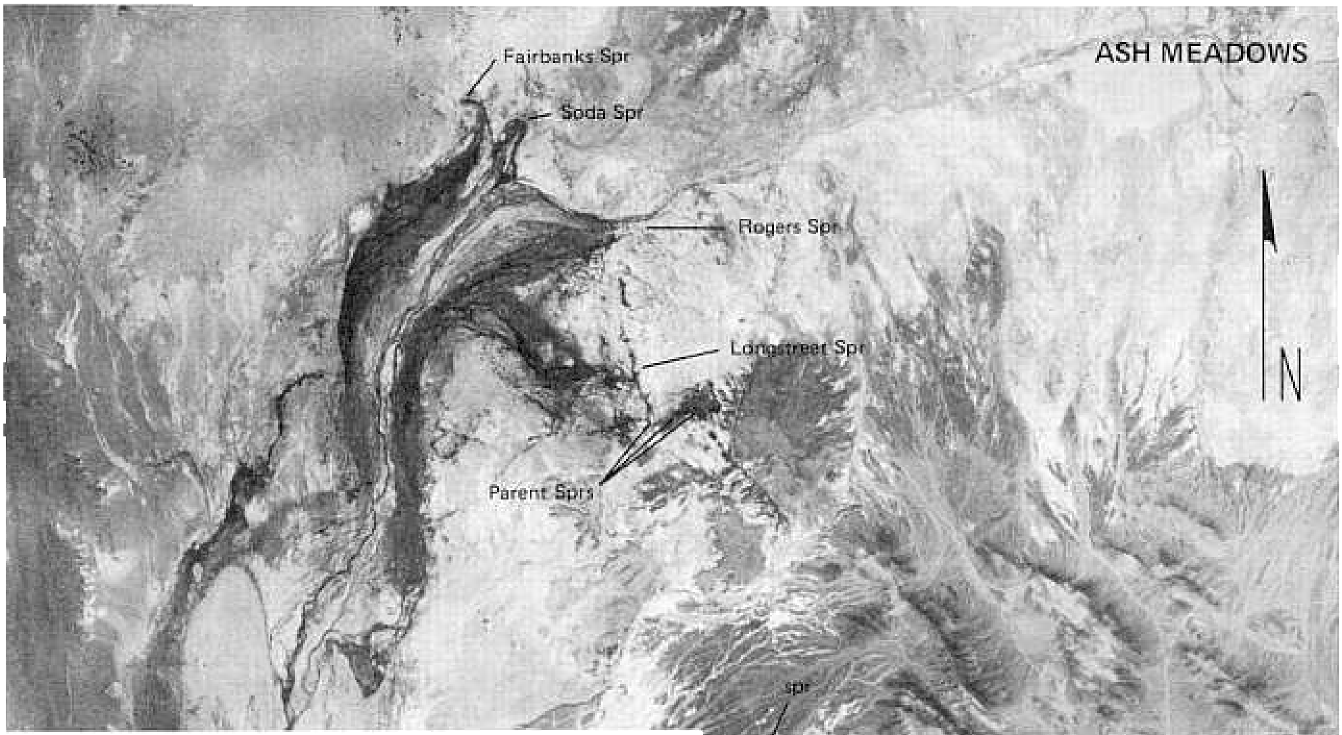
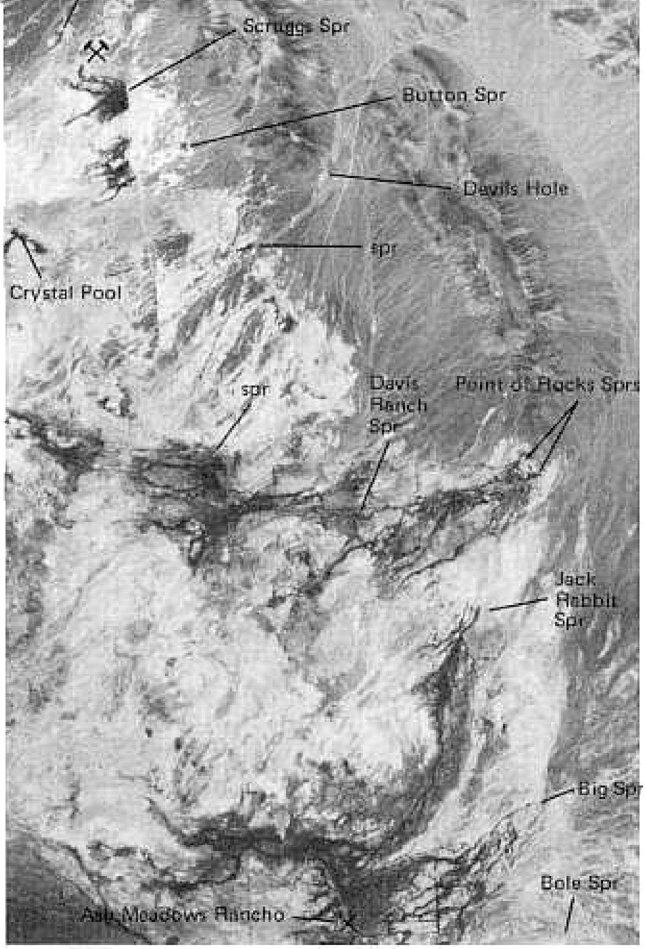




