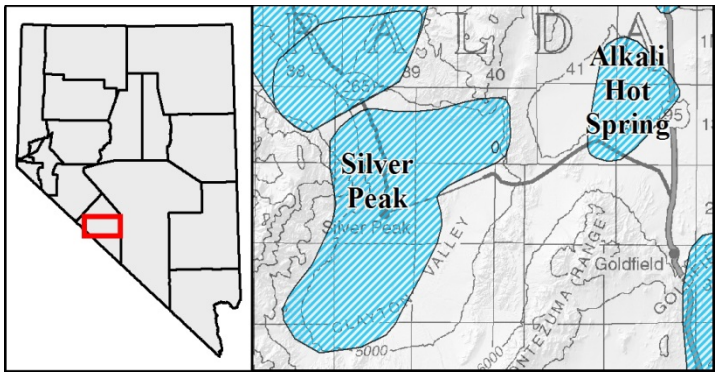
Site Description

Silver Peak
(Updated 2014)



Geologic setting:

Clayton Valley, located within the Silver Peak geothermal cluster, is one of the world's principal sources of lithium. Chemetall Foote Corporation has been producing lithium since 1967, pumping brines from 100 to 300 m-deep Quaternary sediments (Papke, 1976, Davis et al., 1986; Zampirro, 2003). Brine temperatures range from 19.5 to 36°C (Davis et al., 1986). The lithium-rich NaCl brines may result from salt dissolution in playa sediments (Davis et al., 1986), although the ultimate source may be lithium-rich rhyolitic rocks (Papke, 1976; Price et al., 2000). Local hot springs are also highly anomalous in lithium. Additional information on the hydrology and saline minerals of Clayton Valley can be found in Dole (1913) and Meinzer (1917).

Geothermal features:

Early Silver Peak residents described hot waters underlying the whole playa, especially in spring and late winter (Spurr, 1906). Data from lithium-producing wells suggests hot groundwater is confined to the basin margins, with cold waters in the central playa area (Davis et al., 1986). Brines pumped from the central valley typically do not exceed 26.7ºC (Zampirro, 2003). In 1974, Phillips Petroleum Co. drilled 17 boreholes ranging in depth from 39.6 to 93 m and encountered temperatures up to 50.4ºC (Sass et al., 1999).

Three mixed sinter-travertine terraces are outlined by anomalous radioactivity along a 1.5 km zone north of Silver Peak, east of State Route 265 (Henkle et al., 2005a). The terraces are the former site of flowing springs, with active fumaroles found at some (Henkle et al., 2005a, b). The springs probably extended along a north-trending fault on the west side of Clayton Valley that may control emplacement of a Quaternary basaltic cinder cone 6 km north (Henkle et al., 2005).

Silver Peak was first explored in the 1970s by Phillips Petroleum Company which drilled six temperature gradient wells in the area. Exploration resumed in 2005 with two more gradient holes, and in 2009 with ten shallow TG holes drilled by Sierra Geothermal Power (SGP). Surface features include geothermal vents, travertine-manganese silica sinter deposits, fossilized algae mats and complex faulting. The shallow wells have temperatures up to 88°C, geothermometry up to 227°C, and gradients exceeding 500°C/km. SGP also completed detailed MT and airborne Z-tipper Electromagnetic (ZTEM) surveys at Silver Peak (Shevenell and Zehner, 2012).

Silver Peak Hot Springs: Silver Peak Hot Springs are located near the western edge of Clayton Valley playa, just north of Silver Peak (shown at NW¼ SE¼ SE¼ Sec. 15, T2S, R39E on the Goldfield 30´x 60´ topographic map). Eleven springs were originally reported, and the water was used for the municipal water supply (Waring, 1965). By 1980, the site was reported to be dry (Trexler, Koenig, Flynn, et al., 1981; Table E2).

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The springs had a maximum reported temperature of 47.8°C (Waring, 1965). Mariner et al. (1983, p. 105) estimated the reservoir temperature to be 140ºC and 142ºC using silica and Na-K-Ca geothermometers, respectively, and Reed et al. reported a flow rate of 1,890 L/min (1983, p. 40). Silver Peak Hot Springs were reportedly quite radioactive, but contained very small amounts of uranium (Garside, 1973).

A mild thermal anomaly can be found 3 km SW of Silver Peak, at the 24.6ºC monitor well pumping station (T2S R39E 28). NBMG field samplers were allowed access to this well in June 2008 by Chemetall Foote. The estimated reservoir temperatures are 74.8ºC (Na-K-Ca; Fournier and Potter, 1979) and 66.8ºC (chalcedony; Fournier, 1977). A monitor well 1 km NE measured warm (Jennings, personal comm., 2008), as did a second pumping station well (26ºC; NWIS Well 143 S02 E39 28BDBB1; Great Basin Groundwater Geochemical Database).

