Department of Energy
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
P.O. box 98608
Las Vegas, NV 89193-8608

OCT 04 1994

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Washington, DC 20555

"NOT-READILY-AVAILABLE" REFERENCES CITED IN SITE CHARACTERIZATION PROGRESS REPORT 10 (SCPB: N/A)

Reference: Ltr, Shelor to Holonich, dtd 9/17/93

Enclosed are three sets of references that the U.S. Department of Energy (DOE) has determined to be "not-readily-available" for Progress Report 10. As agreed by DOE and the U.S. Nuclear Regulatory Commission (NRC) in the referenced letter, these are references ". . . that are not available through the open literature, published symposia proceedings, or the standard channels for distribution of government reports."

Enclosure 1 is a list of documents referenced in Progress Report 10 that are "not-readily-available." All documents on this list have been acquired and are included in this transmittal.

In addition, Enclosure 2 includes references from earlier progress reports that were not available at the time those "not-readily-available" references were submitted. With this transmittal, all "not-readily-available" references from previous progress reports have now been submitted.

In addition to the three copies provided to the NRC, one is being forwarded to the State of Nevada; one to Nye County, Nevada; one to State Senator Thomas J. Hickey; and one to the DOE/Headquarters Local Records Center.

	Ltr.	Encl.
Charge: NEUD	1	0
HLUR/BC	1	0
OGC/NWMS	1	0
NMSS/ENGB	1	0
NMSS/HLUR	1	0
NMSS/PAHB	1	0

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NH03

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PROGRESS REPORT #10

"NOT-READILY-AVAILABLE" REFERENCES

"Not-Readily-Available" References:

This second group of documents are those referenced in earlier Progress Reports, deemed to be "Not-Readily-Available," but not available at the time those reports were distributed. The following is a listing of the documents in this group:

From Progress Report #7:

Panchalingam, G., "Uncertainty Modeling of Many Correlated and Skewed Random Variables," doctoral dissertation, Purdue University, Lafayette, Indiana.

From Progress Report #9:

Cunningham, M. E., E. P. Simonen, R. T. Alleman, I. S. Levy, R. F. Hazelton, and E. R. Gilbert, 1987. "Control of Degradation of Spent LWR Fuel During Dry Storage in an Inert Atmosphere," PNL-6364, Pacific Northwest Laboratory, Richland, WA.

Deere, D. U., and D. W. Deere, 1989. "Rock Quality Designation (RQD) After Twenty Years," Contract Report GL-89-1, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, 65 pp.

DRI (Desert Research Institute), 1993. "Corrective Action Plan for Environmental Compliance DRI Audit FY93B," Las Vegas, NV.

McGuire, R. K., M. J. Apted, D. B. Bullen, S. Childs, N. G. W. Cook, K. J. Coppersmith, R. L. Keeney, J. M. Kemeny, A. Long, F. J. Pearson Jr., F. Schwartz, M. Sheriden, and R. R. Youngs, 1992. "Demonstration of a Risk-Based Approach to High-Level Waste Repository Evolution, Phase 2," Report TR-100384, Electric Power Research Institute, Palo Alto, CA.

SAIC (Science Applications International Corporation), 1993a. "Environmental Compliance Audit for Audit FY93A," issued May 13, 1993, Technical and Management Support Services, Las Vegas, NV.

SAIC (Science Applications International Corporation), 1993b. "Environmental Compliance Audit for DRI Audit FY93B," issued July 8, 1993, Technical and Management Support Services, Las Vegas, NV.

Vaniman, D. T., and D. L. Bish, 1993. "The Importance of Zeolites in the Potential High-Level Radioactive Waste Repository at Yucca Mountain, Nevada," in Proceedings and Abstracts of the 4th International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites (Zeolite '93), June 20-28, 1993, Boise, ID, pp. 209-211.

DEPARTMENT OF ENERGY
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APR 21 1994

Distribution

U.S. DEPARTMENT OF ENERGY (DOE) POSITION ON THE BOUNDARY OF THE ENGINEERED BARRIER SYSTEM (EBS) (SCP: N/A)

The purpose of this letter is to document DOE's position on the interpretation of an EBS boundary in an underground repository setting. DOE accepts the U.S. Nuclear Regulatory Commission's position that an EBS does not extend into the host rock.

The basis for DOE's position is contained in the enclosed short report, "Boundary of the Engineered Barrier System (EBS)." A draft of this report was developed by the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) in November 1993. The Yucca Mountain Site Characterization Office (YMSCO) coordinated a DOE acceptance review of the report under YMSCO procedure BTP-RSE-001, Revision 0, "Evaluation of Ongoing Activities." The revised report was issued in March 1994. A records package for the review was prepared (Accession NNA.940411.0032). With this letter, DOE considers this topic resolved.

If you have any questions, please contact Thomas W. Bjerstedt of my office at (702) 794-7590 or Steven E. Le Roy of the CRWMS M&O at (702) 794-7836.

Robert M. Nelson, Jr.

Robert M. Nelson, Jr.
Acting Project Manager

AMSL:TWB-3007

Enclosure:
"Boundary of the Engineered
Barrier System"

APR 21 1994

Distribution--Memorandum dated

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Boundary of the Engineered Barrier System (EBS)

March, 1994

U.S. Department of Energy
Yucca Mountain Site Characterization Project Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

ISSUE: BOUNDARY OF THE ENGINEERED BARRIER SYSTEM (EBS)

EXECUTIVE SUMMARY

The definition of the boundary of the Engineered Barrier System (EBS) has been a subject of discussion between the U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) since the days of public comments on the proposed 10 CFR Part 60. NRC's position is that the boundary of the EBS does not extend into the host rock while DOE had interpreted the definition to include a portion of the host rock. As stated in the Site Characterization Plan (SCP) (Reference 10), DOE has been proceeding on the basis that, for the purposes of the SCP, "DOE accepts NRC's position on the definition of the boundary of the EBS." However, there remained an understanding within DOE, as stated in the SCP, that the question of the EBS boundary was still open.

After considering various aspects of this matter, it has been concluded that the issue of the EBS boundary should be dropped and that NRC's position on the definition of the boundary of the EBS should be accepted.

The above conclusion is based on the following premises:

- NRC's position on this matter has a firm basis in the regulations;
- NRC's position is consistent with the provisions of the Nuclear Waste Policy Act (NWPA);
- NRC is cognizant of DOE's underlying concern in seeking a change in the definition of the EBS boundary;
- NRC rightfully contends that DOE's concern can be accommodated by the provisions of 10 CFR Part 60.113(b);
- NRC may be prepared, in applying 10 CFR Part 60.113(b), to consider relaxing the release rate limit for the EBS, provided that the total system performance is not adversely affected and DOE can demonstrate the retardation capability of the host rock as a barrier by adequately characterizing its response;
- The retardation capability of part of the host rock (desired to be included within the EBS) will have to be characterized with a much higher degree of confidence for it to be part of the "engineered" system than would be necessary if it is part of the geologic setting;

- It is extremely unlikely, if not impossible, that the host rock and its behavior can be characterized adequately for it to be a component of an "engineered" system, especially considering the perturbations caused by the heat and the temporal scale of the required predictions of its behavior.

