

#15

INTERIM RESULTS OF MERCURY AND SULFUR RECONNAISSANCE

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## SUMMARY

1. Mercury and sulfur mineralization exhibits a very strong correlation with producing geothermal reservoirs. There is a compelling correlation with many potential geothermal areas.
2. Eighty-three mercury/sulfur prospects outside of known geothermal areas in Nevada, California and Oregon were systematically examined to assess their relative geothermal merits. The criteria used to assess the prospects were: heat flow, current hydrothermal activity, type, age and extent of mineralization, host rock age and presence of silicic volcanism.
3. The prospects and their respective merit ratings are listed in Table 5.
4. Seven prospects were selected for further assessment work, which includes geological mapping, mercury soil surveying and shallow heat flow drilling (Figure 1):

### NEVADA

Silver Cloud	Elko County
Fish Lake	Esmeralda County
Gilbert Junction	Esmeralda County
Alum	Esmeralda County
Rast	Lander County
Pershing	Pershing County

### OREGON

Horsehead	Harney County
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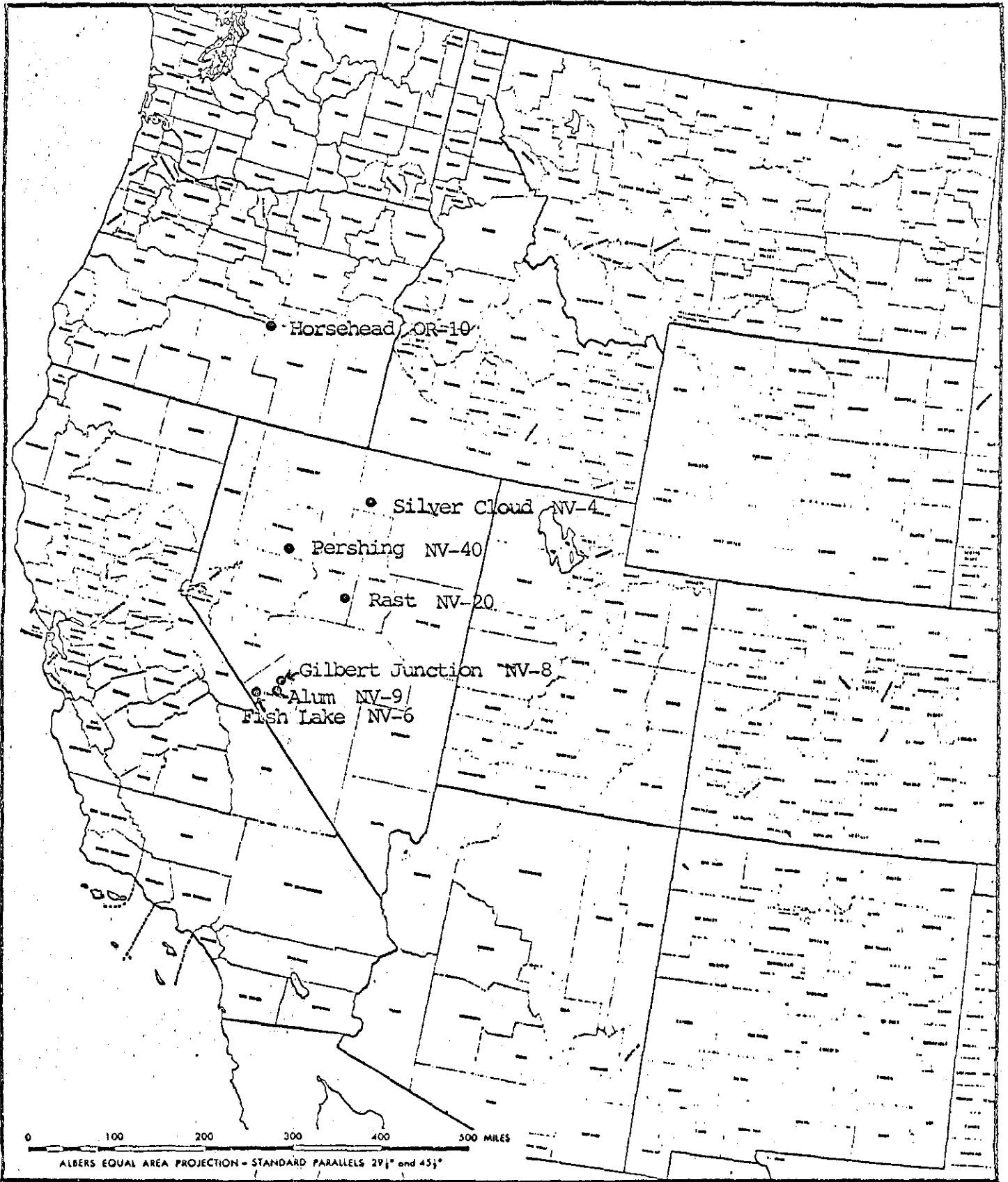


FIGURE 1

## EXPLORATION RATIONALE

While few geologic features are unique to all geothermal reservoirs, occurrences of mercury and sulfur seem somewhat persistent. Table 1 lists selected known reservoirs, and Table 2 lists some possible reservoirs, which have mercury or sulfur deposits associated with them.