Shallow temperature surveys conducted at both Silver Peak and Alum showed minor temperature anomalies but were helpful in narrowing the physical area that should be considered for future geophysical work or drilling (Kratt, 2011).

Chemetall Foote (a subsidiary of Rockwood Lithium, operating Silver Peak) plans to double the capacity of its lithium carbonate production. Rockwood obtained a Department of Energy grant to be used to help install a geothermal power plant at the site, which the company hopes will supply the majority of electric power needs for the lithium mine (Company web site: http://www.rockwoodlithium.com/, July 2013). Toward this end, Rockwood Lithium drilled one observation well that was permitted as a geothermal well to a depth of approximately 5,000 ft in December, 2012. Details of the results of this well are not available.

Pearl Hot Springs: Pearl Hot Springs (Sec. 25, TIS, R40E) had a reported temperature of 36.7°C on January 19, 1967 (Great Basin Groundwater Geochemical Database). These are probably the springs referred to by Spurr (1906) as issuing from the east side of the playa across Clayton Valley from the Silver Peak Hot Springs. A major north-northeast-striking fault may run through the spring area (see Albers and Stewart, 1972, plate 1). Trexler, Koenig, Flynn, et al. (1981; Table E2) reported that the springs were dry.

Miles Silberman may have sampled Pearl Hot Springs in October 1968. The exact sample location is unclear for several reasons: (1) Silberman identified the spring as “Alkali Hot Spring S.W.”, but gave latitude and longitude values for Pearl Hot Springs. (2) Alkali Hot Spring, 15 km east of Pearl Hot Springs, has known chemistry and temperature data. Conductivity and chemistry measurements for “Alkali Hot Spring S.W.” (R40E) are 1-2 orders of magnitude greater than results for Alkali Hot Spring (R41E). (3) Charge balance calculations indicate a good analysis, within 2.4%. These factors suggest a mislabeled analysis for Pearl Hot Springs. Silberman’s analysis yielded reservoir temperatures of 163°C (Na-K-Ca; Fournier, 1979) and 105°C (quartz; Fournier, 1977), and a measured temperature of 47.2°C (Mariner Database, 2001; see Great Basin Groundwater Geochemical Database).

Leasing information: (Map)

The Clayton Valley project combined several RAM properties with adjacent properties belonging to the former Sierra Geothermal, which RAM acquired in 2010. The area included Alkali Hot Springs, Alum,

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Pearl Hot Springs, Weepah, and Montezuma project areas. All project areas were located in Esmeralda County. RAM estimated up to 160 MW of geothermal power from these combined properties. Geophysical surveys were conducted in 2011. A 32 MW power plant was planned to be on the property by 2013. Although RAM held a PPA with NV Energy for delivery of this power, RAM relinquished the leases in 2012 as they focused their efforts on their Nicaragua San Jacinto property (Shevenell and McDonald, 2013).

Bibliography:

Albers, J. P., and Stewart, J. H., 1972, Geology and Mineral Deposits of Esmeralda County, Nevada: Nevada Bureau of Mines and Geology Bulletin 78.

Davis, J.R., Friedman, I., and Gleason, J.D., 1986, Origin of the lithium-rich brine, Clayton Valley, Nevada: U.S. Geological Survey Bulletin 1622, p. 131-138.

Dole, R.B., 1913, Exploration for Salines in Silver Peak Marsh, Nevada: U.S. Geological Survey Bulletin 530.

Dreyer, R.M., 1940, Goldbanks Mining District, Pershing County, Nevada: Nevada University Bulletin, v. 34, no. 1, Geology and Mining Series no. 33, 38 p.

Fournier, R.O., 1977, Chemical geothermometers and mixing models for geothermal systems: Geothermics, v. 5, p. 41-50.

Fournier, R.O. and Potter, R.W., 1979, Magnesium correction to the chemical geothermometer: Geochimica et Cosmochimica Acta v. 43, p. 1543-1550.

Garside, L.J., 1973, Radioactive Mineral Occurrences in Nevada: Nevada Bureau of Mines and Geology Bulletin 81.

Great Basin Groundwater Geochemical Database, Nevada Bureau of Mines and Geology: http://www.nbmg.unr.edu/Geothermal/GeochemDatabase.html

Henkle, W.R., Jr., Gunderson, W.C., and Gunderson, T.D., 2005a, Mercury geochemical, groundwater geochemical, and radiometric geophysical signatures at three geothermal prospects in northern Nevada: Geothermal Resources Council Transactions, v. 29, p. 243-250.

