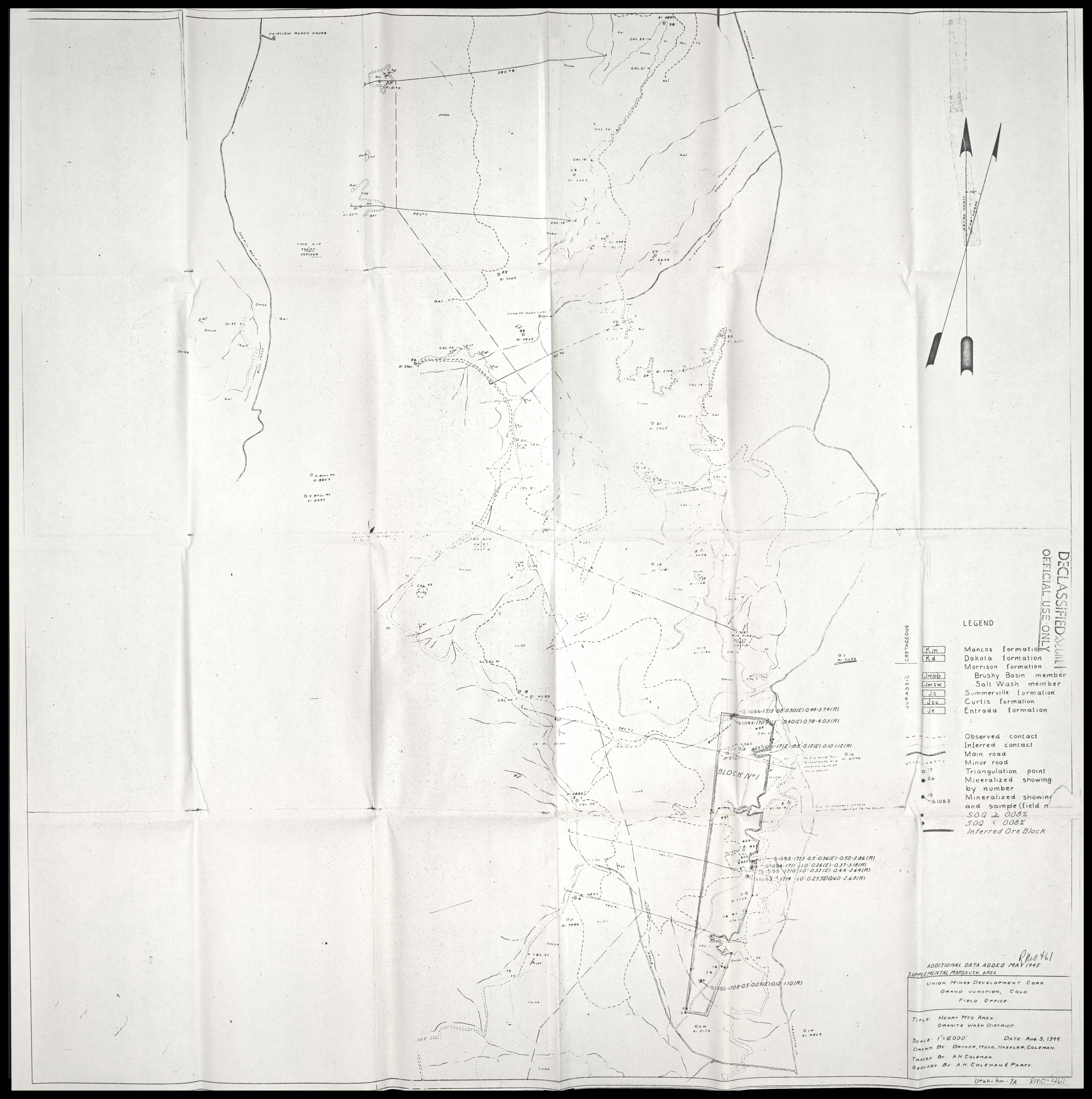


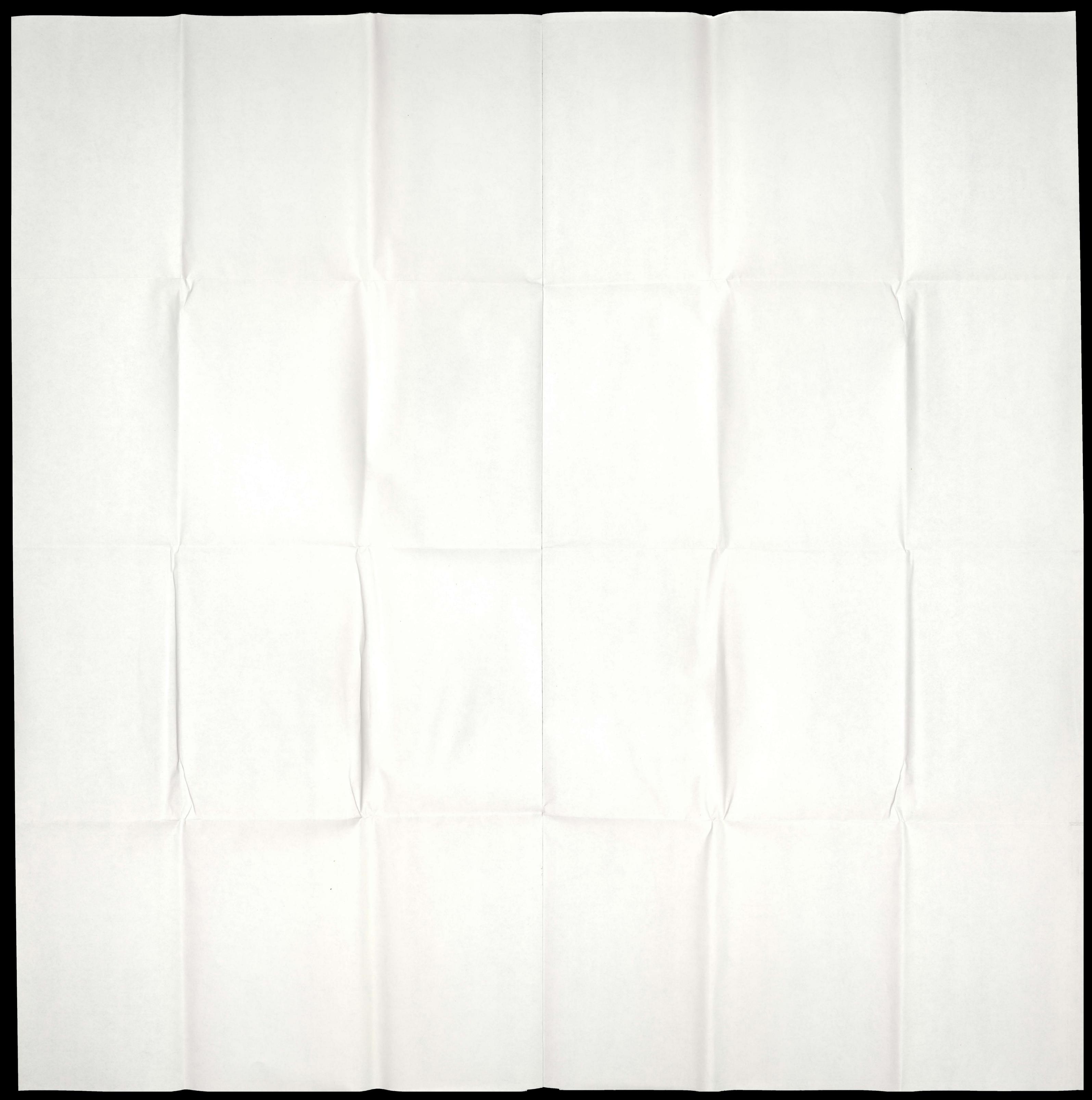


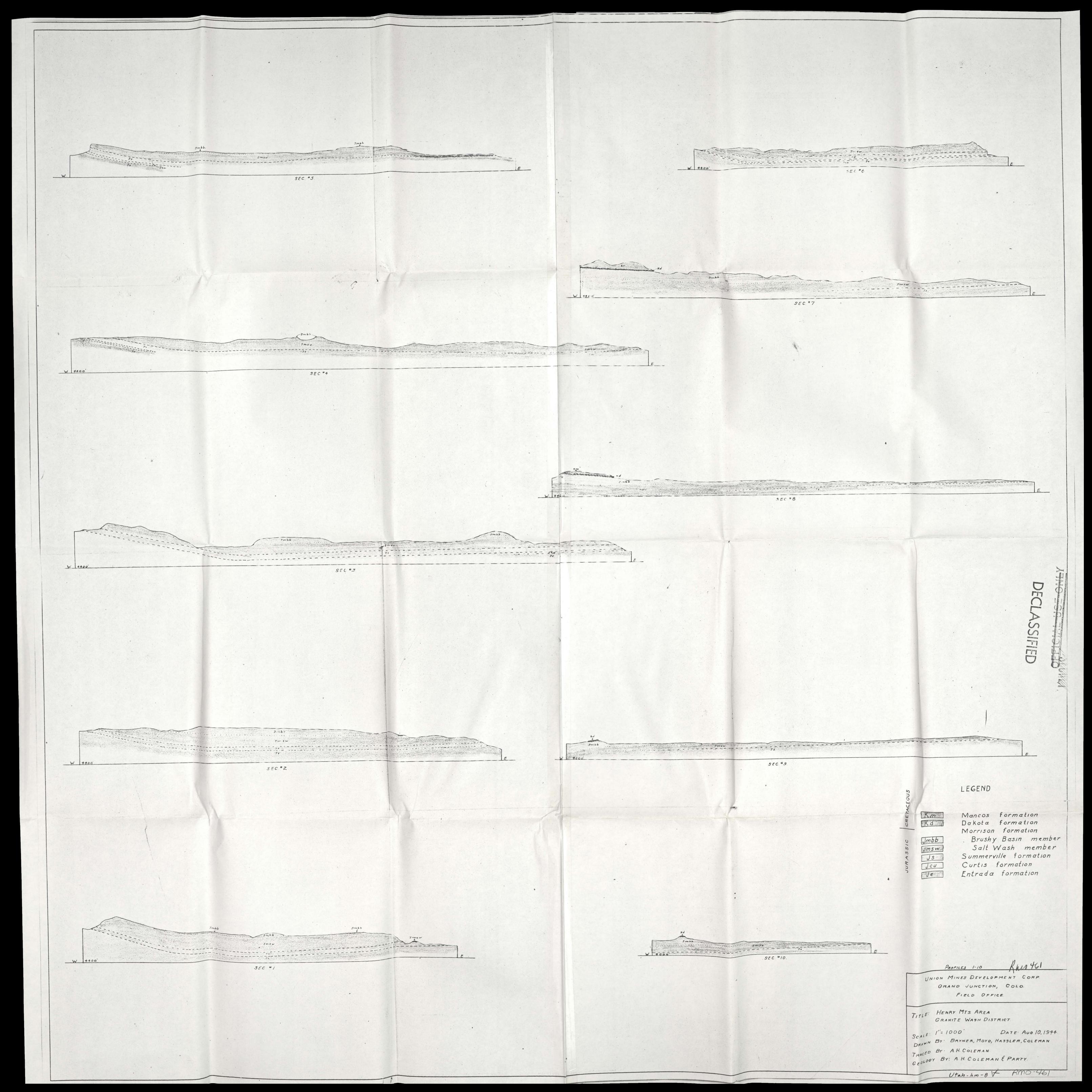


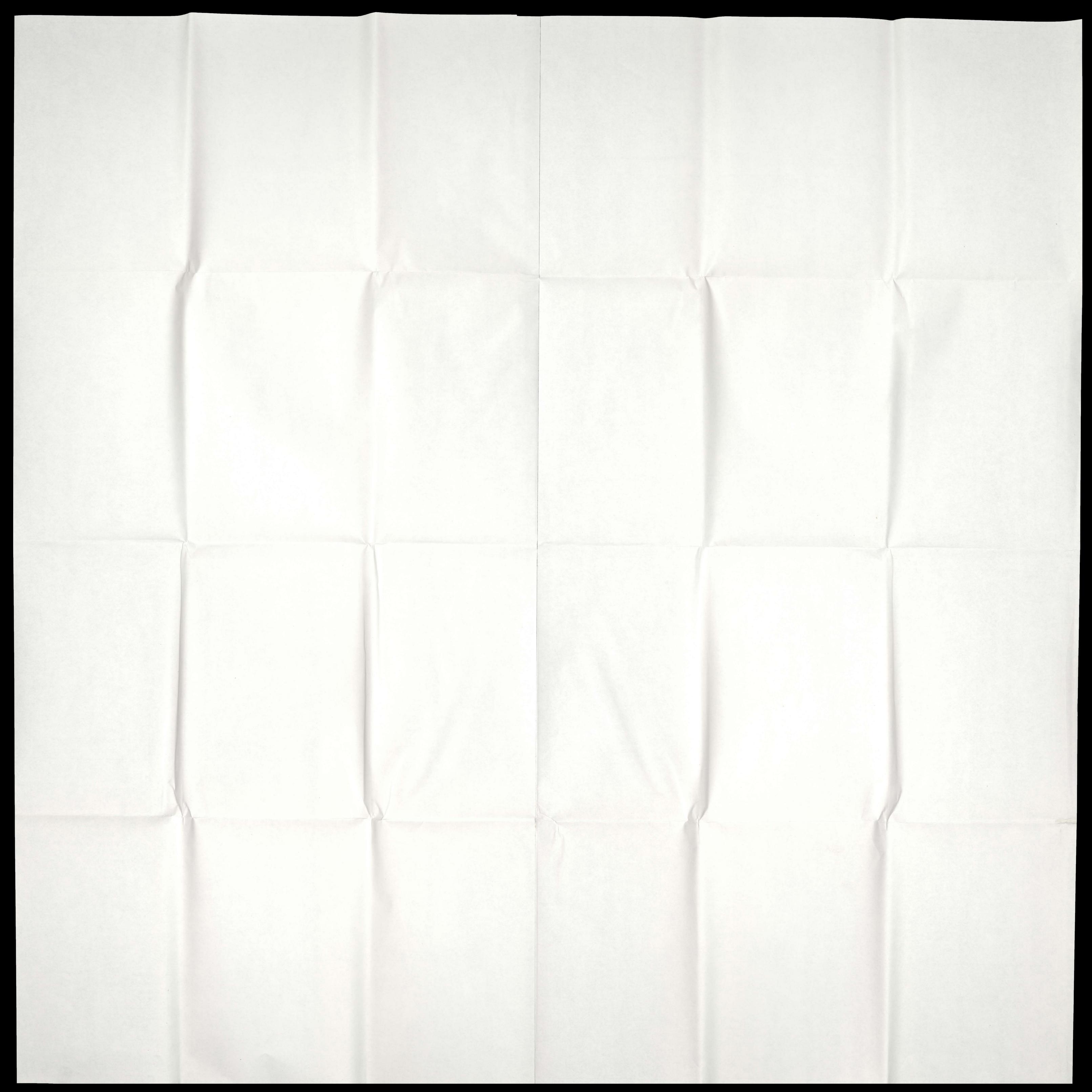












COLUMN #1.

Erosion

Surface.

1

-F.56222

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o'-it' Thinly interbedded fine gr. 35 and green this show. 14-17' Interbedded purplish shale and limestate the latter in part recrystallized in radia

concretionary forms 17'-73' Interbedded ss. and red and green stales.

78'-si' Cross-bedded med. to coorse gr. ss Octas and pebbles to i". Also numerous clay golls

si'ss' Interbedded ss. and red shale

96-112' Cross bedded med to coorse gr. ss Occostonal pebbles to ".

112-128' Interbedded ss and red shale

120'-144' Cross-bedded, med or. 55.

144'-146' Thin bedded, fine gr. 55.

146-159 Cross-bedded, fine to med. gr. s.

153-164' Thin bedded, fine gr. 55. Some shole.

167-180 Cross bedded, med gr. 55.

180-202' Reddish shole, in port colcitic. Also interbedaed ss.

202'220 Cross bedded, fine to med gr. 55. Massive rounded outcrops

220:230' Interbedded fine gr. ss. and shale

230'248' Cross bedded fine to med ar ss. Ore occurs in this zone.

2+0'-263' Reddish, sondy shole.

263'-264' Dense, med. gr ss.

Summerville - Morrison Soltwash contact Slight angular unconformity

Sandrock in column = 56%

Column #2. Description Col. #2. 0'- 10' Thin bedded, fine gr ss.

10'- 80' Gray shales. Some thin linestone beds. These lattenin Groy she recrystollized to rodiated, concretionary calcite. Some interbedded fine gr. ss.

80 89' Cross-bedded, med. gr. ss Some day goils.

00'-102' Red and gray shales. Some interbadded ss

102'- 107' Cross-bedded, med to course gr 55

or-los' Gray and red shale. 102'168' Cross bedded med to coorse ar ss Some clay galls

and seams 168-170' Gray shale.

fres on

Surface

1401

10-194' Cross-bedded, med. gr. ss

34 218' Red, soudy & hale with interbedded ss

210 240' Cross-bedded, time to med. gr ss Ore occurs in this zone

2+8:218 Interbedded, sondy, red shole and ss

Summerville - Morrison Soltwash contact

Slight angular unconformity.

