Mercury Geochemical, Groundwater Geochemical, and Radiometric Geophysical Signatures at Three Geothermal Prospects in Northern Nevada

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ABSTRACT

Ground water sampling, desorbed mercury soil geochemical surveys and a radiometric geophysical survey was conducted in conjunction with geological mapping at three geothermal prospects in northern Nevada. Orientation sample lines from 610 m (2000 ft.) to 4575 m (15,000 ft.) in length were surveyed at right angles to known and suspected faults. Scintillometer readings (gamma radiation - total counts / second) were also recorded at each soil sample station.

At the Reese River prospect, a 60 station sample line crosses a pull-apart basin in the northern Shoshone Range. The eastern third of the sample line crosses a known 514 ^{0}C/km (33^{0}F/100 ft.) heat flow anomaly defined by previous drilling. Desorbed mercury anomalies in the 0.5 ppb to 1.0 ppb range correlate well with the location of known and suspect faults. Radiometric data, while useful at this prospect are not as effective a tool as mercury data for mapping structure because of the masking effect of widespread alluvial deposits.

At the Salt Wells prospect, the 26 station sample line crosses a previously mapped basin/playa bounding fault and a suspected buried fault indicated by the location of a warm spring. Elevated mercury concentrations are detected at the fault trace and in the vicinity of the spring, in addition to anomalous radioactivity.

At the Silver Peak prospect, a basin/playa bounding fault is defined by both mercury vapor and radioactivity anomalies along the 14 station sample line. Mercury anomalies in the 2.0 to 6.0 ppb range and radioactivity anomalies in the + 500 CPS range mark both the location of the fault and associated sub-cropping hot springs sinter (mixed travertine – silica) deposits. A detailed radiometric survey along 4.5 km of strike of the basin bounding fault detects three dormant hot spring vent areas.

Introduction

Mercury soil vapor surveys are not widely used in geothermal exploration in the western US, however the association of mercury vapors with geothermal systems in the Great Basin is well known. The association of mercury with geothermal fluids was studied at Steamboat Springs, Nevada by White (1967 & 1970). Mercury associated with hot water dominated systems was studied at Roosevelt Hot Springs, Utah by Christensen (1980). Mercury vs. temperature gradient was studied at Dixie Valley, Nevada and Noya geothermal prospect in Japan by Matlik and Shiraki (1981). The association of mercury vapors desorbed from soil samples collected near known fault traces over a geothermal field was demonstrated by Smith (2003) at the Moana, Nevada geothermal field using the *Gas'm* technique; this technique was utilized for the soil geochemical work in this study.

The *Gas'm* technique measures adsorbed mercury which is deposited on the silt/clay fraction of soil from vertical migration of vapors through the soil. The mercury vapors are sourced at depth from buried active geothermal systems or in situ weathering of buried ore bodies, hydrocarbon accumulations, etc.

The usefulness of radiometrics as a geologic mapping aide is well known. Though used mostly with airborne surveys for regional studies, a simple to use, hand held scintillometer can prove very useful in distinguishing different rock units in the field. The association of uranium mineralization with active and fossil hot springs systems in Nevada was documented by Garside (1973), and Garside and Schilling (1979), as well as others. Scintillometers used in the geophysical surveys were the Geometrics GR-310 and the Mt. Sopris SC-132.

Both an adsorbed mercury soil geochemical survey and a radiometric geophysical survey were conducted simultaneously in conjunction with geological mapping at three geothermal prospects in Nevada (Figure 1). Orientation sample lines from 600 m (2000 ft.) long to 4570 m (15,000 ft.) long were surveyed at right angles to known major structures at all three prospects. Sample station spacing was 76.2 m (250 ft.) for all