Henkle, W.R., Jr., Gunderson, W.C., and Gunderson, T.D., 2005b, Mercury geochemical, groundwater geochemical, and radiometric geophysical signatures at three geothermal prospects in northern Nevada, *in* Rhoden, H.N., Steininger, R.C., and Vikre, P.G., eds., Geological Society of Nevada Symposium 2005: Window to the World, Reno, Nevada, May 2005, p. 1147–1157.

Jennings, M., personal comm., 2008

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Kratt, C., 2011. Hyperspectral, Shallow Temperature, and Gravity Surveys: A Roundup of Recent Exploration Activity at Silver Peak, Alum, and Columbus Salt Marsh, Esmeralda County, Nevada. Geothermal Resources Council Transactions 35: 853-860.

Mariner, R.H., Brook, C.A., Reed, M.J., Bliss, J.D., Rapport, A.L., and Lieb, R.J., 1983, Low-Temperature Geothermal Resources in the Western United States, *in* Reed, M.J., (Editor), Assessment of Low-Temperature Geothermal Resources of the United States—1982, U.S. Circular 892, p. 31-50.

Meinzer, O.E., 1917, Geology and Water Resources of Big Smokey, Clayton, and Alkali Spring Valleys, Nevada: U.S. Geological Survey Water-Supply Paper 423.

Papke, K.G., 1976, Evaporites and Brines in Nevada Playas: Nevada Bureau of Mines and Geology Bulletin 87.

Great Basin Groundwater Geochemical Database, Nevada Bureau of Mines and Geology: <http://www.nbmg.unr.edu/Geothermal/GeochemDatabase.html>.

Price, J.G., Lechler, P.J., Lear, M.B., and Giles, T.F., 2000, Possible Volcanic Source of Lithium in Brines in Clayton Valley, Nevada, *in* Cluer, J.K., Price, J.G., Strusacker, E.M., Hardyman, R.F., and Morris, C.L., eds., Geology and Ore Deposits 2000: The Great Basin and Beyond: Geological Society of Nevada Symposium Proceedings, May 15-18, 2000, p. 241-248.

Reed, M.J., Mariner, R.H., Brook, C.A., and Sorey, M.L., 1983, Selected Data for Low-Temperature (Less Than 90 Degrees C) Geothermal Systems in the United States; (Reference Data for USGS Circular 892): U.S. Geological Survey Open-File Report 83-250, 129 p.

Sass, J.H., Priest, S.S., Blanton, A.J., Sacket, P.C., Welch, S.L., and Walters, M.A., 1999. Geothermal Industry Temperature Profiles from the Great Basin. U.S. Geological Survey Open-File Report 99-425. http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html

Shevenell, L., and B. McDonald, 2014. Geothermal Energy In The Nevada Mineral Industry (ed. John Muntean), Nevada Bureau of Mines and Geology MI-2012, p 126-148. http://www.nbmg.unr.edu/dox/mi/12.pdf

Shevenell, L., and Zehner, R., 2012. Recent Geothermal Avtivity in Nevada – Spring 2012. GRC Bulletin May/June 2012 p 38. <http://geothermal.org/PDFs/Articles/12MayJune29.pdf>

Spurr, J.E., 1906, Ore Deposits of the Silver Peak Quadrangle, Nevada: U.S. Geological Survey Professional Paper 55.

Trexler, D.T., Flynn, T., Koenig, B.A., and Bruce, J.L., 1981, Nevada Resource Assessment Program, 1980: in Ruscetta, C.A., etal., Editors, Geothermal Direct Heat Program, Glenwood Springs Technical Conference Proceedings: Papers Presented; State Coupled Geothermal Resource Assessment Program Report, v. 1, U.S. Department of Energy Report DOE/ID/12079-39; ESL-59, p.205-227, Available at University of Utah Research Institute, Earth Science Laboratory, Salt Lake City, UT.

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Waring, G.A., 1965, Thermal Springs of the United States and Other Countries of the World: U.S. Geological Survey Professional Paper 492, 383 p.

Zampirro, D., 2003, Hydrogeology of Clayton Valley brine deposits, Esmeralda County, Nevada, *in* Castor, S.B., Papke, K.P., and Meeuwig, R.O., eds., Proceedings of the 39th Forum on the Geology of Industrial Minerals, May 18–24, 2003: Nevada Bureau of Mines and Geology Special Publication 33, p. 271–280.