Sandrock in column = 60%

278-345 Cross bedded, med to caerse gr ss. Some clay galls.

Description: Col. M3 o'-ss' Thin bedded, fine gr ss. with interbedded gray shale, Portions of the shale are limy and purplish in color.

86'-102' Fine to med gr 55. with interbedded grey and red shale.

102 118' Cross-bedded, med to coarse gr. ss. Local conglom: Weathers to light brown.

118-130' Thin bedded, fine gr. ss. Weathers light brownish yellow.

130' Its' Reddish, sandy shale.

148.150' Cross-bedded, med. gr. ss. In part, impregnated by Limonite.

150-174' Fine gr. ss. Weathers white to brownish. Possibly some shale.

17+ 250' Cross-bedded, med gr. ss Weathers gray to white. Some limenitic impregnations. Ore occurs in this zone.

250'-265' Red and gray shales. Some interbedded 55.

265: 326 Cross-bedded, med to coarse gr. 55. Weathers gray white to brownish.

320-340 Covered by Qal.

Column #3.

Approx cont.

with Jmbb

F.

aal.

covered

2.00

AO TETET Ere ort

320 37 SC

Column #4.

Erosion

Surface

- Margan

Description: Col. 44 0'-20' Thin-bedded, fine gr. ss. Some interbedded gray shale. Zone weathers light gray.

20- as' Gray and red shales, some of which are limy. Interbedded lenses of fine to med. gr. ss.

85'.97' Cross-beddod, med to course gr. ss. Some cloy galls. Weathers to light brown.

si'los' Red and gray shale with interbedded lenses of fine gr.ss.

102-124' Cross-bedded, med to coarse ar. 55. Clay galls and seams near battom

124-157 Thin bedded, fine gr ss Weathers white to light brown. In part, impregnated by limonite

157'174' Cross bedded, med. gr ss Weathers grayish white In part, limonite impregnated.

174'-181' Red and gray shale

181-184' Med. gr. ss. Weathers to brown. Locally, heavy limonite impregnations.

184-205' Sandy, red shale.

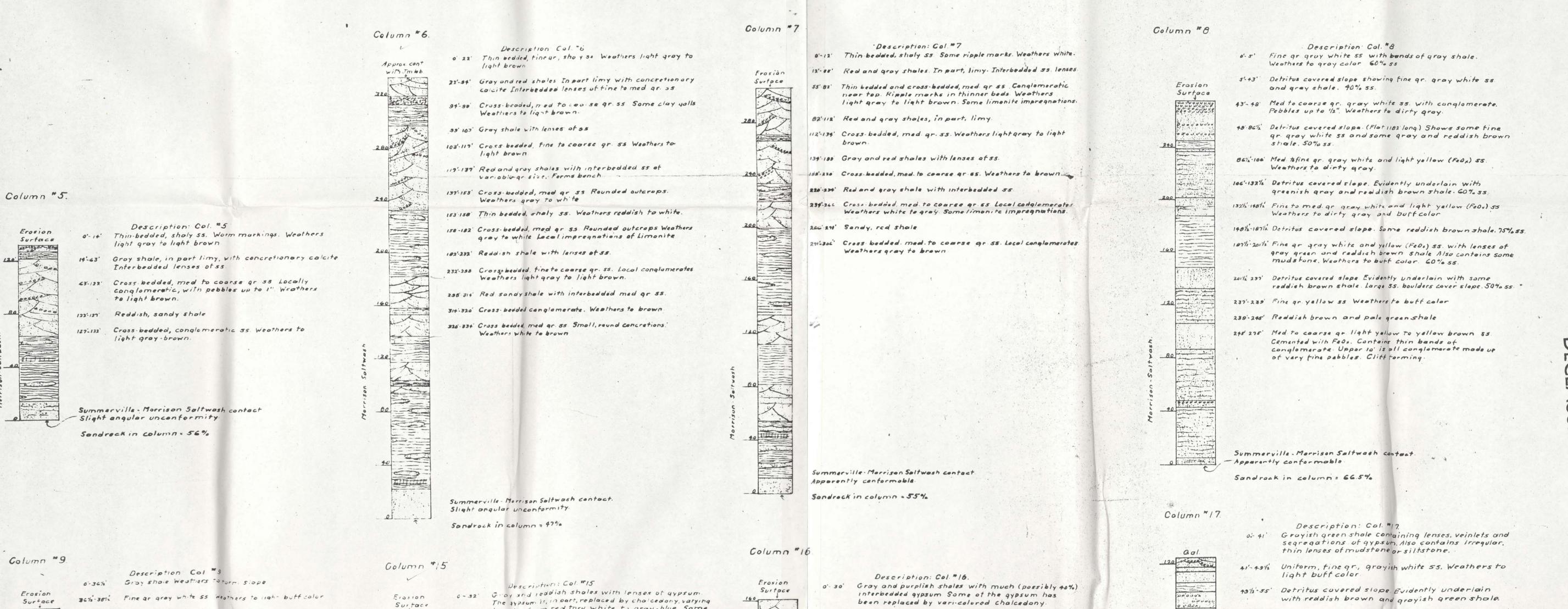
205-237 Cross-bedded, med. gr. ss. Rounded outcrops. Weathers white to gray Local limonite impregnations.

Summerville - Morrison Soltwesh contact. Slight angular unconformity.

Sandrock in column = 55%

Summerville-Morrison soltwash contact Slight angular unconformity.

Sandrock in column = 65%.