STATEMENT OF THE ISSUE

Simply stated, the issue is "What is the boundary of the EBS?" Specifically, does the boundary of the EBS extend into the host rock adjoining the underground openings?

REGULATORY DEFINITIONS

The EBS is defined in somewhat different ways in the Nuclear Waste Policy Act, 10 CFR Part 60, and 10 CFR Part 960. The EBS is defined as follows:

Sec.2(11) of NWPA states:

> "The term 'engineered barriers' means manmade components of a disposal system designed to prevent the release of radionuclides into the geologic medium involved. Such term includes the high-level radioactive waste form, high-level radioactive waste canisters, and other materials placed over and around such canisters."

10 CFR Part 60 states:

> "Engineered barrier system means the waste packages and the underground facility."
>
> "Underground facility means the underground structure, including backfill materials, but excluding shafts, boreholes, and their seals."

10 CFR Part 960 states :

> "Engineered barrier system means the manmade components of a disposal system designed to prevent the release of radionuclides from the underground facility or into the geohydrologic setting. Such term includes the radioactive waste form, radioactive waste canisters, materials placed over and around such canisters, any other components of the waste package, and barriers used to seal penetrations in and into the underground facility."
>
> "Underground facility means the underground structure and the rock required for support, including mined openings and backfill materials, but excluding shafts, boreholes and their seals."

WHY HAS DOE WANTED PART OF THE HOST ROCK INCLUDED IN THE EBS?

The boundary of the EBS evolved into an issue because of DOE's desire to include part of the host rock surrounding the underground facility within the EBS.

DOE's desire to include part of the host rock within the EBS stems from the notion that such inclusion would facilitate demonstration of compliance with the provisions of 10 CFR Part 60.113(a)(1)(ii)(B). This provision prescribes that the release rate of any individual radionuclide at the end of the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1000 years following permanent closure.

The numerical part of this release rate requirement was a cause for concern during the rulemaking for 10 CFR Part 60. It drew a number of comments including those from DOE (Comment Numbers 51, 179, 388, 402 and 406) as documented in NUREG-0804 (Reference 1). References 2 through 9 describe subsequent discussions and deliberations on this subject. Undoubtedly, DOE wanted to include part of the host rock in the EBS in order to have flexibility until the EBS design had matured to a stage where evaluation of the ability of the EBS to meet the release rate requirement could be performed with some degree of confidence.

By excluding any host rock from the EBS the NRC is indicating that the performance of the EBS with respect to the release rate requirement has to be a result of the performance of waste package (which is engineered), the backfill (which is engineered) and any other (engineered) material the EBS designer decides to place between the waste package and the walls of the openings. NRC's position is that the portion of the host rock immediately adjoining the underground facility cannot be considered as "man-made"/"engineered" and hence cannot be included within the Engineered Barrier System, as defined by the NWPA.

It has been argued within the DOE that the process of designing and constructing the underground facility takes into account the role played by the rock adjoining the underground openings in supporting them. And hence, that a portion of the host rock can be considered to be man-made. This argument loses its strength when the fact is considered that the designer has limited control over the role played by the rock and virtually no control over how much of the rock plays this role. Thus, this portion of the host rock can at best be considered as "man-altered", but not "man-made" nor "engineered."

On the other hand, from the perspective of the EBS designer, it is conceivable that the rock adjoining the openings can be treated or grouted to enhance its performance as a barrier. This may make the rock qualify as "engineered" and hence suitable to be included within the EBS. However, the technology to effectively grout the rock to enhance its capability as a barrier under the expected conditions of heat and radiation over the required periods of time does not exist at this time.

BACKGROUND INFORMATION

The origin of the EBS boundary issue can be traced back to the days of public comments on the proposed rule 10 CFR Part 60 and NRC's staff analysis of those comments as documented in NUREG - 0804 (Reference 1). Comment No. 179 from U.S. DOE and the NRC staff response to the comment are on pages 181 and 182 of that document.

In Comment No. 179, the DOE recommended revising the "engineered system" to include the waste package, backfill and a portion of the host rock. The extent of this inclusion of the host rock would be determined on a case by case basis.

The NRC staff responded to Comment No. 179 by saying: "The commentor's recommendation that a portion of the host rock be included in the definition of the engineered barrier system has not been adopted. The engineered barrier system is intended to include only man-made components, which is consistent with the provisions of the Nuclear Waste Policy Act of 1982." It was further elaborated that the provisions of 10 CFR 60.113(b) accommodates DOE's underlying concern.

The DOE's underlying concern was expressed in the "rationale" to the above Comment. Comment No.179 states: "Since 'underground facility' excludes shafts, boreholes, and seals, the above definition implies that these entities, along with surface facilities, are not engineered. If the intended concept is 'engineered barrier system,' that term should be used with a clarification in the concept section. However, note that the control of release requirement which is placed on the engineered system would, in fact, become a requirement on the waste package. While we believe that the proposed 10^{-5} release rate criterion should be dropped or modified, in the event that the commission chooses to retain this criterion, DOE would recommend that some acknowledgement be made of the isolation capabilities of the host rock. The extent of the rock, or rocks, which will be included in the engineered system will be proposed in the license application related to a specific site."

In a letter (Reference 9) dated September 26, 1986 to James Knight of DOE/HQ, NRC's John J. Linehan referred to continued debates within DOE and its contractors regarding the inclusion of a portion of the host rock within the EBS. Mr. Linehan went on to reiterate NRC's position saying "... our interpretation of the engineered barrier system boundary remains unchanged from that provided in our responses to public comments on the proposed rule. That is, the engineered barrier system does not include a portion of the host rock."

In the SCP, the EBS boundary issue is alluded to in Section 8.3.5.10 (on page 29 of that section) where it is stated: "The Yucca Mountain Project adopted the current DOE interpretation of the EBS system boundary to coincide with the surfaces of the excavations within the underground facility. The DOE, however, requires the project to reevaluate the interpretation before the completion of repository and waste package advanced conceptual design. If, in the future, portions of the host rock are to be included in the EBS, the near-field radionuclide transport studies will be needed to resolve this issue (Issue 1.5) and to provide realistic source term to Issues 1.1 and 1.9." It should be pointed out that the words "DOE interpretation" in the foregoing means DOE's acceptance, for the time being, of NRC's position that the EBS does not include a portion of the host rock.

