UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Geochemically anomalous rock samples, and their implication for the occurrence of a hot-spring type gold deposit, from Baker (Abraham) Hot Spring, Juab County, Utah

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SUMMARY

Baker Hot Spring contains geochemically anomalous amounts of gold, arsenic, antimony, manganese, tungsten, and beryllium. The material containing the geochemical anomalies consists of manganiferous tufa deposited from an active hot spring system on the Sevier Desert a few hundred meters east of the edge of a basalt flow associated with Fumarole Butte. The Baker Hot Spring area contains geologic and geochemical traits similar to better exposed hot-spring mineral systems, such as at Golconda, Nevada, Sulphur, Nevada, and parts of Creede, Colorado, which have been mined for metals including gold, silver, sulfur, tungsten, and manganese, and may contain economic concentrations of these, or possibly other, metals in the subsurface.

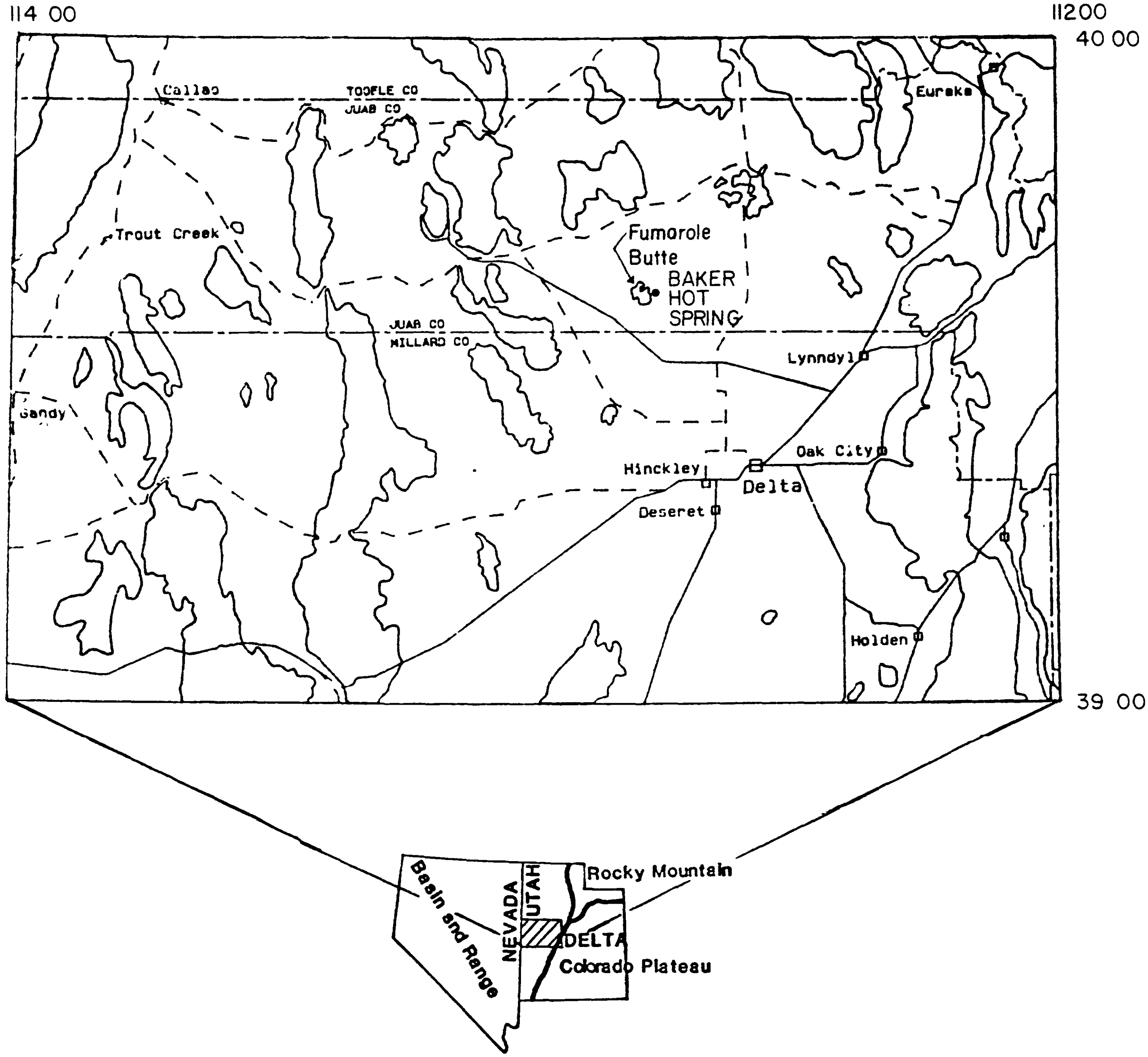
INTRODUCTION

An active hot spring, located about six kilometers southeast of Fumarole Butte in Juab County, Utah, (figure 1) has recently deposited material that is geochemically anomalous in the elements gold, arsenic, antimony, manganese, tungsten, and beryllium. This hot spring is currently listed as Baker Hot Spring on U.S.G.S. topographic maps, but has been referred to as Abraham Hot Spring in several geologic reports (Callaghan and Thomas, 1939; Crittenden, 1951). The hot spring system covers an area of about 0.2 square miles and consists of several low mounds of manganiferous tufa that generally rise ten to 15 feet above the Sevier Desert.

GENERAL GEOLOGIC SETTING