1' in thickness. Some lenses of ss Anti-so tordifine ar gray white ss watness to light but 55 63 Cross-bedded, med. gr ss Weathers to light brown. grayish green and reddish brown shale. -7.1 32'-68' Red and gray shales with lenses of ss color as at gray shale as below top of ss 80% ss 63.68 Gray and red shales with small ss. lenses. 76% 82' Grayish white, time gr. ss. Weathers to pale buff. 68' 118' Cross-bedded, med qr. 55 to conglomerate with 50'-52' Gray shale Upper 2' irregularly bedded. 68' 111 Cross bedded, fine gr. ss to conglomerate Barite "pebbles up to 1" Some clay galls Barite roses" "roses" are locally plantiful in med. gr. partions. 52'-sets Med to coorse ar gray whitess Weathers to butt in some of the med gr. ss. Weathers light gray 82'-861'2 Detritus covered slope. Evidently underloin Weathers to light brown. color. Also irregular conglomerate beds Pebbles with grayish green and redalish brown shale. to light brown. up to 1/2". 111-116' Fine gr. shaly sondstone. Weathers white to reddish 118:168 Cross bedded, med. gr.ss Small, round limonite Bel's-sol's Dirty, fine to coorse qr. groyish white to pole brown. buff ss, interspersed with irregular conglomeratic schice Detritus covered slope Small amount of gray shale concretions present. Weathers light redd sh showing. 75% 55. beds. Pebble size up to 3/4" Slightly cross-bedded. Cross bedded, med to course ar. ss. Weathers gray to 116 161 brown. -712-112 light brown. ~ ccicet's Conglomeratic gray white ss containing peobles 168-178' Thin bedded, fine to med gr ss. Some rough; self-105/2 Detritus covered slope. Possibly underlain by up to 3/4" . Weathers to buff color. rounded, borite comented, concretions to about thin-bedded, shally siltstone and perhaps some shale. 2" in diam present Weathers white to light 10512-113' Soft, grayish white, med. gr. ss. Weathers to coling " Med or groy white and yellow brown (FeD,) ss Cantoins irregular bads of conglomerate, pebble brown form slope. 178-227 Red shole with interbedded ss. Size up to 1/2". 113'-116' Brayish white, fine to med. gr. 55. Forms ledge. 71-78' Detritos covered slope, underlain with grayish green 219'-277' Cross-bedded, med. gr. ss. to conglomerate and reddish brown shale 50° ss Weathers light brown to dark brown. 1161/2-124 Coarse gr., pale buff, irregularly bedded and and cross-bedded ss. Slightly conglomeratic. Flecked with Summerville - Merrison Saltwash contact. Slight angular unconformity. Fine gr gray white ss. heathers to buff color 277-285' Red, sondy shale. Flecked with yellow specks (Feox). Cliff forming. 78-75 Sandrock in column = 63%. Detritus covered slope underlain with gray shale. 205'-200 Dense, med 9r ss Some silicified wood. Weathers Summerville-Morrison-Soltwash contact. Conformable 79'-86' gray to brown. and gradational. B6'-B7' Med to coarse gr. gray white ss. with small irregular beds of conglomerate - pebble size Sandrock in column = 39% up to 3/4" Weathers to butt color. Summerville - Herrisen Saltwach contact Contermable Columns 1-9; 15-17 R MAD 461 Sandrock in column = 38%. UNION MINES DEVELOPMENT CORP. GRAND JUNCTION, COLO. FIELD OFFICE. TITLE: HENRY MTS AREA Summerville - Morrison Saltwash contact GRANITE WASH DISTRICT. Slight angular unconformity. SCALE: 1"= 40 :" 0 The sector Sandrock in column = 66%. DRAWN BY MOYD, HASSLER, COLEMAN. TRACED BY : A.H. COLEMAN

58-761/2 Detritus covered'slope. Evidently underlain with

in color from red thru white to gray-blue Some 30% - 47% Detritus covered slope Yoinly gray shale Evident'y of the gypsum hus been leached out and reprecipitated 55'-58' Fine gr. grayish white ss martin & time 30' 55' Gray and red shales with interbedded ss. contains some bonds of time ar ss 20% ss in the form of cross-fibre, reticulating veinlets up to

de.

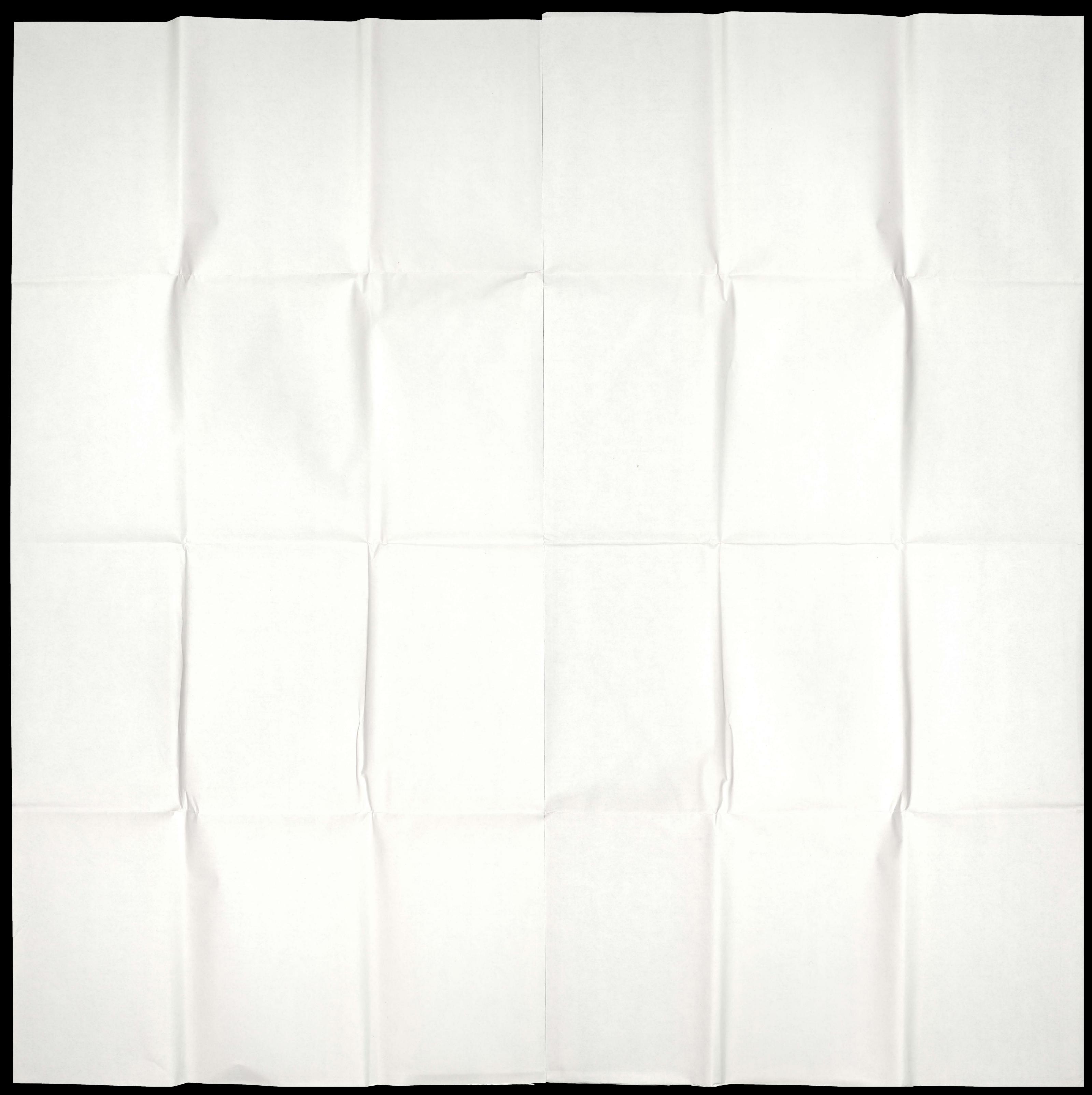
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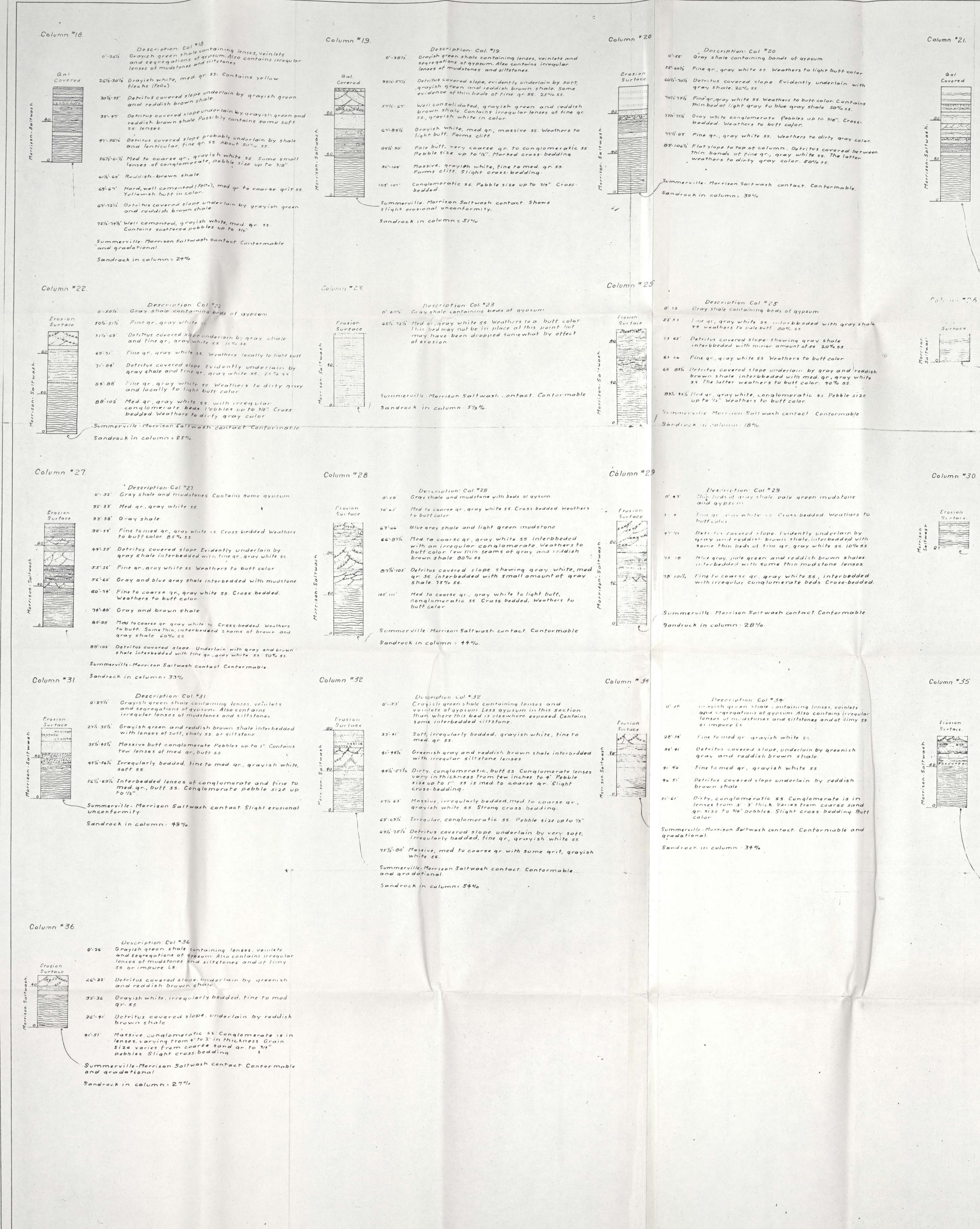
DATE: AUG. 1, 1944.