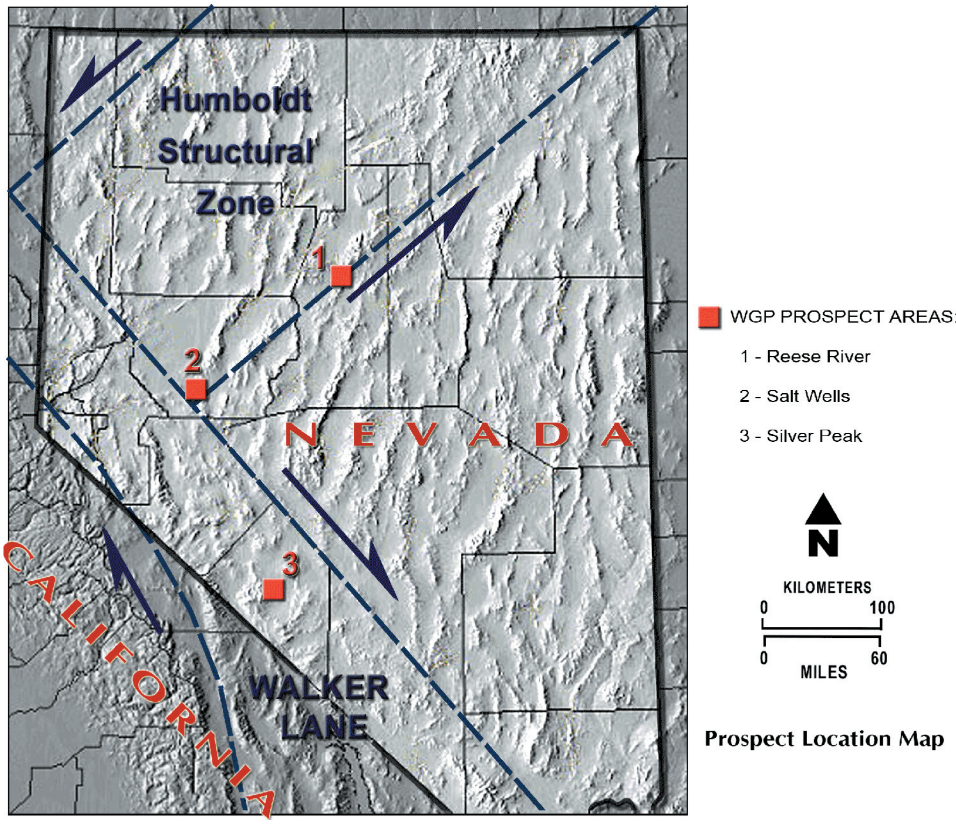

Figure 1. Location of prospects with respect to major structural elements in Nevada (modified from Faulds, et.al., 2004).

three prospects. A soil sample of approx. 1 kg (2.2lbs.) size was collected from a depth of 30 to 45 cm (12 to 18 in.) at each sample station, as well as recordation of a scintillometer reading (gamma rays - total counts per second).

Mercury analyses were conducted at the Minerals Exploration and Environmental Geochemistry laboratory in Reno, NV. An aliquot of the minus 325 mesh fraction of each soil sample is desorbed in a closed container at 50^0 C for 230 hours and at $100\,^{o}$ C for an additional 70 hours. Desorbed mercury was measured using a Tekran AFS mercury detector.

To display the data, cross sections were drawn along sample lines at the three prospects to show our interpretation of the structure at each prospect. The mercury desorb data and the radiometrics data are displayed in graphical format at the same scale as the cross section, above the location of each sample station on the line. Data were collected along additional parallel sample lines at each prospect. For the purposes of this paper though, only one line from each prospect is discussed. Data which we discuss for individual sample lines in this report exhibit positive correlation with data from parallel sample lines at each prospect.

Reese River Prospect

General Geology

The Reese River prospect is located in central Lander County where the Reese River cuts through the Shoshone Mountains. By road, the prospect is about 48 km (30 miles) north of Austin, along SR 305; about 2.5 km (1.5 miles) southwest of the highway. In FY 2005, Western Geothermal Partners was awarded a GRED III cooperative funding agreement from USDOE to explore the Reese River prospect. Research for the portion of this paper dealing with the Reese River prospect was funded in part by USDOE under Cooperative Agreement # DE-FC36-04GO14344; such support does not constitute an endorsement by DOE of the views expressed in this paper.

The 2548 hectare (6295 acre) leasehold lies within a northeast trending intermontane graben, interpreted by us as a pull-apart basin (Figure 2). The age of the graben boundary faults is believed to straddle the Tertiary – Quaternary boundary and very probably is less than 1 million years (Dohrenwend, et. al., 1996). The southeast bounding fault of the graben is located very near the southeast boundary of the Humboldt Structural Zone (HSZ) (Figure 1). The HSZ, one of the major structural features in Nevada, is an approx. 240 km (150 mile) wide northeast trending structural belt which traverses northern Nevada and partially extends into the neighboring states of Oregon and Idaho (Faulds, et. al., 2004).

The southeast boundary fault of the graben juxtaposes upper and lower plate Paleozoic sedimentary rocks of the Roberts Mountain and Golconda thrusts, with Tertiary fanglomerates and lakebed sediments. The displacement along the southeast bounding fault is thought to be on the order of 1.6 km (1 mile) or more. The northwest boundary fault of the graben juxtaposes Tertiary lake bed sediments against the Tertiary Bates Mountain Tuff. The displacement along the northwest bounding fault is thought to be on the order of 1000 m (3000 ft.).

The floor of the graben (about 2.4 km (1.5 miles) wide) is occupied by highly faulted and gently folded Tertiary age lacustrine tuffaceous siltstones, sandstones and conglomerates (Figure 2). Field mapping shows that the Quaternary alluvial fans and terrace gravels which overlie the Tertiary sediments are displaced by numerous interior faults which cut the floor of the graben, suggesting a Quaternary age displacement for at least some of the previously unmapped faults in the interior of the graben.

The lacustrine and fanglomerate facies sediments appear to be about 760 m (2500 ft.) thick and were deposited on a thick sequence of approx. 760 m (2500 ft.) of welded and non welded ash flow tuffs and andesitic to dacitic volcanic flows. This thick Tertiary sequence of volcanic and volcaniclastic rocks appears to unconformably overlie upper plate units of the Roberts Mountain Thrust.

In the early 1980's, Phillip's 66 Minerals Division drilled a uranium prospect at the location of this present day geothermal

