EUREKA COUNTY (continued)

Flynn Ranch Springs [101]

The Flynn Ranch Springs consist of several slightly warm springs of low discharge and a deep pool. The temperatures range from 69° to 70°F, and the discharge is reported to be 10 gallons per minute. The springs are located in S5,T25N,R53E, about one-half the distance between Shipley's and Bruffey's Hot Springs, along the west edge of the Sulphur Spring Range.

Sulfur Springs [105]

Two slightly warm springs are located in S36,T23N, R52E along the east side of the Sulphur Spring Range about 8 miles south of Shipley's Hot Springs. The temperature of the springs is 74°F and they discharge about 20 gallons per minute. These springs are near the mountain front, and may be related to a possible extension of the frontal fault near Siri Ranch and just north of Shipley's Hot Springs.

Thompson Ranch Spring [106]

A warm (69° to 75°F) spring issues from alluvium adjacent to limestone at Thompson Ranch on the east side of Diamond Valley in S3,T23N,R54E (Mifflin, 1968). This spring may be the same as the Jacobson Ranch Springs reported by Waring (1965). Harrill (1968) suggests that the spring is probably fault-controlled, as is, according to Roberts and others (1967), a part of the range front along the edge of the Diamond Range.

Hot Creek springs [98]

Six springs flow from alluvium just adjacent to limestone bedrock. The main spring orifice is reportedly in bedrock. The springs are in S12,T28N,R52E (Mifflin, 1968). The reported temperature is 84°F. These springs have reported discharges of 1,800–2,250 (Eakin, 1961) and 5,900 (Mifflin, 1968) gallons per minute. This flow often largely maintains Pine Creek which flows north down the center of Pine Valley. The Na-K-Ca thermal reservoir estimate is near the spring temperature (Mariner and others, 1974).

Raine Ranch? Springs [95]

Springs in S6,T31N,R52E are reportedly warm and flow 100 gallons per minute (Bradberry and Associates, 1964).

HUMBOLDT COUNTY

Double Hot Springs–Black Rock Hot Springs [131]

A number of hot springs are located in alluvium along the west side of the Black Rock Range (fig. 27). These springs are normally 1 mile or less from the bedrock outcrops, and are aligned along a 7 mile long zone from south of Black Rock Point to Double Hot Springs (Hose and Taylor, 1974). The springs are along a major range-boundary fault with slight Holocene displacement which extends north from Black Rock Point to Soldier Meadows, a distance of approximately 35 miles. A hot spring is also present in S10,T37N,R26E about 5 miles north of Double Hot Springs (Waring, 1965), and warm ground was encountered about half a mile north of that spring in a U. S. Geological