The mean annual air temperature in Pahrump Valley is 65°F, while spring and well temperatures range from 70° to 82°F. The average temperature gradient in the valley, as determined from water-well data, is approximately 1°F per 85 feet (Malmberg, 1967). All springs with temperatures of 70°F or greater were included in Appendix 1, the same practice followed elsewhere in this report. However, in Pahrump Valley, only water wells having a temperature of 70°F or greater combined with a temperature gradient higher than 1°F per 75 feet were used in this compilation (see fig. 15 for the Las Vegas Basin). Malmberg (1967) suggests that the spring temperature at Bennett's Springs, for example, indicates that the water probably originated from a single water-bearing zone approximately 850 feet deep. The abnormally high ground-water temperatures in Pahrump Valley are probably related to the deep circulation of much of that water.

Other warm springs and wells in Nye County

Most of the thermal springs and wells in Nye County which are not described in the preceding sections are in the northern half of the county. A few deep (1,700–1,800 feet) wells in the Yucca Flat area on the Nevada Test Site are also included in Appendix 1 (see Schaff and Moore, 1964). Water temperatures at the other undescribed springs and wells in Nye County are usually 100°F or less, although a spring in Hot Creek Valley (S30,T7N,R51E) is reported to be 142°F (Hose and Taylor, 1974). Little detailed information is available on these springs and wells in most cases, although a detailed location map is available for Pedro and Reveille Mill Springs (fig. 37).

PERSHING COUNTY

Leach (Pleasant Valley, Nelson's, Guthrie) Hot Springs [235]

Leach Hot Springs are located near the south end of Grass Valley in S36,T32N,R38E, slightly more than 1 mile west of the major frontal fault on the west side of the Sonoma Range. The springs have several other names, including Pleasant Valley, Nelson's, and Guthrie Hot Springs. The spring temperatures reported at Leach are up to boiling, which would be 204°F at that elevation. Tempera-