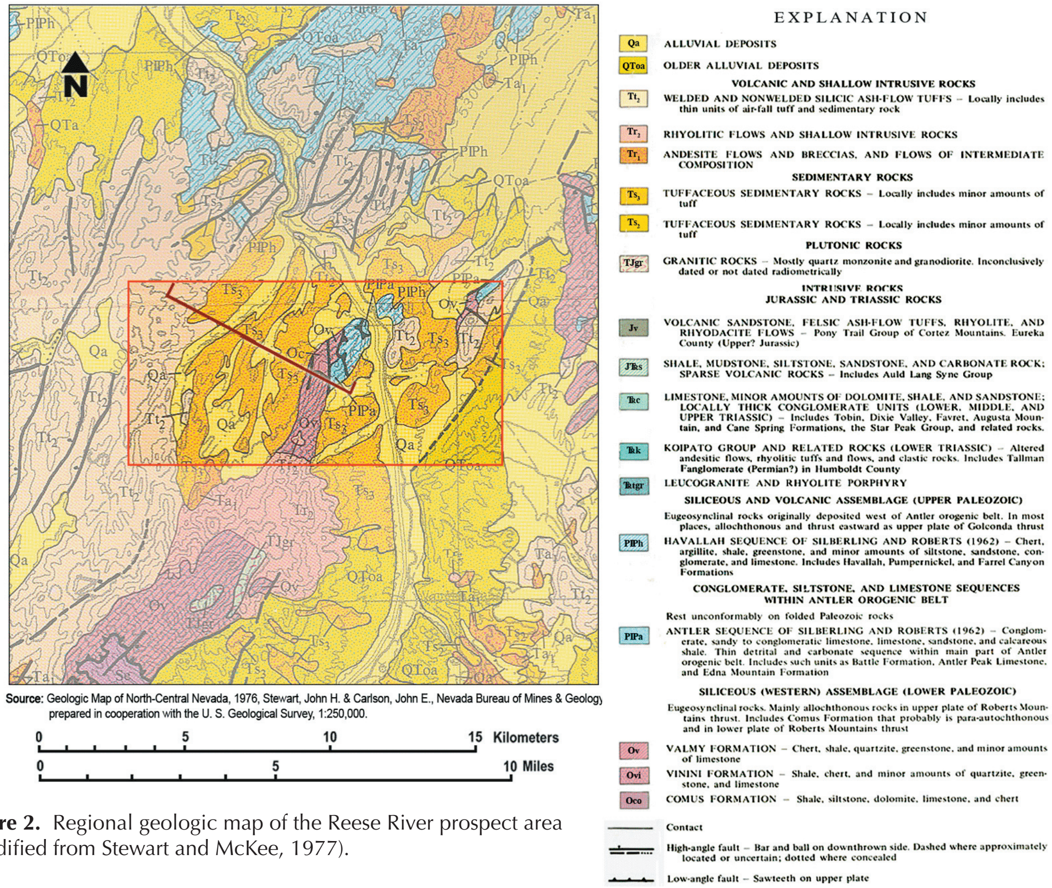

Figure 2. Regional geologic map of the Reese River prospect area (modified from Stewart and McKee, 1977).

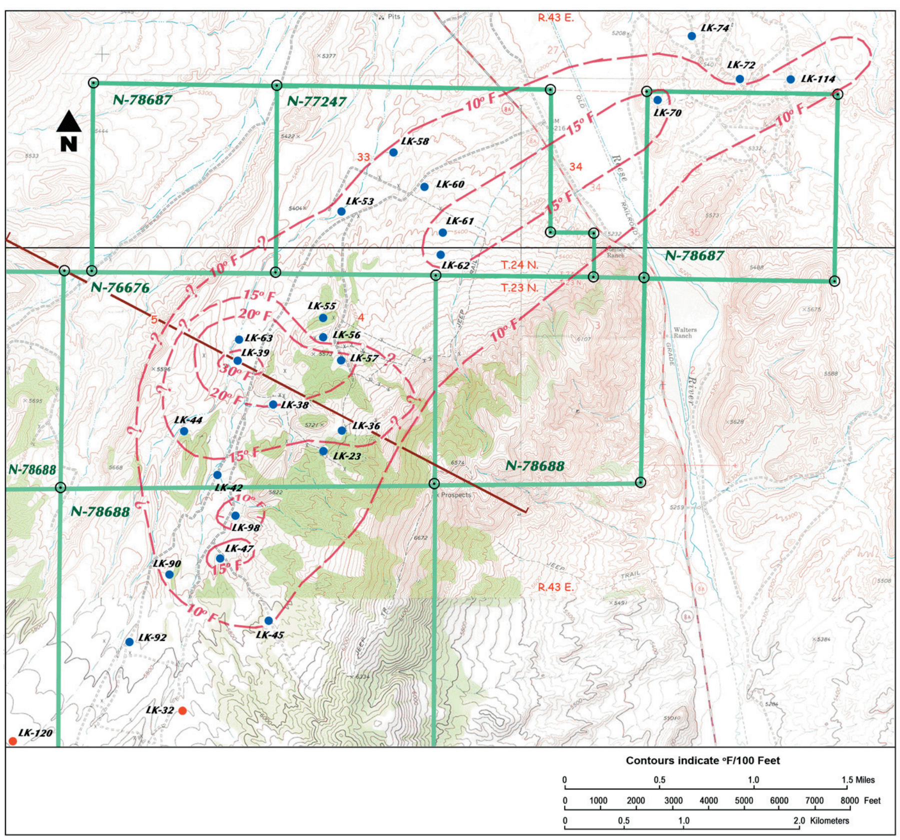

Figure 3. Isogradient contour map (°F/100 ft.) Reese River prospect.

prospect. During the drilling operations, the drill tools in some of the holes intersected abnormally hot water. Phillip's Geothermal Division was called in and the 28 mineral exploration holes were completed as geothermal gradient holes (R. Benoit, PC, 2004). The temperature logs of the geothermal gradient holes were collected and published by USGS in website format as an open file report (Sass, et. al., 1999).

Our review of the USGS data base shows that of the 28 temperature gradient holes present at the prospect, 25 have published gradient calculations in the lower parts of the hole greater than 150°C/Km (8°F/100 ft.) Contoured data show that the > 150°C / km heat flow anomaly defined by the Phillips drilling is approx. 4.8 km (3 miles) long in the northeast direction by approx. 1.6 km (1 mile) wide. This suggests significant heat leakage along the southeast bounding fault of the graben. The hottest part of the anomaly, which reaches a calculated gradient of >514°C/km (32.3 °F/100 ft.), is defined by the temperature log of hole LK-39. The cross section (Figure 4, overleaf) cuts through this well.