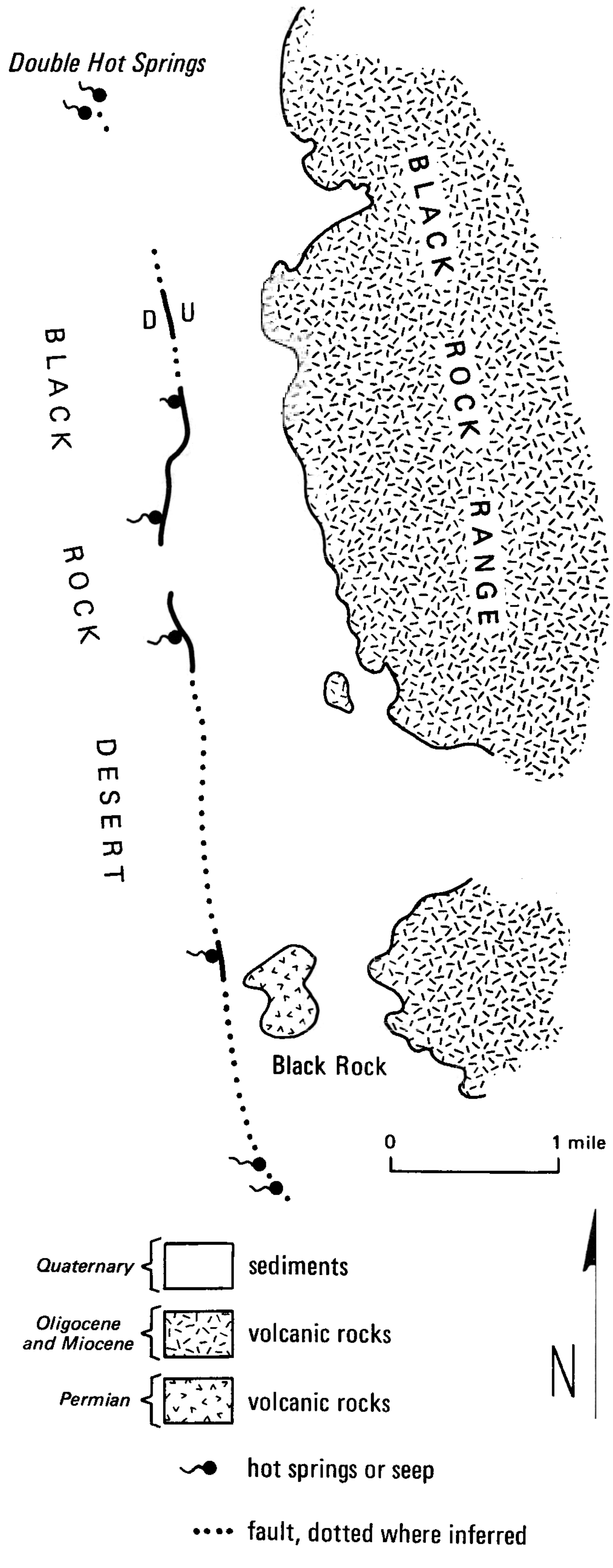


FIGURE 27. Geologic map of the Double Hot Springs–Black Rock area (after Hose and Taylor, 1974).

Survey test hole (Olmsted and others, 1975). Thus, the known extent of the thermal anomaly is about 12 miles. No data are available for the northern portion of the boundary fault. To the south of Black Rock Point the fault crosses the Black Rock Desert (fig. 27) and joins with a fault associated with the hot springs at the Trego area in Pershing County (L. T. Grose, written communication, 1977). Hose and Taylor (1974) suggest that the Holocene displacement on this fault may be related to an earthquake of magnitude 4.1 at latitude 41°N, longitude 119°W in 1936.

The hot springs along this zone were used for drinking, bathing, and stock watering by wagon-train emigrants (Paden, 1949) on the Applegate–Lassen Trail. Today they are used for stock watering and irrigation.

The nearest young volcanic rocks are the less than 6-million-year-old basalts 40 to 50 miles to the north along a north-northeast trending lineament which runs from Soldier Meadows to Railroad Point (fig. 28). The Double Hot Springs–Black Rock Hot Springs fault appears to turn to the northeast and join this lineament just west of Soldier Meadows Hot Springs.

Higher concentrations of dissolved solids are reported from springs near the south end of the fault. This is believed to be due to contamination of the waters by more saline brines which probably collect in low areas of the Black Rock Desert (Hose and Taylor, 1974).

Estimates of the subsurface aquifer temperature based on SiO_2 content show reasonably consistent temperatures for springs at either end of the fault. These estimated aquifer temperatures are 275° to 298°F. Trace amounts of both travertine and siliceous sinter are reported (Hose and Taylor, 1974).

Water temperatures at springs along the fault are usually 130° to 170°F, with temperatures up to 202°F, which is near boiling for this elevation (4,000 feet), reported from the spring furthest south along the fault.

Two heat-flow drill holes in the central part of the Black Rock Desert (within 3 miles of Black Rock), which are not affected by the local movement of thermal ground water, indicate that the heat flow in the Black Rock Desert area is probably not more than two heat flow units (HFU), which is not unusually high for the northern Basin and Range province (Olmsted and others, 1975).

Pinto Hot Springs [129]

The second highest spring temperatures in Humboldt County are reported from about 1 mile north of Pinto Mountain. These springs shown in S17,19,T40N,R28E on the Pinto Mountain 7½-minute quadrangle, are East and West Pinto Hot Springs, respectively. Location data given in older references are somewhat confused, owing to the irregular nature of the land grid in this area. Reported temperatures for the springs, which are about 1 mile apart, are 199° to 201°F. The water analyses are also quite similar, indicating a close hydrologic connection. The springs are in a small outcrop area of quartz monzonite (Willden, 1964, plate 1) in some low hills of mafic Tertiary volcanic rocks along the west margin of the Black Rock Desert. The estimated thermal reservoir temperatures using the conductive silica geothermometer are 324° to 329°F (Mariner and others, 1974). Travertine and siliceous sinter are interlayered in the spring deposits at the springs (Hose and Taylor, 1974). Batzle and others (1976a) report on telluric profiles at Pinto Hot Springs.

