NVTRIP

MEMORANDUM FOR: Ronald L. Ballard, Chief
Geosciences & Systems Performance Branch, HLWM

THRU: Philip S. Justus, Section Leader
Geology/Geophysics Section
Geosciences & Systems Performance Branch, HLWM

FROM: Harold E. Lefevre, Geologist
Geology/Geophysics Section
Geosciences & Systems Performance Branch, HLWM

SUBJECT: REPORT DESCRIBING ACTIVITIES ASSOCIATED WITH THE JANUARY 23 THROUGH 27, 1989 TRIP TO VARIOUS LOCATIONS IN NEVADA INCLUDING THE YUCCA MOUNTAIN SITE, THE SAMPLE MANAGEMENT FACILITY, THE NRC'S LAS VEGAS OFFICE AND THE U.S. GEOLOGICAL SURVEY'S V. E. MCKELVEY'S MINERALS RESOURCES FORUM AT RENO

PLACES VISITED:

1. January 23, 1989 - Yucca Mountain Project Site; Nevada Test Site and vicinity including the "G" Tunnel, Sedan Crater, Carpet Bag Fault, and the Sample Management Facility.

2. January 24, 1989 - NRC's Office at Las Vegas, Nevada.

3. January 25-27, 1989 - The U.S. Geological Survey's Fifth Annual V. E. McKelvey Forum on Mineral and Energy Resources at Reno, Nevada.

PURPOSE OF TRIP:

1. January 23, 1989 - Yucca Mountain Project Site and Nevada Test Site and vicinity.

   To acquire a basic understanding and appreciation, through direct observation, of the geologic environment of, and in the immediate vicinity of, the Yucca Mountain Project (YMP) Site.

   Of particular interest was the inspection of the surficial exposures/deposits in the vicinity of the proposed Exploratory Shaft Facility (ESF) for an indication of surface rupture attributable to the possible "fault" suggested through interpretation of geophysical (electrical resistivity) data.

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2. January 24, 1989 - NRC Offices at Las Vegas.

   To review documents and other materials possibly not yet on file at Headquarters, but of potential value to the Staff.

3. January 25-27, 1989 - The McKelvey Forum at Reno, Nevada sponsored by the U. S. Geological Survey.

   To attend the (1) USGS's forum on mineral resources research (which was limited chiefly those of Nevada) and (2) to be appraised of the collaborative research between the USGS and industry, academia and other State and Federal Government agencies.

NEVADA TEST SITE/YUCCA MOUNTAIN PROJECT (YMP) SITE AND VICINITY ACTIVITIES OF JANUARY 23, 1989

Nevada Test Site and Vicinity Segment

In order to acquire a rudimentary background of the YMP geologic setting, a general reconnaissance (snapshot) of the geology of the Nevada Test Site (NTS), which is situated immediately to the east of the YMP, was graciously provided by Mr. Paul Prestholt , NRC's Senior On-Site Representative for the YMP. Stops on the NTS included (1) the G-Tunnel Complex, (2) Sedan Crater and (3) the Carpet Bag fault. Before exiting the NTS we visited the DOE's Sample Management Facility (SMF).

Since the stops made on this segment of the January 23 trip are identical to those made by many preceding NRC staff and since the stops have been previously described, no further description of either the facilities (G-Tunnel Complex or the Sample Management Facility) or the man-induced (through nuclear explosions) features such as Sedan Crater and the Carpet Bag fault features is considered necessary. As a note, the SMF presently houses soil and rock samples acquired through varied YMP investigations and will serve, upon resumption of YMP site characterization activities, as the YMP's processing, analysis and archiving facility. The reader is referred to the October 18, 1988 trip report of Anthony T. Cardone, Headquarters Staff geologist describing (among other items) Mr. Cardone's comments and observations regarding both the G-Tunnel Complex and the SMF.

Yucca Mountain Project Segment

Following our departure from the NTS, Paul Prestholt and I drove to the crest of Yucca Mountain and stopped in the vicinity of Hydrologic Hole USW-H5 for an view of the geologic environment, particularly those to the west, including Bare Mountain and the volcanologic features in Crater Flat. The panorama to the west within Crater Flat included the large cinder cones (Black Cone and Red Cone), several smaller cones and to the south, the Lathrop Wells cinder cone. The Sterling Mine (gold) site on the east flank of Bare Mountain, some 9 1/2 miles west of the Yucca Mountain crest, is clearly visible.

Proposed Exploratory Shaft Facility Segment

Because of the lateness of the day, we proceeded directly to our second and final stop at the YMP site, the proposed Exploratory Shaft Facility (ESF) Site on the north wall of Coyote Wash. The objective of the Exploratory Shaft(s) stop was to examine the surficial deposits (rock outcrops and soil overburden) for evidence of possible fault displacement*.

I observed no evidence of fault offset either in the immediate vicinity of the ESF or on the slopes of Coyote Wash to the north and south. However, closely-spaced bedrock fracturing lacking detectable offset was noted in the vicinity of the proposed ESF.

Upon returning to NRC Headquarters, I closely examined the photographs that I had taken while in the ESF area, including the north and south slopes of Coyote Wash, for evidence of structural deformation. I observed no suggestion of fault offset.

The YMP photographs (Crater Flat and vicinity of the ESF) are available for inspection at H. Lefevre's work station (5H-24), NRC Headquarters, 11555 Rockville Pike, Rockville, Maryland.

*NOTE: The suggestion that a fault may exist in the vicinity of the ESF stemmed from an interpretation of geophysical data (electrical resistivity survey) made by Smith and Ross (DOE contractor) in 1982. My examination of low sun angle photographs of the ESF area that had been acquired under State of Nevada contract indicated no direct evidence of fault displacement in the vicinity of the ESF. However, the apparent absence of detectable surface evidence for faulting in itself does not necessarily negate the actual presence of faulting since the trace of a recognized feature, the Ghost Dance fault, located some 800 feet west of the proposed ESF in the upper portion of Coyote Wash, is clearly visible in the photograph but is not apparent on the ground.