The Baker Hot Spring has produced about 715 tons of manganese oxide ore that averaged 20% manganese and 0.26 % sulphur (Callaghan and Thomas, 1939). The manganese deposits occur as a thin bed and as lenses and nodules in a tufa dome that is located near the eastern edge of a Quaternary basalt flow on the floor of the Sevier Desert. Alkaline hot waters are currently emanating from several orifices in the dome and have a total discharge of over 1200 gallons a minute, reach temperatures of 182 F, and average 3900 parts per million in dissolved solids (Callaghan and Thomas, 1939). The manganese ore was mined from a bed of manganese and iron oxides mostly covered by porous calcite and consisted mostly of psilomelane and pyrolusite in which vugs are lined with limonite (Callaghan and Thomas, 1939). Apparently, most of the manganese-rich material has been removed as Crittenden (1951) reports that relatively little material remains that contains more than 15 percent manganese. The uppermost layers of the mound are composed of clay, iron oxide, and porous calcite (Crittenden, 1951).

Figure 1. Index location map of Baker (Abraham) Hot Spring, Juab County, Utah.



GEOCHEMISTRY

Several rock samples from the hot spring were collected in 1986 as part of the USGS's Delta CUSMAP (Conterminous United States Mineral Assessment Program) project. The samples were analyzed for 31 elements using standard emission spectrographic methods (Grimes and Marranzino, 1968) and for six elements (gold, bismuth, arsenic, antimony, zinc, and cadmium) using various wet-chemical methods (Thompson and others, 1968 [Au]; Welsch and Chao, 1975 [Sb]; Welsch, 1979 [As]; Viets, 1978 [Bi, Cd, Zn]). Table 1 includes a list of samples from Baker Hot Spring that were anomalous in one or more of a group of selected elements. These samples all represent only the uppermost layer of the hot spring deposit and consist of various types of chemically-precipitated materials, including calcium carbonates, iron oxides, manganese oxides, and silicates. The samples are geochemically anomalous in the suite of elements gold, manganese, arsenic, antimony, beryllium, and tungsten.