RMA-461

GEOLOGY BY: A.H. COLEMAN & PARTY.

Utah - hm-9



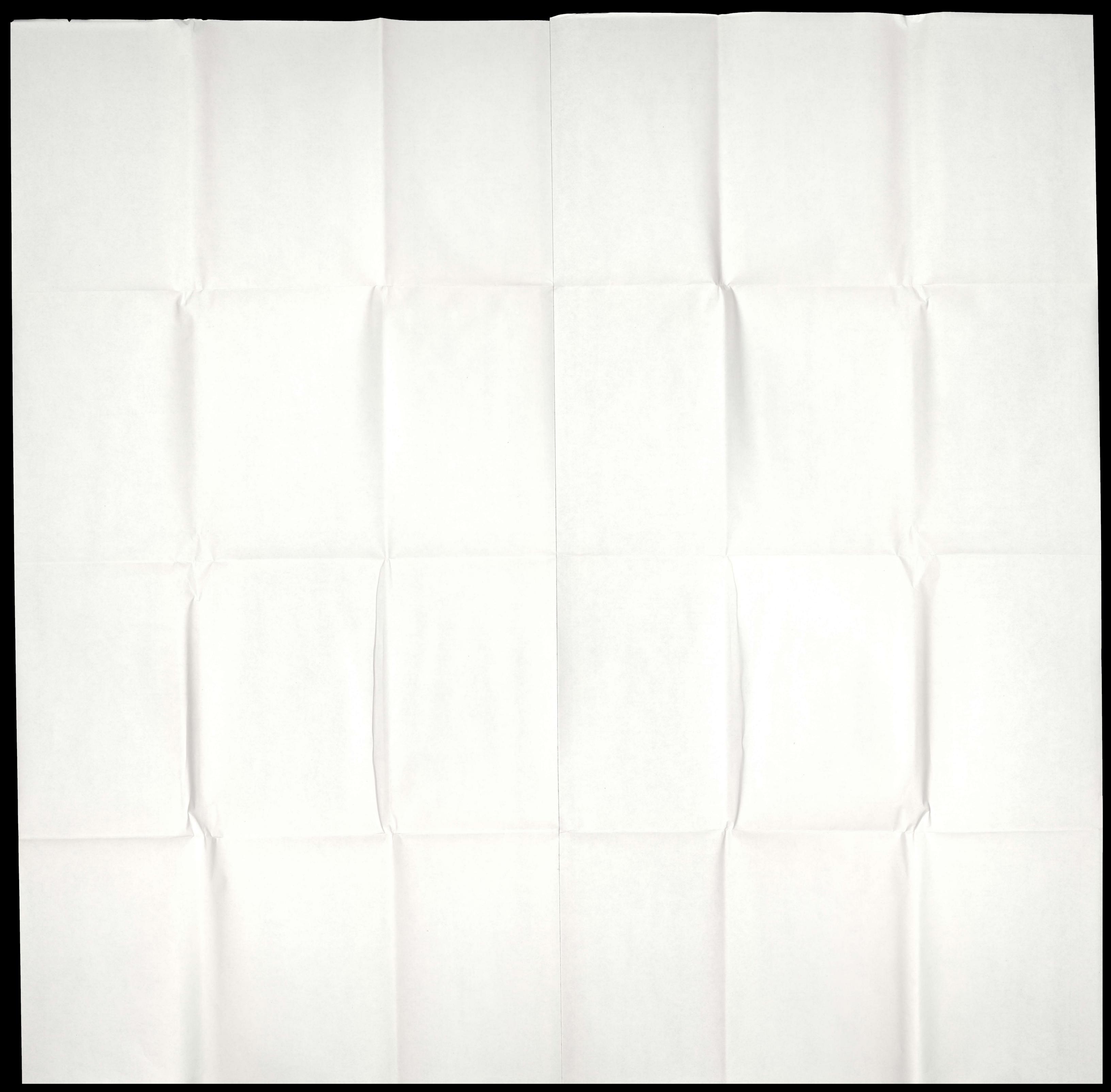


## Description: Col. #21. 0'- 4+12' Gray shall containing bands of gypsum 441/2 471/2' Fine gr. gray white iss. Weathers to dirty gray and light buff color. 471/2-521/2 Detritus covered slope. Evidently underlain with gray shale and fine ar, gray white ss. 20% ss. 5212'5312' Fine gr., gray white ss Weathers to light buff. s31/2'-s61/2 Detritus covered slope with some gray shale showing thru. 50% 55 scil 621/2 Irregular conglomerate beds interbedded with med. ar, gray white ss. Conglomerate pebble size up to 14" Slight cross bedding. Weathers to dirty gray and light butt color cz1/2-701/2 Detritus covered slope showing 4" bed of med. gr., gray white ss. in place. Also some blue-gray shale 101/2-761/2 Fine qr, gray white ss. Cross bedded Weathers to butt color. Also contains some gray shale Boto ss. 1612 Brin Blow sand covered slope. Med gr., gray white ss. exposed in places. Also some gray shale 60% 55. Orth' 95th Med ar, light butfss with interbedded light green shale. Top 2' is an irregular conglomerate with pebbles up to 1/2" Weathers to buff color 85% 55 ssh-113' Some gray shale in place, showing thrua blow sand covering Quantities of small pieces of silicified wood. 60% 55. Summerville. Morrison Saltwash contact. Conformable. Sundrock in column = 43 %. Description: Col. # 20. - Summerville Morrison Saltwash contact. Conformable Sandrockin culumn= 0% Description Col #30 Thin beds of gray shale and mudstoned 0' 27' interbedded gypsum Summerville Morrison Saltwash contact Conformable. Sandruck in coluinn = 0% Description Col. #35 o' +2' Greenish gray shale containing lenses, veinlets and segregations of gypsum. Also contains irregular lenses of mudstones and sillstones and of limy 55 or impure Ls. 42'46 Massive, butt, conglomeratic ss. Varies from coarse sand gr. size to 1" Pebbles 46'so' Petritus covered slope, underlain by greenish and reddish brown shale 50'53' Grayish white, time to med. gr. 55. 53-55 Detritus covered slope, underlain by reddish brown shale. 55'-59' Sott, irregularly bedded, groyish white to greenish white 55. 59'651/2 Detritus covered flat slope. Underlain by reddish brown shale Contains some thin lenses of soft. grayish white 55 2540 ss. 65% To Dirty, butt, conglomeraticss Conglomerate is lenticular, varying in thickness from 3" to 2'. Crain size varies from med gr to 3/4" pebbles. Strong cross-bedding. Summerville Morrison Saltwash contact. Slight erosional uncontermity. Sandrock in column: 24 %.

Columne 18-32; 34-36, RWD 461 UNION MINES DEVELOPMENT CORP. GRAND JUNCTION, COLO FIELD OFFICE TITLE: HENRY MTS; AREA. GRANITE WASH DISTRICT. SCALE: 1'= 40' DATE: AUG 4, 194A DRAWN BY: HASSLER, COLEMAN. TRACED BY : A.H. COLEMAN

GROLDEY BY: A. H. COLEMAN & PARTY

Utah hm-10.



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Golumn #10.

0'-26'	Description: Col #10. Interbodd sh. and Ls. Ls is massive, gray and in bed I' thick or less. Sh. predominates
26'-29'	Grayish white, lenticular, highly calcareous ss. fipe to med. gr. Cross-bedded.
29-32'	Greenish gray, highly fractured, soft sh.
32'35'	Ls, sh. and ss These beds are similar to the Ls., sh. and ss. beds described in lower part of column.
35'-38	Sh and ss. similar to those below. Ss. heds about I thick
38'-42'	Unbedded, white, fine 9r., colcareous ss. Soft. forms rounded bluff.
38-57	Poor outerop. Contains some sh.
57'-59	Fine to med. gr ss Shaly. Calcareous Contains maroon sh. seams. Ss. generally weathers into rounded forms and is pole, grayish-green in color.
59'-68'	Massive, white, fine to med irregular ar. ss Vary faint bedding. Contains zones of chert and clay peobles. Loose grained.
68'-71'	No outcrop. Shale indicated in talus.
71-82	Massive, white, lenticular ss. Cross bedded. Weathers t tan. Med. gr. to conglomeratic. Conglomerate is mainly of chart pebbles but some clay pebbles are present.
82'-121'	Outcrop very incomplete. Occasional ss beds
121-139'	Massive, ledge-torming, med to fine gr. 55. Loose grain. Evenly cross-bedded. Calcareous.
134'-148'	Poorly exposed. Mainly loose qr. 55. 80% 55.
198'156'	Massive, gray, med. to fine gr. ss. Cross. bedded
156-160	Poorly axposed. Some shale showing
160.176	White to tan, fine qr to grit, lenticular ss. Ledge. forming. Cross-bedded
176'-192'	Ss. with minor shale (2%). Fine to med ar Faintly bedded and cross-bedded. Pronounced iron stain and interstitial limonite.
192-214	Poorly exposed. Est 80% ss.
214'-216'	Interbeaded time gr, palegreen, ss and maroon sh. Est 60% ss.
	White, fine qr., colcoreous ss. Ledge forming. No . evident bedding
220'-294'	Poorly exposed. Est. 85% ss.
249:254	Fine-med.qr., iron-stained ss. Shaly near canter. Profuse cross-badding Est. 95% ss.
254'-268'	Paorly exposed Est. 65% ss.
268'-286'	Med gr to fine conglomeratic \$5 Very pebbly near to Forms cliff. Solution pits. Contains white, opaque, interstitial matter Limonite-stained. Cross bedded Calcareous.
286-300	Med. qr. to grit, cross-be dded ss. Forms bluff. Solutio coverns
Sandrock	kin column = 73%

0'-6' Talus. Est 80%. 6'-7' White fine gr. Erosion

Surface. 2325 ----TITI and the second second 1.2.1 THI

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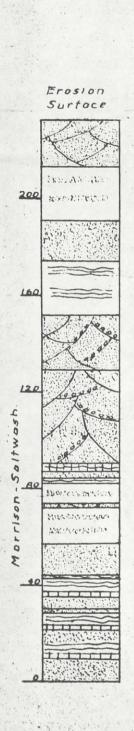
Column #37.