Baltazor (Continental) Hot Springs [111]

Baltazor Hot Springs are located in S13,T46N,R28E at the north end of Continental Lake. They are along a fault which bounds the east side of the Pueblo Mountains, and which is a small part of a lineament which extends from Soldier Meadow Hot Springs through Baltazor Hot Springs and into Oregon (Hose and Taylor, 1974). This lineament is at least 65 miles long and can be seen in the fault pattern shown on the preliminary geologic map of Nevada at 1:500,000 (Stewart and Carlson, 1974). A warm spring in S12,T44N,R27E also lies along this lineament, and a subparallel zone extends from Summit Lake along the east side of McGee Mountain to Bog Hot Springs, where it reportedly terminates. In the vicinity of McGee Mountain, steam and warm water are reported from along this fault, and a core hole, reported 131°F at 200 feet (Wendell, 1970, p. 95, 98, 109), possibly in the vicinity of the Painted Hills mercury mine in S23?,T45N,R27E. The only young (less than 6 m.y.) volcanic rocks in this area are basalts which are exposed just to the northwest of this fault in the extreme northwest corner of Humboldt County (Stewart and Carlson, 1976a).

Hose and Taylor (1974) have suggested that this N30°–35°E lineament existed as a large fault in the early Tertiary terrain and that tectonism that occurred after the Oligocene and Miocene volcanic rocks were deposited resulted in modest renewed displacement that manifested itself in the volcanic cover.

Water temperatures at Baltazor Hot Springs are at or near 200°F, and small amounts of both travertine and siliceous sinter are present. The best estimates of the reservoir temperature are 306°F and 329°F for the Na-K-Ca and silica geothermometers, respectively and traces of travertine and siliceous sinter are reported (Mariner and others, 1974).

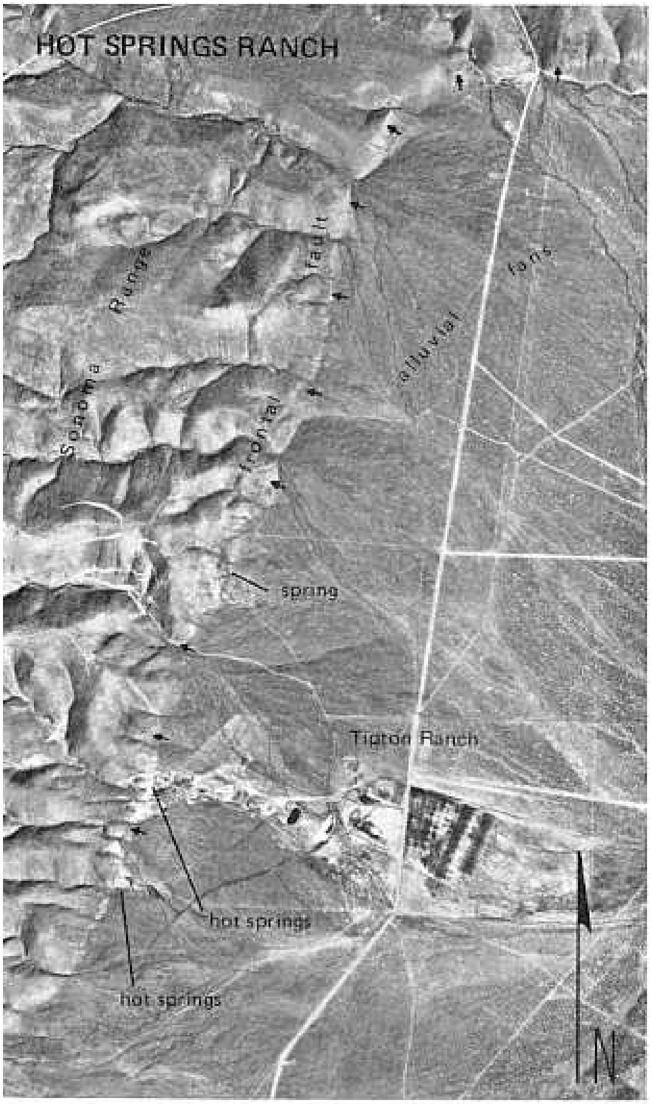
Hot Springs (Tipton) Ranch [146]

Hot springs at Tipton Ranch in S4,5,T33N,R40E have temperatures as high as 185°F (Mariner and others, 1974). These springs are along a N20°E fault which forms the boundary of the Sonoma Range in that area. The spring deposits are predominantly travertine with a trace of siliceous sinter. The "best" estimates of the thermal-aquifer temperature are 381° to 385°F (Mariner and others, 1974). Wollenberg (1974b) reports that slightly anomalous radioactivity (up to 22.5 μR/hr) is present at the springs. In 1974 Magma Power Co. drilled a geothermal well at Tipton Ranch to a total depth of 3,071 feet. The well has also been called the "Pumpernickel Valley well."

Golconda area [139]

Hot springs are found in S29,32,T36N,R40E near the town of Golconda, and hot water is present in a drill hole at the Golconda tungsten mine in S36,T36N,R40E.

