RECEIVED BY DTIE MAY 1 1970

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver, Colorado 80225

MASTER

GRAVITY SURVEY OF THE Uel5j SITE, AREA 15,
NYE COUNTY, NEVADA

1970

Prepared Under
Agreement No. AT(29-2)-474

for the

Nevada Operations Office
U.S. Atomic Energy Commission

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

- a. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method or process disclosed in this report may not infringe on privately owned rights; or
- b. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method or process disclosed in this report.

As noted in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee or such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Federal Center, Denver, Colorado 80225

GRAVITY SURVEY OF THE Uel5j SITE, AREA 15,
NYE COUNTY, NEVADA

By

Don L. Healey

Abstract

Interpretation of gravity data along three lines through the Uel5j site indicates the presence of an inferred major normal fault about 400 feet east of a fault mapped on the ground surface where a quartzite ridge crops out. The interpretation indicates that there is 1,200-1,300 feet of vertical displacement on this fault; whereas there is only 100 feet of displacement on the mapped fault. The configuration of the quartzite ridge is well defined by the gravity anomaly, and the interpretations shows a structural high to the west of the ridge where the gravity data define a gravity-high nose.

Introduction

The Uel5j site is located in the central part of the Jangle Ridge quadrangle (fig. 1). A small low knoll of Precambrian Stirling Quartzite crops out in the center of the site. The outcrop is surrounded by Quaternary alluvium, but on its west side the alluvium is only a few feet thick and is underlain by Tertiary zeolitized tuff. The alluvium consists mainly of pebble- to cobble-sized pieces of quartzite with minor amounts of limestone, dolomite, and tuffaceous material in a matrix of sand and silt. The geology of the Jangle Ridge quadrangle, which includes the Uel5j site, has been described by Barnes, Christiansen, and Byers (1965). A detailed site study, supplemented by the drilling program and analyses of drill hole cuttings was made by L. D. Ramspott and D. O. Emerson of the Lawrence Radiation Laboratory (oral commun., 1969).

Figure 1.--Index map of the Nevada Test Site showing Jangle Ridge quadrangle (diagonal lines) and area of the Uel5j gravity survey (shaded).

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States nor the Commission nor any person acting on behalf of the Commission makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights.

B. Assumes no liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above person acting on behalf of the Commission includes any employee or contractor of the Commission or employee of such contractor to the extent that such employee or contractor of the Commission or employee of such contractor prepares, disseminates, or provides access to any information pursuant to his employment or contract with the Commission or his employment with such contractor.

A detailed gravity survey was made July 7 and 8, 1969. The gravity observations were taken at 107 grid points that had previously been established by a field party from Holmes and Narver, Inc. The field party also established the horizontal and vertical positions of the grid points. The grid orientation is N. 21° W.; lines 1, 5, and 9 were extended 2,000 feet east and 1,500 feet west beyond the internal 9- x 9-line grid. Row E was extended north and south 1,500 feet (fig. 2, in pocket). The gravity observations were made with a La Coste and Romberg gravity meter (G-177) that previously had been checked over calibration loops in Colorado (Mount Evans) and California (Mount Hamilton). A correction factor of 1.0002 was determined from this work and the factory calibration was corrected by this amount.

The gravity data were also corrected for the effect of earth tides, latitude, elevation, and terrain. To circumvent the tedious terrain corrections, a terrain-correction map was constructed--selected stations around the grid were corrected and these values were then contoured. The terrain corrections at the remaining grid points were then determined from the contoured map. The resulting interval accuracy of this gravity survey is thought to be ± 0.1 milligal.

Density data

In the Uel5j area, Birdwell gamma-gamma density logs were taken in 5 of the 8 drill holes shown on figure 2. With the exception of Uel5j and K-5, the drill holes were named for the grid point at which they were drilled. Uel5j was drilled at grid point E-5 and hole K-5

was drilled at grid point 500E on line 5. The results of the interpretation of these density logs, although not of good quality, indicate the following: (1) 1,376 feet of zeolitized tuff (above the water table) averages 1.75 g/cc (grams/cubic centimeter); (2) 268 feet of zeolitized tuff (below the water table) averages 2.20 g/cc; (3) 337 feet of alluvium (below the water table) averages 2.00 g/cc; and (4) 801 feet of Precambrian Stirling Quartzite (below the water table) averages 2.50 g/cc. The density-log data above the water table in the quartzite and alluvium is inconclusive. The density of the dry alluvium was taken as 1.75 g/cc (same as dry zeolitized tuff) and all quartzite was taken as 2.50 g/cc.

Interpretation

The complete Bouguer gravity anomaly values determined at the Uel5j site are shown contoured on figure 2 at 0.1 mgal intervals. Also shown are the surface traces of three distinct faults and the locations of eight exploratory holes. The depths to the upper surface of the Precambrian Stirling Quartzite, determined by these drill holes, was used as a guide in the interpretation of the gravity data.