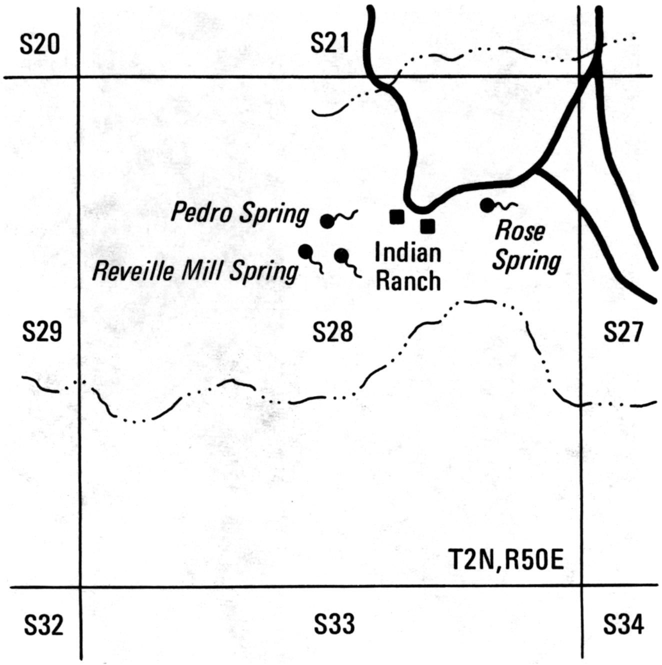
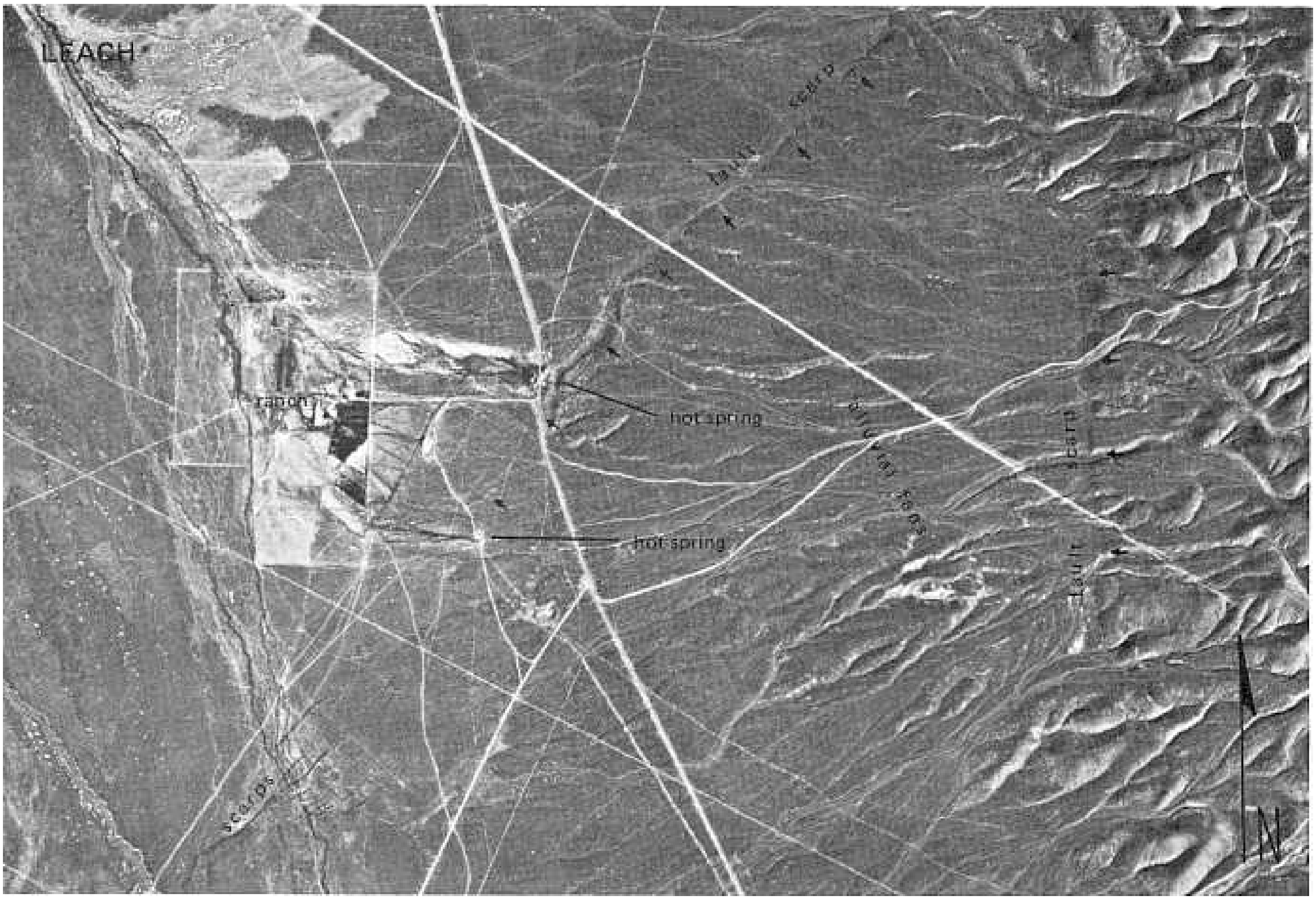


FIGURE 37. Reveille Mill and Pedro Warm Springs, Nye County (from sketch map by Alvin McLane).

tures as high as 212°F are reached within 100 feet of the surface (Olmsted and others, 1975) as seen in Figure 38. The estimated thermal aquifer temperature is between 311° and 349°F for the various chemical geothermometers (Mariner and others, 1974). The spring flow is used for stock watering and irrigation at a ranch just west of the springs.

The springs issue from steeply inclined, fault-controlled conduits in Quaternary alluvium and Tertiary sedimentary rocks. Late Paleozoic and early Mesozoic sedimentary and volcanic rocks are exposed east of the springs (fig. 39) and probably underlie the spring area at depths of several hundred feet (Olmsted, 1974; Olmsted and others, 1975).

Leach Hot Springs lie on a prominent 20- to 30-foot-high fault scarp in the alluvium. This scarp is part of a system of faults related to the major north-trending boundary fault along the Sonoma Range. This major fault can be traced for several miles to the north of the springs, and probably continues to the south through Mud Spring and somewhat to the west of the Goldbanks Mining District on the eastern edge of the East Range. In the Goldbanks Mining District, a mercury-bearing silica "apron" of chalcedony and minor opaline silica forms a north-trending, linear mantle over Miocene fanglomerates and silicic tuffs (Dreyer, 1940; Noble and others, 1975). The silica deposition here is of hot springs origin (Dreyer, 1940) and appears very similar to the sinter deposits in the Leach Hot Springs area. However, Noble and others (1975) report that the Goldbank mineralized rocks are intruded and overlain by 12 to 15-m.y.-old basalts and rhyolites, indicating a Miocene age for the Goldbanks deposits. Therefore, it seems likely that the Goldbanks mineralization is a shallow manifestation of the hydrothermal systems which produced the many 14 to 16-m.y.-old precious deposits in northern