Approximately 12 springs are reported at Golconda Hot Springs, with temperatures ranging from 109° to 165°F (see Appendix 1). The area was famous as a resort and health center where early settlers often spent several weeks



at its large hotel drinking and bathing in the mineral waters (Miller and others, 1953).

In the early 1880's, Adams and Bishop (1884) reported that farmers in the vicinity used the springs for scalding swine. The swimming area at that time was a hole excavated in the ground. Also, the water was used for irrigation, and radishes, lettuce, onions, etc. were raised early in the growing season due to the warmth produced by the hot-spring water. A 175-foot-deep well drilled in 1940 was used from 1940 to 1945 for water in the chemical plant treating the tungsten-iron-manganese ores from the Golconda Mine, 4 miles to the east (D. I. Segerstrom, written communication, 1972). For many years the water from this well was used for health baths at the Golconda Hot Springs Hotel.

Penrose (1893) reported that the deposits of Golconda Hot Springs were highly charged with manganese oxides. Some of the areas around the hot spring vents are anomalously radioactive, up to 175 μR/hr (Wollenberg, 1974b), and thorium may be present in the water (D. I. Segerstrom, written communication, 1972). Also, a few parts per million tungsten are reported.

The spring deposits at the Golconda Hot Springs are reported to consist of travertine, and an estimate of the thermal reservoir temperature using the silica geothermometer is 239°F (Mariner and others, 1974). Basalt flows younger than 6 m.y. are present about 2.5 mi south of the Hot Springs area (Stewart and Carlson, 1976b).

At the tungsten-manganese deposits of the Golconda Mine in S36,T36N,R40E, as much as 6 feet of tungsten-bearing ferruginous and locally manganiferous clayey gravel rests on steeply dipping Cambrian rocks. Much of the ore is overlain by up to 20 feet of travertine. The tungsten is believed to have been deposited from water emerging from a fissure in phyllite beneath the deposit, and the travertine was deposited from spring waters issuing from a parallel fissure in limestone upslope from the tungsten deposit (White, 1955, p. 136). In a few places,

Hot-water pool at Golconda Hot Springs, Humboldt County.

travertine underlies the ore, and although the relative age of the travertine and tungsten deposits is not completely clear, White (1955a) believes that they were deposited contemporaneously. Barium occurs within the manganiferous tungsten deposits, and barite nodules have been found locally in the travertine. Analyses of the ore indicate that it is anomalous in Co, Nb, Ni, As, Be, Ge, and Th (Ralph Erickson, personal communication, 1971).

The most likely explanation for this deposit seems to be that it is of hot-springs origin, deposited at or very near the present land surface. A 258-foot-deep drill hole at the mine contained marcasite throughout its entire depth (D. I. Segerstrom, written communication, 1972), another indication of deposition at shallow depth and low temperature. The bedded deposit is underlain by scheelite-bearing skarn rocks, and remobilization of tungsten and arsenic could account for all of the metallization associated with the hot-spring water (Berger and others, 1974).

The Golconda tungsten-manganese deposit has been interpreted as being related to the high-water stage of Lake Lahontan (see Willden, 1964, p. 111). Although the deposits are about 100 feet above the highest late Pleistocene shoreline (Kerr, 1940), the springs that formed these deposits probably had their greatest discharge when the lake level and surrounding ground-water levels were high (Willden, 1964). This relationship with Pleistocene Lake Lahontan would make the deposit very young, probably less than 50,000 years old. Erickson and Marsh (written communication in Berger and others, 1975) suggest that the deposit is the result of spring activity less than 5 m.y. old.

A drill hole in the C SW/4 S36,T36N,R40E at the site of the Golconda Mine has a temperature of 143°F at 220 feet. As there was considerable marcasite encountered in this hole, the temperature could be due to oxidation of sulfide minerals (D. I. Segerstrom, written communication, 1972). A spring about 600 feet to the northeast of this well is reported to flow 1.5 gallons per minute of 69°F water.

Howard Hot Spring [117]

Water temperatures at Howard Hot Spring (S4,5,T44N, R31E) are usually reported to be 118° to 136°F, although Sinclair (1962a) does list one spring with a temperature of 163°F. There are several described hot springs in Waring (1965) and Stearns and others (1937) for which detailed location data are lacking, but which may refer to Howard Hot Springs. Hose and Taylor (1974) report that siliceous sinter is present, and they prefer a 262°F estimated reservoir temperature using the silica (conductive) geothermometer.