Findings

Both the 50°C and 100°C mercury desorb data show spikes directly above or near the outcrop of six of the nine mapped faults which cross the sample line. Even though the desorbed mercury values are quite small (max of 0.371 ppb at station 5.0W-low temp, and max of 0.946 ppb at station 16.5W-high temp), samples of the soils collected at or near the outcrop of faults show anomalous values with respect to neighboring samples.

The 100°C desorb data show the location of several of the more important faults better than the 50°C desorb data does for this line. In particular, the faults at stations 8.5E, 7.0E and 2.0E are shown better by the higher temperature data. These three faults; in particular the 8.5E and 7.0E faults appear to be associated with the hottest part of the heat flow anomaly. The

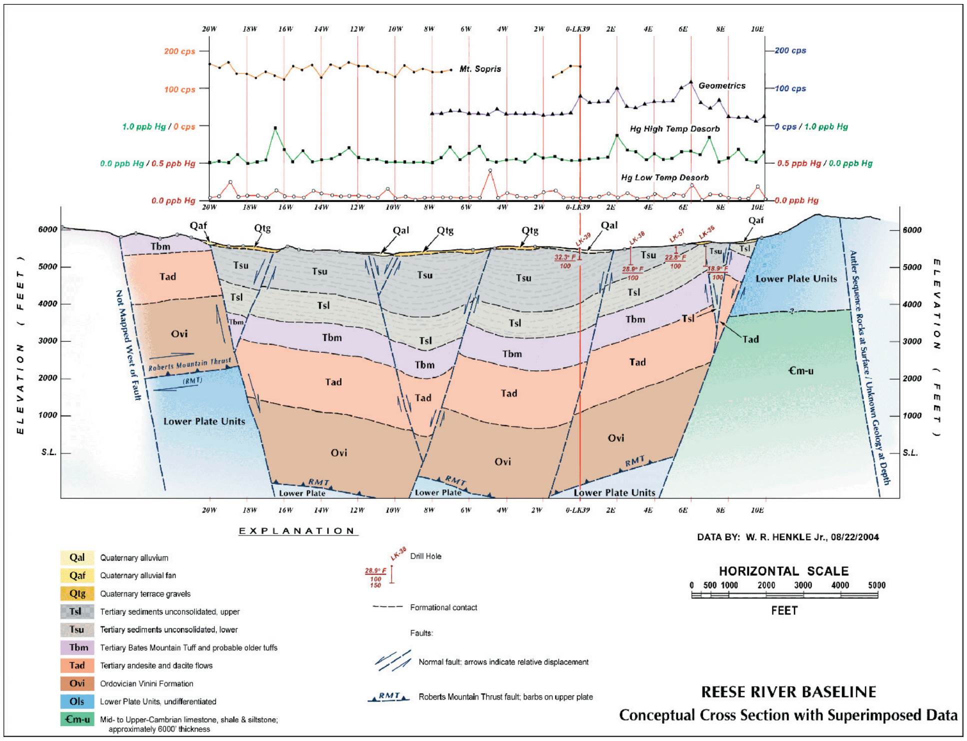

Figure 4. Conceptual cross section through Reese River prospect with superimposed data (looking north).

fault which has a prominent topographic expression at station 5.0W is better shown by the lower temperature desorb data. The corresponding higher temperature data (expressed by a double peak) are offset by one station to the west. The fault at station 16.5W is hardly noticeable on the low temperature plot but is the maximum anomaly (0.946 ppb) for the entire line on the high temperature plot.

Scintillometers manufactured by both Geometrics and Mt. Sopris were used to collect the data displayed for the sample baseline. The Geometrics unit failed at station 8W during the survey. A Mt. Sopris SC-132 unit was used to complete the survey and for subsequent sample lines. Field experience suggests that the Mt. Sopris unit reads about twice the intensity in CPS as the Geometrics unit for gamma radiation in the 0 to 200 CPS range.

The outcrop belt of the upper Tertiary lake bed sediments stands out as counts range between 50 and 116 CPS between stations 0-LK 39 and 8.0E. The fault at station 8.0E is expressed on this line as an abrupt decrease in radioactivity from the >50 CPS to the 20 to 27 CPS range. Approx. a 3m (10 ft.) layer of alluvial fan sediments found at the surface from station 8.0E to 9.5E creates a masking effect of the natural radioactivity of the older beds in this portion of the sample line.

Older, coarser grained Tertiary sediments outcrop about 120 m (400 ft.) to the south of the baseline. These beds dip to the southeast and are in fault contact with younger, finer grained sediments which dip to the northwest in outcrop. This geology is projected onto the cross section. Surveys along other sample lines at the prospect show that the older Tertiary sediments are as radioactive as the younger sediments, if not slightly more so, than the younger sediments.

The fault at station 6.5E is expressed by a radiation peak of 116 CPS at station 6.0E. The reason for the 76m (250 ft.) offset of the signature from the outcrop is unclear. The major fault at station 2E is expressed by a radiation peak of 101 CPS. Alluvium which outcrops from station 0-LK 39 to near 2.0E provides steady radiation readings in the 65 to 80 CPS range.