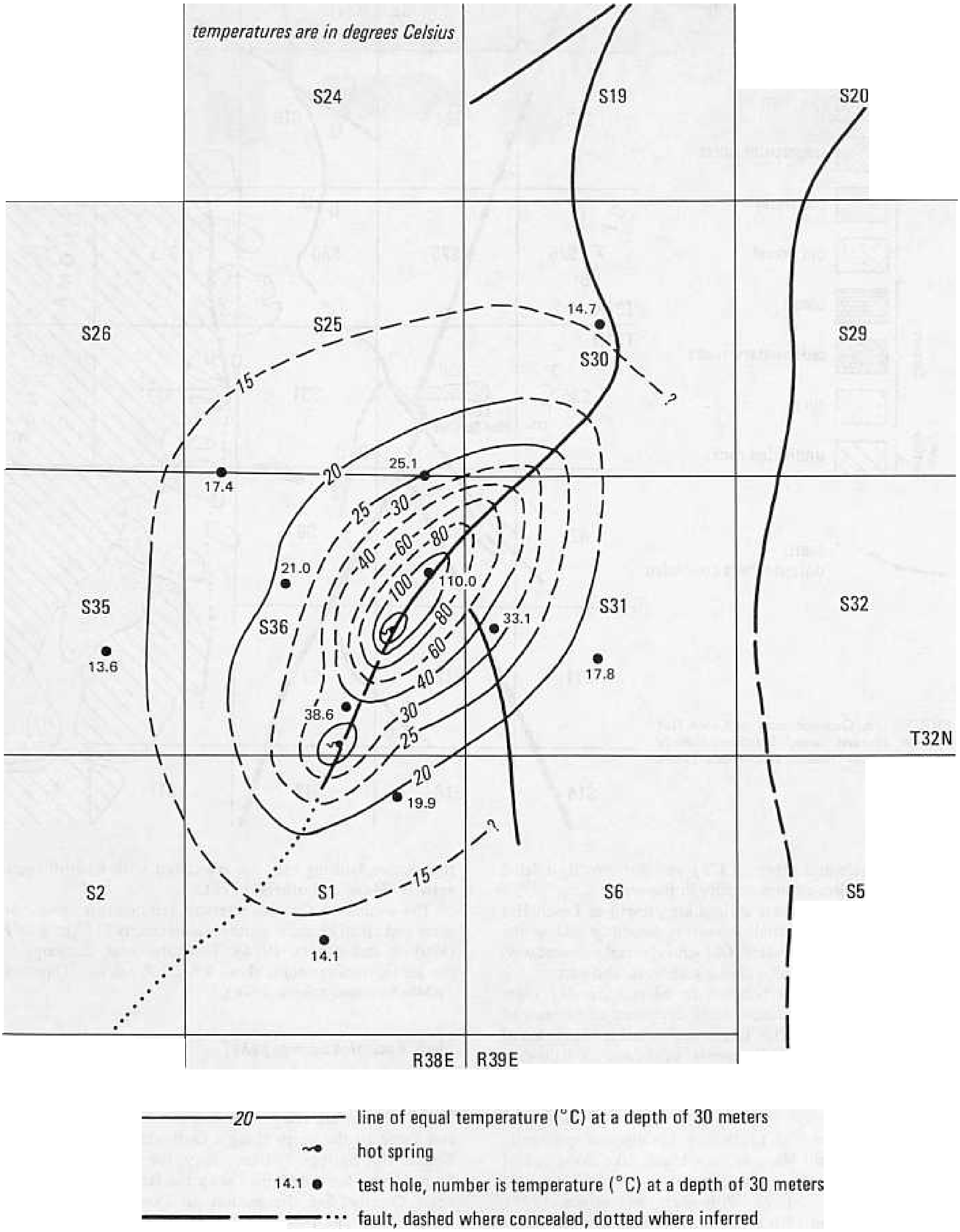


FIGURE 38. Map of Leach Hot Springs thermal area, Pershing County, showing temperatures at a depth of 30 meters, December, 1973 (modified from Olmsted and others, 1975, figs. 31 and 33).