VISIT OF JANUARY 24, 1989 TO NRC'S OFFICES AT LAS VEGAS, NEVADA

Since an early afternoon flight to Reno precluded the possibility of an additional field trip to the YMP site vicinity, a visit was made instead to the NRC's office at Las Vegas. The purpose of the visit was to research the office library holdings in order to review documents and other materials possibly not yet on file at Headquarters, but of potential value to the Staff. Among others, the more significant scanned items included:

1. Geologic Map of the Jackass Flats Area, Nye County, Nevada, compiled by Florian Maldanado, 1985; USGS Miscellaneous Investigations Map I-1519.

2. Topographic maps of the Yucca Mountain area, Nye County, Nevada; series of six black and white maps compiled by the U.S. Geological

Survey, Branch of Astrogeology, at Flagstaff, Arizona in 1984 and released as Open File Report 85-620 at a scale of 1:5,000.

3. Yucca Mountain Project, Surface-Based Investigations Plan, December, 1988.

   COMMENT: Volume 4, Section 5.0 (Map Sheets) contains a useful set of figures (Maps 1 and 2) showing existing activities and proposed activities, respectively.

   PROBLEM: Since there is no figure combining the existing and proposed activities one is not able to easily determine the extent of coverage.

   SUGGESTION: DOE should prepare another figure combining the activities identified on Maps 1 and 2.

   OBSERVATION: I was unable to find any reference to surface-based investigations dealing with human intrusion, specifically natural resources (mineral, energy, or ground water). Does this mean that none are planned by the DOE?

   NOTE: It is apparent that the Surface-Based Investigations Plan (SBIP) is a compendium of plans that have been addressed in more detail in the Site Characterization Plan (SCP). As a result, the SBIP contains nothing "new" in the investigations area, but is nevertheless very useful in presenting the overall surface-based plan. Because of the "TBD" status of many investigations no plans are presented for natural resources-related activities.

4. Yucca Mountain Project Atlas.

5. Compilation of documents in the NRC's Las Vegas Office Library.

   a. NRC Headquarters Staff (Charlotte Abrams) is periodically sent an updated PC "floppy disk" listing the current Las Vegas office holdings.

6. Acquisition of U.S. Geological Survey Documents.

   a. Mr. Prestholt has established contacts within the USGS enabling him to acquire USGS products at no cost to the NRC and within a relatively short time frame. Historically, acquisition of such documents by the Headquarters Staff has been a frustrating, time-consuming process (because of the nature of the procurement process). In order to alleviate this problem Mr. Prestholt has offered to serve as a "funnel" for the Headquarters Staff requests for a reasonable number of USGS publications. Such requests would be coordinated through Mr. King Stablein, Headquarters, HLPD.

THE U.S. GEOLOGICAL SURVEY'S McKELVEY FORUM AT RENO, NEVADA ON JANUARY 24-27, 1989

The Fifth Annual Vincent E. McKelvey Forum, sponsored by the U.S. Geological Survey, was held on January 24-26, 1989 at Reno, Nevada. On the following day, January 27, a workshop entitled "Minerals Industry and Government Cooperative Studies on Concealed Mineral Deposits within the Basin and Range - A Geophysical Perspective" was convened. Attendance (over 1,100 scientists, miners and other specialists) at the forum exceeded the USGS's January 19 estimates of 400 by nearly 300 per cent. Reflecting the Nevada mining industry's keen interest in precious metals, nearly 50 per cent of the talks/poster sessions were devoted to gold. However, the overall focus of the meeting/workshop was on USGS research on mineral resources in general, with special emphasis on the mineral resources of Nevada.

Since more than 90 oral reports and poster sessions were presented at the forum, no attempt will be made to discuss, or to even specifically identify, all of the papers/posters. In order to present the material considered most relevant to the high-level waste program, the following is presented:

1. The programs of both the Forum of January 24-26, 1989 and the Workshop (January 27) are attached (see Enclosure 1.)

2. A general summary of the Forum has been extracted from a April, 1989 "Geotimes" report by Louise J. Fisher and is presented below.

3. A March 9, 1989 trip report prepared by R. G. Raney of the U.S. Bureau of Mines (Spokane, WA) describing several Forum papers of particular relevance to the program is described briefly below and is presented in its entirety as Enclosure 2.)

4. Additional Forum highlights/comments contributed by H. Lefevre are presented below.

5. A copy of U.S. Geological Survey Circular 1035 entitled "USGS Research on Mineral Resources - 1989 - Programs and Abstracts. Fifth Annual V. E. McKelvey Forum on Mineral and Energy Resources" is attached as Enclosure 3. Circular 1035 contains abstracts of each of the Forum's talks and poster sessions.

Additional details relative to Items 2, 3 and 4 above are presented below:

Portions of the Louise J. Fisher Summary (Geotimes, April 1989, p. 18) Report of theForum (see Item 2, above)

"G. Brian Bailey, USGS Sioux Falls, S.D., discussed the evaluation of advanced visible and infrared image spectrometer and other remotely sensed data for mineral exploration in semi-arid terrains. V.J.S. Grauch, USGS, Denver, spoke about interpreting concealed range-front faults in Nevada from gravity and

digital fault data and the significance for gold explorations. Albert H. Hofstra, USGS, Denver, showed a correlation of oxygen-isotope values of whole rocks with gold content over several orders magnitude. David A. John, USGS, Menlo Park, California, discussed regional tectonic controls on mineralization and detailed perigenesis in the deposits."

"The poster sessions included mineral-resource assessments, geological information systems, general topics, investigations of mineralization processes and mineralization systems, geochemical research, and geophysical investigations. Most of the mineralizing-process and mineralizing-system posters dealt with locations in the western U.S. and People's Republic of China."

Trip Report of Russell G. Raney, U.S. Bureau of Mines (see Item 3, above)

Mr. Raney's synopses and summary of the four presentations identified below are of particular relevance to the high-level waste program from the natural resources perspective. Papers 1, 2, and 4 are also significant from the structural geology aspect (faulting, in particular.)

The following presentations have been discussed by Mr. Raney in Enclosure 2:

1. Methodology for Analysis of Concealed Mineral Resources in Nevada: A Progress Report -- by D. P. Cox, et al.

2. Analysis of Concealed Mineral Resources in Nevada: Constraints from Gravity and Magnetic Studies -- by R. C. Jachens, R. J Blakely, and B. C. Moring.