To the west of station 0-LK 39, the line crosses 3 to 6 m (10 to 20 ft.) thick Quaternary Terrace gravels which blanket upper Tertiary sediments over most of the western floor of the graben. The gravel cover is broken by faulting at station 4.5W. At this location, radiation is slightly stronger at 50 CPS because the upper Tertiary sediments are exposed on the scarp of the up thrown fault block. The remainder of the Geometrics unit data (west of the fault to station 8.0W) are quiet, suggesting that no structures are crossed.

With the Mt. Sopris data, the fault between stations 9.5W and 10.0W is expressed by a decline in radiation from 164 to 136 CPS. Instrument readings stay in the 135 – 140 CPS range from station 10.0W to 11.0W which is an alluvial covered valley. Readings increase to the 160 CPS range to the west of station 11.5W. Readings cluster mostly around 160 CPS from station 11.5E to 15.5W where the predominant outcropping unit is the upper Tertiary lacustrine sediments. The one exception to this grouping is at station 14.0W (130CPS) where a small stream bed was traversed. From station 16.0W to 18.5W, readings are between 124 and 146 CPS where the Tertiary lacustrine sediments are covered by Quaternary terrace gravels. Slightly higher readings which cluster around 165 CPS are found close to the basin margin fault at stations 19.0W to 20.0W. At these stations, increasing amounts of float shed from the uplifted horst block west of station 20.0W cover and are mixed with the terrace gravels.

Salt Wells Prospect

General Geology

The Salt Wells prospect is located in south central Churchill County, about 24 km (15 miles) southeast of Fallon. By road, the prospect is about 80 km (50 miles) east southeast of Reno, along US highway 50. The prospect is from 0.3 km (0.5 miles) to 4.8 km (3.0 miles) southwest of the highway.

The 1554 hectare (3840 acre) prospect lies astride Eight Mile Flat playa, a part of the Salt Wells basin. The playa is bounded by active normal faults both on the northeast and southwest flanks. The faults on the northeast flank of the playa show historic movement (1954), while those on the southwest flank of the playa show signs of Holocene movement (Bell, 1984). The southwest bounding fault is informally called the

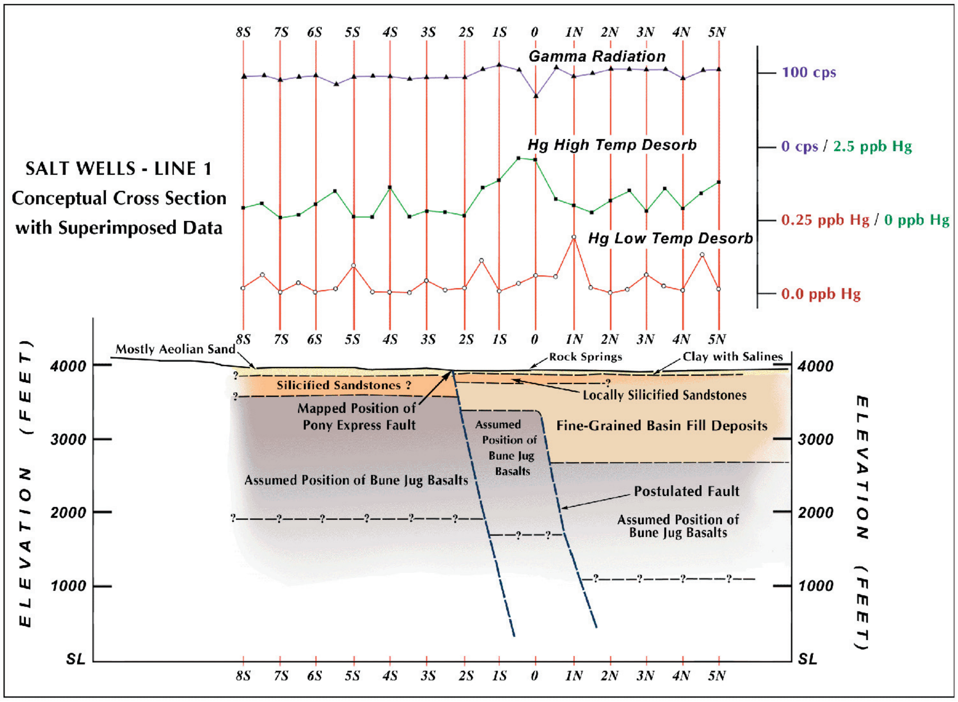

Figure 5. Conceptual cross section through Rock Springs at Salt Wells prospect with superimposed data (looking west).

Pony Express fault in this paper. It forms the boundary of the predominately aeolian sand covered Cocoon Mountains pediment with the clay rich sediments of the playa. Displacement along the Pony Express fault (Figure 3) is unknown but may be at least 150 m (500 ft.). The fault is productive about 3.2 km to the west northwest where it intersects north-south trending faults of the Bunejug Mountains system. A 10 Megawatt binary plant is planned for construction here during 2005.

The prospect is located near the intersection of the southern boundary of the HSZ and the Walker Lane (Figure 1), two of the major structural features of Nevada. The Pony Express fault appears to have at least one companion stair- step fault to the north of the outcrop; this is suggested by the presence of Rock Springs, located about 300 m (1000 ft.) basinward of the fault scarp. Other than the presence of Rock Springs, there is no other topographic expression of the hypothesized companion fault.

Anadarko Petroleum Corporation's Geothermal Division held numerous leases in the vicinity of the prospect leasehold in the early 1980's. During the time they operated in the area, they drilled two water wells to a depth of 49 m (160 ft.) each, on the leasehold, about 0.8 km (0.5 miles) to the east of the section shown on Figure 3. Well #1 was drilled on the down-thrown side of the Pony Express fault, well #2 on the up-thrown side. Well #1 encountered silicified Pleistocene sands to total depth beneath approx. 12 m (40 ft.) of clay rich fine grained lake sediments. The shallow geology from these two wells is projected on to Figure 3.