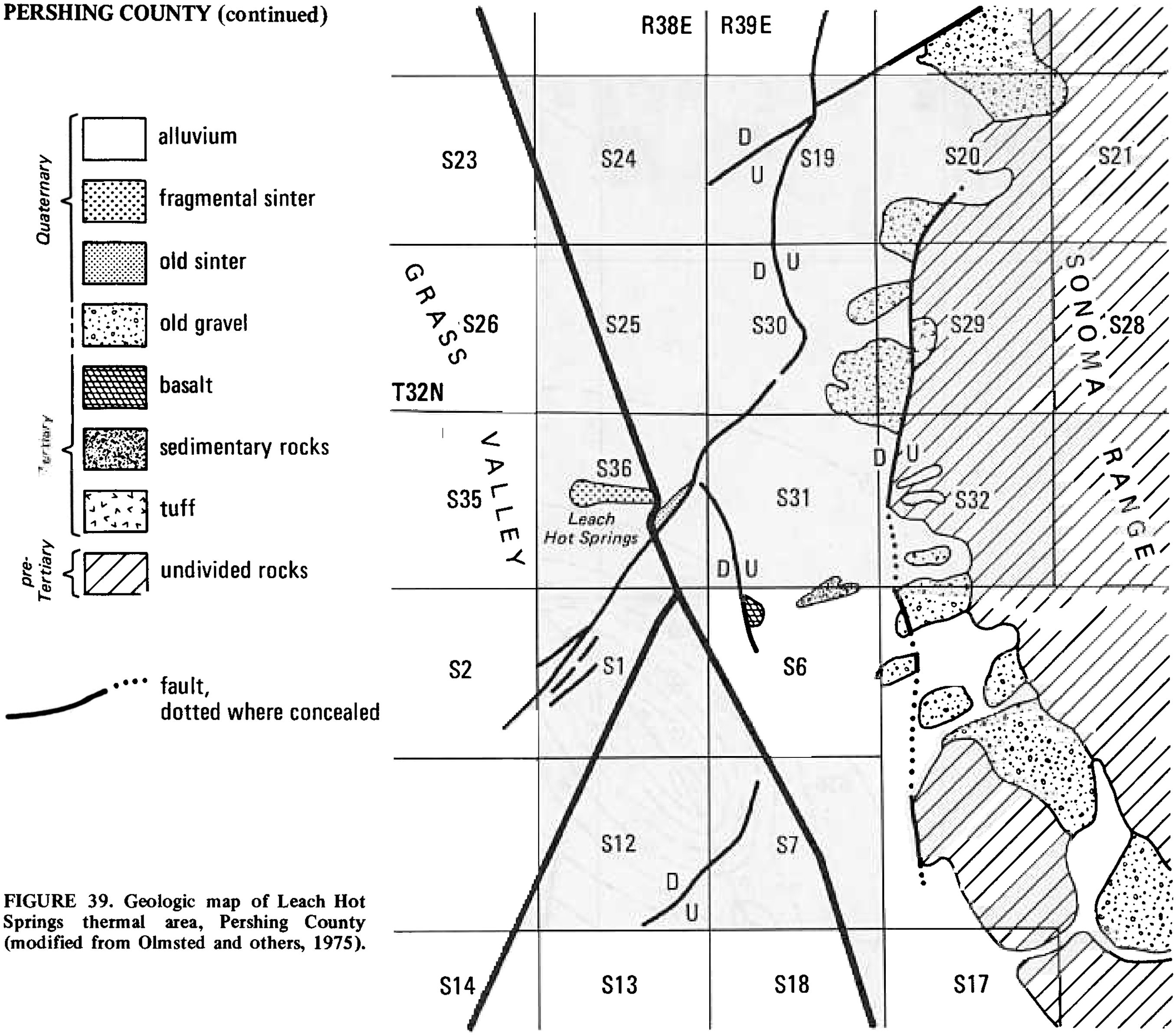


FIGURE 39. Geologic map of Leach Hot Springs thermal area, Pershing County (modified from Olmsted and others, 1975).

Nevada (Noble and others, 1975), and not directly related to the present hot-springs activity in the area.

More than 30 separate springs are present at Leach Hot Springs, and the material depositing presently and in the past is predominately silica. Old sinter, mainly chalcedony, is exposed along a half-mile-long zone to the east of the springs. This sinter is believed to be considerably older than the opaline sinter now being deposited to the east of the springs (fig. 39). This fragmental sinter is composed of pebble- to sand-sized fragments of white to light-gray opaline silica down gradient from the springs. The fragments have been distributed by spring runoff (Olmsted and others, 1975).

The fault system at Leach Hot Springs was apparently established in early Miocene, as a basalt dike along one of the faults in the spring area (fig. 39) is 14 to 15 m.y. old (Noble and others, 1975; Wollenberg and others, 1975). Many of these faults cut some of the alluvial deposits in the valley and act as ground-water barriers. A zone of intersecting lineaments southwest of the springs corresponds to an area of appreciable microearthquake activity, suggesting that active faulting may be associated with hydrothermal activity (Majer and others, 1976).

The estimated thermal reservoir temperature, based on silica and alkali-element geothermometers, is 311° to 349°F (Mariner and others, 1974). The total heat discharge of the geothermal system is about 1.8×10^6 cal/sec. (Olmsted, 1974b; Sass and others, 1976).