The Waste Package Implementation Plan, Rev.0, February 1993, Yucca Mountain Site Characterization Project (Reference 11) states in Section 2.3, Page 2-3 "..... the DOE has assumed that the boundary of the EBS coincides with the surfaces of the excavations within the underground facility, consistent with the current NRC position, for the purposes of evaluating radionuclide release rates. However, it is recognized that rock properties may be modified as a result of the engineered system and that these properties affect the long-term performance of the WPs as well as the eventual rate of transport of radionuclides into and through the rock, regardless of where the boundary is drawn. Thus, a reassessment of the inclusion of a portion of the host rock within the EBS boundary may be required as the design of the EBS matures."

ANALYSIS

It should be noted that none of the three "regulatory" definitions (listed above) by itself has a provision by which a part of the host rock can be included in the EBS. Even DOE's own guidelines, 10 CFR Part 960, do not explicitly include "underground facility" as part of the EBS. However, its definition of "underground facility" is such that the "rock required for support" is part of the underground facility. On the other hand, although 10 CFR Part 60 explicitly includes the underground facility in its definition of the EBS, its definition of underground facility does not include "the rock required for support."

Thus, only when the definition of EBS in 10 CFR Part 60 is combined with the definition of "underground facility" in 10 CFR Part 960 can one claim any regulatory basis to include "the rock required for support", i.e, a portion of the host rock in the EBS. This makes such a claim tenuous at best.

It is, therefore, concluded that NRC has a firm regulatory basis to insist that the EBS boundary does not extend into the host rock, especially since such a definition is consistent with the NWPA.

DOE's underlying concern in seeking the inclusion of part of the host rock within the EBS is that without the host rock it may be difficult for the EBS to meet the 10^{-5} release rate limit. NRC has said that the provisions of 10 CFR Part 60.113(b) can accommodate DOE's underlying concern. NRC staff has further explained, in the Staff Response to Comment No. 51 on Page 110 of Reference 1, that "..... the radionuclide retardation capability of the host rock is one of the factors the Commission will consider in approving an alternative to the one part in 100,000 per year release rate specified in paragraph 60.113(a)(1)(ii)(B); and it, therefore, could be taken into account to the extent that DOE can characterize its performance as a barrier based on tests and measurements conducted during the site characterization program."

The above staff response to Comment No. 51 can be taken to mean that NRC will consider any demonstrated role played by the host rock adjoining the underground facility in the total system performance and relax the release rate limit, if appropriate, by invoking the provision of 10 CFR Part 60.113(b). This ought to alleviate any concern EBS designers may have relative to meeting the 10^{-5} release rate limit. Looked at in another way, the above staff response can be taken to mean that if the role played by the host rock can be demonstrated, its contribution toward the total system performance will be taken into account regardless of which subsystem the host rock is a component of.

It may also be pointed out that DOE's concern relative to the 10^{-5} release rate limit was well founded earlier with the concept of thin walled borehole emplaced containers having little room for placement of engineered backfill between the container and the host rock. With the evolving concept of large drift emplaced multi-purpose containers and the ability to place substantial engineered backfill between the container and the host rock, the concern about failing to meet the release rate limit has lost significance.

NRC's basic objection to including part of the host rock in the EBS is that doing so will violate (and would require amending) the NWPA because the host rock is not man-made. The contention that "the rock required for support" is part of the underground facility and, therefore, is man-made, is considered to be a weak argument. Also, for any component to be included in an engineered system, its properties and its behavior over the expected range of conditions and times must be characterized with a comparable degree of confidence as that for the other components of the system. It will be extremely difficult to attain such a standard in the characterization of the behavior of the host rock in the near-field environment.

CONCLUSION

Considering the above, it is concluded that the issue related to the definition of the boundary of the EBS be dropped and that NRC's position, i.e. the boundary does not extend into the host rock, be accepted.

REFERENCES

1. Staff Analysis of Public Comments on Proposed Rule 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories", NUREG-0804, U.S Nuclear Regulatory Commission, December, 1983.

2. Cloninger, M.O, et al., An Analysis on the Use of Engineered Barrier for Geologic Isolation of Spent Fuel in a Reference Salt Site Repository, PNL-3356, December, 1980.

3. Cloninger, M.O and Cole, C.R. A Reference Analysis on the Use of Engineered Barriers for Isolation of Spent Nuclear Fuel in Granite and Basalt, PNL-3530, 1982.

4. Chu, M.S., Ortiz, N.R., Wahi, K.K., Pepping, R.E., Campbell, J.E., An Assessment of the Proposed Rule (10 CFR 60) for Disposal of High-Level Radioactive Waste in Geologic Repositories. NUREG/CR-3111, SAND 82-2969, November, 1983.

5. Oversby, V.M., and Wilson, C.N. Derivation of a Waste Package Source Term for NNWSI from the Results of Laboratory Experiments, UCRL- 92096, September, 1985.

6. Memorandum from Ralph Stein, OCRWM, DOE/HQ to Don Veith, NNWSI with attachment, "Draft Regulatory Definition for Waste Package Post-Emplacement Compliance Strategy." April, 1986

7. Letter Report on "Definition of the boundary for the engineered barrier system" from SNL to WMPO, May 20, 1986.

8. Inter-office memo dated July 17, 1986 from U-Sun Park of SAIC to Mike Voegele of SAIC reviewing the letter report of Reference No. 7 above.

9. Letter dated September 26, 1986 from J. J. Linehan (NRC) to James Knight (RW-20)

10. DOE (U.S Department of Energy), 1988. Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area, Nevada; Office of Civilian Radioactive Waste Management, Washington, DC.

11. Waste Package Implementation Plan, Rev.0, February 1993, Yucca Mountain Site Characterization Project, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, DC.

Characterization of the Physical and Hydrologic Properties of Desert Alluvium Used in a Large Scale Ponding Experiment at Yucca Mountain, Nevada. A.L. FLINT*, W.R. GUERTAL, M.H. NASH, and L.L. Hofmann, U.S. Geological Survey and Foothill Eng.

A large scale ponding experiment was conducted near a 20 m exposure of desert alluvium. Profile description and sampling, borehole geophysics, and laboratory analysis were used to determine the physical and hydrologic properties prior to the ponding experiment. Soil development and the existence of distinctive stratigraphic layers were identified and bulk density, porosity, grain density, and water retention were measured in the laboratory. Borehole geophysics data were evaluated to determine its application to other locations where core or exposure were not available. The borehole geophiscs included neutron probe, a truck-mounted compensated neutron porosity tool, and a gamma-gamma density tool. The borehole geophysical measurements identified the distinct stratigraphic layers and provided wet bulk density, water content, and porosity measurements.