1-13' Talus Mainly s .13'-18' White, soft, sill 18' to' Talus Mainly 5 40'-48' Silty Ls and c Gray Ls predor thickness varia 48-51' Fine gr., lentice si'sa' Silty Ls. and with shale sea 58'-65' Fine gr. to grit. 65' 76' Talus Est. 60% 76-78' Thin bedded, s 78'-91' Massive, fine t forming. Cross Weathers to pi 91'-97' Poor outerop. 3

97-102' Poor outcrop. 102-106' Talus. Est. 60% 106-123' Fine to med a 123-134' Poor outerop Li Est 60% 55. Sandrock in column = 3

and the second

145	Co	lumn	#14.	



	Description: Col. IT.
0-28%	Sh., Ss., Ls. and gypsum Gypsum is silty and sholy. Only upper 8' accessible.
28%-30	Pale butf, thin-bedded, fine gr. Ss.
30'-4212'	Poorly exposed. Mainly Sh., Ls. and qypsum in eauol amounts.
+21/2-++	Gray, highly fractured, highly colcareous Sh. Weathers to rounded blocks.
F. 4'- 57'	Massive, danse, tine gr. 5s Massively bedded with silty, friable partings
57'-72'	Poorly exposed. Est. 40% Ss.
12'-74'	Fine to course gr. Ss. Weak cross-bedding
79'- 02'	Tolus Est. 50% Ss.
92'-841/2	Highly fractured, gray, calcareous mudstone
341/2- 871/2	Fine qr. to silly 5s with shaly parting
371/2'-901/2	Silty to sondy Ls with some Sh
001/2-129	Fine to coorse ar, cross-bedded Ss. Bluff forming. Pebble streaks Small fragment of fossil bane of base
9'-151'la	S5. like that at 90%-123' but less pebbly. Thin bedded at top.
5112-174'	Talus. Est. 60% sh.
· + '- 191'	White, soft, fine to med. gr. Ss. Massive. Bedding faint or absent. Thin-bedded at top. Petrified logs at this horizon
1'-2131/2	Talus Est. 60% 55
3%-233	White, fine to coarse ar. Ss. Soft Bench-forming. Cross bedded.
androc	k in column = 69%.
1.1	

Description: Col. #14.

						green	from	n th	in
	0 4		10	-121/2		Poorly	Y @ *	POS	ed.
	Contact Jmbb	-	12	12-50		Talus			
2 44	2					silty			
			ġ¢	81		Foorly Ss.15 and c and i	mee	d.to s.he	fir
160	Covered		8	1'-185		Interb bads. congle of Sh by a of the pocke	Is i in m lum e Ss ats.	uds vds s, St Ss i	cu 10 to co co
20			103	12-23		Poor o voryi beddi betwa	n9	fro	~
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## Desci o'-10' Interbedded Sh is from thin een in color

Column #11.

					and the second second
	Col	lumn #12.			Column *13
Description Col #11.				Description Col #12	and the second second
s. Est ao% sh te.tine gr., well cemented ss. No evident bedding.			0' 3' 3'-6'	Norly exposed Est 80% sh. White, lonticular, fine qr, shaly ss. Cross-bedded	
15. Mainly sh.				Colcareous. Shaly near top	Erosion Surtace
te, soft, silty Ls. with shale partings.		Fiosian Surface	6' 32' 32' 34'	Talus Pale gray. Mainly sh. with minor Ls. and 55 beds Grayish white, fine to med gr., lenticular ss. Cross-bedded	200 i gan sonnakanga
s Moinly sh. with Ls bods less than i' thick.		al the manager	34'-40'	Finetomed or ss interbedded with sh. Lower 2' has	
Y Ls and calcareous siltstone in alternate beds. Y Ls predominates and Is more resistant. Its		The main		clay pebbles Est 70% 35.	160
e gr., lenticular 55 No evident bedding.		80	40'- 47' 47 48'	White, fine to med. gr, lenticular ss. Cross-bedded	ejinaritekteri ejinaritekteri
ty Ls. and calcareous siltstone interbedded			48' 51'	Tolus Est 90% sh	
1 shale seams.		ACR	51.52	White, Lenticular, cross-bedded ss Has scottered pebbles	\$ 120
s gr. to grit, conglomeratic \$\$ Cross bedded. S. Est. 60% ss, 40% sh.	2.50	40	52'.58	Js. similar to bed below	i fuel
bedded, silty and calcoreous, moroon mudstone.	r 1 5 0 1		58' 62'	Falus Est. 504, Ss.	in s
sive, fine to med. 4r, conglomeratic ss. Bluff- ming. Cross-bedded. Spotted with iron stain	. 4. 7101	ELUTE	62'.60' '	Fine gr., lenticular, conglomaratic 55. Conglomerate is sub ongular to rounded Some chart Cross-bedded	BO MUSEUMAN CO. SALA
iners to pitted surface		0	66-69	(ray, thin.badded, silty Ls. Green-gray bed at top	
outerop. Bormore 1/2'-1' ss. beds				White, fine ar, cross-badded 55 Beds are 0.8-10' thick	
r outcrop. Mainly gray, massive Ls c.			70'-77'	Med ar, conglomeratic ss. Lenticular Cross-bedded Est 90% ss	90
to med gr. ss. Some sh. Est Bo ss			77'-80	Vary weakly hedded, white, med. ar. Ss.	2////25
r outerop Lenticulor, triable ss bed (3) at top 60% ss.			80' 83'		
Column = 37%				White, mad gr 5s	0
				Platy and silty Ls.	
1			85.87	Mad qr., pabbly 55. White, opaque, interstitial matter abundant.	
		inter the		Massive, fine to coorse qr. 5s. Pabbly streaks Crossbedded	
				Platy, fine qr., irregularly bedded Ss. Pitted. Iron stoined	
				ine to mad ar ss Cross-bedded Ladge-forming	
				ch in calumn = 53%.	
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	Colu	mn #38			Column #39.
Description: Col.#37 rbedded 5h and 55 55 is med to fine gr. and in			0'.15'	Description: Col. # 38. Talus. Appears to be a gr., tine gr. Ss.	
s from thin plotes to 2' in thickness. Shole is pole in in color. Est. 90% 55.				Poor outcrop 5s and Sh. alternating in uneven but	
ly exposed. Gray, non-crystalline Ls	- 1			fairly persistent beds Ss. is fine ar with a few grit streaks. Sh is soft and highly fractured	
s Est 70% Ss. 20% Sh. 10% Ls. Several beds of Ss. lar to those in 0'-10' Lower '13 contains much		Jmbb.		Tolus Probably a continuation of beds 15:31	Contact Jmbb
y 1.5		1		Talus. Pole graan Probably mainly shi	
ly exposed Est 90% Ss Ss interbedded with Sh s med to fine gr. with gritty streaks, Irregular cross hedded. Sh is green and purple in color	4			Ss in tan, lenticular ledges, 12'-212' thick, seperated by talus zones Est. 70% Ss Ss. is fine gr. and cross- bedded.	360
is lenticular		Z	77'-81	Pale purplish gray to pale green Ls L's is in lenticular	
rbedded Ss. and Sh. Ss. Isin irregular, massive . Is lenticular and cross-bedded. Contains		and and a		beds that weather into rounded blocks. Bods are separated by Sh. seams. 13 of zone, near top. is med.	720
lomeratic beds There are about 3 zones h., mudstone and silty Ls., usually bounded	-			gr. Ss.	
he Ss. Sh. also becaus throad the Ss. in kets. Ss contains some fissure fillings of		Keepe		Interbedded Ss. and Sh. Ss. is in lenses, separated by Sh. and is fine to med ar, with a few pebbles and grit streaks. Est 80% Ss.	Just
ganese oxido.	3	50 - 10 A WA	88: 924	Maroon mudstone Highly fractured but fairly	280
autorop. 5s is slope-terming and in beds ying from platy to 2' in thickness. Gross		any mint		persistent. Also some minor Ss. lenses.	and the second
ding is in alignment with platy bedding Talus waan Ss. auterops is rusty color.		- Talua		Fine to med.gr Ss. Cliff-forming. Cross bedding and pebble and grit lenses, make it irregular in thickness.	
to coorse gr., irregularly bedded Ss. Cross-hedded	E	20 70100		Poor outcrop Interbedded Ss with maroon mudstone and colcareous siltstone Beds are 11/2' in thickness	290
ly axposed. A Ss. that resembles that of 239-2521/2.		The second		Upper half of zone is talus	U.A.M. NAC
to coarse qr, irregularly bedded Ss. Pitted. Cross.		A MAR		Ss with thin beds of grit and conglomarate. Interbedded Ss., mudstone and Sh. in irregular	L
ina contropming.	2	80		Deas and lonses. Beds meet in undulating contact. Ss. is mainly at top and battom of zone Sh. and	200
ost outcrop carried by 830' Brunton-pace				mudstone are very colcareous and purple to maroon in color.	Sei
nerse ta Brushy Basin contact. n calumn = 86%.		TX	15112-18512	Cliff-forming Ss. Partially exposed. No bedding except that of intersecting sets of cross-bedding.	STANGE STAN
	4 2	20		Some pala green Sh. seems. Ss. fine to med. gr. Est. 98% - Ss.	140
	two	1	185%-135	Tolus.	< Minatoria
	-	The second second	100' 010'	Treesular undulation hade at the and structure, with	

199-213' Irregular, undulating beds of Ss. and slitstone, with local lanses. Est 80% Ss. 5s is med, to finear, tough and well comented It contains accessional Sh. seams, clay pebbles and thin beds of coarse to gritty 5s. Siltstone is pole green to pole purple and moreon. It weathars to pillow-like surface and is highly fractured.

213'-257' Fine to course ar, cross-bedded Ss. Uiffeforming. Contains clay pebbles. 257'-274' Falus. Est 5040 55.

a p 1145.

Talus.

111215

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274'288' Ss and Sh., poorly exposed Ss. is in platy, irregular beds, i thick and is fine to med. gr. Sh is in irregular beds and lenses Sh. is in irregular beas and lenses and weathers to a pillowy surface. Its color is grayish purple to pole green and it is very colcore 208-326' Cliff-forming Ss. Surface is rough and irregular due to pitting and to zones of irregular hardness. It. is cross-badded and contains grit, peobles, conglomerate lanses and clay publies

326'-336' Tolus. 336-363' Ss. similar to that of 288-326' but contains tewer pebbles and lass grit; Softerand forms ledges. 363-419' Fine to med. gr. Ss. Contains thin lenses of grit

and pabbles. Strong cross-bedding 25' above bottom of this zone, there is 6' of irregular, lenticular Siltstone. It is calcareous and purple to maroon in color. 13' above this zone is a similar bed, 2' thick. 41912-457 White, fine to med ar. Ss., similar to that of 363'-41912' but with very little grit and no pebbles.

Weak cross-bedding. Contains white, interstitial partiales; possibly clay or chart. Sandrock in column = 83%.

> Notes - All Ss. In these columns appears to be culcureous In varying degrees. It all consists mainly of sub angular to raunded quartz grains. Its weathered surface is pale tanto grayish white and its fresh surface is white to grayish-white.

## Description: Col. #13. 0'-55' Sh. Ss. and Ls. Poorly exposed. Extremely lenticular, especially in Ss Color is greenish gray. Av. bed thickness is 1'. Beds are somewhat alternated. Ss. 1s fine to med. gr. Sh. is fine with uneven tracture. Ls. 1s mossive and gray in color. At 20' there is much cross-fiber gypsum, suggesting fissure filling. si-sit Ls with minor amounts of 5h Ls is pole green-gray to purplish-gray Ls is silty to sandy and weathers to rounded forms Beds 1/2' thick, separated by Sh. seams. 57% 64% line to med. ar., lenticular 55, with pebble streaks. Massively bedded. Cross. bedded. 64%-70% Ls., 55 and Sh beds like those at 0-55'. 55 makes thin ledges. Toli-7712 Fine to med. 9+ Ss. Massively bedded and cross-bedded. 77% 87' Talus. Est. 50% 55 87'-91' Pale green to maroon, calcareous Sh and siltstone. Finely banded. Hard. Ledge-torming. gi 112' Fine to med. ar., massive, cross-bedded Ss. Pabble streaks, Cliff forming. White in color. 112'-114' Dark gray, massive Ls. 114-12212 White, weakly bedded, fine to med. gr., Ss. Forms bench. 1221/2-1231/2 White, mod. gr., ledge-forming SS. Pronounced iron stain. 12312-129 Folus. Est 50% 55 129-130% White, thin-bedded, time gr. 55. Very calcoreaus. Ledge-forming. 1301/-1331/2 Talus. Est. 60% Sh 133%-134% Fine qr., ledge-forming Ss. 134%-185' Tolus Est. 60% Ss. Small amount of silty Ls. 145-147% Mudstone with minor amounts of siltstone, Calcareous. Thin-bedded. Finely fractured. Maroon and green in color. 1471/2-1811/2 Poorly exposed Est 80% Ss.

i Bil's-19+1's Weakly bedded, Cross-bedded Ss. Pebbly streaks. Cliff-forming.