SIGNIFICANCE OF GEOCHEMICAL SUITE

The significance of anomalous metals in the surface deposits at Baker Hot Spring may be their use as a guide to the presence of larger metallic deposits below the surface. The most significant potential for possible mineral deposits associated with the hot spring is probably not in the mound directly precipitated by the waters emanating at the surface. This material has already been mined for manganese, and its total mass is not very large. Any potential deposit below the surface in this area may show geologic and geochemical characteristics similar to hot spring precious metal deposits recently summarized in papers such as White (1981), Silberman (1982), Silberman and Berger (1985), Berger and Silberman (1985), and Henley (1985). Figure 2 is a cartoon of only a few of the possible geologic environments which may exist in the subsurface in the vicinity of Baker Hot Spring, any of which may have localized circulating, metal-bearing fluids with the eventual deposition of such metals. The most likely site for the deposition of a subsurface mineral deposit in this area might be within a stratiform bed which has been open to fluid circulation for a long period of time, and which was capped by a relatively impermeable bed, possibly either the basalt of Fumarole Butte, or a marl layer in the Lake Bonneville sediments.

GEOLOGIC ANALOGUES

Although details concerning the subsurface geology at Baker Hot Spring are lacking, they probably share some of the same traits as the Golconda tungsten-bearing hot spring system in Nevada (e.g, Kerr, 1940; Erickson and Marsh, 1971), the fossil

Figure 2. Schematic representation of possible styles of metallization located in the subsurface near Baker (Abraham) Hot Spring, Juab County, Utah. **NOTE:** The scale and subsurface geologic framework are not known; they are shown for discussion purposes only and may not represent the true geology. Parts of the diagram are generalized from Berger and Eimon (1983) and Kerr (1940).