A.L. Flint, (702) 295-5970 P. 205

Agronomy Abstracts

1993 Annual Meetings

American Society of Agronomy
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Soil Science Society of America

Cincinnati, Ohio November 7–12, 1993

Shallow Infiltration Processes in Two Small Arid Watersheds at Yucca Mountain, Nevada. L.E. FLINT*, J.A. HEVESI, and A.L. FLINT, Raytheon Services Nevada and U.S. Geological Survey, Mercury, Nevada

Infiltration processes were studied in 2 small arid watersheds at Yucca Mountain, Nevada, to provide conceptual information to aid in the development of numerical hydrologic models. The primary data consisted of 3 years of monthly neutron logs of volumetric water content from 35 boreholes to 20 m. The data were categorized according to topographic position within the watersheds: ridgetop, sideslope, alluvial terrace, and active channel. Three principal mechanisms influencing infiltration were analyzed: 1) topographic features such as slope, aspect, microtopography, and elevation, 2) geologic controls such as soil or bedrock, and 3) meteorological factors such as precipitation. The shallowest water penetration occurred on alluvial terraces with high water storage capacity and no overland flow, and the deepest pulses of water were in sideslope location with shallow or no soil over bedrock. The largests volumetric increases occurred in the ridgetops, probably due to meteorological factors. Preliminary conclusions suggest that profiles in different topographic positions are distinct and can be broadly categorized for modeling infiltration.

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Large Plot Ponded Infiltration on a Skeletal Desert Alluvial Soil Sequence. W.R. GUERTAL*, L.L. HOFMANN and A. L. FLINT, Foothill Eng., Foothill Eng., and U.S.G.S., Nevada.

A ponded infiltrometer constructed of a 3.6 m diameter outer ring and three 0.6 m diameter inner rings were used to study infiltration into a layered skeletal desert alluvial soil sequence. Fifty thousand liters of water infiltrated into the soil under a constant 10 cm head during a 14 day period. Vertical water movement was monitored with a neutron probe. The satiated vertical conductivity of the surface soil was estimated to be 1.77 cm/hr using the early time steady state infiltration rate. The wetting front moved to a depth of 5.5 meters in approximately 7 days and the average volumetric water content at the end of 14 days increased by approximately 15%, which accounted for 18% of the total volume of water applied. The other 82% of the water presumably moved laterally at the contacts of the major horizontal units, and out of range of the neutron probe.

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Developing and Verifying a Numerical Model of Water Content Profiles in Alluvium at Yucca Mountain, Nevada.

J.A. HEVESI* and A.L. FLINT, U.S. Geological Survey

A model to simulate water content profiles in an arid alluvium wash at Yucca Mt., Nevada, was developed using a finite difference approximation of Richards equation. Precipitation was measured at the study site, while evapotranspiration (ET) was modeled as an empirical function of potential ET and simulated water content within an estimated root zone. Potential ET was calculated with the modified Priestly-Taylor equation using measured solar radiation and air temperature. The parameters defining the empirical ET function were calibrated by a comparison of simulated water content profiles with measured profiles obtained by geophysical logging of boreholes at the study site from 1990 to 1992. Overland flow and net infiltration through the alluvium were assumed to be insignificant during the calibration period. The calibrated model was verified by comparing predicted profiles with the measured profiles for 1993. Results indicated that site-specific predictions of water content profiles were possible for periods when surface flow could be neglected.

J.A. Hevesi. (702) 295-5970

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A Large-Scale, Automated, Constant Head, Double-Ring Infiltrometer. L. L. HOFMANN*, W.R. GUERTAL, W.J. DAVIES, and A. L. FLINT, Foothill Eng., Foothill Eng., and U.S.G.S., Nevada

The infiltration rate of a soil is an important parameter for understanding other physical and hydrologic properties of that soil. An inexpensive, automated, constant head, double-ring infiltrometer system was developed and used for continuous, long term ponded field infiltration studies in skeletal, arid soils. This system maintained a minimum 30 mm head (± 1 mm) in a 640 mm diameter ring, using a pair of one-way electronic floats and a solenoid valve. Surface influx was determined by measuring water outflow from a 208 liter feeder tank equipped with a calibrated pressure transducer. The pressure transducer measured changes in tank water level to a resolution as fine as 2 mm of head. The entire system was automated with a datalogger and was successfully tested in the field for 14 continuous days.

L. L. Hofmann, (702) 295-5990

P208

Agronomy Abstracts

1993 Annual Meetings

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Cincinnati, Ohio

Field Water Retention of Skeletal Desert Soils, Yucca Mountain, Nevada. D.B. HUDSON* and A.L. FLINT, Foothill Eng. and U.S. Geological Survey.

Field soil water retention data were collected from surface soils on ridgetops, sideslopes, and washes at Yucca Mountain Nevada. The purpose of collecting this data was to measure the field range of water retention data during both wet and dry periods. During the winter and early spring, soil water potentials were measured with tensiometers and soil water contents were measured gravimetrically. When the soils dried to potentials below the tensiometer range (less than -0.05 MPa), soil samples were periodically collected at 5 cm intervals from the surface to 30 cm and the water potentials were measured with a chilled-mirror psychrometer. The data from these potential profiles ranged from approximately -100 MPa near the surface to greater than -0.3 MPa at 30 cm. Combining all the data resulted in continuous water

and Mualem-van Genuchten models both satisfactorily described the data, with the former performing marginally better for five of the six soils. In the supply potential range zero to -10 cm, *K* was reduced by three to four orders of magnitude in loam, silt loam and silt clay soils and by two orders of magnitude in two sandy soils. Field-saturated *K* was largest in the finer-textured soils. Spatial variability in *K* was small to moderate for all soils.

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Determination of Water Retention Characteristics of a Skeletal Soil at Yucca Mountain, Nevada.

M.S. NASH* and A.L. FLINT, Foothill Engineering and U.S. Geological Survey.

Water retention characteristics of a skeletal soil are a function of both the soil fraction (<2 mm) and the rock fragments (>2 mm). The water retention relation can be estimated from laboratory measurements of the separate water retention properties of the soil and rock fragments. The separate properties may be combined volumetrically based on the field proportions of each fraction. Water retention characteristics were measured for the soil, the rock fragments, and various combinations of each. Preliminary results indicate that combining the separate water retention properties of the components of a skeletal soil produces of good description of the water retention characteristics of that skeletal soil.

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Cincinnati, Ohio

November 7–12, 1993

Properties Controlling the Seasonal Variability of Soil Surface Water Content in an Arid Watershed at Yucca Mountain, Nevada. M.H. NASH*, A.L. FLINT, and M.S. NASH, Foothill Engineering and U.S. Geological Survey

Mapping of surficial material properties is needed to develop watershed models. Although many properties can be mapped, determining which properties should be mapped first is important. A number of soil properties including texture and water content, and meteorological properties such as radiation load and precipitation were measured. Data were analyzed using multiple regression to rank the importance of each property in controlling the soil surface water content. Preliminary results indicate that changes in soil surface water content during and following initial wetting were controlled mainly by solar radiation load and soil texture. Therefore, early mapping of these properties would be useful for development of a desert watershed model.