Black Rock Hot Springs [131]

Springs in S3,10,T35N,R26E just inside the north boundary of Pershing County have temperatures up to 204°F. These are related to springs at Black Rock Point and those to the north along a fault which passes through Double Hot Springs. For simplicity, the springs in Pershing County have been described with the larger group in Humboldt County. See the section on Double Hot Springs–Black Rock Hot Springs. The fault at Black Rock Hot Springs crosses the Black Rock Desert and joins with a basin-margin fault at Trego (see the following description of the Trego area).

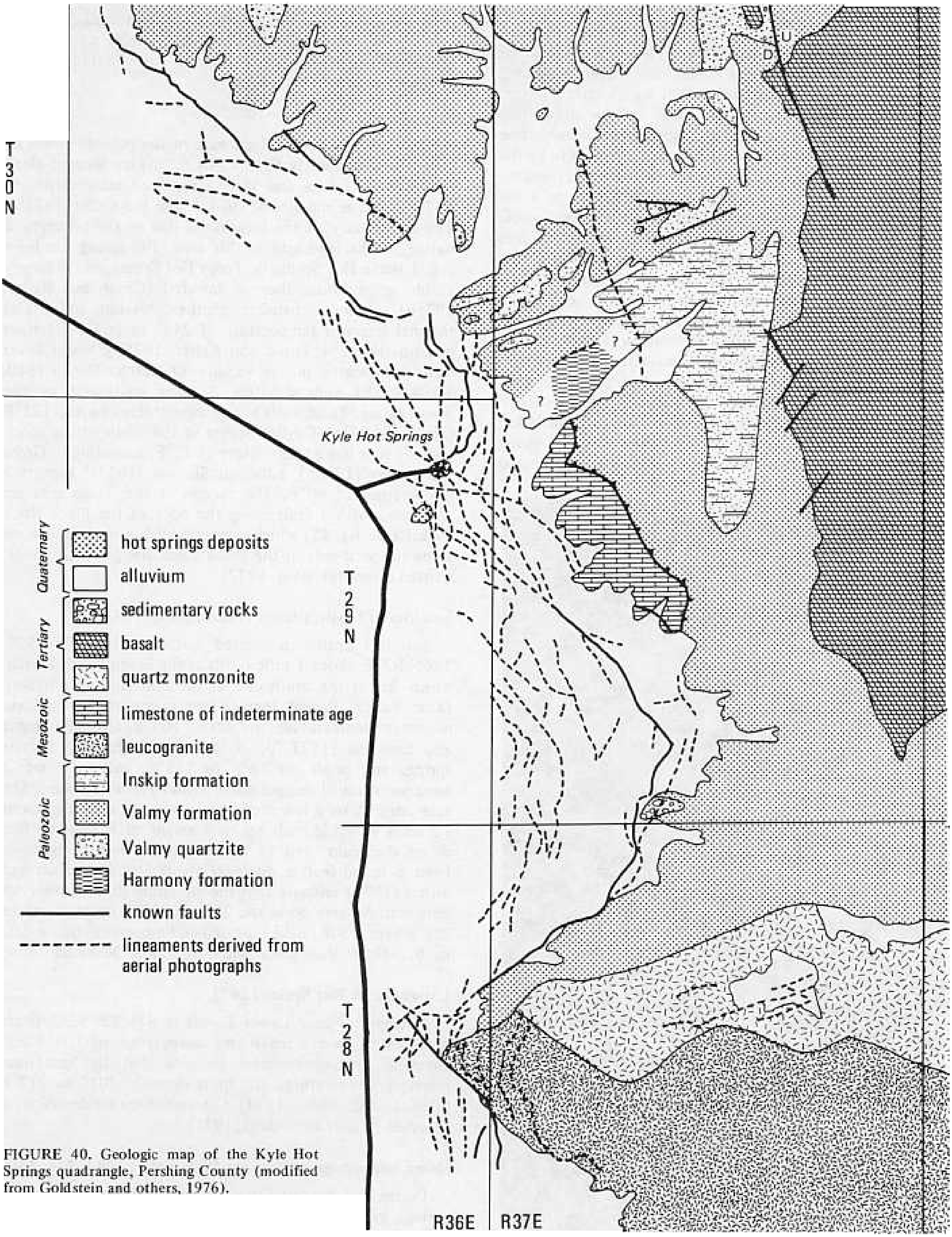
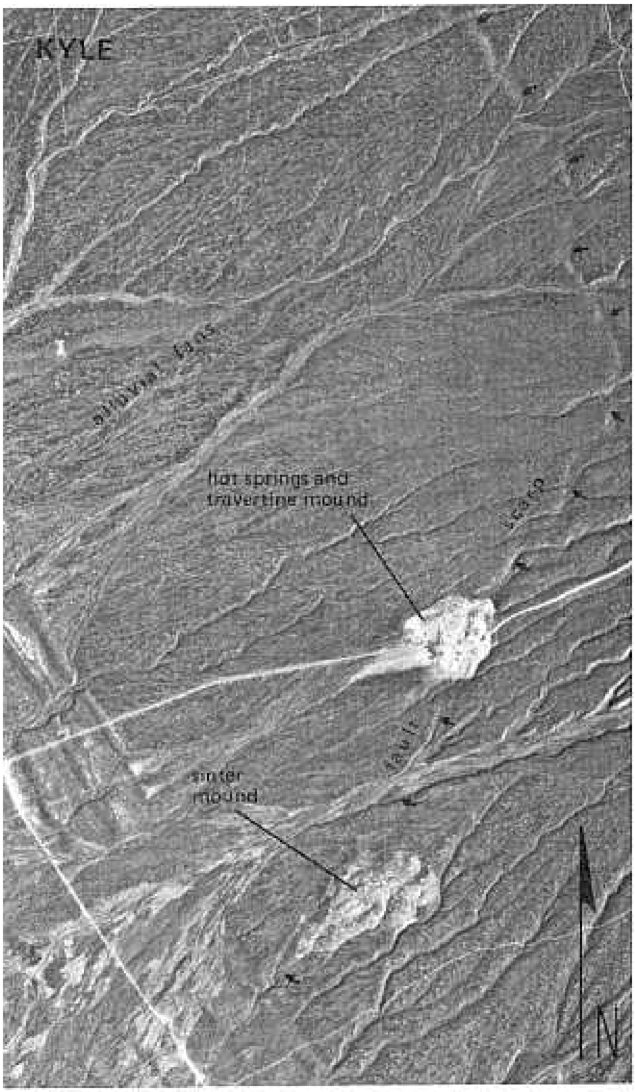