The gravity anomaly exhibits an elongate high--a trend that parallels the grid orientation. The closed high, east of drill hole Uel5j, is over the outcropping Precambrian quartzite. The indicated high on the extension of row E south of the 9- x 9-line grid is also over outcropping quartzite. The steep gravity gradient, down on the northeast, indicates the presence of a major fault in the vicinity

of row H. A gravity-high nose trends northwest from grid points A-5 through 500W, line 9. A gravity low, also trending northwest, extends between grid points 2000E, 1500E, and 1000E on lines 1, 5, and 9, respectively.

Two-dimensional analyses of the gravity data were made along extended lines 1, 5, and 9 using the density values described above. Cross sections along these three lines are shown in order from south (line 1) to north (line 9) on figure 3.

Line 5 (fig. 3), because of the excellent control provided by drill holes A-5, C-5, Uel5j, I-5, and K-5, was interpreted first. The contact between the tuff and the quartzite slopes westward from the outcrop to a point west of A-5. Between A-5 and 1000W a horstlike structure in the quartzite is indicated. Such a structure is necessary to match the calculated gravity values with the anomaly. The gravity high that trends northwest from A-5 (fig. 2) is the expression of this structure. The normal fault located at row H apparently is not the main fault (fig. 3). The gravity interpretation is facilitated greatly by an inferred second fault between rows H and I as shown. Drill hole I-5 verifies the contact between the quartzite and the tuff as shown on figure 3. The inferred vertical displacement on this second fault is 1,300 feet.

Line 1 has drill hole D-1 as its only control point. However, the overall structure shown on figure 3 was dependent upon the interpretation of line 5 as a starting point. The final result of

LINE 9

LINE 5

LINE 1

Figure 3.--Generalized geologic cross sections as determined by analyses of gravity data, Ue15j site. Short dashes indicate the water table (SWL). Numbers under drill holes are depths to quartzite. Qal, Quaternary alluvium; Tv, Tertiary volcanics; pCs, Precambrian Stirling Quartzite. Assumed densities in g/cc are also shown.

this interpretation is shown. The horst structure is not shown, as line 1 is off the gravity nose. Over the quartzite ridge the normal fault near row H has a similar step down. A second inferred fault, located 400 feet east of row H, again facilitates the interpretation. The inferred vertical displacement on this fault is also 1,300 feet.

Line 9 has drill hole D-9 for depth control and the interpreted structure is similar to that of lines 1 and 5. The fault located near row H is interpreted as having 100 feet of offset. The inferred fault 100 feet east of row I is the major structural feature of the cross section. This fault has an interpreted vertical displacement of 1,200 feet. Between drill hole D-9 and the fault located east of row 1000W the structure is interpreted to be slightly domed. This is the area of the gravity-high nose on figure 2. On line 9, a section of alluvium below the water table, having a density of 1.75 g/cc, was assumed to help match the calculated value to the measured gravity. It would appear that a greater thickness of low-density material, probably alluvium, is present to the north.

In each of the above three interpretations bulk density differences above and below the water table were assumed for both the alluvium (with the exception of line 9) and the zeolitized tuff. Also, it was assumed that 400 feet of tuff underlies the alluvium east of the quartzite ridge. This last assumption is not verified by drilling but is geologically reasonable. In fact, a much greater thickness of tuffaceous rocks may underlie this area (Harley Barnes, oral commun., 1969). If the alluvium is less thick than shown and

the volcanic rocks are more dense than 2.2 g/cc, a considerable thickness of volcanic rocks would be required to match the gravity anomaly. Such a situation would also require a greater fault offset than the 1,200 and 1,300 feet shown at row I on lines 1, 5, and 9 (fig. 3).

The contact elevations along the upper surface of the quartzite, obtained from the interpretation of the above three cross sections, were plotted and contoured at 50-foot and 100-foot intervals on figure 4. The result is an inferred structure contour map of the upper surface of the Precambrian Stirling Quartzite.

The subsurface features described earlier in the text are readily apparent on figure 4. The structural low, probably a fault, between A-5 and 500W on line 5 is readily apparent. The interpreted structure, whose axis parallels row 500W, is thought to be a reasonable solution of the structure represented by the gravity-high nose in this area. The structure east of row 500E is shown as two structural highs separated by a northwest-trending structural depression that apparently widens northward.

Conclusions

The foregoing interpretation of the Uel5j gravity data is substantiated by exploratory drilling and by the applied bulk densities which were taken from gamma-gamma density logs in some of these holes. The structural configurations of the quartzite surface are believed to be accurate in a roughly circular area that encompasses the exploratory drill holes. Beyond the drill-hole controls, the accuracy of the interpretation is highly dependent upon the accuracy and applicability of the density contrasts used.

6

Figure 4.--Structure contour map of upper surface of Precambrian Stirling Quartzite based on two-dimensional analysis of gravity data, Uel5j site. Contour intervals 50 and 100 feet. U, upthrown side, and D, downthrown side of fault.

Reference

Barnes, Harley, Christiansen, R. L., and Byers, F. M., Jr., 1965,
Geologic map of the Jangle Ridge quadrangle, Nye and Lincoln
Counties, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-363.