3. Volcanic-Tectonic Setting and Geology of the Paradise Peak Gold-Silver-Mercury Deposit, Nye County, Nevada --by David A. John, Robert E. Thomason, Charles W. Clark, and Edwin McKee.

4. Interpreting Concealed Range-Front Faults in Nevada from Gravity and Digital Fault Data and the Significance for Gold Exploration -- by V. J. S. Grauch and D. L. Sawatzky.

Additional Forum Highlights/Comments:

* Many State-wide geological/geophysical maps are being prepared by a myriad of agencies and private firms, many of which will be issued within the coming six to twelve months including:

  - Geologic and geophysical analysis of the subsurface geometry of basins in the central and western Great Basin: Implications for the analysis of concealed mineral resources in Nevada (see Enclosure 3, p. 14, for abstract of paper by J. C. Dohrenwend, et al.)

- Tectonic synthesis of the central Walker Lane and adjacent regions of Nevada and California (available on May 1, 1989; see Enclosure 4.)

* There is considerable interest in the area of geophysical investigations aimed at the discovery/definition of anomalies for the purpose of identification of potential areas of mineral concentration.

* Because of the association of mineral deposits with faulting there is considerable interest in the location and exploration of faults, especially in the identification of fault intersections.

* Given the state of advancing technology, especially in the area of geophysical minerals exploration, which in turn can be used in the identification of structural features, site characterization efforts of the Yucca Mountain Project can proceed with more confidence through utilization of exploratory techniques such as CSAMT (controlled source audio-frequency magnetotellurics) that have become available only within the past several years. CSAMT is a deep penetrating high-resolution resistivity technique which has the ability to map resistivity changes in bedrock geology beneath hundreds of feet of alluvial and volcanic cover.

SUMMARY OF PERTINENT POINTS:

Proposed Exploratory Shaft Facility, Yucca Mountain Site

Following examination of surficial exposures (bedrock and overburden) no evidence of offset indicating the possible presence of faulting was observed in the immediate vicinity of the proposed exploratory shaft facility at Coyote Wash.

Visit to NRC's Las Vegas Office

Review of the DOE's document, "Surface-Based Investigation Plan of December, 1988" indicated that no plans relating to the assessment of natural resources have been identified by the Department.

McKelvey Forum at Reno, Nevada

Numerous Forum papers and poster sessions have direct applicability to YMP site characterization from both the structural aspect as well as to the assessment of natural resources. The papers of (1) D. P. Cox, et al.. R. C. Jackens, et al. and (3) V. J. S. Grauch and D. C. Sawatsky (see R. G. Raney trip report - Enclosure 2) are particularly relevant.

Although the investigations and techniques described at the Forum have been designed for mineral resources purposes, these investigations and techniques are invaluable also in the identification and definition of structural features that bear upon the tectonic stability (or instability as the case may be) of the Yucca Mountain geologic setting.

RECOMMENDATIONS:

1. The Department of Energy's document entitled "Yucca Mountain Project, Surface-Based Investigations Plan, December, 1988" contains separate figures showing existing field activities and proposed activities. The overall utility of this document could be much improved by combining the existing and proposed activities on a single figure which would be revised as site characterization proceeds. This figure could be included in DOE's semi-annual up-dates of the Site Characterization Plan.

2. The DOE (and the NRC) should maintain cognizance of state-wide (Nevada) developments in natural resources exploration techniques, investigations, and discoveries and the potential application of such investigative techniques to the characterization of the Yucca Mountain Project site from both the tectonics and natural resources aspects.

3. The DOE (and the NRC) should maintain close contact with those McKelvey Forum 1989 authors whose products (data and maps) have a potential bearing on the characterization of the geologic setting of the Yucca Mountain Project. Copies of these products should be acquired and evaluated for possible application at the YMP.

4. The DOE should identify those investigations and studies (both completed and proposed) from which the assessment of natural resources has been and is to be derived.

S/

Harold E. Lefevre, Geologist
Geology-Geophysics Section
Geosciences & Systems Performance Branch, HLWM

Enclosures:
1. Forum and Workshop Programs
2. Trip Report of R. G. Raney, U.S. Bureau of Mines
3. U.S. Geological Survey Circular 1035
4. Tectonic Syntheses of the Central Walker Lane Prospectus

DISTRIBUTION:

Central Files	REBrowning, DHLWM	BJYoungblood, DHLWM	RLBallard, HLGP
JOBunting, HLEN	JLinehan, HLPM	HLGP r/f	NMSS r/f
PPrestholt, HLPD	KStablein, HLPD	DChery, HLGP	PJustus, HLGP
HLefevre, HLGP	CAbrams, HLGP	KMcConnell, HLGP	JTrapp, HLGP
MBlackford, HLGP	AIbrahim, HLGP	ACardone, HLGP	JRussell, CNWRA
RRaney, USBM			

OF	HLGP	HLGP					
NAME	HLefevre/11	PJustus					
DATE	8/16/89	8/11/89					

ENCLOSURE 1

PROGRAM

TUESDAY, 24 JANUARY

7:00 to 10:00 PM POSTER SESSION

WEDNESDAY, 25 JANUARY

8:30 AM Welcome and opening remarks

8:40 AM An introduction to the research programs of the U.S. Geological Survey—by Michael P. Foose

9:00 AM Overview and preview of U.S. Geological Survey ore deposit research: Fifth Annual V.E. McKelvey Forum—by Lorraine H. Filipek

9:30 AM Methodology for analysis of concealed mineral resources in Nevada: A progress report—by Dennis P. Cox, Steve Ludington, Maureen G. Sherlock, Donald A. Singer, Byron R. Berger, Richard J. Blakely, John C. Dohrenwend, Donald F. Huber, Robert C. Jachens, Edwin H. McKee, Christopher M. Menges, Barry C. Moring, and Joe Tingley

10:00 AM Analysis of concealed mineral resources in Nevada: Constraints from gravity and magnetic studies—by Robert C. Jachens, Richard J. Blakely, and Barry C. Moring

10:30 AM COFFEE AND POSTER BREAK

11:00 AM KEYNOTE LECTURE: Modern geoscience in the quest for gold: An Australian perspective—by Richard W. Henley