Dyke Hot Spring [119]

Dyke Hot Spring is approximately 11 miles south of Howard Hot Spring in S25,T43N,R30E. It lies at the southern end of a fault which forms the east boundary of the Pine Forest Range. The temperature is reported to be as high as 158°F (Sinclair, 1962a). The estimated thermal-aquifer temperatures are 262°F and 279°F, although these are from mixed waters, and may be significantly below the true thermal-aquifer temperature. A trace of travertine is reported (Mariner and others, 1974).

Cordero Mercury Mine [109]

White (1955a) reported that the lower workings of the Cordero Mercury Mine (S33,T47N,R37E) were noticably hot, in the order of 86° to 95°F, but no precise temperature measurements were taken. He also mentioned that the level of oxidation in the mine was between the 500- and 600-foot level. Water wells downslope from the mine have temperatures of up to 140°F (Visher, 1957) at depths of 400 to 600 feet. Isotopic analysis of the well waters indicates a strong dominance by water of meteoric origin (White, 1974). A well in S17,T47N,R38E, 5.5 miles northeast of the Cordero Mine, has a reported temperature of 90°F.

Bog Hot Springs [110]

Bog Hot Springs in S7,18,T46N,R28E have been used since the turn of the century for stock watering and irrigation of over 400 acres of wild hay. Also, they are presently used for domestic water and hot mineral water baths on the Bog Hot Springs Ranch (Peterson, 1976). The springs are reported to discharge as much as 1,000 gallons per minute, and are probably associated with an active fault zone (Sinclair, 1963c). The highest surface temperature reported is 131°F (Sanders and Miles, 1974), and estimates of the reservoir temperature from chemical geothermometers are approximately 227°F, although the springs may be a mixed-water system.

Bog Hot Springs are located at the north end of the western branch of a major lineament which extends from Soldier Meadows Hot Springs into Oregon (fig. 28), a distance of over 65 miles (Hose and Taylor, 1974). Geothermal anomalies are reported along the western branch of this lineament to the south in the vicinity of McGee Mountain (see preceding description of Baltazor Hot Springs).

Soldier Meadows Hot Springs [128]

The hot springs in Soldier Meadows are generally in and around S23,T40N,R24E. The area is named for the soldiers which were stationed at a U. S. Army field camp, Camp McGarry, located in the northern part of the meadows in the 1860's. Hose and Taylor (1974) have described a N30°–35°E lineament which is believed to extend from Soldier Meadows 65 miles to the northeast into Oregon (see the preceding sections on Baltazor and Bog Hot Springs). There are a large number of thermal springs in the Soldier Meadows area, with temperatures reported as high as 129°F. Grose and Keller (1975b) mention 49 distinct features noted on airborne thermal infrared scanner imagery, which are believed to be distinct thermal springs. Some warm springs were noted in areas where no thermal springs have been reported in the literature.

The discharge of some springs is estimated to be up to 500 gallons per minute, and the spring temperatures often fall into a bimodal distribution at approximately 70° and 126°F (Grose and Keller, 1975b). A considerable number of springs with temperatures of 110° to 120°F are located along a flowing creek, which had an average temperature of 100°F in the spring of 1973. The Na-K-Ca estimated reservoir temperature (149°F) is near the spring temperatures (Mariner and others, 1974).