Cuttings descriptions from well #1 mention trace chloritic alteration throughout and minor vein chalcedony and increasing silicification with depth at near total depth. The lithology described for well #2 is similar to that found in well #1 except for the absence of chloritic alteration and chalcedony veins in well #2. The Bune Jug basalt is thought to be about 490 m (1600 ft.) thick in the vicinity of the leasehold (Willden and Speed, 1974). Depth to the Bune Jug basalt as shown on Figure 3 is postulated.

Findings

Warm spring waters sampled from both Rock Springs and an artesian water well located approx. 520 m (1700 ft.) to the west southwest shows dissolved silica contents of 79.6 and 104 ppm, respectively. The artesian water well is sited about 33 m (100 ft.) basinward of the Pony Express fault scarp. Silica contents such as these suggest a potential reservoir temperature of between 125°C (257°F) and 139°C (283°F) for faults of the Pony Express system, using the quartz conductive geothermometer.

Both the 50°C and 100 °C mercury desorb data show spikes above or near the outcrop of both the mapped and the inferred fault which the line crosses. For the low temperature data, the 0.11 ppb spike at station 1.5S and the 0.20 ppb spike at station 1.0N correlate with, but are offset to the north of the Pony Express and the companion Rock Springs faults. Data spikes at stations 4.5N and 5.0S are similar in magnitude to the Pony Express fault spike at station 1.5S and may indicate buried faults of similar magnitude.

The high temperature desorb data show a broad six station anomaly over both the Pony Express and the companion Rock Springs faults. The maximum magnitude of this anomaly is also rather strong at > 2.0 ppb. This indicates significant leakage of mercury vapors along the Rock Springs fault.

Radiometric data were collected with the Mt. Sopris unit. The most striking anomaly shown on this data plot is the negative spike at station 0.0 (the physical location of Rock Springs). This < 30 CPS anomaly is probably caused by masked radiation from the thick vegetative cover that covers the clayey potassium-rich playa sediments at the orifice of the spring. A more subtle anomaly is noted between stations 2.0 and 1.5S, where the line crosses the Pony Express fault. South of the fault, where aeolian sands cover the underlying geology, counts are consistently below 100 CPS. North of the fault, where saline clays cover the playa surface, counts are primarily above 100 CPS except at the location of Rock Springs.

Silver Peak Prospect

General Geology

The Silver Peak prospect is located in central Esmeralda County, just north of the community of Silver Peak. By road, the prospect is approx. 224 km (140 mi) southeast of Reno, via US 95 and SR 265. The prospect is approx. 32 km (20 mi) south of US 95 along SR 265.

The 2304 hectare (5760 acre) leasehold lies along the western boundary of Clayton Valley, a large closed topographic and structural basin. The prospect is located in the central portion of the Walker Lane (Figure 1) a northwest striking regional structural feature which parallels the California – Nevada border for approx. 800 km (480 miles). In the vicinity of the prospect, the Walker Lane is a system of northwest striking right-lateral strike slip faults approx 120 km (72 miles) wide.

The precise age of the faults which form the eastern and western boundaries of the Clayton Valley basin is poorly understood at this time. Pleistocene faults are mapped along the eastern boundary of the basin, and Quaternary to late Tertiary faults are mapped along the south western basin boundary by Nevada Bureau of Mines and Geology geologists (Dohrenwend, et. al., 1996). Faults that bound the basin in the immediate vicinity of the prospect juxtapose Quaternary lake bed sediments against Cambrian bedrock.

Two faults that appear to control ground water flow in Clayton Valley intersect in the north central part of the leasehold. The Cross Central fault (Zampirro, 2003) is a northwest striking Walker Lane fault that juxtaposes Cambrian bedrock with Quaternary sediments and forms the northeast boundary of the Mineral Ridge horst block. A north-south trending range-front fault called the Silver Peak fault in this paper, parallels SR 265 from where it intersects the Cross Central fault, south to the community of Silver Peak for a distance of about 4.6 km (3.0 miles) and forms the western boundary of the Mineral Ridge horst block. A Quaternary aged basaltic cinder cone and associated flows is located about 3.2 km (2 miles) north of, and on strike with this fault suggesting that it continues northwards in the subsurface.

In the early 1980's, Phillips 66 Geothermal Division drilled a temperature gradient well north of Silver Peak, near the intersection of the Cross Central fault and the Silver Peak fault. A geothermal gradient of 715°C / km (39.3°F / 100 ft.) was calculated for this 40m (130 ft.) deep well (Sass, et. al., 1999). The data from this well, Spk – 03, shows a maximum temperature of 36.1°C (122.6°F) at TD.

Work by Chemetall Foote has shown that the Cross Central fault traverses the entire 6.4 km (4.0 miles) width of the valley in the subsurface and intersects with the Angel Island and Paymaster Canyon faults on the eastern boundary of the basin. Ore grade lithium brines are localized along that fault intersection on the east side of the basin (Zampirro, 2003).

Findings

This study found that extensive Pleistocene to Holocene mixed travertine and silica sinter terraces are juxtaposed against Cambrian bedrock along the Silver Peak fault, from where it intersects the Cross Central fault south to the community limits (Figure 4). Field evidence suggests that the thickness of the Quaternary and Holocene age sediments on the down-thrown block of the Silver Peak fault is at least 230 m (750 ft.), although the exact thickness is not known.