Table 1. Mercury and sulfur associated with known geothermal reservoirs

<u>Country</u>	<u>Reservoir</u>	<u>Mercury</u>	<u>Sulfur</u>
United States	Geysers	Several districts	Native S deposits
	Roosevelt		Native S deposits
	Humboldt House	Mine	
	Steamboat Springs	Mine	Native S deposits
	Yellowstone		Native S deposits
	Coso Hot Springs	District	Native S deposits
Italy	Larderello		Native S deposits
	Mt. Sabatini		Native S deposits
Japan	Matsukowa		Native S deposits
	Kowakidani		Native S deposits
	Ibusnki		Native S deposits
New Zealand	Broadlands		Native S deposits
China	Tengwn		Native S deposits

Table 2. Mercury and sulfur associated with suspected geothermal reservoirs in the United States

<u>Reservoir</u>	<u>Mercury</u>	<u>Sulfur</u>
Lassen Peak		Native S deposits
Niland	Mine	Native S deposits
Dixie Valley	Mine	
McCoy	Wild Horse District	
Mono Lake		Native S deposits
Crane Creek	Idaho-Almaden District	
Alvord Hot Spring	Steens-Pueblo District	
New York Canyon	Mine	Native S deposits
Knoxville	Knoxville District	

Native sulfur is a very common, widespread element in crustal rocks. It occurs in one of three ways: salt domes, sedimentary deposits and surface deposits associated with volcanism. The deposits which are associated with volcanic activity result from either fluid or vapor phase deposition. Association of thermal springs and native sulfur deposits has long been a matter of record. Native sulfur is often associated with cinnabar.

The vast majority of sulfur production in the United States is from salt domes along the Gulf Coast. However, there are numerous non-commercial sulfur deposits in California and Nevada. These native sulfur deposits are generally surficial deposits associated with Cenozoic volcanic or tectonic activity.

Native sulfur deposits are more widely distributed, though fewer in number, than mercury deposits. In California several occurrences are known along the San Andreas fault system and Coast Range. Native sulfur also occurs within the Cascade Mountains, Sierra Nevadas and Transverse Ranges, as well as in the Central Valley, Great Basin, Mojave Desert and the Salton Trough (Calif. Div. Mines, 1966). In Nevada native sulfur deposits are generally associated with range front faults. Oregon, Idaho and Washington have no reported native sulfur deposits.

Regions of recent Tertiary or Quaternary volcanism and tectonism are prime areas for mercury deposition. Mercury is generally associated with deposits formed from hydrothermal solutions caused by mercury's high vapor pressure. Deposits of this nature are common throughout the western United States. Deposits in Arkansas and Texas are two exceptions. The total production for the United States, by state, is as follows:

California	86.3%
Texas	4.6%
Nevada	4.0%
Oregon	3.2%
Idaho	1.0%
Arkansas	0.4%
Arizona	0.2%
Washington	0.2%
Utah	0.1%

Ninety percent of this production has come from 20 mines (Bailey, 1962).

The vast majority of mercury in California closely follows the trend of the San Andreas fault system and the Coast Range. Exceptions include three small districts within the Klamath Mountains and one very small district at the southern extent of the Sierra Nevada Range (Ca. Div. Mines, 1966).

In Oregon mercury deposits occur largely in the Cascades and along the intersection between the Cascades and the Coast Range. There are two additional major districts: one along the intersection between the Blue Mountains and the Cascades; the other occurs along the southern extent of the Steens Mountains in southeastern Oregon (Brooks, 1971).

Mercury distribution in Nevada is more extensive than in either California or Oregon, although the majority of the prospects are smaller. Reported occurrences are on, or closely associated with, range front fault systems. The occurrences of mercury deposits with known thermal anomalies are particularly striking in Nevada (Lawrence and Wilson, 1962).

Table 4. Observations sufficient for assigned rating

<u>Rating</u>	<u>Heat flow</u>	<u>Current hydro-thermal activity</u>	<u>Age, type, extent of mineralization</u>	<u>Age of host rock</u>	<u>Age and type of nearby extrusives</u>	<u>Type of deposits i.e., S or Hg</u>
8,9,10	>5.0 HFU	Hot springs Hot wells Fumaroles	---	Quaternary	---	---
5,6,7	2.5-5.0 HFU	Warm springs Warm wells	Massive or extensive opalite deposits. Intense and extensive argillization. Rating decreases with increasing age.	Pliocene-Pleistocene	Quaternary-Late Tertiary acid volcanics. Rating decreases with age and mafic content.	S and Hg
1,2,3,4	<2.5 HFU	Cold springs Cold wells	Alteration is non-silicious, local and incomplete.	Tertiary	Early and Middle Tertiary	Hg

The ratings assigned using the above chart appear in the following list of prospects examined during the reconnaissance program:

Table 5. Evaluated prospects

NUMBER	DISTRICT	MINE	TOWNSHIP	RANGE	RATING
<u>California: Alpine</u>					
CA-1	Leviathan	Cherokee, Apine, unnamed mines (12N, 21E) Leviathan, Zaca (10N, 21E)	10N	21E	5
<u>California: Kings</u>					
CA-2	Parkfield	Atlas, Dawson	23S	16E	2
<u>California: San Benito</u>					
CA-3	Central San Benito	Unnamed	16S	10E	4
CA-4	New Idria	Clear Creek	17-18S	11-12 E	3
<u>California: San Luis Obispo</u>					
CA-5	Unnamed	Deer Trail	32S	16E	3
CA-6	Rinconada	Rinconada, Mercury Belle	30S	14E	4
CA-7	San Luis Obispo	Cambria, Hamilton, Warner, Klau, Buena Vista, Oceanic	26S	8-10E	5
<u>California: Santa Barbara</u>					
CA-8	Cachuma	Red Rock, several innamed prospects	7N	29W	3
CA-9	Graciosa Ridge	Sulfur district, oil patch	9N	33-34W	2
CA-10	Los Prietos	Gibraltar, unnamed mine	5N	27W	2
<u>California: Santa Clara</u>					
CA-11	New Almadin	Guadalupe, Day tunnel, Randol tunnel English Town, New Almadin	8-9S	1E	6
<u>California: Stanislaus</u>					
CA-12	Phoenix	Phoenix, 2 unnamed prospects	6S	5E	2
<u>California: Ventura</u>					
CA-13	Sunset Oil	Sulfur district	9N	23W	2
<u>Nevada: Churchill</u>					
NV-1	Holy Cross	Cinnabar Hill	15N	30E	2
NV-2	Fairview	Several unnamed mines	16N	34E	2
NV-3	Mountain Wells		17-18N	32E	2
<u>Nevada: Elko</u>					
*NV-4	Ivanhoe/Rock Creek	Butte Quicksilver, Coleman, Govenor, Jackson Surprise, Rimrock, Homestake, Silver Cloud, Rock Creek, Teapot	37-38N	47-48E	7
<u>Nevada: Esmeralda</u>					
NV-5	Fish Lake Valley	B & B, Red Rock	1S	33-34E	3
*NV-6	Fish Lake Valley	Hg	1S	35E	7
NV-7	Gilbert	Castle Rocks	3N	38E	4



NUMBER	DISTRICT	MINE	TOWNSHIP	RANGE	RATING
*NV-8	Gilbert	Gilbert Junction	3N	39E	6
*NV-9	Alum	Alum	1S	39E	7
<u>Nevada: Humboldt</u>					
NV-10	Winnemucca	Several unnamed mines	36N	37E	2
NV-11	Poverty Peak	Cahill, Hapgood, Holt, Prentiss, Snowdrift, Turillas, Wholeys	40N	40E	3
NV-12	Dutch Flat	Dutch Flat, Last Chance	38N	40E	4
NV-13	Bottle Creek	Baldwin, Birthday, Blue Canyon, McAdoo, Niebuhr, Red Ore, White Peaks, White Peaks Mines	40N	33E	4
NV-14	Opalite	Cordero, Disaster Peak	47N	37E	5
NV-15	National	Buckskin Peak, Canyon Creek, unnamed prospects	45N	39E	2
NV-16	Unnamed	Gayer-Moo, Plymouth	35N	38E	2
NV-17	Potosi	Getchell	39N	42E	2
NV-18	Red Butte	Rattlesnake Canyon	35N	30E	2
NV-19	Sulphur	Nevada Sulphur	35N	29E	5
<u>Nevada: Lander</u>					
*NV-20	Unnamed	Rast	21N	45E	9
NV-21 <sup>22</sup>	Unnamed	Warm Springs Prospect	27N	43E	4
<u>Nevada: Lyon</u>					
NV-22 <sup>23</sup>	DeLongchamps	Various unnamed mines	18N	24E	4
<u>Nevada: Mineral</u>					
NV-23 <sup>24</sup>	Cedar Mountain	Lou prospect	8N	36E	2
NV-24 <sup>25</sup>	Pilot Mountain	Red Top (Red Wing)	6N	36E	2
NV-25 <sup>26</sup>	Rawhide	Poinsetta	11N	33E	4
<u>Nevada: Nye</u>					
NV-26 <sup>27</sup>	Manhattan	Houston Oil & Mineral	8N	44E	5
NV-27	Mariposa Canyon	Big Four Mine	9N	44E	3
NV-28	Union	War Cloud property	12N	39E	2
NV-29	Union	Nevada Cinnabar	12N	39E	3
NV-30	Union	Mercury Mining Company	12N	39E	3
NV-31	Union	San Pedro	12N	40E	3
NV-32	Unnamed	Unnamed	1S	43E	1
NV-33	Unnamed	Telluride	12S	38E	2
NV-34	Unnamed	Thompson	11S	48E	3
NV-35	Cuprite	Relston	4S	43E	5
NV-36	Unnamed	Montezuma	3S	41E	3
NV-37	Unnamed	Finger Rock	11N	36E	3