1991/2-206' Poorly exposed. Thin bedded, soft Ss. Est. 70% Ss.

Sandrock in column = 60°/0.

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	Service and the service of the		
	0'-2'	Description: Col #39. Talus Probably soft, thin-bedded, Ss. with minor Sh.	
	2'-41/2'	Fine to coorse, irregular, weakly cross-bedded Ss. Forms ledge.	
N	\$'12'- #Z'	Poor outerop f'above bottom there is a 11/2' bed of Ss. overlain by 2' of soft gray Ls. and Sh.	
	42' 451/2	55. Deds like those of 2'-912'	
	45 1/2 . 72'	Tolus. Irregular, cross-bodded, fine qr. to pebbly Ss. Est. 90% 5s.	
	72'-102'	Fine to med. gr. Ss. Cliff-forming, Blocky, with crude vartical sointing. Strong cross-bedding and bads of grit and pubbles. Near middle of zone there is an irregular, pole green siltstone, interbedded with the Ss.	
	102'-182'	Poor outcrop. Slope is steep at bottom and gradual at top and Broken by resistant, blocky ledges of Ss., s' in thickness. Intervening talus shows thin-bedded, rusty, fine to coarse gr. Ss. There are accessional seams of pole green silt.	
	182:204%	Fine ar to grit, crossbadded Ss. Shows pitting. Waathers to steep, rounded bluff.	
	20+6-238	Talus, rusty colored with thin slobs to large angular blocks of pitted, dirty brown Ss. 11' above the bottom there are some 2'-3' ledges of time to med. 95, weakly cross bedded Ss. The thin, even bedding of these ledges is brought out by weatharing. The upper 17' is talus with some Sh. evident. Est. 80% 55.	
	238'-253'	Fine to med. qr., cross-bedded Ss. Shows qrit streaks. Forms blocky to crudely rounded cliff.	
1. 1. A. S.	253'-262'	Folus. Indications of thin bedded, undulating Ss with some Sh.	
		Discontinuous ledges of fine to coorse qr., cross-bedded 55. Shows some silty phases and pebble conglomerate Forms steep, rounded bluff.	
		Lower 25' has 53 showing pebble beds and langes as well as 2 lanses of calcareaus, purple-green siltstone interbedded with tan Ls. Next 25' shows a more pebbly and cross-bedded Ss. interbedded with a thin siltstone seam. Upper 20' shows a less pebbly Ss. which rounds off into a dip slape	
		Kin column = 84%.	

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Columna 10-14:37-39 UNION MINES DEVELOPMENT CORP. GRAND JUNCTION, COLD. FIELD OFFICE TITLE: HENRY MTS. AREA.

SCALE: 1= 40' DATE: AUG. 10, 1944.

GRANITE WASH DISTRICT.

DRAWN BY: L. BRYNER. TRACED BY: A.H COLEMAN. GEOLOGY BY: A. H. COLEMAN & PARTY.

Utah - hm - 11

Rm0-461



Column #40:

Column #41.

Contact

Jmbb.

1,302366433

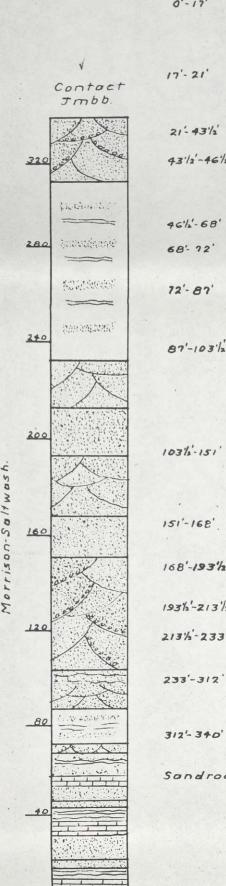
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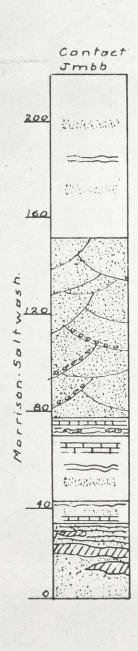
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	Description: Col. * 40. Ls., Ss. and Sh. in alternating beds Ls. predominates in middle of zone. Ss. is fine qr., irregular and in undulating beds. Ls. is gray, massive and concretionary. Sh. is gray, soft and highly fractured.		
17'-21'	Tough, dense, lenticular, fine to med.ar. Ss. Irregular banding and crumbling may be contemporaneous with deposition.		240
21-431/2	Ls., 55 and Sh. as in 0'-17'. Poorly exposed.		
43'/2'-46'/2	Fine to med. qr. Ss. Irreqular bedding is similar to Ss. of 11'-21' Ss. is highly calcareous. Calcite cleavages give broken surface a sparkling appearance.	•	290
4611-68	Sh., Ss. and Ls. as in o'-17', but Sh. pre dominates		1
68- 72'	Fine to med. qr., cross bedded Ss. Some grit lenses. Forms irregular ledge.		
72'- 87'	Poor outcrop Probably alternating 2' beds of Ss. and Sh. Ss is thin bedded, soft and fine to med gr Sh. is very soft and marcon to pale green in color		191
87'-103'la	Ss. and siltstone. Lower half of zone is. Ss. cliff; irregular, cross-bedded and with many grit and pebble beds. Upper half of zone has alternating Ss. and thin-bedded siltstone with Sh partings. Color is dark brown, purplish and maroon. Makes rusty colored slope.	1- Saltwash.	120
10312-151	Ss. Makes steep, rounded bluff. About middle of zone, a thin beddad, silty Ss. phase makes a bonch. Remainder of Ss. is lenticular, cross bedded, fine to mad. gr., with many grit and pebble beds. Sandy bench. Thin plates and blocks of Ss. are	Morrison	_8/
168'-1931/2	abundant Est. 80% Ss. Irregular, thin bedded and cross-bedded Ss. Forms		4
	steep rounded bluff. Sandy bench. Ss. is thin bedded and silty Est. 80% Ss.		
	Irreqular, thin bedded, cross-bedded fine-med an Ss. Weathers to rounded cliff.		
233'-312'	Partly exposed Probably dirty brown, tough, fine to med. gr. Ss. in 4' ledges. Talus indicates mudstone and Sh. Est. 8n% Ss.		_
312'- 340'	Irregular, thin-bedded, cross-bedded Ss. with lenses of pebbles and grit. Forms bluff.		
Sandroc	Kin column= 71%.		

	Description: Col. #41.
0'-50'	Poor outcrop. Pale gray to pale green talus containing Ss., Sh. and Ls. Ss. is in isolated ledges, 2' in thickness. It is thin-bedded and silty at bottom but massive and more calcareous toward top. Ls. predominates in lower zone. It is gray in color and in 1/2't beds. Sh. is gray and highly fractured.
50'- 62'	Med. qr., cross-bedded Ss. Irreqular to lenticular and contains many grit beds. Forms rounded bluff.
62'-73'	Poor outcrop. Few thin bedded ledges of Ss. Forms bench Talus is brown to tan Est. 80% Ss.
73'-107'	Irregular, thin bedded, bench forming Ss at top of zone Contains pebble conglomerates, especially at base From 73'- 82' there is a highly calcareou. Zone of siltstone, mudstone and Sh. Forms rounded bluff.
107'-118'	Bench. No outcrop except a 2' bed of gray Ls. near to
118'-135'	Rounded bluff of irregular, thin bedded Ss. Stron cross bedding forms bench at top.
135-163	Partly exposed bench and slope with many 5' ledges of cross-bedded, fine to med. gr. Ss Talus is white to tan. Est. 30% Ss.
163'-203'	Bench. Mainly talus of rusty to white color Occasional 1'-2' beds of thin-bedded, cross-bedded fine to med. gr. Ss. Est. 80% Ss.
203'-216'	Irregular to lenticular, cross-bedded, fine to coorse ar Ss. Some grit beds.
216-228	Bench. Rusty colored talus with some thin- bedded, undulating Ss. ledges. Forms bluft
228'-242'	Irregular, thin beds (4'-s') of fine to med at Ss Weak crass-bedding. Some grit beds forms bluf
Sondrod	k in column = 67%.

Column \* 44



	Description: Col. # 44.	
0 '- 32'/2'	Base of zone is a cliff, changing to talus slope of top. Zone consists of grayish white to pale grayish grean gypsum, irregularly bedded and with veinlets of secondary gypsum. Gypsum is silty and contains shale seams There is a resistant ledge of very calcareous Ss. at 'base.	
321/2-421/2	Talus Ls., Ss. and Sh. Many gray, massive Ls. fragments in lower 2/3 of zone. Gray, finely fractured Sh. toward top	-
421/2-70	Talus slope Ss., Sh. and Ls Ss. is fine qr. and in undulating l'ledges with some interbedded	

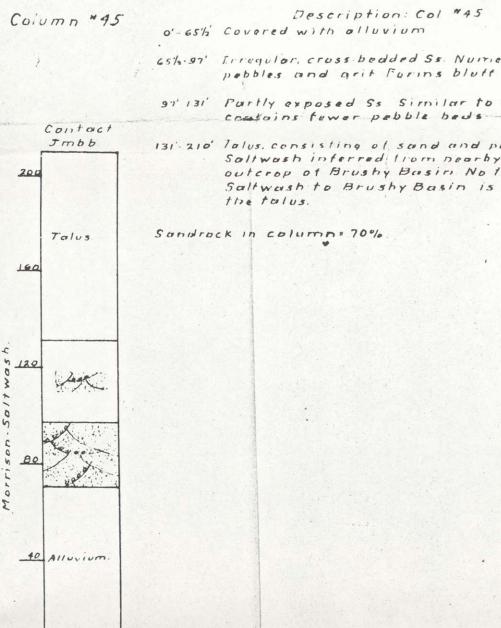
undulating l'ledges with some Sh. seams. Sh. is gray and grean in color. 15 is in groy, 11/2"- 3" tragments. 70-77' Silty Ls and colcareous siltstone interbedded

with thin Ss. lenses. Weathers to a lumpy surface Beds are l'thick, very irregular and highly fractured. The color is gray to maroon. There are occasional thin Sh. seams.

17'-151' Cross bedded Ss. Forms clift. Contains a few siltstone beds Irregular but parsistant. Has rounded pephle conglamerate beds, aspacially in lower half. Shows minor plications, probably · contemporaneous with deposition very soft where woathered

151-220' Talus Mainly Ss. with some Sh. This thickness was added to the column by making a Bruntonpace traverse to the Saltwash. Brushy Basin contact, a distance of 700' from the point where the preceding beds were measured.

Sandrock in column = 64%.



rop except a 2' bed of gray Ls. near top. f of irregular, thin bedded Ss. Strong Forms bench of top. bench and slope with many 5'

Est. 90% Ss. alus of rusty to white color beds of thin-bedded, cross-bedded,

beds (q'-s') of fine to med qr Ss dding. Some grit beds Forms bluff.