12:00 LUNCH

1:00 PM The Getchell trend airborne geophysical demonstration project, north-central Nevada—by D.B. Hoover, V.J.S. Grauch, M.D. Krohn, V.F. Labson, and J.A. Pitkin

1:30 PM Geology and origin of the Jerritt Canyon sediment-hosted disseminated gold deposits, Nevada—by A.H. Hofstra, G.P. Landis, R.O. Rye, D.J. Birak, A.R. Dahl, W.E. Daly, and M.B. Jones

2:00 PM Volcanic-tectonic setting and geology of the Paradise Peak gold-silver-mercury deposit, Nye County, Nevada—by David A. John, Robert E. Thomason, Charles W. Clark, and Edwin H. McKee

2:30 PM Structural control on epithermal gold veins and breccias in the Mesquite district, southeastern California—by G.F. Willis, R.M. Tosdal, and S.L. Manske

3:00 PM COFFEE AND POSTER BREAK

3:30 PM INTRODUCTION (5 MINUTES): Evolution of the five Midcontinent CUSMAPs and the Midcontinent SCM project—by Walden P. Pratt

3:35 PM Late Cambrian lithofacies and their control on the Mississippi Valley-type mineralizing system in the Ozark region—by James R. Palmer and Timothy S. Hayes

4:00 PM Tectonic and stratigraphic control of subsurface geochemical patterns in the Ozark region—by R.L. Erickson, Barbara Chazin, M.S. Erickson, E.L. Mosier, and Helen Whitney

4:30 PM A conodont color alteration anomaly in central Indiana—Possibility of Mississippi Valley-type hydrothermal activity—by A.G. Harris, C.B. Rexroad, R.T. Lierman, and R.A. Askin

5:00 PM Proterozoic anorogenic granite-rhyolite terranes in the midcontinental United States—Possible hosts for Cu-, Au-, Ag-, U-, and REE-bearing iron-oxide deposits similar to the Olympic Dam orebody—by P.K. Sims, K.J. Schulz, and Eva B. Kisvarsanyi

7:00 PM DIRECTOR'S LECTURE: New perspectives on the interrelationship of tectonics and ore-forming processes in the Great Basin: Implications for exploration—by Byron R. Berger

8:00 to 10:00 PM POSTER SESSION

THURSDAY, 26 JANUARY

8:30 AM Evaluation of Advanced Visible and Infrared Imaging Spectrometer and other remotely sensed data for mineral exploration in semiarid terrains—by G.B. Bailey and J.L. Dwyer

9:00 AM Interpreting concealed range-front faults in Nevada from gravity and digital fault data and the significance for gold exploration—by V.J.S. Grauch and Don L. Sawatzky

9:30 AM Mosaic faulting as a guide to mineral exploration in the Richfield 1° × 2° quadrangle, western Utah—by Thomas A. Steven

10:00 AM Volcanism, extensional tectonics, and epithermal mineralization in the northern Basin and Range province, California, Nevada, Oregon, and Idaho—by James J. Rytuba

10:30 AM COFFEE AND POSTER BREAK

11:00 AM Genetic model for the carbonate-hosted Pb-Zn-Cu-Ag-Au manto-chimney deposits of the Gilman, Colorado district, based on fluid inclusion, stable isotope, geologic, and fission-track time-temperature studies—by D.W. Beaty, C.G. Cunningham, C.W. Naeser, and G.P. Landis

11:30 AM A deposit model for gold-bearing skarns—by Jane M. Hammarstrom, Greta J. Orris, James D. Bliss, and Ted G. Theodore

12:00 McKELVEY FORUM LUNCHEON
LUNCHEON ADDRESS: Gold-rich massive sulfides on the modern sea floor and their ancient analogs—by Steven D. Scott

2:00 PM Active deposition of sediment-hosted massive sulfide in Escanaba trough, Gorda Ridge—by Robert A. Zierenberg, J.M. Edmond, J.F. Grassle, A.C. Campbell, S.L. Ross, and W.C. Shanks III

2:30 PM Potential for epigenetic gold and sedex-type Pb-Zn-Ag-Ba deposits in the Taconic Allochthons, eastern New York and western Vermont—by John F. Slack and Kenneth C. Watts, Jr.

3:00 PM COFFEE AND POSTER BREAK

3:30 PM Early-middle Proterozoic unconformities: Unconventional sources for platinum group and precious metals—by Richard I. Grauch

4:00 PM Oxygen isotope map of the fossil hydrothermal system in the Comstock Lode mining district, Nevada—by Robert E. Criss, Duane E. Champion, and Mary F. Horan

4:30 PM Multiple sources for gold in the Juneau gold belt, Alaska—by Rainer J. Newberry and David A. Brew

5:00 PM Metallogenesis of lode mineral deposits of "mainland" Alaska—by Warren J. Nokleberg, Thomas K. Bundtzen, Donald J. Grybeck, and Thomas E. Smith

LIST OF POSTERS

I. GENERAL TOPICS and GEOLOGICAL INFORMATION SYSTEMS

1. Minerals Information Office—by Susan M. Marcus, Raymond E. Arndt, Paul G. Schruben, Carl Carlson, and Jane Jenness
2. Geologic-map information and where to find it—by H. Kit Fuller
3. The Development of Assessment Techniques Program (DAT) of the U.S. Geological Survey—by Michael P. Foose
4. The Strategic and Critical Minerals Program (SCM) of the U.S. Geological Survey—by William C. Bagby
5. A review of the proposed standard for digital cartographic data—by Robin G. Fegeas, Hedy J. Rossmeissl, and Robert D. Rugg
6. Multidisciplinary considerations in a digital geologic map—Applications and afterthoughts—by S.H. Moll, J.L. Dwyer, C.A. Wallace, J.E. Elliott, C.M. Trautwein, and J.E. Harrison
7. A simplified digital geologic map of Nevada for regional gold resource assessment—by S.P. Marsh, E. Sandoval, and J.L. Plesha
8. Three-dimensional characterization of regional structures using an advanced geographic information system—by D.B. Stewart, B.E. Wright, J.D. Unger, J.D. Phillips, and L.H. Liberty
9. Mineral resource assessment of the Butte 1° × 2° quadrangle using geographic information system technology—by J.E. Elliott, C.M. Trautwein, J.L. Dwyer, and S.H. Moll