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Cincinnati, Ohio

United States Department of the Interior
GEOLOGICAL SURVEY
U. S. Geological Survey, MS 425
Denver Federal Center
Denver, Colorado 80225

TAKE PRIDE IN AMERICA

Date: November 22, 1993

To: Tim Sullivan, DOE

From: Dennis O'Leary, USGS-YMPB

Re: Proposal to excavate trenches in the Rock Valley fault zone, NTS.

1-350317 6

This proposal describes where trenches are recommended to be excavated in the Rock Valley fault zone. Technical details of the trenches, their locations, and the needs supporting the decision on where to site trenches is given. This memorandum satisfies milestone 3GTN003M.

1. Need for trenching

Work in SCP Activity 8.3.1.17.4.4.1 (Evaluate the Rock Valley fault zone) in Study Plan 8.3.1.17.4.4 (Evaluate strike-slip faults proximal to the site in northeast-trending zones) has generated a need for one or two trenches across fault traces of the Rock Valley fault zone. Trench excavations are necessary to help determine the most recent displacements and the nature of fault deformation in Quaternary strata cut by faults of the Rock Valley fault zone. Field work during FY 93 has shown that natural exposures do not provide adequate data for determining most recent (Quaternary) fault slip along the zone. Therefore, information necessary for a proper estimate of seismic hazard, such as most recent activity, magnitude of displacement, recurrence, and sense of motion, must be obtained by trenching fault scarps or fault traces that cut the Quaternary surface. A single estimate of Quaternary slip for the Rock Valley fault zone is based on logs and dates from two trenches that cross the same scarp of a single fault (Yount, Shroba et al., 1987; Figure 1). The proposed new trenches will provide data on two major fault strands located north and south of the fault trenched by Yount, Shroba et al. (1987; Figure 1). In effect, the total population of major strike-slip faults in Rock Valley active in the Quaternary will be sampled and a range of slip rates more representative of the Rock Valley fault zone and suitable for probabilistic fault slip analysis should be made available.

2. Description and character of the sites and trenches

1. Trench RV-3 (Note: proposed trench IDs follow trench designations RV-1 and RV-2 of Yount, Shroba et al. (1987). Trench RV-3 site is located in Area 25, south of Skull Mountain and north of the Jackass Flats road (Figure. 1). The trench will span a prominent, bouldery scarp of the northernmost major fault strand where it crosses a low-relief rocky wash; this scarp appears to be the youngest accessible morphological expression of this fault (Figure. 2). The trench will be oriented NNW and be at least 40 m long. The west wall will be a clean vertical face approximately 3.1 m deep, the floor will be 2 m wide; the east wall will be benched at a depth of 2 m, giving the trench a total width of about 5 m. Excavation will begin at the north end.

Just east of this site, two parallel test pits, oriented ENE, each about 5 m long, may be excavated at the discretion of the PI. These pits may be needed to determine lateral fault offset, if the main trench reveals a fault having significant left-lateral offset.

2. Trench RV-4 This trench will be developed at the discretion of the PI from one of three test pits to be excavated across subtle fault traces located in Area 27, east and west of the old NNW-trending jeep road that formerly provided access to this area (Figures. 1, 3). The test pit sites cross two fault traces that are direct projections of the major southernmost fault strand of the Rock Valley zone (Figure. 3). Because the fault traces cross a nearly flat sandy, gravelly surface and do not form a

ENCLOSURE

clearly expressed scarp, the exact location of the fault plane is uncertain and the amount of displacement along these traces may be negligible. Therefore, the PI will examine each test pit to determine which, if any, shall be developed into a loggable trench having the same dimensions as trench RV-3. The test pits will be oriented NNW, will be 2m deep, about 1.5 m wide, and will be no longer than 20 m, Excavation will begin at the north ends.

3. Trench sites

Trench RV-3 site is located at UTM coordinates 4062810mN, 571890mE in the Specter Range NW 7.5 quadrangle (Figure. 4). Travel west on the Jackass Flats road 2.45 miles from its intersection with the area 27 paved acess road to a stake flagged blue and orange on the north side of the road. Follow blue flagged creosote bushes north up the shallow wash for about 1.1 km to the trench site which is marked by two orange flagged stakes about 40 m apart. The two parallel test pit sites are located about 20 m east of the trench site and are marked by orange flagged stakes.

The test pit sites for trench RV-4 are located at UTM coordinates 4063050mN, 579860mE, and 4062490mN, 579210mE in the Camp Desert Rock 7.5' quadrangle (Figure 5). Permission is needed to enter and work in area 27. Travel to the area 27 guard gate for ID check, then turn and head south for about 1 mile. The dirt jeep road is on the left at a narrow vertical arrow sign that faces south. The dirt road is in good condition and does not require 4WD; it may be accessible to a flat-bed truck via a wash just south of the intersection with the paved road. Travel south on the dirt road for 1.89 miles to a stake flagged yellow and pink on the left next to a bush flagged orange. Follow yellow and pink flagged creosote bushes east to the orange flagged stakes at a test pit site about 180 m east of the road.

Travel south on the dirt road another 1/4 mile to a stake flagged yellow and pink on the right. Follow yellow and pink flagged creosote bushes west for about 520 m to two test pit sites more or less north and south of each other and marked by orange flagged stakes (Note: these two sites are so close to each other they are both located by the second set of UTM coordinates given above).

4. Technical procedures

The trenches will be logged according to standard and established Geologic Procedures GP-07, Conventional Geologic Mapping of Trench Walls; GP-39, Geophotogrammetric Mapping of Trench Walls-Field Work; or GP-53, Geologic Mapping of Trench Walls with a Total Station.

5. Applicable Approved QA Grading

SCP study 8.3.1.17.4.4 has a YMP approved QA grading package QAGR G1232844 that was approved February 24, 1993 under YMP Administrative Procedure 5.17Q. All work is considered quality affecting.

6. Points of contact

Dennis O'Leary, U. S. Geological Survey, Denver Federal Center, MS 425, Denver Colorado 20225; 303 236-0022.

7. Planning and Control System (PACS) information

This work will be conducted in support of compilation of the historical earthquake record in task 3GTN003M within SCP activity 8.3.1.17.4.4.1, in that it will furnish data on the ages and recurrence of fault movement in Rock Valley during the Quaternary Period.

8. Health and safety

All USGS field work will be conducted in accordance with an approved safety code ("USGS Safety and Environmental Health Handbook") as well as DOE-YMP safety regulations.