				Description: Col #42.
			0'-50'/2'	Steep talus slope Ss., Ls. and Sh. At 15-20' there are at
				least 2 fine to med. gr. Ss ledges, 3' in thickness
				They are very lenticular with siltstone partings.
				Very tough, highly colcareous and cross.bedded
		~		The beds are contorted; probably contemporaneous
		-		with deposition. Ls is gray in color and in rounded
		Contect		blocks. Sh. is gray in color and highly fractured.
	.1	Jmbb.		
		60.04	5012.56	Fine to med. gr., irregular, cross-bedded Ss. Some
				course ar to grit beds Blacky, vertical
		60000000		fracturing
	280			
		53	56'-59'	Alternate siltstone and mudstone beds, 1/2' in
				thickness. They are irregular and green to purple
		000000		in color. Siltstone forms ledges. Mudstone is highly
				fractured and contains some Sh. seems. Both are
		12.1 12.2 12.2 (2.5)		highly calcareous.
	240		59'-62'	Fine to med. ar., irregular and lenticular 55. Some
	240			Sh. seams and grit at base. Forms cliff.
		Sternart.	62'. 66'	Siltstone. Knobby surface Makes undulating
				contact with beds above and below. Dirty pole
				purple and green in color. Calcoreous and
		Barry Start		with some Sh and mudstone seams.
	200	and the second		and some she and mudstone seams.
			66'-A2'/2	Crossbaddad Se Part 111
		all states	or one	Cross-bedded Ss Poorly defined conglomerate
				and grit lenses. Lumpy to rounded surface.
2		M	A2% A0	Bench Tolus Wilder + + + + + + + + + + + + + + + + + + +
S		Markey Office	01100	Bench Tolus. I's' 55 beds interbedded with pole
2		1133		green Sh. Ss. increases toward top.
+-	160		89' 104'	S5. similar to 66'- 82'/2'
0			05 104	0 3. 31 milar To 66 - 82'12'
5	101		104'.108'	Shallow har I Est 50% Ss
ç	1	<u>Marchart</u>	104 100	Shallow banch Covered. Est. 50% SS.
S O			100' 174	Fine to med ar 35 Occasional grit and pabble
ĩ		litter at	100-147	hada Farred of 35 UZCasional ditt and parate
L				beds. Forms rounded bluff.
S	120			
-		Durinitie		
		2000 - 10 - 10 - 10 - 10 - 10 - 10 - 10		Bench. Tolus Errequior, thin bedded Ssledges and
	2	199-19		
			124' 152'	Bench. Tolus Errequior, thin bedded Ssledges and rusty Sh, especially at base
			124' 152'	Bench. Tolus Errequior, thin bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross bedded Ss. Some
		a de la come	124' 152'	Bench. Tolus Errequior, thin bedded Ssledges and rusty Sh, especially at base
	80		12+'-152' 152'-160'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff.
	80		124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss.
	80		124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some cluy pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragments of Ls
	80	and the second	124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss.
	<u>. 80</u>	and the sea	124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Small, rounded, gray fragmants of Ls near top Est. 80% Ss
	80		124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top Est. 80% Ss Fine to med. gr. Ss. Some interstition limonite. Forms
	80	and the second	124' 152' 152' 160' 160-238'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Small, rounded, gray fragmants of Ls near top Est. 80% Ss
			124' 152' 152' 160' 160-238' 238-255%	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr. Ss. Some interstition limonite. Forms bluff with bench on top.
	80		124' 152' 152' 160' 160-238' 238-255%	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr. Ss. Some interstition limonite. Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses
			124' 152' 152' 160' 160-238' 238-255%	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstitial clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr. Ss. Some interstitial limonite Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses Siltstone and mudstone are pale green and
			124' 152' 152' 160' 160-238' 238-255%	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstitial clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Small, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr Ss. Some interstitial limonite Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses Siltstone and mudstone are pale green and maroon in color. Ss. is fine gr., irregular and
			124' 152' 152' 160' 160-238' 238-255%	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstitial clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr. Ss. Some interstitial limonite Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses Siltstone and mudstone are pale green and
			124' 152' 152' 160' 160-238' 238-255% 255% 257'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh., especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstition clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Smoll, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr. Ss. Some interstition limonite. Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses Siltstone and mudstone are pale green and maroon in color. Ss. is fine gr., irregular and tan in color.
			124' 152' 152' 160' 160-238' 238-255% 255% 257'	Bench. Tolus Errequior, thin-bedded Ss ledges and rusty Sh, especially at base. Fine to med. gr., weakly cross-bedded Ss. Some clay pebbles and interstitial clay. Forms bluff. Talus slope with 4' massive to thin-bedded Ss. beds. Small, rounded, gray fragmants of Ls near top. Est. 80% Ss Fine to med. gr Ss. Some interstitial limonite Forms bluff with bench on top. Ss., siltstone and mudstone in interbedded lenses Siltstone and mudstone are pale green and maroon in color. Ss. is fine gr., irregular and

Collumn #42

Description: Col #42. Steep talus slope Ss., Ls. and Sh. At 15-20' there are at least 2 fine to med. gr. Ss ledges, 3' in thickness They are very lenticular with siltstone partings. Very tough, highly calcareous and cross-bedded. The beds are contorted; probably contemporaneous with deposition. Ls is gray in color and in rounded blocks. Sh. is gray in color and highly fractured. Fine to med. gr., irregular, cross-bedded Ss. Some course ar to grit beds Blacky, vertical fracturing Alternate siltstone and mudstone beds, 1/2' in thickness. They are irregular and green to purple in color. Siltstone forms ledges. Mudstone is highly fracturad and contains some Sh. seams. Both are highly calcareous. Fine to med. qr., irregular and lenticular Ss. Some Sh. seams and grit at base Forms cliff. Siltstone. Knobby surface Makes undulating contact with beds above and below. Dirty pale purple and green in color. Calcoreous and with some Sh and mudstone seams. 1/2 Cross-bedded Ss Poorly defined conglomerate and grit lenses. Lumpy to rounded surface. 9' Bench Tolus. I's Ss Deds interbedded with pole green Sh. Ss. increases toward top. 4' S5. similar to 66'- 82'12' B' Shallow bench Covered. Est. 50% SS. 4 Fine to med. gr. 95 Occasional grit and pabble beds. Forms rounded bluff 2' Bench. Tolus Erregular, thin-bedded Ssledges and rusty Sh, especially at base. o' Finetomed. gr., weakly cross. hedded Ss. Some cluy pebbles and interstitial clay. Forms bluff.

Column #43:

Contact

1, 1, 1, 1,

Jmbb.

"Fine to med. gr, irregular, thin bedded Ss. Some grit and public beds. Also some green Sh and silty searns. Sandrockin column - 73%.

ption: Col	#45	
רחעוֹעטוו		
bedded Ss.	NUITIC	rous

91' 131' Purtly exposed Ss Similar to 65% . 97', but contains fewer pebble beds 131-210' Talus, consisting of sound and pebbles. Top of Soltwash inferred from nearby definite

outcrop of Brushy Basin No transition from Saltwash to Brushy Basin is indicated in

thin beds of

Column #47 Contact Jmbb. R 1. ... - Quis Q.1 NI 120 ----L L Z. K 2 -----J. 2 I. 2. GI F 2 -121777 E. 1 D.1-CI B.1.-TIT

Description Col "41 0' 512' Siltstone Finaly banded to mossive. Soft Pale green to gray in color Irregular in thickness Contains large embayments and fragments of the overlying gypsum Some irregular zones of grit sh 321's Partly exposed. Irramular beds of gypsum with Sh. and mudstone seams white in color Some nodules of red and gray chart 3212:33' Gray, non crystalline 1.5 Very finely fractured 33-35 line gr. Ss. Weak cross bodding. Erregular in thickness fragmants of underlying 1s at base of zone Forms ledge 35' 40%' Talus, containing Ls and Ss with minor amounts of Sh Uppar holf of zone shows groy, highly Fractured, pure to silty Ls. 401-13' Silly to fine gr. Ss Irregular in thicknes. Thinbedded Contoins 1.5. tragments. 93.94 Highly fractured, aray to green Ls Rounded tracture Silty to earthy. 99:471/2 Erroqular, crossbodded 55 Hos some coorse gr to grit bads. Forms ladge 471/2-57' Gray colored talus Hus some highly tractured siltstone and fine ar Ss.; both calcareous. 57-61' Fine to course gr Ss. Weak cross bedding Forms irregular ledge Gray colored talus Est 70% Sh. and mudstone. Some 61' 84 thin bedded siltstone at top and base Bf' 116 Upper 21' is obscured. Lower 11' is a Ss. ladge, chonging to a bench at top. Ss is fine gr with occasional grit and pabble conglom beds Weathers to rounded surface Weakly cross-bedded. 116-11712 Med to fime ar, resistant Ss ledge. 11712-123' Talus Est. 60% 55 123' 141' Upper half is obscured. Lower half is fine to medar So ledge Rounded, thin bedded and cross bedded 1+1' 157' Uppers' is obscured Remainder is Ss bluff, changing to bench at top. Ss is cross bedded. deeply pitted and contains tragmants of green Sh and siltstone It is thin bedded and sufter near top Est. 80% Ss. 157' 173' Fine to med. gr., cross-bedded 5s Lowars' contains siltstone and Sh tragments, also small piece of fossil bone Forms bench and blutt Upper 10' is more thin baddad. 173'189' Talus. Est 40% Ss. Upper hult shows pale brown mudstone. 183'-2001/2 Med. to coarse gr., cross. bedded Ss with some Sh seams. Some thin public lenses Forms cliff. 200/2223' Fine to med. gr. Ss., forming slope and bluff. Ss is similar to that of 109'-2001'z', but tiner ar. and sufter Some grit phases. 223'236' Talus. Moroon to pale tan in color. Est. 50% Ss. At one point, shows some highly fractured, maroan mudstone. 236-293 Weakly cross bedded Ss. Some proble and grit beds. Weathers to rounded surface Forms clift. 293'. 304 Fine to med. gr. Ss. Forms bluff. Surface rough and deeply pitted Weak cross badding Contains much opeque, white, interstitial matter Silty at base. 304'-312' Talus. Est. 60% 55. 312'-346' Fine ar Ss Irregular in thickness and deeply pitted. Weak cross bedding Silty at base. Some grit and pebble beds. Forms cliff.

Note: Chip samples were taken uf this column. Letters at left of column currespond to the letters un the samples. The numerals, following the latters, indicate the number of chip samples taken from each bed

Sandrock in column = 67%

Description: Col. \*43. 0'-21'2' Siltstone Pole green in color Lenticular. Colcareous. 21/2'-B' Resistant 55 ledge. Fine to coarse gr. Irregular, thin bedded and cross bedded. Pale gray in color 8-78' Talus slope. Ss., Ls and Sh. Ls. is abundant in lower third of zone. Ss. ledges and Sh. seams increase in upper portion. 78' 150% Cross bedded Ss Irregular in thickness. Some grit and pebbly conglomarate beds and lenses in lower part, but upper part is nearly free of these. 45' phove bottom there are many Sh. and siltstone pebbles. 150% 175' Talus Bench. Thin bedded to blocky Ss. with Sh. lenses. Talus is rusty to pale green in color. 175'188' Fine to med. gr, cross-bedded Ss. Irregular and thin bedded Rounded to blocky Forms bluff. 188'.199' Partly exposed banch. Lower half of zone is moinly Sh. Upper half is 1/2' Ss ledges with some Sh. Ss. is thin-bedded with low angle cross-bedding. 194-1981's Irregular, cross bedded, fine gr. Ss. Some interstitial Limonite. Forms bluff. 198%-245% Rusty colored tolus Dirty brown, blocky to thinbedded Ss ledges. Ss. is lenticular, time gr. and with low angle cross-bedding 245%-313' SS. cliff Very irregularly groded. Irregular, thin cross-bedding. Some silty zones. Ss shows spherical, pea size, Limonitic concretions. There are some peoble conglomerate and grit lenses. Ss. is highly pitted. At 45' there are pebbles of pale green siltatone and fragments of chalcedany and petrified wood. Sondrock in column= 72%.