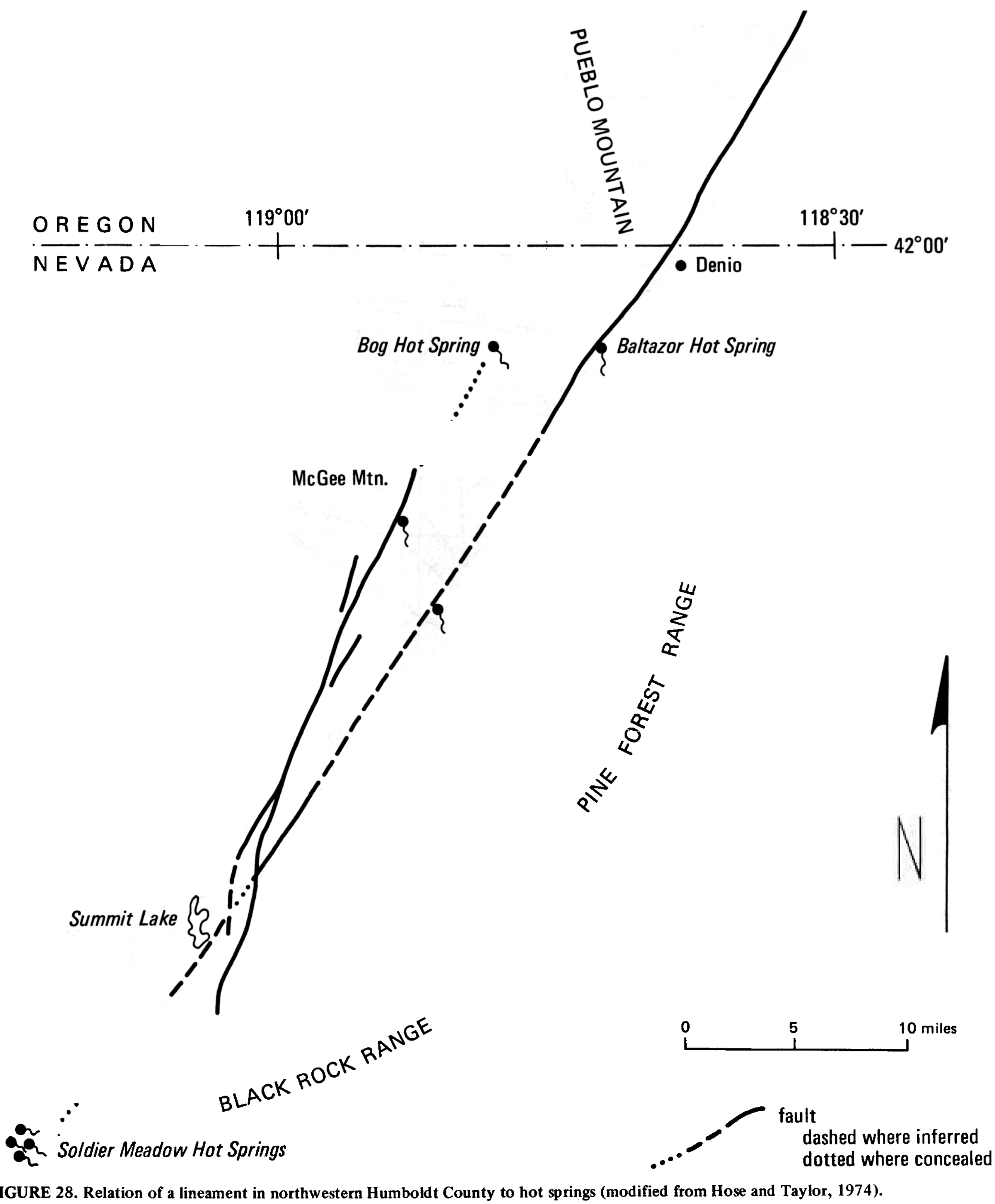
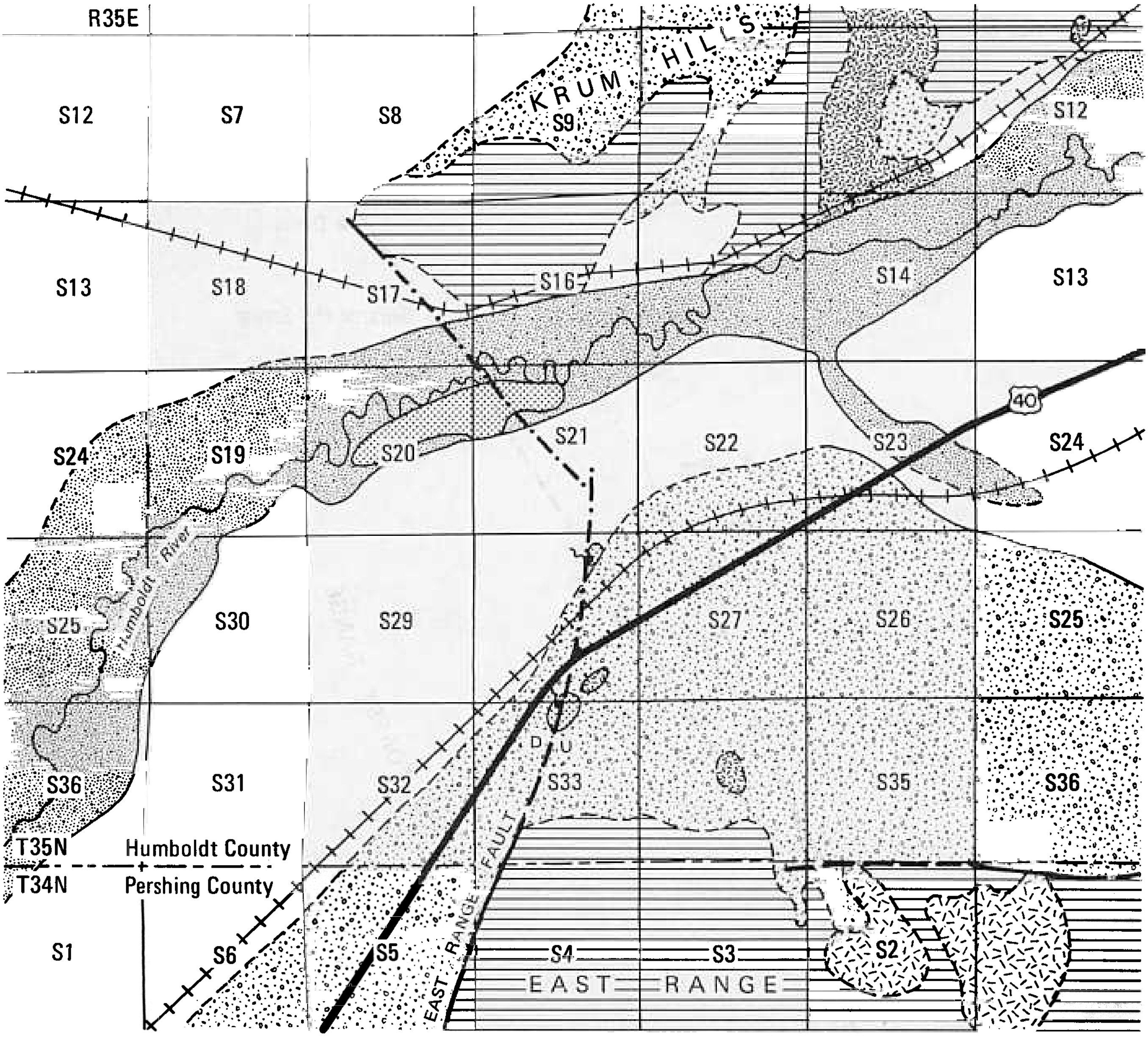