9. References

Yount, J. C., et al., 1987, Trench logs from a strand of the Rock Valley fault system, Nevada Test Site, Nye County, Nevada: U. S. Geological Survey Miscellaneous Field Studies Map MF-1824,

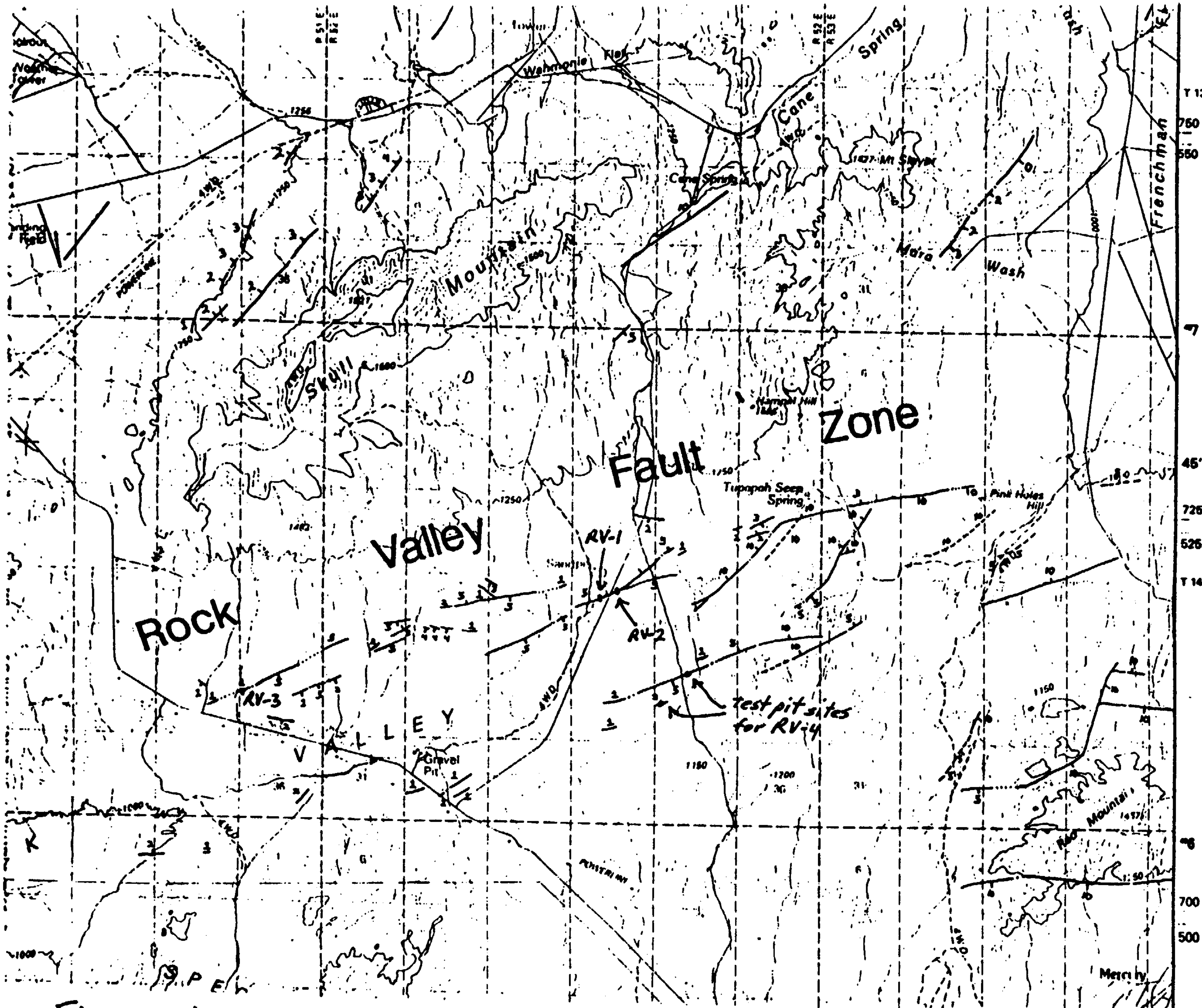
Rock Valley Fault Zone
Skull Mountain
Wahmonie Flat
Cane Spring
Cane Springs
Mara Wash
Frenchman
Tippipah Seep Spring
To Pint Holes Hill
Gravel Pit
V A L L E Y
RV-1
RV-2
RV-3
test pit sites for RV-4
Red Mountain
T 13 S
T 14 S
750
550
45'
725
525
700
500
R 51 E
R 52 E
R 53 E