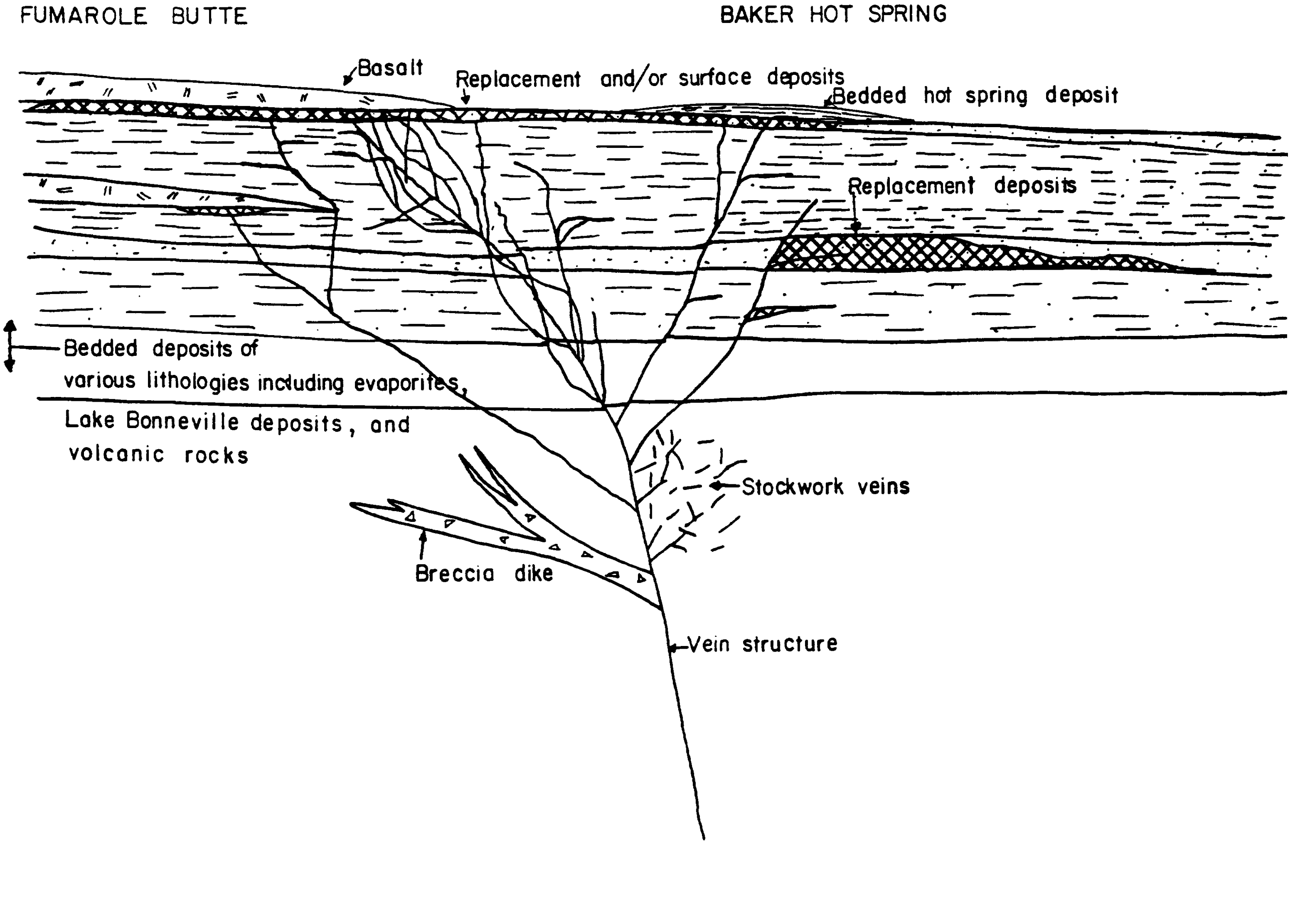


Table 1. Selected geochemical data from Baker Hot Spring, Utah and the Golconda and Sulphur, Nevada hot spring mineral systems.

Sample #	Rock Type	Au	As	Sb	W	Mn	Be
BAKER HOT SPRING							
5123	Iron-rich wad	<.05	400	220	<50	1500	10
5124A	Iron-rich wad	<.05	300	220	200	5000	7
5124B	Manganese-rich wad	0.35	500	500	200	>5000	2
5124C	Manganese-rich wad	0.25	600	500	500	>5000	15
5215B	Travertine	<.05	70	76	50	>5000	<1
5215C	Manganese-rich wad	<.05	800	580	500	>5000	20
5215D	Travertine	<.05	250	250	100	>5000	<1
SULPHUR							
S-1	Alunite vein in silicified rock	<.05	60	300	50	150	<5
S-2	Silicified pyritic sediment	0.50	100	36	<50	1000	2
S-3	Silicified pyritic sediment	0.20	120	20	<50	1000	2
S-6	Silicified sediment	1.5	120	1700	50	200	15
GOLCONDA							
G1	Soft, black manganese oxide	<20	1500	<200	7%	>10%	30
G2	Soft, orange-brown iron oxide	<20	15,000	<200	7000	3%	30

NOTE: all values in parts-per-million except where listed as percentages.

DATA SOURCES:

Baker Hot Spring: (unpublished data), analyses by B.F. Arbogast, P.L. Hageman, and T.A. Roemer, U.S.G.S.; analytical techniques described in text.

Sulphur: Silberman (1982) and Silberman (unpublished data); analyses courtesy R.M. O'Leary and R.F. Hansen, U.S.G.S.

Golconda: Marsh and Erickson (1975); analyses courtesy N.M. Conklin, U.S.G.S.

hot spring precious-metal system at the Sulphur mining district in Nevada (e.g., Wallace, 1987), and the moat-fill sediment-hosted precious-metal deposit in the Creede district, Colorado (e.g., Smith, 1981; Rice, 1984). Geochemical data for the Creede deposits are not available, but it is known to contain anomalous amounts of silver, sulfur, barite, and manganese. Comparative geochemical data for the Golconda and Sulphur deposits are presented in table 1. These two systems, along with the Baker Hot Spring system, display anomalous amounts of gold, arsenic, antimony, tungsten, beryllium, and manganese. In addition, barium and sulfur also occur in anomalous amounts in all of these systems, e.g., Kerr (1940), Wallace (1987), and Callaghan and Thomas (1939). Historically these deposits have been mined for gold, silver, sulfur, tungsten, and manganese and it seems reasonable to expect that any or all of these metals, and possibly some additional metals, may exist in economic concentration in the subsurface near Baker Hot Spring.

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