II. MINERAL RESOURCE ASSESSMENTS

10. Mineral resource assessment of the White Mountains National Recreation Area, east-central Alaska—by Florence R. Weber, Thomas D. Light, Richard B. McCammon, and C. Dean Rinehart
11. Geology and mineral resources of the Port Moller region, western Alaska Peninsula, Aleutian Arc—by Frederic H. Wilson, Willis H. White, and Robert L. Detterman
12. Mineral resource assessment, Bendeleben and Solomon quadrangles, western Alaska—by Bruce M. Gamble
13. Regional geochemical studies of the Ajo and Lukeville 1° × 2° quadrangles, Arizona—by Harlan Barton and Paul K. Theobald
14. Delta CUSMAP Project: Mineral assessment in the Tintic-Deep Creek mineral belt of the eastern Great Basin, Utah—by Douglas B. Stoeser, Carol N. Gerlitz, Constance J. Nutt, Holly J. Stein, John Hand, Michael A. Shubat, and Judith L. Hannah
15. Geoelectric studies in the Delta, Utah, quadrangle—by D.L. Campbell and V.F. Labson
16. The Tooele 1° × 2° quadrangle, western Utah: An example of a CUSMAP preassessment study—by Holly J. Stein, Viki Bankey, C.G. Cunningham, David R. Zimbelman, Michael A. Shubat, David W. Brickey, D.L. Campbell, and M.H. Podwysocki
17. Precious-metal deposits in the Hailey and western Idaho Falls 1° × 2° quadrangles, Idaho—by Ronald G. Worl, Earl H. Bennett, Falma J. Moye, and P.K. Link
18. Gravity and magnetic anomaly patterns in mineral resource exploration, Hailey CUSMAP, Idaho—by M. Dean Kleinkopf
19. Geological studies of the International Falls and Roseau 1° × 2° CUSMAP quadrangles, northern Minnesota—by W.C. Day, T.L. Klein, D.L. Southwick, and K.J. Schulz
20. Regional geophysical studies for the International Falls and Roseau CUSMAP projects—by Robert J. Horton, Val W. Chandler, Robert E. Bracken, and James E. Case

III. INVESTIGATIONS OF MINERALIZING PROCESSES AND MINERALIZING SYSTEMS

A. Western U.S.

21. Geological and geophysical analysis of the subsurface geometry of basins in the central and western Great Basin: Implications for the analysis of concealed mineral resources in Nevada—by John C. Dohrenwend, Robert C. Jachens, Richard J. Blakely, Barry C. Moring, and Christopher M. Menges
22. Tertiary tectonic evolution of the central Walker Lane, western Nevada—by Richard P. Keller, John S. Oldow, Richard F. Hardyman, and John W. Geissman
23. Study of the stratigraphy of the gold-bearing Preble Formation near the type locality, north-central Nevada—Some benefits to exploration—by Dawn J. Madden-McGuire
24. Characterization of carbon in sediment-hosted disseminated gold mineralization at Jerritt Canyon, Nevada—by Joel Leventhal and A.H. Hofstra
25. Geology and geochemistry in the vicinity of the Adelaide Crown mine, Humboldt County, Nevada—by Theresa M. Cookro and Ted G. Theodore
26. Bismuth minerals associated with placer gold, Battle Mountain mining district, Nevada—by Ted G. Theodore, Gerald K. Czamanske, Terry E.C. Keith, and Robert L. Oscarson
27. $^{40}Ar/^{39}Ar$ studies of fluid inclusions in vein quartz from Battle Mountain, Nevada—by Brent D. Turrin, Edwin H. McKee, Ted G. Theodore, and James E. Conrad
28. Multiple ages of disseminated gold mineralization associated with volcanic cycles in southwestern Utah and adjacent Nevada—by W.R. Miller and J.B. McHugh
29. Reconstruction of primary features and isotopic evidence for multiple sulfur sources at the Red Dog zinc-lead-silver deposit, Noatak district, Alaska—by Jeanine M. Schmidt and Robert A. Zierenberg
30. Sulfur isotope characteristics of bedded and vein barite deposits, north-central Nevada—by Stephen S. Howe
31. Volcanogenic massive sulfide deposits in pre-Tertiary island arc and ocean basin environments in Nevada—by Maureen G. Sherlock
32. Composition and geologic setting of stratiform manganese deposits in the southern Basin and Range province—by Randolph A. Koski, Robin M. Bouse, James R. Hein, and Marilyn L. DeRosa
33. Industrial rock and mineral resources of Arizona: A survey of resource problems and opportunities by the producers and users of resource information—by Edwin W. Tooker and Larry D. Fellows
34. Preliminary map showing the location of productive lode and placer gold deposits and significant gold prospects in Montana—by David Frishman, J.E. Elliott, E.E. Foord, R.C. Pearson, and W.H. Raymond
35. As, Bi, Hg, S, Sb, and Te geochemistry of the J-M reef: Constraints on the origin of platinum group element-enriched sulfides in layered intrusions—by M.L. Zientek, T.L. Fries, and R.W. Vian

36. Chemical modeling of ore and gangue deposition in the Creede, Colorado, epithermal system—by Geoffrey S. Plumlee

B. Midcontinent

37. Contrasting sulfur sources for lower versus upper midcontinent Mississippi Valley-type ores—Implications for ore genesis—by Martin Goldhaber
38. Manganese potential of the Cretaceous rocks flanking the Sioux Ridge, Minnesota and South Dakota—by Dale R. Setterholm and Richard H. Hammond
39. Tectonic and magmatic development of the Midcontinent rift: A synthesis of new seismic, chemical, and isotopic data—by W.F. Cannon, S.W. Nicholson, and Alan Green
40. Metallogeny of the Midcontinent rift in the Lake Superior region—by S.W. Nicholson, K.J. Schulz, and W.F. Cannon
41. Geochemistry of igneous rocks of the Penokean orogen: Implications for metallogeny and tectonic setting—by K.J. Schulz and P.K. Sims