FIGURE 28. Relation of a lineament in northwestern Humboldt County to hot springs (modified from Hose and Taylor, 1974).

Northern East Range area [142]

Warm springs and wells are located at the northwestern corner of the East Range in S28,T35N,R36E (Cohen, 1962c, 1964). These springs are along the extension of a range-boundary fault which is believed to cross U. S. Highway I–80 near the center of S28, according to geophysical evidence (Cartwright and others, 1964). The springs are approximately 82° to 84°F and high in boron. Water wells down-gradient from the springs also contain 2 to 15 ppm boron (Cohen, 1964).

The East Range fault described above is believed to intersect a buried northwest-trending fault which has been extended southward from the Krum Hills (fig. 29). These



Quaternary
- siliceous and calcareous spring deposits
- fluviatile and subaerial deposits
- lacustrine deposits – sediments of Lake Lahontan
- fanglomerate – forms alluvial fans

Tertiary
- volcanic rocks

Jurassic
- plutonic rocks

Mesozoic
- sedimentary rocks

spring

fault, dashed where approximately located; dot-dash where located by geophysical exploration

FIGURE 29. Generalized geologic map of the northern East Range area and vicinity (from Cartwright and others, 1964, with some modifications from Hawley and Wilson, 1965).

HUMBOLDT COUNTY (continued)

faults are projected on the basis of geophysical evidence plus the presence of thermal water in springs and wells along the fault. Also, the alluvial units are altered in the vicinity of the faults, and spring deposits are present at several areas. These spring deposits consist of both siliceous sinter and travertine (Cohen, 1962b). The deposit in S33 is at the approximate maximum level of Pleistocene Lake Lahontan, and is possibly related. In that case, the deposit would be younger than approximately 50,000 years. White (1955a) describes the travertine at one spring terrace (probably in NE/4 NW/4 S33,T35N,R36E) as being light brown in color and very porous. One sample contained 9 percent Mn and 0.3 percent WO_3. The present spring is not depositing travertine.

Tungsten-bearing manganese veins in E/2 SE/4 S5,T34N, R36E are along the west border of the East Range, and near the East Range fault. This property has been called the Victory Lode, and is located just inside Pershing County, but is included with this Humboldt County description because of its possible relation to the fault. The veins consist largely of calcite with films of manganese and iron oxides. Other gangue minerals are quartz, chalcedony, and gypsum. R. J. Roberts (quoted in White, 1955a), believes that these veins are the "roots" of spring deposits now removed by erosion. They are no doubt older than the travertine deposits to the north, but are probably genetically related (White, 1955a).

Sulphur area [141]

The Sulphur Mining District is an old sulfur-mining area, with minor associated mercury. No thermal activity is now evident, but White (1955a) reported that a strong odor of H_2S can be noticed in some of the short adits of the Devil's Corral workings (S30,T35N,R30E).