Figure 1

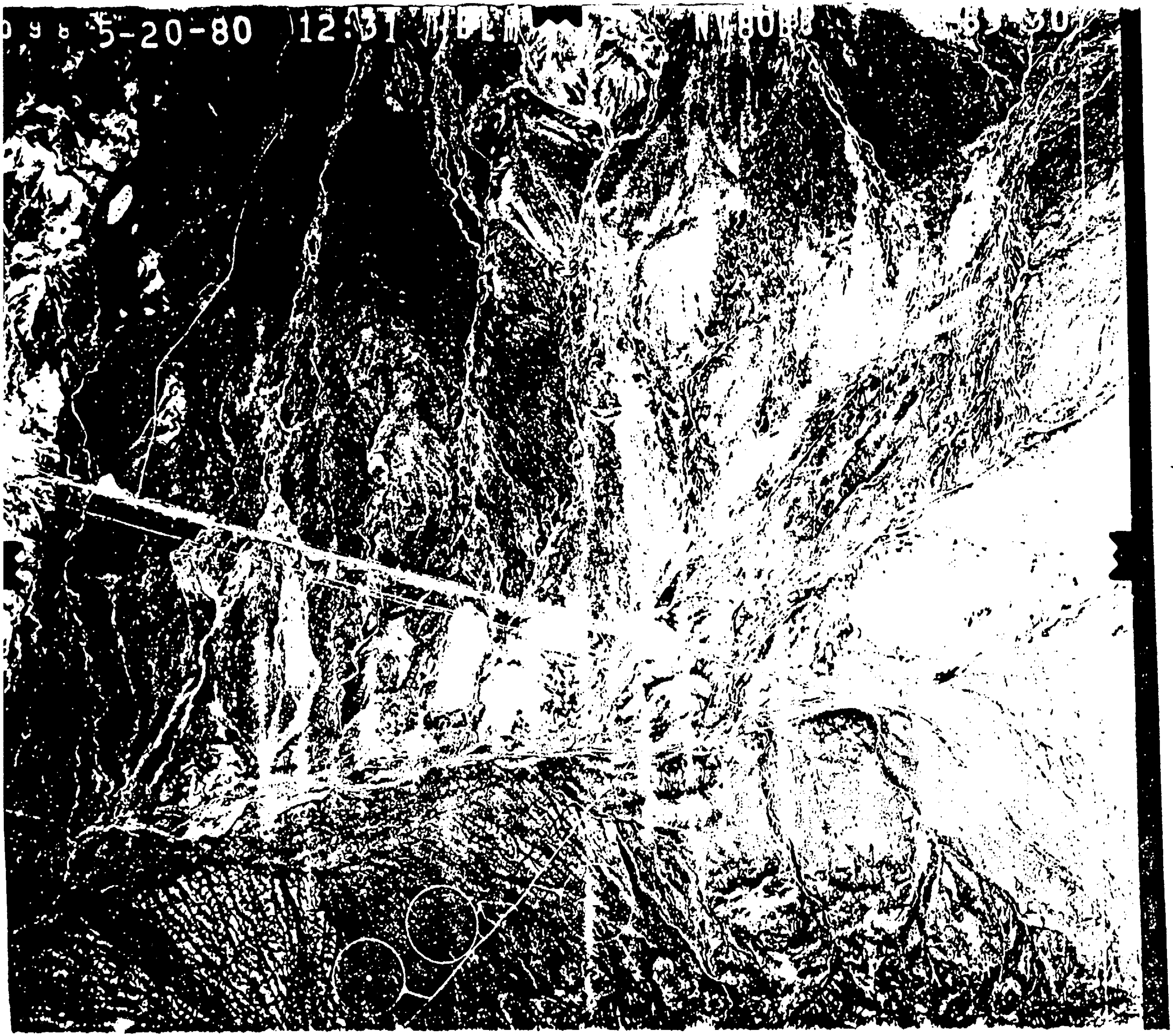

Figure 2

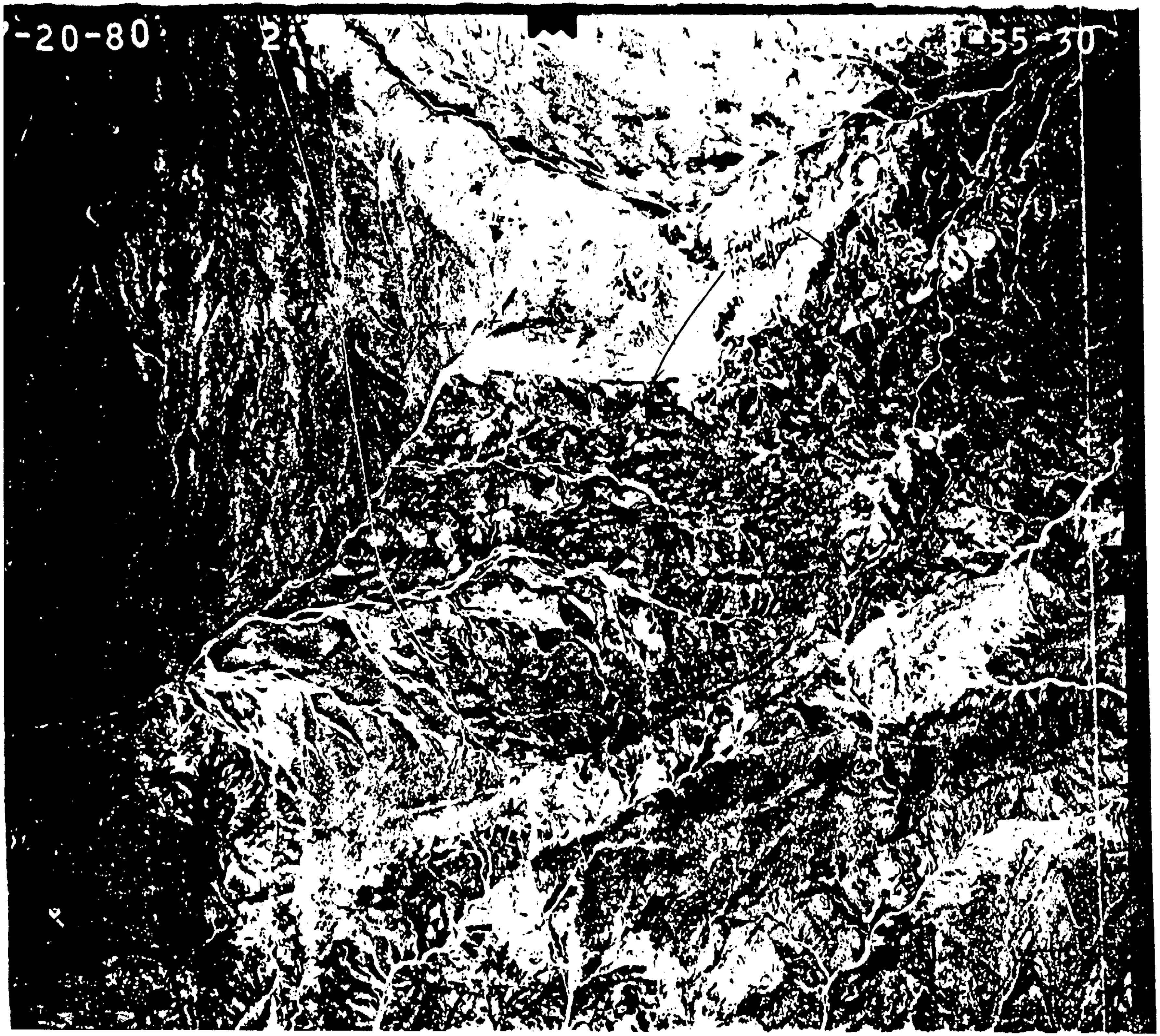

Figure 3

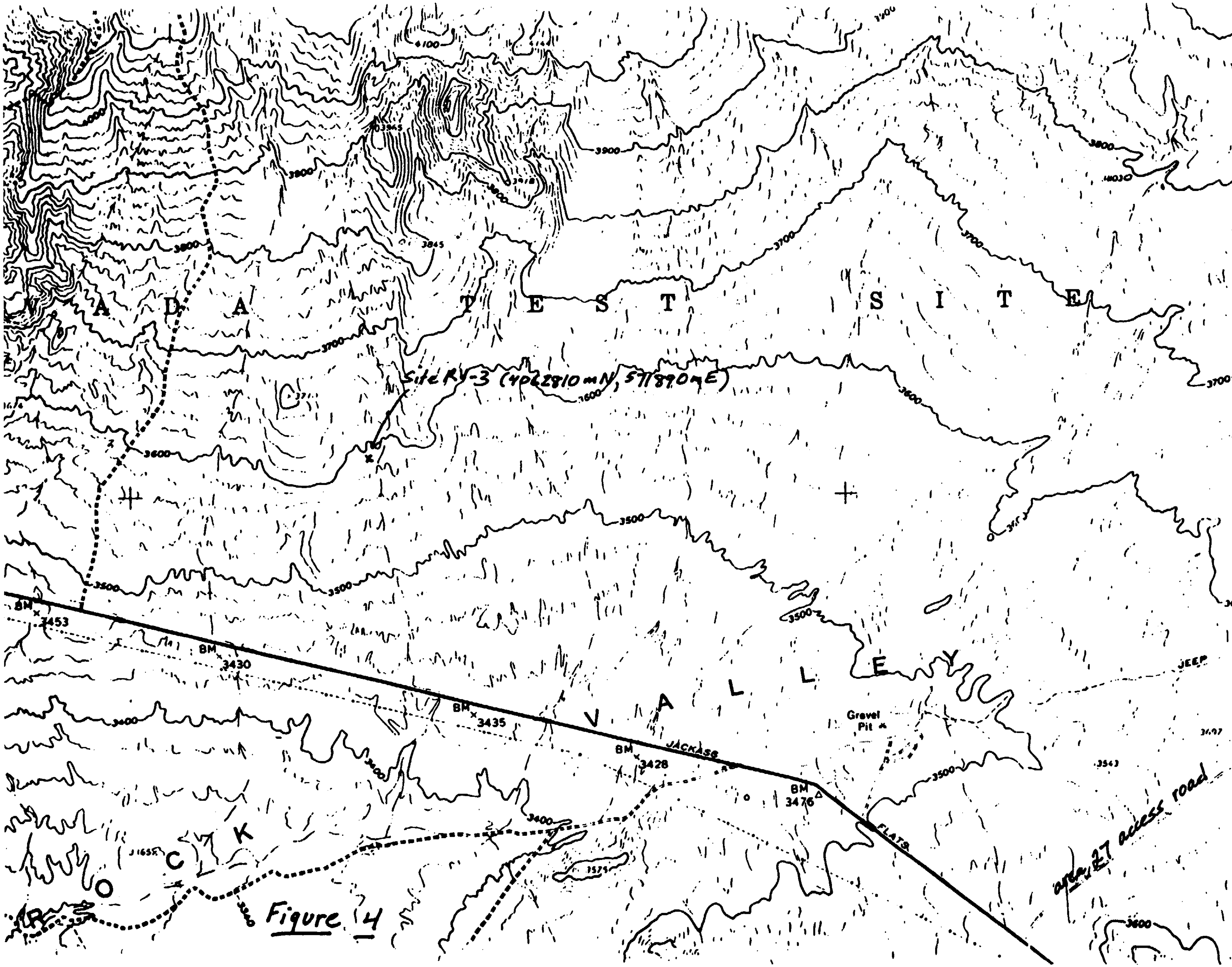
NEVADA TEST SITE
ROCK VALLEY
Site RV-3 (4062810 mN, 571890 mE)
JACKASS FLATS
Gravel Pit
JEEP
BM 3453
BM 3430
BM 3435
BM 3428
BM 3476
3500
3600
3700
3800