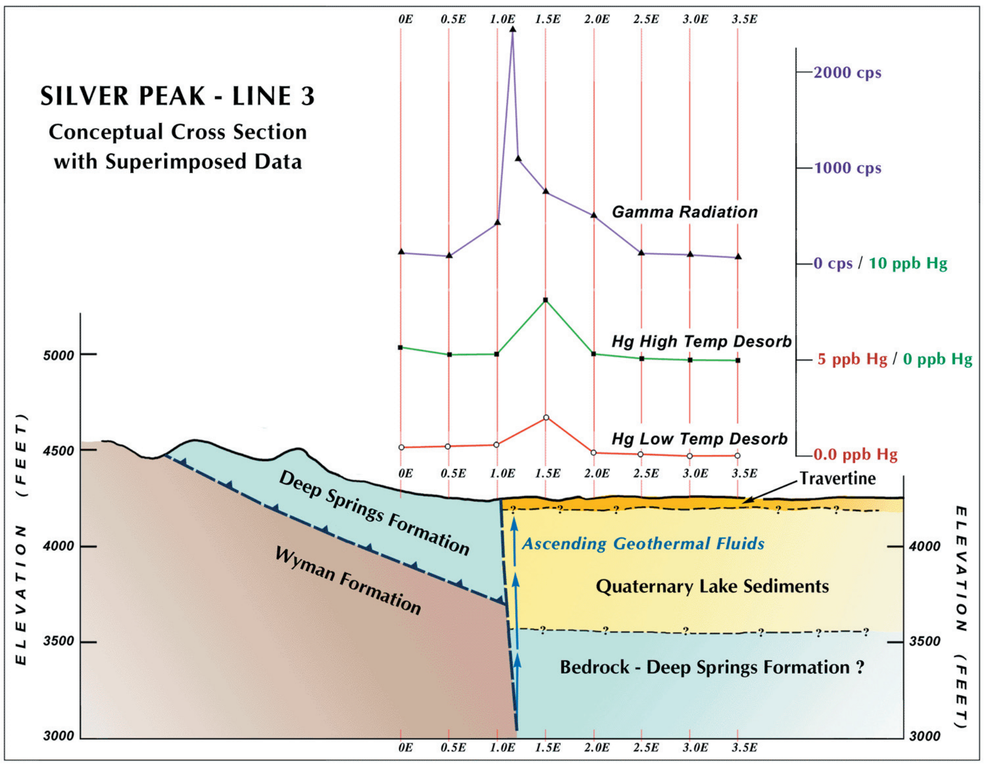

Figure 6. Conceptual cross section through Silver Peak prospect with superimposed data (looking north).

Sampling of the abandoned but still open Blair Mill well drilled in the early 1900's near the intersection of the Cross Central and Silver Peak faults shows a temperature of 49.7°C (147°F) at 6.1 m (20 ft.). A water sample from this well tested at 134 ppm silica. A published analysis of water sampled from the Silver Peak Waterworks Spring, located along the Silver Peak fault, approx. 3.2 km (2.0 miles) to the south, shows a silica content of 140 ppm (Garside, 1994). Using the quartz adiabatic geothermometer, the silica content from both samples suggests a potential at depth reservoir temperature at of 147°C - 149°C (297°F - 300°F) along the Silver Peak fault.

Mercury data from Silver Peak line 3 (Figure 4) show an obvious correlation with the position of the Silver Peak fault. The apparent offset to the east is probably an artifact of sample spacing. Tighter sample spacing would have probably shown better correlation with the actual surface trace of the fault. Interestingly, the magnitude of the data spikes (2.043 ppb - low temp and 6.43 ppb - high temp), matches closely with the 3.0 ppb mercury content of our Blair Mill well water sample.

Radiometric data for this prospect were also collected with the Mt. Sopris unit. The spectacular 2650 CPS spike at station 1.0E + 18m (60 ft.) marks the position of the Silver Peak fault. Because the scintillometer readings were continuous, the fault trace could be precisely located while traversing between stations 1.0E and 1.5E. This work indicates that background gamma radiation for the Silver Peak prospect area is between 100 to 200 CPS. The readings from the sinter terrace between stations 1.0E and 2.5E are highly anomalous.

A series of sinter terraces approx. 2.5 square km (1.0 square mi.) in aerial extent crop out along the Silver Peak fault from near the junction of the Cross Central and Silver Peak faults south to the community limits. Three large mounds which mark the dormant spring orifices are found along and mark the trace of the fault. The vent areas of the springs, some of which have active fumaroles, and the general dimensions of the mounds were mapped using radiometrics (Figure 5).

The association of radioactivity along the Silver Peak Fault with dormant hot spring activity is obvious. Assays of surface grab samples from inside the 2000 CPS contour in the northern anomaly are inconclusive as to the mineral assemblage responsible for this rather remarkable radioactive occurrence.