The sulfur was deposited by hot springs, and these probably had their greatest discharge when the level of Pleistocene Lake Lahontan and the surrounding ground-water level was high. All of the deposits are at or near the upper level of the lake, except for the Peterson deposit, which is in a fault zone considerably above the upper level of Lake Lahontan (Willden, 1964, p. 111).

LANDER COUNTY

Beowawe Geysers [94]

The geothermal activity at Beowawe Geysers is found in both Eureka and Lander Counties but most of the spring area is in Eureka County, and for simplicity the descriptions and water quality data are included in that county.

Spencer Hot Springs [162]

The hot springs and wells at Spencer Hot Springs are mainly located in the SE/4 S13,T17N,R45E (projected). There are also springs to the east of the main spring area (fig. 30), in S14,T17N,R45½E (Fiero, 1968). Meinzer (1917, p. 50, 91) reports the presence of a travertine terrace nearly 1 mile long and half a mile wide with spring deposits not more than 50 feet thick. According to Meinzer (1917), the main spring is 144°F, the north spring 117°F, and the east spring "normal." Hot water from the main spring is conducted by steel pipe to a concrete-lined pool

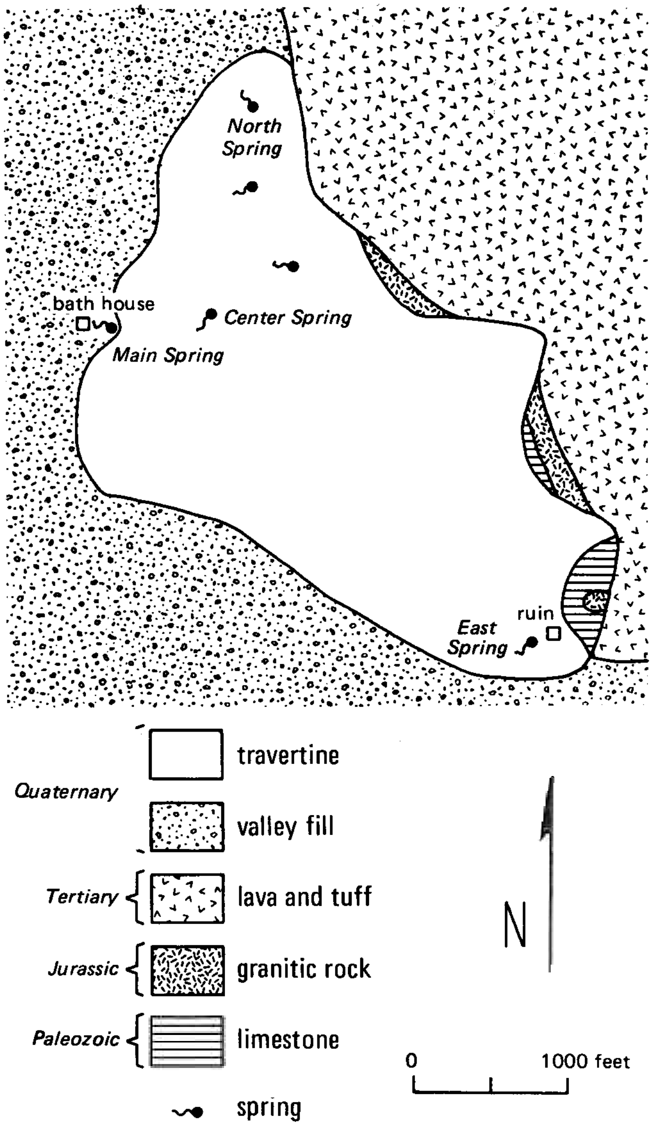


FIGURE 30. Geologic map of Spencer Hot Springs area, Lander County (modified from Meinzer, 1917).

(Sanders and Miles, 1974). Wollenberg (1974b) reports that the spring has slightly anomalous radioactivity (19 μR/hr).

Except for Sanders and Miles (1974), who report that the springs are at the boiling point, the highest temperature, 162°F, was recorded by Mariner and others (1974), who suggest that the best estimate of the reservoir temperature is 253°F, using the silica geothermometer. Fiero (1968) believes that the water discharging at Spencer Hot Springs may originate in Monitor Valley to the east after flowing through the intervening Paleozoic carbonate and clastic rocks. The geology of the hot springs and surrounding area is also shown on the 1:62,000 geologic map by McKee (1968).

Smith Creek Valley [159, 160]

At least four hot springs are reported from widely separated areas in Smith Creek Valley. The northernmost of these (no. 102, pl. 1) is in NW/4 NW/4 S36,T20N,R40E at Peterson's Mill (Mount Airy 7½-minute sheet). Everett and Rush (1964) report an 85°F well at this location. The hot