NUMBER	DISTRICT	MINE	TOWNSHIP	RANGE	RATING
<u>Nevada: Ormsby</u>					
NV-38	Unnamed	Valley View property	15N	20E	2
<u>Nevada: Pershing</u>					
NV-39	Spring Valley	American Canyon Cinnabar	28N	34-35E	2
*NV-40	Antelope Springs	Crawford, Juniper, (Nevada Quicksilver) Pershing, Bunker Hill Group, Montgomery, S & J Mine	27N	34E	6
NV-41	Lovelock Sulfur	Unnamed	27N	32E	3
NV-42	Goldbanks	Goldbanks, Oldtimer, Pronto Plata	30N	38W	2
NV-43	Rosebud	Unnamed	34N	29-39E	3
NV-44	Mount Tobin	Last Chance, Mount Tobin, North Fork	28-29N	39-49E	6
<u>Nevada: Storey</u>					
NV-45	Castle Rock	Castle Peak, Washington Hill	18N	21E	3
<u>Nevada: Washoe</u>					
NV-46	Lone Pine	Antelope prospect	45N	21E	2
NV-47	Peavine	Golden Fleece, several unnamed mines & prospects	20N	18-19E	3
NV-48	Unnamed	Taylor-Branch	20N	22E	2
NV-49	Unnamed	Unnamed prospect	20N	23E	3
NV-50	White Horse (Olinghouse)	Unnamed mines	21N	23E	4
<u>Oregon: Douglas</u>					
OR-1	Tiller	Poor Boy prospect	29S	1W	2
OR-2	Tiller	Umqua	29S	2W	2
OR-3	Bonanza	Nonpareil	25S	4W	2
OR-4	Bonanza	Bonanza	25S	4W	2
OR-5	Elkhead	Elkhead	23S	4E	2
<u>Oregon: Harney</u>					
OR-6	Steens-Pueblo	Farnham & Pueblo Groups	40S	35E	3
OR-7	Steens-Pueblo	Rabbit Hole prospect	39S	34E	2
OR-8	Steens-Pueblo	Fisher, Regal, Sheepherder, Blue Bull, Mogul, Lucky Star, Blair Group, O'Keefe claims, Nellie B Group, Lucky Strike, Red Hill prospect, Eldorado Fields lode, Red Dome	36-37, 39S	32 3/4-34E	2
OR-9	Steens-Pueblo	Alexander, Jackpot, Last Chance prospect	34S	34E	9
*OR-10	Horsehead	Horsehead	27S	25E	5
<u>Oregon: Jackson</u>					
OR-11	Upper Applegate	Hopeless, Lucky 13, Mammoth, Bobbit, Palmer Creek, Steamboat, Phillips, ALR prospect	38-41S	4W-1E	2

NUMBER	DISTRICT	MINE	TOWNSHIP	RANGE	RATING
OR-12	Trail	Roxana, War Eagle, Mountain King, Rayone	33-34S	3-2W, 1E	2
<u>Oregon: Josephine</u>					
OR-13	Meadows	Murray, Empire, Barr, Lightning Ridge prospect	35-37S	9-7W	2
<u>Oregon: Lake</u>					
OR-14	Quartz Mountain	Manzanita	37S	16E	2
OR-15	Summer Lake	Courier prospect	32S	16E	4
OR-16	Pinto	Pinto	41S	18E	2
OR-17	Coyote Hills	Gray prospect	35S	23E	2
OR-18	Quartz Mountain	Rosalite	38S	17E	2
<u>Oregon: Lane</u>					
OR-19	Black Butte	Black Butte	23S	3W	2
<u>Oregon: Malheur</u>					
OR-20	Opalite	Bretz, Opalite, several unnamed prospects	40-41S	40-41E	9

## RECOMMENDATION FOR FURTHER ASSESSMENT WORK

Six prospects in Nevada and one prospect in Oregon were chosen for further assessment work from among the eighty-three prospects examined in the reconnaissance program. Choice of the prospects was made according to the geologic and geothermal criteria described earlier in this report.

The assessment program for each of the seven prospects will consist of three types of examinations:

1. Geologic mapping of approximately four square miles surrounding the prospect at a scale of 1:24,000 with particular emphasis placed on faulting and structure which may control convective heat flow.
2. A mercury survey covering the geologically-mapped area.
3. Drilling and logging of 1-3, 50-100 meter gradient holes in close proximity to the prospect site.

The above assessment program will be completed in December, 1980.

The geology and geothermal features of the seven selected prospects are described below.

### Fish Lake Valley Prospect, NV-6 Esmeralda County, Nevada

The Fish Lake Valley mercury/sulfur prospect is located thirteen miles north of Dyer and is accessed from State Highway 3A by a graded county road.

The prospect is located in the north-central portion of the north-trending Fish Lake Valley. The valley is bounded on the west by the uplifted White Mountain batholith of Mesozoic age and in the east by the Silver Peak Range, which consists of a Paleozoic sedimentary section overlain by Pliocene-

Quaternary volcanics (Albers, et.al., 1965).

The prospect lies at the southern edge of an extensive pile of Lower Pliocene rhyolite tuffs. Numerous north-trending normal faults traverse the tuff deposit. One of the major faults of this system intersects the prospect and is evident in the prospect pits by numerous gouge and fracture zones.

The rhyolite tuff in and around the prospect pits is highly argillized, white and friable, whereas the surrounding tuff is light brown and more strongly indurated. Abundant opalite and chalcedony veining with associated sulfur and cinnabar is found in the prospect pits. The mineralization is controlled by fault and fracture zones associated with the normal faulting.

The prospect is located on, and surrounded by, unpatented federal land.

Gilbert Junction Prospect, NV-8

Esmeralda County, Nevada

The Gilbert Junction mercury prospect is located twenty-five miles west of Tonopah and is reached from Highway 95 by a one-half mile unmaintained dirt road.

The prospect lies on the southeast edge of the arcuate Monte Cristo Range, which consists of thick deposits of Middle Pliocene Gilbert Andesite, Miocene rhyolite breccia and local cappings of Plio-Pleistocene basalts. The Late Tertiary volcanics overlie an Upper Paleozoic and Lower Mesozoic sedimentary basement. The prospect lies four miles northwest from the large displacement range front faulting of Lone Mountain (Albers, et.al., 1965).