3900
4100
3845
3945
area 27 access road

Figure 14

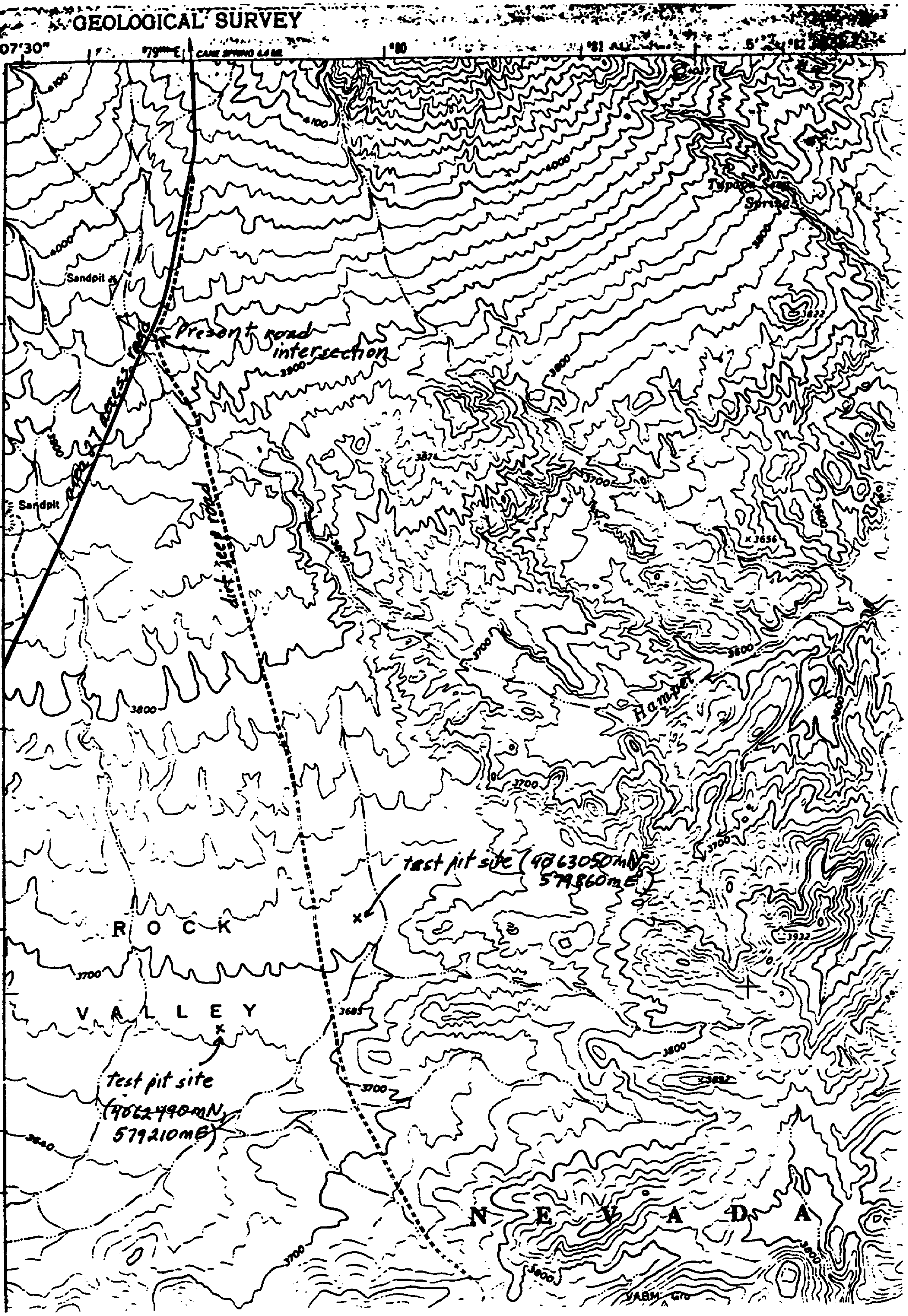
GEOLOGICAL SURVEY
116°07'30"
36°45'
42'30"
Sandpit
Sandpit
access road
Present road intersection
dirt jeep road
Hampel
ROCK VALLEY
NEVADA
test pit site (4063050mN 579860mE)
test pit site (4062490mN 579210mE)

Figure 5