Distribution

Nevada Operations Office, U.S. Atomic Energy Commission, Las Vegas, Nev.:

W. W. Allaire
E. M. Douthett (3)
D. M. Hamel, NVOO Technical Library (15)
R. R. Loux (3)
R. E. Miller/C. E. Williams
W. D. Smith, Jr.
H. G. Vermillion

U.S. Atomic Energy Commission, Mercury, Nev.:

D. T. Schueler, NTSSO
CETO Library (Attn: E. A. Schultz) (2)

U.S. Atomic Energy Commission, Washington, D. C.:

M. B. Biles, DOS
Maj. Gen. E. B. Giller, AGMMA (2)
Richard Hamburger, DPNE

Division of Technical Information, U.S. Atomic Energy Commission,
Oak Ridge, Tenn. (2)

Defense Atomic Support Agency:

Chief, Nevada Branch, Test Command, Mercury, Nev. (2)
Director (Attn: SPSS), Washington, D. C.
Test Command (Attn: Dr. Benjamin Grote, Albuquerque, N. M.)

Los Alamos Scientific Laboratory, Los Alamos, N. M.:

Robert Bradshaw
R. H. Campbell
R. W. Newman
W. E. Ogle
R. R. Sharp

Los Alamos Scientific Laboratory, Mercury, Nev.:

Robert Bradshaw

Lawrence Radiation Laboratory, Livermore, Calif.:

L. D. Ramspott
P. E. Coyle
D. O. Emerson
J. W. Hadley
G. H. Higgins
H. L. Reynolds
D. L. Springer
Geoscience Group (Attn: A. E. Lewis)
Technical Information Department

Lawrence Radiation Laboratory, Mercury, Nev.:

R. D. McArthur

Sandia Corporation, Albuquerque, N. M.:

J. R. Banister
M. L. Merritt
B. F. Murphey
W. C. Vollendorf
W. D. Weart

Sandia Corporation, Mercury, Nev.:

B. G. Edwards

NVVO Panel of Safety Consultants:

L. K. Bustad, Univ. Calif., Davis, Calif.
D. U. Deere, Univ. Ill., Urbana, Ill.
L. S. Jacobsen, 267 Belgreen Pl., Oakmont, Santa Rosa, Calif.
Carl Kisslinger, St. Louis Univ., St. Louis, Mo.
G. B. Maxey, DRI, Reno, Nev.
N. M. Newmark, Univ. Ill., Urbana, Ill.
L. A. Sagan, Palo Alto Medical Clinic, Palo Alto, Calif.
Vincent Schultz, Wash. State Univ., Pullman, Wash.
T. F. Thompson, 866 Burlway Road, Burlingame, Calif.
W. G. VanDorn, Scripps Inst. Oceanography, La Jolla, Calif.
L. G. von Lossberg, Sheppard T. Powell & Assoc., Baltimore, Md.
J. T. Wilson, Univ. Mich., Ann Arbor, Mich.
S. D. Wilson, Shannon & Wilson, Inc., Seattle, Wash.

Advanced Research Projects Agency, Washington, D. C.:

V. C. Fryklund

Battelle Memorial Institute:

J. B. Kirkwood, Columbus, Ohio (10)
R. G. Fuller, Las Vegas, Nev.

Desert Research Institute, Las Vegas, Nev.:

A. E. Peckham

Eberline Instrument Corporation, Santa Fe, N. M.:

W. S. Johnson

Environmental Research Corporation:

O. A. Israelsen, Alexandria, Va. (2)
J. A. Lahoud, Las Vegas, Nev.

Environmental Sciences and Services Administration, U.S. Coast & Geodetic Survey, Las Vegas, Nev.:

K. W. King

Fenix & Scisson, Inc.:

Grant Bruesch, Mercury, Nev.
M. H. May, Las Vegas, Nev.

Holmes & Narver, Inc.:

P. D. Pack, Las Vegas, Nev.
Resident Engineer, Mercury, Nev.

Isotopes, A Teledyne Company:

M. M. Bell, Las Vegas, Nev.
P. R. Fenske, Palo Alto, Calif.
L. B. Werner, Palo Alto, Calif.

Ken O'Brien and Associates, Albuquerque, N. M.:

Dallas Donegon

U.S. Army Corps of Engineers, Anchorage, Alaska:

District Engineer

U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss.:

J. M. Polatty
William Steinriede, Jr.
Library

U.S. Bureau of Mines, Denver, Colo.:

P. L. Russell

U.S. Public Health Service, Las Vegas, Nev.:

M. W. Carter (2)

U.S. Geological Survey, Washington, D. C.:

J. T. Hack

W. T. Pecora

Military Geology Branch

Chief Hydrologist, WRD (Attn: Radiohydrology Section)

U.S. Geological Survey, Mercury, Nev.:

Geologic Data Center (15)

Figure 2.--Complete Bouguer gravity anomaly map of the Uel5j site. All gravity values are negative and the contour interval is 0.1 milligal. Three surface faults are shown by dashed lines.