The prospect pits expose Quaternary tuffaceous lake deposits, which exhibit intense argillization with cinnabar mineralization in joints and fractures. Mineral holes in the prospect exhibit heat flow of 3.1 HFU.

The prospect is located on, and surrounded by, unpatented federal land.

Alum Prospect, NV-9  
Esmeralda County, Nevada

The Alum mercury/sulfur prospect is located ten miles north of the town of Silver Peak and is reached from Highway 47 by two miles of unmaintained dirt road.

The prospect lies on the southwestern edge of the Weepah Hills, which consist of flat-lying to gently-dipping sandstone, shale and water-lain tuff, which may be as young as 6.9 m.y. (Albers, et.al., 1965).

The production pits and surrounding tuffaceous lake beds exhibit moderate to complete argillization with local opalite and chalcedony deposition. Cinnabar and native sulfur are disseminated along faults and fractures and in bedding-controlled lenses. Steeply dipping and contorted beds in close proximity to the prospect indicate fault control of the hydrothermal alteration.

The prospect is located on, and surrounded by, unpatented federal land.

Rast Prospect, NV-20  
Lander County, Nevada

The Rast prospect is located twelve miles northeast of Austin and is reached from Highway 50 via the graded Grass Valley Road.

The prospect lies at the eastern base of the north-trending Toyabe Range, which, in this region, is made up of Paleozoic limestones and quartzites. North-trending normal faulting with the down-dropped blocks to the east intersect the prospect. The faults offset uplifted alluvium and lake beds of Quaternary age.

Miocene andesites occur in isolated outcrops three miles to the east and make up the major rock type of the Simpson Mountains seven miles to the east (Stewart, et.al., 1977).

The prospect lies in alternating thickly-bedded quartzite and limestone covered with a few meters of Quaternary lake sediments.

Mineralization consists of limonite and cinnabar staining in fractures and joints in lake beds and underlying Paleozoic rocks. Minor silicification was also noted.

Heat flow measurements of 9.0 to 10.4 HFU were made.

The prospect is located on, and surrounded by, unpatented federal land.

Pershing Prospect, NV-40

Pershing County, Nevada

The Pershing prospect is located fifteen miles east of Lovelock and is reached by paved road and one mile of unmaintained dirt road from Interstate 80.

The prospect is located on the southwestern flank of the Humboldt Range and lies at the intersection of the north-trending Humboldt range front fault and the northwest-trending normal faults of the Antelope Springs Mining District. The rocks consist of steeply-dipping and contorted limestones, shales and sandstones of Triassic and Jurassic age (Johnson, 1977).

Mineralization consists of calcite and hematite veining and pervasive argillization. Mine workings have been reported as warm, although no heat flow data exists for the district.

The prospect lies in an area of alternating federal and Southern Pacific Railroad sections. The federal sections covering most of the Antelope District have been leased, but several sections northwest of the district, in close proximity to the Humboldt range front fault, remain open.

southwest, paralleling the Midas Graben to the northwest. The second set trends southeast, intersecting the first set at  $90^{\circ}$ . The faults predate the youngest rhyolite flows (Stewart and Carlson, 1976).

A large portion of the tuff has been silicified in the district. Sheets of opalite have been formed in the vicinity of the Silver Cloud mine. There is extensive clay alteration.

Land usage is controlled by the Bureau of Land Management, except for a few small mining claims.



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O'Brien Resources: Mine Evaluation Report

OR-14

DATE: October 16, 1980 GEOLOGIST: W. Teplov

GPS: \_\_\_\_\_

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Quartz Mtn. MINES VISITED: Manzanita

LOCATION: <sup>NW 1/4</sup> SEC: 36 T 37 N (S) R 16 (E) W COUNTY: Lake STATE: OR

TYPE OF DEPOSIT: Volcanic-Opalite CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Rhyolite breccia, highly sheared and faulted.

ALTERATION/MINERALIZATION: Extensive argillization, opalization more localized forming massive lenses several feet in thickness and filling fault breccias. Cinnabar disseminated in opalite and as thin coatings on fractures and in vugs.

HEAT FLOW DATA: \_\_\_\_\_

REMARKS/FURTHER ASSESSMENT WORK: The deposit was open-pitted with dimensions of ~ 100 x 100m on the NW flank of Quartz Butte. Deposit appeared uplifted and dissected, thus indicating a pre-Quaternary age.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-15

DATE: October 16, 1980 GEOLOGIST: W. Teplow

GPS: Fremont Point - 7 1/2'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Summer Lake MINES VISITED: Carrier Prospect (owned by Colahan, tel: 943-3331)

LOCATION: <sup>NW 1/4</sup> SEC: 36 T 32 N (S) R 16 (E) W COUNTY: Lake STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite and andesite tuff

LITERATION/MINERALIZATION: Extensive and locally complete argillization of andesite and andesite tuff; limonite, MgO veining in argillized zones associated with fault breccias. Mineralization uncovered in two small bulldozer cuts in hillside (20' x 15').

HEAT FLOW DATA: Well on farm - 1 mile south of prospect - reported cold.; 6 miles SE Chevron drilled - produced 30°C artesian, 50 gpm. Well in progress at Paisley: 105°C at 260m.

REMARKS/FURTHER ASSESSMENT WORK: Project is adjacent to large displacement normal fault bordering the western margin of Summer Lake. Much of land bordering the lake is privately owned.