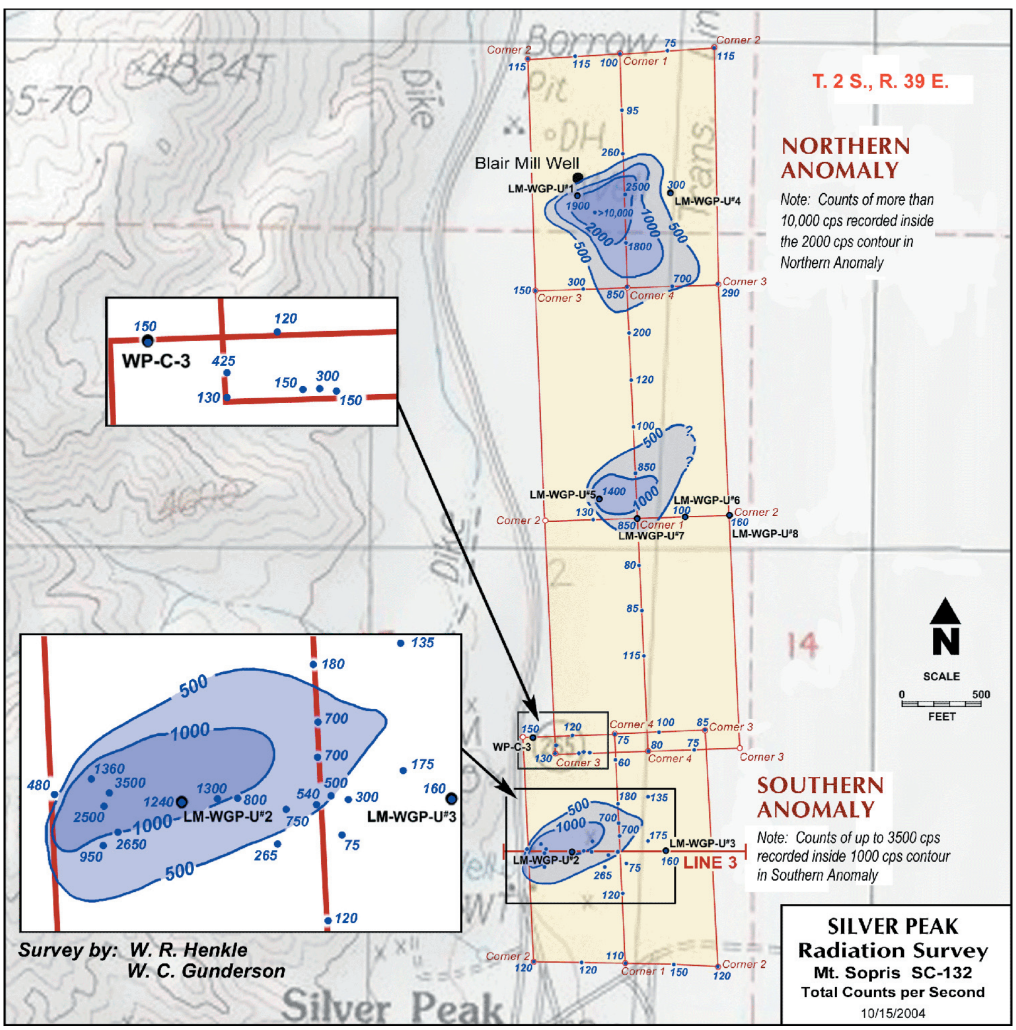

Figure 7. Gamma radiation survey of Silver Peak fault trace in dormant hot spring area

Conclusions

Reese River

At the Reese River prospect, the mercury desorb data were very useful in locating the position of both obvious and subtle faults. The high temperature data were slightly better than the low temperature data at pinpointing fault locations. Desorbed mercury values for soil samples from this prospect were very low (max of 0.37 ppb low temp and 0.95 ppb high temp) when compared with those found at the other two prospects. This may be due to sealing of the faults at depth where the fault planes cross the rather thick clay rich Tertiary lake bed sediments. Or possibly, it could be because the geothermal reservoir is deeper relative to the other two prospects. Because there is a very large and exceptionally hot geothermal heat anomaly indicated at this prospect, the first hypothesis is more probable.

The usefulness of radiometrics at this prospect was hindered by the masking effect of widespread Quaternary alluvial fan and terrace gravel sediments which overlie much of the outcrop area of the upper Tertiary lake beds.

Salt Wells

At the Salt Wells prospect, the low temperature mercury desorb data show offset spikes to the north of the outcrop of known and suspected but buried faults. Because the high angle normal faults have a dip to the north, this offset may be indicating vertical mercury vapor leakage from the projected down-dip fault plane at depth. The high temperature desorb data show a large continuous data-spike over the outcrop area of both the Pony Express and the Rock Springs Faults. The magnitude of the maximum high temperature data spike for these six soil samples is twice that for the Reese River samples. This may indicate either a more permeable fault zone at shallow depth or a shallower geothermal heat source or both.

Radiometrics prove to be very useful at pinpointing the location of the two main faults at this prospect. The magnitude of the gamma radiation data-spikes at this prospect are very subtle (< 5 CPS) except at the actual position of Rock Springs.

Silver Peak

At the Silver Peak prospect, both the low temperature and high temperature desorb data show spikes when crossing the Silver Peak fault. The 58 m (190 ft.) offset to the east is probably an artifact of the sample station spacing. If the sample station spacing was decreased in the area of the fault trace, better precision would probably be achieved. The magnitude of both the high and low temperature data-spike for the soil sample collected near the fault trace was from two to six times that for the Reese River samples. It was also very close to the dissolved mercury content from the Blair Mill well water sample. This is probably because of the overlapping coincidence of a very permeable fault zone and a shallow hot water anomaly.

Radiometrics was the most useful tool in locating the trace of the Silver Peak fault at this prospect. This is directly relates to the rather spectacular radioactivity associated with the hot springs deposits at this prospect.

Both anomalous mercury concentrations and anomalous radioactivity are associated with many hot springs fluids in the Great Basin. For these reasons, geothermal prospectors should consider using these simple and inexpensive techniques to aid in unmasking the structural geology during the geologic mapping phase of prospect definition.

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