C. Eastern U.S.

42. Caraway-Back Creek volcanic center, central slate belt, North Carolina: Newly recognized thermal source for precious- and base-metal mineralization—by Robert P. Koeppen and Terry L. Klein
43. Stratabound copper and zinc mineralization in Triassic lacustrine beds of the Culpeper basin, Virginia—by Gilpin R. Robinson, Jr. and Joseph P. Smoot
44. Fluid inclusion and mineralogic studies of a palladium-platinum anomaly zone in the Reeser's Summit diabase, Pennsylvania: Evidence for hydrothermal transport—by Harvey E. Belkin
45. Anomalous palladium-platinum occurrences in Mesozoic quartz-normative tholeiitic suites in the Eastern United States—by David Gottfried, A.J. Froelich, P.J. Aruscavage, and Norma Rait
46. Rare-earth resource potential: Monazite distribution in the Fall Zone Coastal Plain sediments of western South Carolina—by James P. Owens and Andrew E. Grosz

D. Marine Studies

47. Hydrothermal and hydrogenetic ferromanganese oxide mineralization of active volcanic arcs—by James R. Hein, Marjorie S. Schulz, and Jung-Keuk Kang
48. Chemical analysis of ocean floor manganese crusts—by Herbert Kirschenbaum, F.T. Manheim, P.J. Aruscavage, and C.M. Lane-Bostwick
49. Silt-size rutile in Quaternary sediment of the Gulf of Maine—A large, unconventional TiO_2 resource—by Page C. Valentine and Judith A. Commeau

E. International Studies

50. Characteristics and geochemistry of gold deposits in northern Sonora, Mexico—by Miles L. Silberman and David A. Giles
51. New tin deposits in the Amazon basin, Brazil—by C.H. Thorman, L.J. Drew, and M. Drucker
52. Geology, geochemistry, and age of the Gejiu batholith and associated polymetallic deposits, southern China—by Lawrence W. Snee and Wang Zhifen
53. The H8 dolomite host rock of the Bayan Obo iron-niobium-rare-earth-element ore deposit of Inner Mongolia, China—Origin, episodic mineralization, and implications—by E.C.T. Chao, J.A. Minkin, J.M. Back, P.M. Okita, Edwin H. McKee, R.M. Tosdal, M. Tatsumoto, Wang Junwen, C.A. Edwards, Ren Yingzhen, and Sun Weijun
54. Geologic setting of iron-niobium-rare-earths orebodies at Bayan Obo, Inner Mongolia, China, and a proposed regional model—by L.J. Drew, Meng Qingrun, and Sun Weijun
55. Petrography, chemistry, age, and origin of the rare-earth iron deposit at Bayan Obo, China, and implications of Proterozoic iron ores in Earth evolution—by J.A. Philpotts, M. Tatsumoto, K. Wang, and P-F. Fan

IV. GEOCHEMICAL INVESTIGATIONS

56. Seasonal variations in concentrations of helium and carbon dioxide in soil gases at the Roosevelt Hot Springs known geothermal resource area, Utah—by Margaret E. Hinkle
57. Flow injection analysis applications in mineral resource exploration and environmental chemistry—by Delmont M. Hopkins
58. Mineral resource and geochemical exploration potential of coal that has anomalous metal concentrations—by Robert B. Finkelman and Robert D. Brown, Jr.
59. Geochemistry of soils in the Carson River valley, Nevada—by Ronald R. Tidball
60. Evaluation of multiple geochemical sample media at the Betze gold deposit, Eureka County, Nevada—by J.H. McCarthy, Jr., J.A. Erdman, T.G. Lovering, and K.H. Bettles

V. GEOPHYSICAL INVESTIGATIONS

61. Aeromagnetic and gravity studies of a buried porphyry copper deposit near Casa Grande, Arizona—by Viki Bankey and Douglas P. Klein
62. Spectral reflectance changes in vegetation associated with anomalous concentrations of metallic elements—A potential tool for mineral exploration—by Barbara A. Eiswerth, Nancy M. Milton, and David A. Mouat
63. The applications of airborne radar for mineral and energy resources exploration—by John E. Jones, Allan N. Kover, and Bruce F. Molnia
64. Airborne imaging spectrometer data as an aid to mineral mapping, Cuprite, Nevada—by M.H. Podwysocki and O.D. Jones
65. Application of developing technology in airborne geophysics, Effie-Coon Lake Complex, Minnesota—by Bruce D. Smith, V.F. Labson, Robert E. Bracken, Robert J. Bisdorf, Viki Bankey, Robert P. Kucks, Robert J. Horton, Michael G. Medberry, Jay A. Sampson, and J.L. Plesha
66. Plans for integrated airborne geophysical study of the Geophysics Environmental and Minerals demonstration area, south-central Colorado— by Kenneth Watson, D.H. Knepper, R.N. Clark, J.A. Pitkin, V.F. Labson, D.L. Campbell, L.C. Rowan, F.A. Kruse, K. Lee, and E. Livo

Workshop on
Minerals Industry and Government Cooperative Studies on Concealed Mineral Deposits within the Basin and Range
a Geophysical Perspective

Bally's Hotel, Reno, Nevada

Friday, January 27, 1989 8:00 a.m. - 4:30 p.m.

(Morning Session)	(Session Chairman)	Gary Raines, USGS
8:00-8:05 A.M.	Welcome & opening remarks	Gary Raines, USGS
8:05-8:20	USGS programs in mineral resources	Bill Bagby, USGS
8:20-8:40	Industry perspective on cooperative work	Ted Wilton, Freeport McMoRan
8:40-9:00	Need for geophysical characterization of mineral deposit models	Ed Ballantyne, U. of Missouri, Rolla, consultant
9:00-9:20	Where and how do we proceed with geophysics	Jack Corbett, consultant
9:20-9:40	Coffee break	
9:40-10:00	USGS geophysical directions in mineral deposit investigations	Tom Hildenbrand, USGS

Session on The Getchell Trend Cooperative Program: an example of cooperative studies.
Participants: Pinson Mining, E. Kretchmer, Chief Geologist; FirstMiss Gold, R. Nanna, Chief Geologist; Santa Fe Pacific Mining, R. Owen, Senior Staff Geologist; Battle Mountain Exploration, C. Payne, Senior Geologist; USGS; principal investigators, A. Wallace, geology, P. Theobald, geochemistry, D. Hoover, geophysics.