RATING: 1 2 3 (4) 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-16

DATE: October 16, 1980 GEOLOGIST: W. Teplow

SPS: Dog Lake - 7 1/2'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Pinto MINES VISITED: Pinto

LOCATION: <sup>SW 1/4 NW 1/4</sup> SEC: 6 T 41 N (S) R 18 (E) W COUNTY: Lake STATE: OR

TYPE OF DEPOSIT: Opalite-Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite breccia

ALTERATION/MINERALIZATION: Argillization - moderate to complete; opalization in irregular lenses within argillized zone. Limonite veining and staining with disseminated cinnabar in opalite and as coatings on fractures.

HEAT FLOW DATA: --

REMARKS/FURTHER ASSESSMENT WORK: Localized extent and high elevation of deposit indicate poor thermal prospect.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-17

DATE: October 15, 1980 GEOLOGIST: W. Teplow

APS: Rabbit Hills SW - 7 1/2'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Coyote Hills MINES VISITED: Gray Prospect

LOCATION: SEC: 14, 15, 23 T 35 N (S) R 23 (E) W COUNTY: Lake STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite, coarse-grained, massive with platy fracture

ALTERATION/MINERALIZATION: Extensive argillization of andesite over 2-3 square miles; locally complete alteration to white clay. Limonite, hematite veining in fracture zones up to 10cm thick.

HEAT FLOW DATA: 12°C at 200 feet in airtight tunnel.

REMARKS/FURTHER ASSESSMENT WORK: Lack of silica mineralization and cold underground temperature indicates low thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-18

DATE: October 16, 1980 GEOLOGIST: W. Teplov

APS: Cougar Peak - 7 1/2'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Quartz Mtn. MINES VISITED: Rosalite

LOCATION: <sup>SW 1/4</sup> SEC: 5 T 38 N (S) R 17 (E) W COUNTY: Lake STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: \_\_\_\_\_

ROCK UNITS: Welded rhyolite tuff

ALTERATION/MINERALIZATION: Extensive to complete opalization. Cinnabar disseminated and in veinlets and stringers permeated the tuff.

HEAT FLOW DATA: \_\_\_\_\_

REMARKS/FURTHER ASSESSMENT WORK: None.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-13

DATE: October 17, 1980 GEOLOGIST: G. Maurath

PS: Selma - 15'

PHOTOS: None

DISTRICT NAME: Meadows MINES VISITED: Murray, Empire, Barr, Lightning Ridge Prospect

LOCATION: SEC: T 35-37 N (S) R 9-7 E (W) COUNTY: Josephine STATE: OR

TYPE OF DEPOSIT: Sedimentary CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Vein fillings

ROCK UNITS: Host rock is generally serpentine of Jurassic age.

ALTERATION/MINERALIZATION: Some pyrite occurs, along with cinnabar, as vein fillings.

HEAT FLOW DATA: None - Barr mine, Lightning Ridge, Swede Basin and Last Chance prospects are reported normal.

REMARKS/FURTHER ASSESSMENT WORK: Age of host rock and lack of heat flow data justify low rating. Empire mine is within wild and scenic river reserve.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-11

DATE: October 14-15, 1980 GEOLOGIST: G. Maurath

MAPS: Lake Creek, Ashland, Talent, Ruch - 15'

PHOTOS: None

DISTRICT NAME: Upper Applegate MINES VISITED: Hopeless, Lucky 13, Mammoth, Bobbit, Palmer Creek, Steamboat, Phillips, ALR prospect

LOCATION: SEC: T 38-41 N(S) R 4W-1E E W COUNTY: Jackson STATE: OR

TYPE OF DEPOSIT: Sedimentary/Opalite CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Vein and fracture fillings; disseminated.

ROCK UNITS: Triassic sedimentary and metamorphic rocks with some Cretaceous granite in the southeastern portion of the district. The majority of the district is composed of rocks of the Triassic Applegate Group. The Hopeless, Lucky 13 and Mammoth prospects are of the opalite type, but have no evidence of production.

MINERALIZATION: Cinnabar is generally associated with fault zones being concentrated in the gouge. Calcite veining with cinnabar enrichment is common.

HEAT FLOW DATA: Tunnel - ALR prospect (27,39S,1E) - 12°C at 60'; Phillips (36,38S,1W) - 12°C at 45'; Palmer Creek - 12°C at 60' and spring in tunnel - 10°C at 150'; Steamboat - 10°C at 75', BHT 9.4°C at 13m.

REMARKS/FURTHER ASSESSMENT WORK: Age of host rock and low heat flow justify low rating.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good



O'Brien Resources: Mine Evaluation Report

OR-9

DATE: October 9, 1980 GEOLOGIST: G. Maurath

SPS: Alvord Hot Springs - 7 1/2'

PHOTOS: None

DISTRICT NAME: Steens-Pueblo MINES VISITED: Alexander, Jackpot, Last

Chance prospects

LOCATION: SEC: 30 T 34 N(S) R 34 (E) W COUNTY: Harney STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Vein fillings and disseminated throughout fault gouge.

ROCK UNITS: Tertiary andesite; some silicified tuff was observed in the area.

ALTERATION/MINERALIZATION: The cinnabar occurs in zones of clay alteration which are fault controlled. Some cinnabar is disseminated through the rhyolite; however, it does not appear to be controlled by fractures.