FIGURE 40. Geologic map of the Kyle Hot Springs quadrangle, Pershing County (modified from Goldstein and others, 1976).

Kyle Hot Springs [238]

Kyle Hot Springs are located in S1,12,T29N,R36E. The locality is on the east edge of Buena Vista Valley less than 1 mile west of a mountain-front fault which cuts alluvium (Stewart and Carlson, 1976b). The springs and spring deposits are clearly associated with several intersecting sets of faults (fig. 40). North-trending faults seem to be the principle conduits for thermal water (D. C. Noble, written communication, 1974). The spring area consists of a circular pool 6 feet in diameter which has little if any visible discharge. A low mound of siliceous sinter about 450 feet in diameter is present, and siliceous sinter and sulfur are presently being deposited. The odor of H_2S is noticable. The area has been used in the past as a health resort by a few people from Lovelock and other communities (Loeltz and Phoenix, 1955, p. 30–31). Wollenberg (1974b) reports that the pools are anomalously radioactive (250 to 500 μR/hr). The maximum temperature has been variously reported as 159°F (Loeltz and Phoenix, 1955), 171°F (Mariner and others, 1974) and 204°F (Sanders and Miles, 1974). Mariner and others (1974) report that the spring deposits are mostly travertine with a trace of disseminated silica, and they estimate the thermal-aquifer temperature to be 340° to 381°F by use of the silica and Na-K-Ca geothermometers. D. C. Noble, (written communication, 1974) reports that spring deposits about 0.7 miles southeast of the present Kyle Hot Springs contain considerable amounts of siliceous sinter.



Trego area [233]

Hot springs about 1.8 mi east of the railroad siding of Trego (approximately S31?,T34N,R26E) are located along the railroad tracks and have a reported temperature of 187°F (Mariner and others, 1974; Grose and Keller, 1975b). The uncertainty of the location is due to the unsurveyed nature of the land grid in this area. The spring has been called Butte Hot Spring or Trego Hot Spring, and is clearly visible on airborne thermal infrared (Grose and Keller, 1975b). Various chemical geothermometers indicate a thermal reservoir temperature of 248° to 262°F (Mariner and others, 1974; Grose and Keller, 1975b). Warm water wells are located in the vicinity of Garrett Ranch (S10, T33N,R25E) approximately 2 miles southwest of the Trego siding. These wells have temperatures of up to 125°F (Sinclair, 1963a). Coyote Spring to the north of the ranch about 1 mile has a temperature of 72°F, according to Grose and Keller (1975b), although Sinclair (1963a) reports a temperature of 60°F. The springs at the Trego area are associated with a fault along the edge of the Black Rock Desert (see fig. 41) which connects with a long fault zone along the west side of the Black Rock Range (L. T. Grose, written communication, 1977).