	(Session Chairman)	Don Hoover, USGS
10:00-10:05	Introduction	Don Hoover, USGS
10:05-10:25	Geology of the Getchell Trend and vicinity	Alan Wallace, USGS
10:25-10:45	Geochemical studies on the Getchell Trend	Paul Theobald, USGS
10:45-11:00	Remote sensing studies	Dennis Krohn, USGS
11:00-11:15	Magnetic & gravity studies	Tien Grauch, USGS
11:15-11:30	Gamma ray studies	J. Pitkin, USGS
11:30-11:50	Use of the Controlled Source Audio-magnetotelluric method to map subsurface resistivity in Nevada gold exploration	Phil Hallof, consultant to Pinson Mining

11:50- 1:15 PM LUNCH

(Afternoon Session)

1:15-1:30	New electromagnetic and magnetic systems development	V. Labson, USGS
1:30-1:50	Other electrical studies and geophysical summary	Don Hoover, USGS
1:50-2:10	Coffee break	
2:10-3:00	Panel discussion on government-industry cooperation	

(Panel Chairman) Bill Bagby

Panel members: Bill Bagby, USGS, Bruce Smith, USGS, Ed Bloomstein, Santa Fe Minerals, Ted Wilton, Freeport McMoRan, Jack Corbett, consultant; Roger Pemberton, Noranda; Tony Barringer, Barringer Geoservices

The panel will address the following question:

1. How can we develop and implement continuing industry-government cooperative studies that will answer the needs of both parties?

3:00-to closing Questions and discussion from the audience.

ENCLOSURE 2

MAR 09 1989

TRIP REPORT
FIFTH ANNUAL V. E. McKELVEY FORUM
ON MINERAL AND ENERGY RESOURCES
JANUARY 24-27, 1989
RENO, NEVADA

BY
RUSSELL G. RANEY
WESTERN FIELD OPERATIONS CENTER, SPOKANE, WA

Pursuant to Work Directive 022 under Task Order 002, Interagency Agreement NRC-02-85-004, Russell G. Raney, Bureau of Mines, Western Field Operations Center, attended the following presentations at the McKelvey Forum:

1. Methodology for Analysis of Concealed Mineral Resources in Nevada: A Progress Report--by D. P. Cox, et. al.

2. Analysis of Concealed Mineral Resources in Nevada: Constraints from Gravity and Magnetic Studies--by R. C. Jachens, R. J. Blakely, and B. C. Moring.

3. Volcanic-Tectonic Setting and Geology of the Paradise Peak Gold-Silver-Mercury Deposit, Nye County, Nevada--by David A. John, Robert E. Thomason, Charles W. Clark, and Edwin McKee.

4. Interpreting Concealed Range-Front Faults in Nevada from Gravity and Digital Fault Data and the Significance for Gold Exploration--by V. J. S. Grauch and D. L. Sawatzky.

Two copies of USGS Circular 1035, "USGS Research on Mineral Resources, 1989--Program and Abstracts" are enclosed.

SYNOPSES OF PRESENTATIONS

Methodology for Analysis of Concealed Mineral Resources in Nevada: A Progress Report--by D. P. Cox, et al.

The progress report of an ongoing program of the USGS and Nevada Bureau of Mines and Geology was accompanied by numerous slides of the resource delineation maps and the data used in their preparation. Copies of these slides were not available to Forum attendees. Therefore, considerable detail is missing.

Areas in Nevada permissive for undiscovered mineral deposits are presented on maps (1:1,000,000 scale) being compiled by USGS and Nevada Bureau of Mines and Geology geoscientists. The maps will show mineral occurrences by deposit type and present an estimate of the number of undiscovered within the map area. Permissive areas, as defined by the USGS, are areas. . ."containing geologic environments in which one or more mineral deposit models may occur and include those areas in which possible host rocks are concealed but are present within 1 kilometer 1/ (km) of the surface."

Folios associated with the maps will include: 1. Maps and tables classifying about 500 deposits by deposit model, 2. tonnage and grade models appropriate to Nevada; 3. maps of regional geology and geochronology of igneous rocks, and; 4. maps of magnetic and gravity data and their interpretation. Derivative maps based on data presented in the folios will show: 1. Areas covered by up to 1 km of Cenozoic rock and sediments; 2. shallow magnetic sources; 3. neotectonic analysis and; 4. subsurface basin geometry.

Other maps in the folio will illustrate the subsurface distribution of Mesozoic and Tertiary intrusions, Tertiary volcanic rocks, and certain pre-Tertiary sequences of sedimentary and volcanic rocks.

Volumes of rock, 1 km thick, containing permeable and/or reactive rocks within 10 km of a plutonic body or within 5 km of a subvolcanic intrusion or caldera margin, are considered permissive for epigenetic igneous-related deposits

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1/ In defining areas permissive for mineral deposit occurrence ("those areas containing geologic environments in which one or more mineral deposit models may occur and include those areas in which possible host rocks are concealed but are present within 1 km of the surface"), Dr. Cox was quick to explain that the 1 km cutoff was selected for modelling purposes and does not represent a physical constraint to mineral or energy exploration. The arbitrary cut-off reflects current geologic/geochemical/ geophysical knowledge and would certainly be extended to greater depths as this knowledge is expanded.

NOTE: It may be advantageous for NRC and BOM (and DOE) to obtain copies of these maps and data when completed as they may have application in site characterization. Caution should be exercised, however, in application of the delineation maps, and the 1 km cutoff should be recognized for what it is: a lower bound of the current state of knowledge, not a physical limit on the depth of exploration.

Analysis of Concealed Mineral Resources in Nevada: Constraints from Gravity and Magnetic Studies--by R. C. Jachens, R. J. Blakely, and B. C. Moring.

Regional gravity and magnetic studies of Nevada are being used to infer subsurface structure and lithology, primarily in areas beneath Cenozoic cover, as part of an analysis of concealed mineral resources of the entire State. The geophysical studies have six major goals:

1. To define the thickness of the Cenozoic cover;
2. To constrain permissible lithologic identity of buried pre-Cenozoic basement;
3. To map the location and extent of concealed plutons;
4. To delineate known and identify unknown calderas;
5. To define areas of shallowly buried Tertiary volcanic rocks, and;
6. To delineate areas (both exposed and concealed) of possible hydrothermal alteration.