HEAT FLOW DATA: tunnel (Alexander mine) - 15°C at 200', ΔT Broken Lock grad = 378°C/km q = 26.5 HFU.

REMARKS/FURTHER ASSESSMENT WORK: Area is reportedly leased to a small oil company from OK. Two drilling programs (500' and 1500') have been conducted. Area has been leased and dropped by several companies in the past. Alvord HS occurs along the range front portion of the prospect. Hg survey has been run within the last year by DOE (?). This is a KGRA.

RATING: 1 2 3 4 5 6 7 8 (9) 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-10

DATE: October 15, 1980 GEOLOGIST: W. Teplow

MAPS: Burns AMS

PHOTOS:

DISTRICT NAME: Horsehead MINES VISITED: Horsehead

LOCATION: NW<sup>1</sup>/<sub>4</sub>SE<sup>1</sup>/<sub>4</sub> SEC: 32 T 27 N(S) R 25 (E)W COUNTY: Harney STATE: OR

TYPE OF DEPOSIT: Opalite CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Late Tertiary welded lithic and crystal tuffs, andesitic to rhyolitic opalite dome emplaced in tuff beds.

ALTERATION/MINERALIZATION: Opalization and opalite replacement of rhyolitic welded tuff; local complete argillization - alteration may be traced in float approximately 200m southward. Cinnabar finely disseminated in opalite and argillaceous zones.

HEAT FLOW DATA:

REMARKS/FURTHER ASSESSMENT WORK: Young opalite deposit may indicate recent thermal activity which could be verified with one 75-100m gradient hole adjacent to the opalite deposit.

Drill site located 300m ESE of retort on access road.

RATING: 1 2 3 4 (5) 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-6

DATE: October 9, 1980 GEOLOGIST: G. Maurath

IPS: #27,28 advance - 7 1/2'

PHOTOS: None

DISTRICT NAME: Steens-Pueblo MINES VISITED: Farnham and Pueblo Groups

LOCATION: SEC: 8-9 T 40 N(S) R 35 (E) W COUNTY: Harney STATE: OR

TYPE OF DEPOSIT: Metamorphic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Vein fillings

ROCK UNITS: Tertiary schist with quartz veins. Some meta sediments and an unindurated andesitic breccia were observed north and west of the prospect.

LITERATION/MINERALIZATION: Very little cinnabar was observed; traces of malachite.

HEAT FLOW DATA: 2 adits - 18°C at 15' (1 mile south of prospect); stream - 12°C.

REMARKS/FURTHER ASSESSMENT WORK:

No further work is recommended.

RATING: 1 2 (3) 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-7

DATE: October 8, 1980 GEOLOGIST: G. Maurath

APS: #29 advance - 7½'

PHOTOS: None

DISTRICT NAME: Steens-Pueblo MINES VISITED: Rabbit Hole Prospect, <sup>SOUTH</sup>

o'Keefe, Spring Creek, Aztec, Pueblo, Apache, Farnham of Pueblo

LOCATION: SEC: 11, 12T 39 N (S) R 34 (E) W COUNTY: Harney STATE: OR

TYPE OF DEPOSIT: Diabase dike CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Vein fillings

ROCK UNITS: Tertiary diabase dike. Area is mantled with unaltered alluvium.

ALTERATION/MINERALIZATION: Extensive clay alteration is present. Minor amounts of calcite occur in veins. Only minor amounts of cinnabar were observed.

HEAT FLOW DATA: None - shaft reported normal.

REMARKS/FURTHER ASSESSMENT WORK: Alteration is associated with the dike, which has been extensively eroded. I do not feel the prospect warrants further investigation due to lack of heat flow data and type of deposit.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

3110  
HIF

O'Brien Resources: Mine Evaluation Report

OR-20

DATE: October 8, 1980 GEOLOGIST: G. Maurath

PS: Adel, Jordan Valley AMS

PHOTOS: None

DISTRICT NAME: Opalite MINES VISITED: Bretz, Opalite, several unnamed prospects

LOCATION: SEC: T 40-41 N(S) R 40-41 (E)W COUNTY: Malheur STATE: OR

TYPE OF DEPOSIT: Volcanic/Opalite CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Disseminated vein fillings

ROCK UNITS: Tertiary tuff, opalite, opalite breccia. No overburden occurs at the Opalite mine; it is a topographic high. There is 5'-20' of overburden at the Bretz mine.

ALTERATION/MINERALIZATION: The tuff has been extensively altered and silicified in places. Very little unsilicified tuff is present at the Opalite mine. Clay alteration is extensive and related to fault and fracture zones at the Bretz mine. Cinnabar is controlled by fault zones in the Bretz mine but is disseminated in the Opalite mine.

HEAT FLOW DATA: BHT 11.7°C at 16m, tunnel 18°C at 25', three ATs (attached) for Bretz mine. Tunnel 14.5°C at 100' and AT (attached) for Opalite mine; BHT 20.2°C at 18m (Opalite).

REMARKS/FURTHER ASSESSMENT WORK: Heat flow at Bretz mine and apparent age of mineralization indicate no further work is needed. The heat flow values at the Opalite mine warrant drilling one to two gradient holes.

The area is leased by Placer-Amex.

RATING: 1 2 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-19

DATE: October 22, 1980 GEOLOGIST: W. Teplow

PS: Anlauf - 15'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Black Butte MINES VISITED: Black Butte

LOCATION: <sup>NW $\frac{1}{4}$</sup>  SEC: 16 T 23 N (S) R 3 E (W) COUNTY: Lane STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite breccia, fine-grained with abundant andesite clasts 1-10cm.