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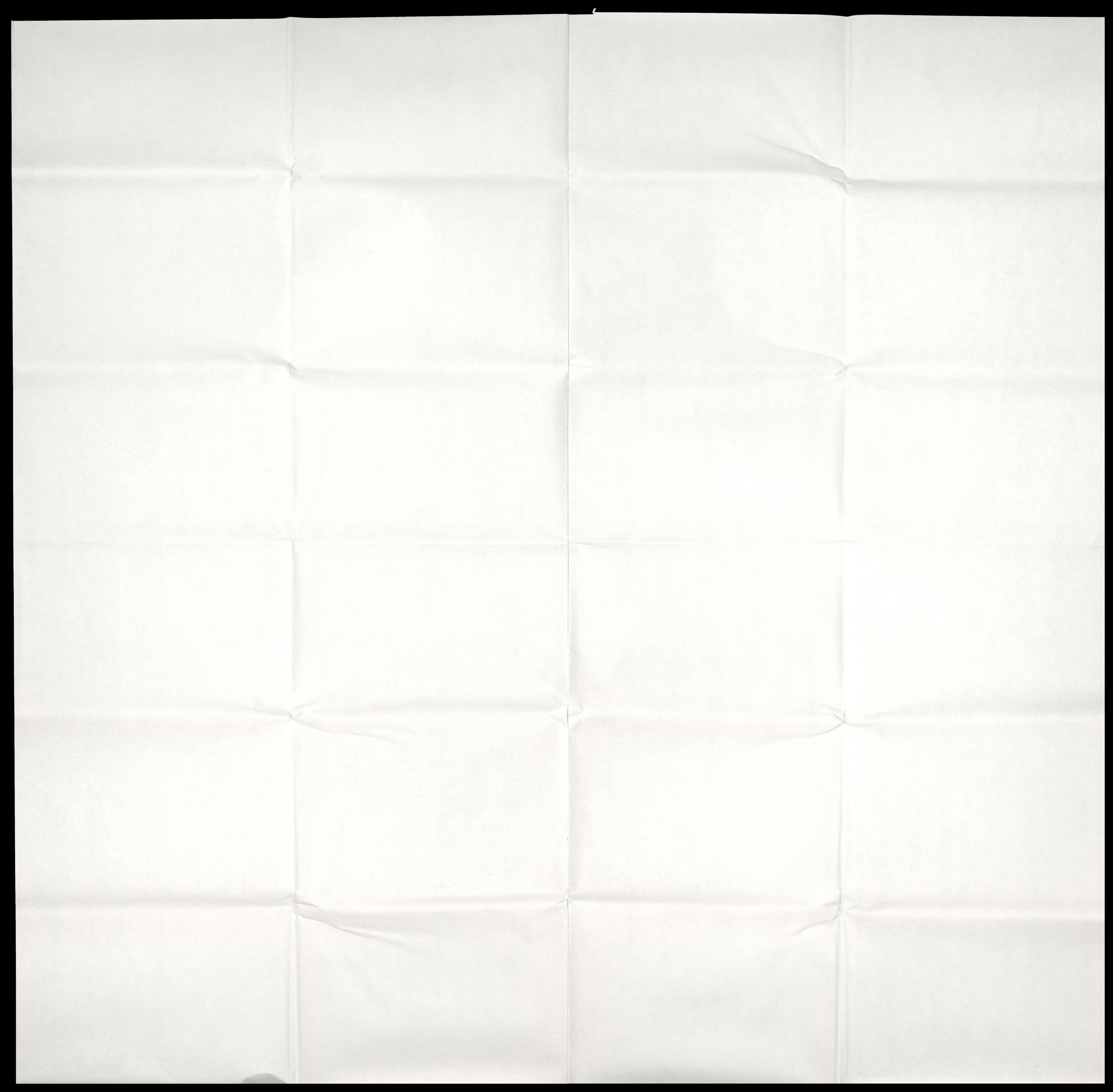


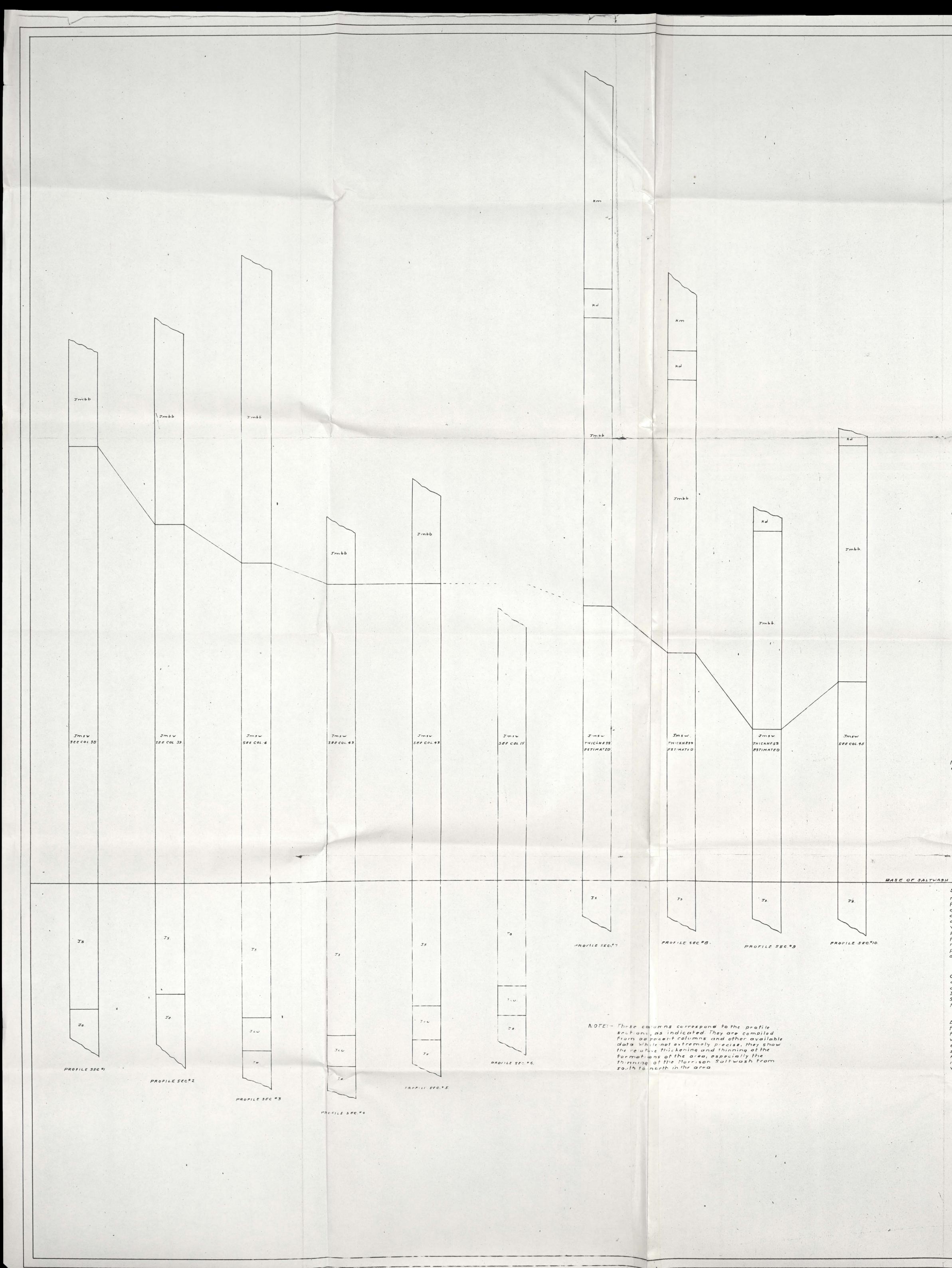
Note: All the Ss in these columns appears to be calcareous in varying degrees. It consists mainly of sub-angular to rounded quartz grains The weathered colo: varys from tan to dirty white The freshly broken surface is white to grayish white

Columns 40-45,47 Rhin 461 UNION MINES DEVELOPMENT GORP. GRAND JUNCTION, COLO. FIELD OFFICE. TITLE: HENRY MTS. AREA. GRANITE WASH DISTRICT. SCALE: 1=40' DATE: AUG. 9. 1944 DRAWN BY: L. BRYNER. TRACED BY : A.H. COLEMAN. GEOLOGY BY: A.H. COLEMAN & PARTY.

Utah-hm-12

RMO-461





SECRET OFFICIAL USE ONLY DECLASSIFIED BRUSHY BASIN FORMATION. The lower 60'-70' of this formation is a rusty to dark brown, med. to coarse gr, Ss., with much grit evident. It also contains interbedded conglomerates with pebbles up to 1" size. There is local cross-bedding. This portion of the Brushy Basin might be carrelated with the Westwater member of the Upper Morrison, but it dues not resemble the Westwater where seen elsewhere and is therefor thrown into the Brushy Basin in this area. The remaining upper portion of the formation consists of dark pink, reddish-brown, grayish white and greenish gray Shules and mudstones. Inter bedded with these sholes is an occasional thin bed (less than 2') of Ss. that is fine to med. gr. and shows local cross-bedding. Avantities of chalcedony were noted. The upper portion of the formation weathers to a characteristic "Bad Land" appearance. MORRISON-SALTWASH FORMATION. See detail columns for description. SUMMERVILLE FORMATION. Consists of thinly bedded. reddish brown and gray white mudstone or very fine gr. 55 Contains large avantities of bedded gypsum as well as secondary voinlets of gypsum and chalcedony noted. Some fibrous barite veinlets were noted, cutting across bedding planes the formation is notable for its even bedding, few beds being over I'in thickness. Alho soft and non-resistant to erosion, in this area, it is protected by the more resistant Morrison capping and forms vertical cliffs. CURTIS FORMATION. Consists of fine gr., thin-bedded, glauconitic Shale and shaly Sandstone. It is groyish green in color. Shows slight cross-bedding locally. It is non-resistant to erosion and forms slopes. Some gypsum was noted, with chalcedony replacing the gypsum. ENTRADA FORMATION. Reddish - brown, mudstone to fine qr. sandstone. Contains inter-bedded groy white to cream white beds that are more resistant to weathering than are the reddish beds. Shows strong eross bedding between bedding planes. Also contains some thin shale seams locally. It is not very resistant to weathering in this area. Wind erosion weathers it into fontastic columns and bosses. It forms the valley floor in this area. Wang Correlations T UNION MINES DEVELOPMENT CORP. GRAND JUNCTION, COLO. FIELD OFFICE. TITLE: HENRY MTS. AREA. GRANITE WASH DISTRICT. DATE : AUG. 10, 1944. SCALE: 1'= 40' DRAWN BY: A.H. COLEMAN. TRACED BY : A. H. COLEMAN. GEOLOGY BY: A. H. COLEMAN & PARTY. RMO-461 Utah-hm-13 6 UVVV