Primary statewide data sources for these studies are: 1. A digital isostatic residual gravity map based on approximately 71,000 point observations, 2. a digital map of the magnetic field compiled from 38 separate surveys and analytically continued to 300 m above terrain, 3. detailed but widely spaced aeromagnetic profiles collected at 120 m above the ground surface, 4. a compilation of drill-hole data, 5. a simplified geologic map, and 6. digital topography.

Combined analysis of these data sets, when completed, will result in statewide maps showing approximate depth to dense (generally pre-Cenozoic) basement and the distribution of concealed but near-surface magnetic sources (generally Tertiary and Quaternary volcanic rocks).

NOTE: Graphics presented by the author suggest that these data may be very useful in assessing the mineral and resource potential of the Yucca Mountain site. Inquiry of the USGS will be made by this office to determine the availability of the maps and data.

Volcanic-Tectonic Setting and Geology of the Paradise Peak Gold-Silver-Mercury Deposit, Nye County, Nevada--by David A. John, Robert E. Thomason, Charles W. Clark, and Edwin McKee.

Discovered in 1983, the Paradise Peak deposit consists of a large hot-spring type gold-silver-mercury deposit located in the southwestern Paradise Range near Gabbs, NV. Published preproduction resources include 12 million tons ore averaging 0.097 oz/ton gold, 3.53 oz/ton silver, and 50 ppm mercury. Most of the ore body is hosted in Tertiary rhyolite tuffs; the ore body was emplaced several millions of years after the formation of the host rocks.

The deposit was emplaced during a period of early Miocene (pre-Basin and Range) crustal extension. Other precious metal deposits that formed during or shortly following this extensional event include the Tonopah, Goldfield, Santa Fe, and perhaps Rawhide.

NOTE: A good example of epigenetic mineralization following emplacement of the volcanic rocks by several million years. This mode of mineralization should be thoroughly addressed during site characterization.

Interpreting Concealed Range-Front Faults in Nevada from Gravity and Digital Fault Data and the Significance for Gold Exploration--by V. J. S. Grauch and D. L. Sawatzky.

Recent exploration efforts have been concentrated on concealed range-front faults since the discovery of the bonanza Sleeper deposit which is spatially associated to a partially concealed range-front fault system in north-central Nevada.

Regional gravity data from Nevada were mathematically manipulated and digitally compared to interpret concealed range-front faults. The technique, based on the properties of the horizontal gravity gradient, estimates the locations of density boundaries which are steeply dipping boundaries between rocks having contrasting densities, such as at geologic contacts or faults. This method of interpreting faults from calculated density boundaries could become an important exploration tool at both local and regional scales.

NOTE: This interpretation method may have useful applications in site characterization as it reportedly has both local and regional applications. The authors will be contacted by this office for possible further information.

SUMMARY

A number of points brought out by the authors may have application to the resource assessment of the proposed repository site at Yucca Mountain. These include:

- According to Cox 1/, rock assemblages containing permeable and/or reactive rocks within 10 km of a plutonic body or within 5 km of a subvolcanic intrusion or caldera margin, are considered permissive for epigenetic igneous-related deposits. These conditions may prevail at the Yucca Mountain site. At Yucca Mountain, silicic volcanic rocks overlie Paleozoic rocks that include both reactive and permeable units. Further, the site lies on the eastern margin of a postulated caldera (Crater Flat), and a deeply-buried pluton may underlie the Paleozoic rocks 2/.

- In his discussion of the Paradise Peak deposit, John 3/ suggests that gold/silver/mercury mineralization took place at this deposit several millions of years after emplacement of the rhyolite tuff host rocks. While not commonly associated with syngenetic base and precious metal (BPM) deposits, John has shown that silicic tuffs (such as that at Yucca Mountain), under the proper conditions, may host significant epigenetic BPM deposits.

- The Paradise Peak Au/Ag/Hg deposit as an example of a BPM deposit associated with range-front faulting; such faulting is known to exist west of Yucca Mountain on the western margin of Crater Flat at Bare Mountain. Grauch and Sawatzky 4/ have described a method of interpreting range-front faults based on calculated density boundaries that may be useful in the resource assessment at or in the vicinity of Yucca Mountain.

- Jachens 5/ describes current geophysical studies whose goals, among others, is to map the location and extent of concealed plutons, delineate known calderas, and identify unknown calderas. The identification of concealed plutons and/or calderas under or near Yucca Mountain would provide insights to the resource potential of the site.

REFERENCES

1/ Cox, D. P., S. Ludington, M. G. Sherlock, D. A. Singer, B. R. Berger, R. J. Blakely, J. C. Dohrenwend, D. F. Huber, R. C. Jachens, E. H. McKee, C. M. Menges, B. C. Moring, and J. Tingley. Methodology for Analysis of Concealed Mineral Resources in Nevada: A Progress Report. USGS Circular 1035, 1988, pp. 10. See synopsis of paper in this report.

2/. Bath, G. D. and C. E. Jahren. Interpretation of Magnetic Anomalies at a Proposed Repository Site Located in the Yucca Mountain Area, Nevada Test Site. USGS Open-file Report 84-120, 1984.

3/. John, D. A., R. E. Thomason, C. W. Clark, and E. H. McKee. Volcanic-Tectonic Setting and Geology of the Paradise Peak Gold-Silver-Mercury Deposit, Nye County, Nevada USGS Circular 1035, 1988, pp. 37. See synopsis of paper in this report.

4/. Grauch, V. J. S. and D. L. Sawatzky. Interpreting Concealed Range-Front Faults in Nevada from Gravity and Digital Fault Data and the Significance for Gold Exploration. USGS Circular 1035, 1988, pp. 26. See synopsis of paper in this report.

5./ Jachens, R. C., R. J. Blakely, and B. C. Moring. Analysis of Concealed Mineral Resources in Nevada: Constraints from Gravity and Magnetic Studies. USGS Circular 1035, 1988, pp. 35. See synopsis of paper in this report.