Abundant plagioclase phenocrysts 1-5mm. Mafic intrusive on ridge crest above mine.

Age of andesite - Lower Miocene.

ALTERATION/MINERALIZATION: Plagioclase altered to clay. Aphanitic groundmass dull and soft, indicating extensive argillization. Cinnabar found in veins and as massive replacement in andesite.

HEAT FLOW DATA: \_\_\_\_\_

REMARKS/FURTHER ASSESSMENT WORK: High topographic situation of mine, relative old age of host rock, extensive dissection and lack of silica mineralization indicate a lack of current thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

OR-3

DATE: October 23, 1980 GEOLOGIST: W. Teplow

MAPS: Glide - 15'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Bonanza MINES VISITED: Nonpareil

LOCATION: SEC: 10 T 25 N (S) R 4 E (W) COUNTY: Douglas STATE: OR

TYPE OF DEPOSIT: Sedimentary CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Umpqua Formation, Lower Eocene, massive and thickly bedded mudstone and buff, fine-grained argillaceous sandstone.

GENERATION/MINERALIZATION: Limonite veining in fracture zones. Cinnabar found as coating on fracture surfaces.

HEAT FLOW DATA: ---

REMARKS/FURTHER ASSESSMENT WORK: Lack of silica mineralization, recent faulting and young volcanics indicate lack of current thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

OR-4

DATE: October 23, 1980 GEOLOGIST: W. Teplow

MAPS: Glide - 15'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Bonanza MINES VISITED: Bonanza

LOCATION: <sup>NW $\frac{1}{4}$ SW $\frac{1}{4}$</sup>  SEC: 16 T 25 N(S) R 4 E(W) COUNTY: Douglas STATE: OR

TYPE OF DEPOSIT: Sedimentary CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Umpqua Formation, Lower Eocene, dark gray, thick bedded sandstone, inter-bedded massive mudstone.

ALTERATION/MINERALIZATION: Limonite veining in fracture zones in mudstone; minor chalcedony and cinnabar in limonite veins. Large mine dumps and production of 39,000 flasks Hg indicate rich and extensive deposit.

HEAT FLOW DATA: ---

REMARKS/FURTHER ASSESSMENT WORK: Absence of extensive silica mineralization; major faulting and young volcanics indicate lack of present thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good



O'Brien Resources: Mine Evaluation Report

OR-5

DATE: October 22, 1980 GEOLOGIST: W. Teplow

SPS: Anlauf - 15'

PHOTOS:

DISTRICT NAME: Elkhead MINES VISITED: Elkhead

LOCATION: <sup>NE 1/4</sup> SEC: 21 T 23 N (S) R 4 (E) (W) COUNTY: Douglas STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite welded tuff; fine-grained, massive - Lower Eocene.

ALTERATION/MINERALIZATION: Tuff argillized; cinnabar occurs as disseminated blebs and as fracture coatings.

HEAT FLOW DATA:

REMARKS/FURTHER ASSESSMENT WORK: Relative old age of host rock, lack of silica mineralization and absence of major faulting indicate lack of current thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

DATE: October 23, 1980 GEOLOGIST: W. Teplow

MAPS: Red Butte - 15'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Tiller MINES VISITED: Poor Boy Prospect

LOCATION: <sup>SE 1/4</sup> SEC: 16 T 29 N (S) R 1 E (W) COUNTY: Douglas STATE: OR

TYPE OF DEPOSIT: Sedimentary CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Lapilli tuff and ash flow. Fine-grained, light tan, massive to thickly bedded - Oligocene and Lower Miocene.

ALTERATION/MINERALIZATION: Extensive argillization, locally complete; forming white lenses 20-50cm. Cinnabar occurs in fractures and argillized zones in tuff.

HEAT FLOW DATA: \_\_\_\_\_

REMARKS/FURTHER ASSESSMENT WORK: Absence of silica mineralization, major faulting and recent volcanic rocks indicate lack of current thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good

O'Brien Resources: Mine Evaluation Report

01

OR-2

DATE: October 23, 1980 GEOLOGIST: W. Teplow

SPS: Red Butte - 15'

PHOTOS: \_\_\_\_\_

DISTRICT NAME: Tiller MINES VISITED: Umpqua

LOCATION: <sup>NE 1/4</sup> SEC: 34 T 29 N (S) R 2 E (W) COUNTY: Douglas STATE: OR

TYPE OF DEPOSIT: Volcanic CRYSTALLINE FORM: Amorphous

MODE OF OCCURRENCE: Cinnabar

ROCK UNITS: Andesite, fine-grained with abundant plagioclase phenocrysts, overlain by lithic pebble conglomerate interbedded with dark gray shale - Eocene.

ALTERATION/MINERALIZATION: Andesite locally completely argillized, with yellow calcite veining. Partially argillized andesite contains dark gray calcite veining with minor pyrite, arsenopyrite and cinnabar (?).

HEAT FLOW DATA: \_\_\_\_\_

REMARKS/FURTHER ASSESSMENT WORK: Lack of silica mineralization, major faulting and recent volcanics indicate absence of current thermal activity.

RATING: 1 (2) 3 4 5 6 7 8 9 10  
Poor Good