Sou (Seven Devils, Gilbert's) Hot Springs [243]

Sou Hot Springs is located mainly in the SW/4 S29, T26N,R38E about 1 mile north of the Seven Devils Ranch, which lies at the south end of the Sou Hills in northern Dixie Valley. Recent temperature measurements indicate maximum temperatures are about 163°F, although Hague and Emmons (1877, p. 705) reported that the hottest springs and pools are 160° to 185°F, and there was a great variation of temperatures within a short distance. The area consists of a low mound of travertine covering about 12 acres which is built up to a height of at least 60 feet above the plain. Ten to twelve circular hot-spring pools from 6 to 60 feet in diameter are reported. Mariner and others (1974) estimate that the minimum thermal-reservoir temperatures may be in the 212° to 237°F range. Senterfit and others (1976) have reported audiomagnetotelluric data in the Dixie Valley Known Geothermal Resource Area.

Lower Ranch Hot Spring [247]

Hot springs near Lower Ranch in S16,T25N,R39E are reported to have a maximum temperature of 104°F and chemical geothermometers indicate that the minimum reservoir temperatures are approximately 201° to 212°F (Mariner and others, 1974). Calcareous spring deposits are reported (Muller and others, 1951).

Other hot springs in northern Dixie Valley [244, 246, 248]

Cohen and Everett (1963) report that virtually all the springs in Dixie Valley are thermal. Hyder or Cone Hot Springs in S28,T25N,R38E have reported temperatures from 83° to 175°F (Cohen and Everett, 1963), and McCoy

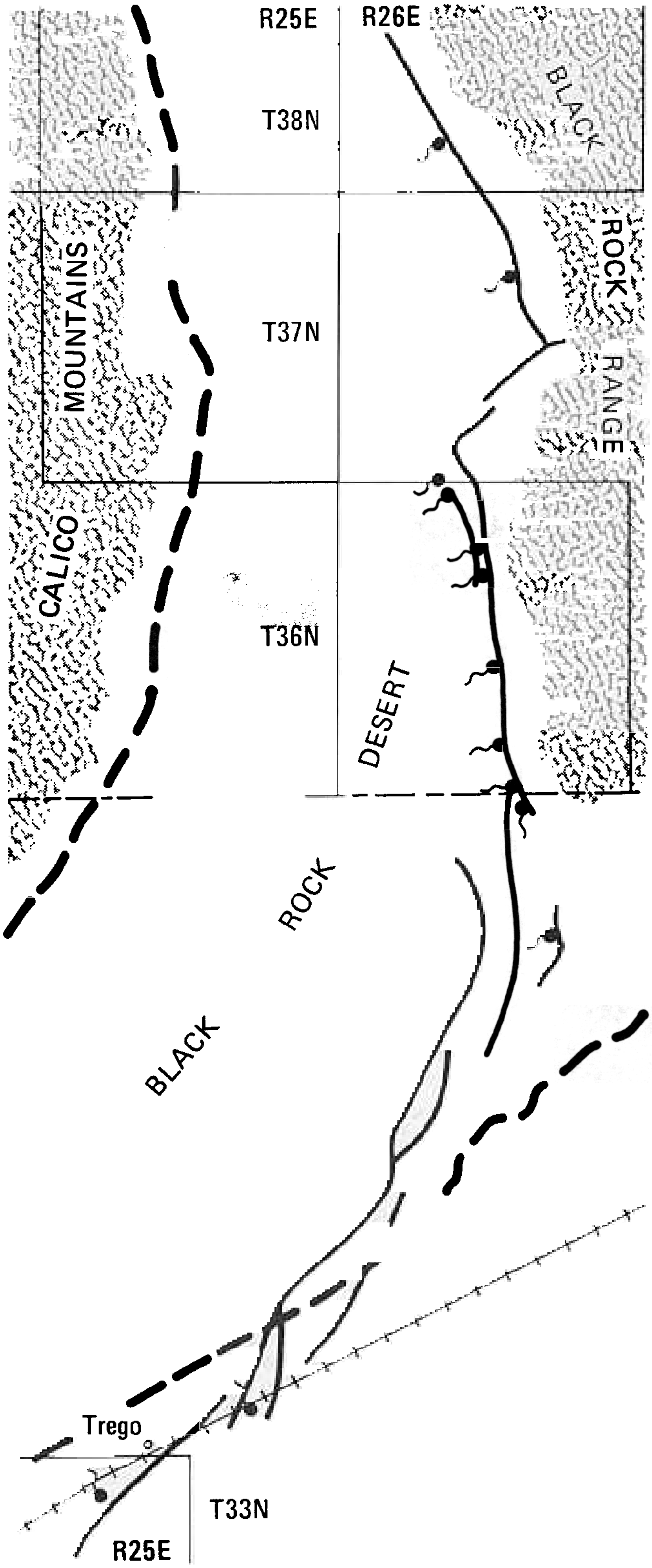


FIGURE 41. Map of Black Rock Fault and associated thermal springs, Humboldt and Pershing Counties (after unpublished map by L. T. Grose, 1975).

Springs in S33,T26N,R39E are approximately 120°F. In addition, a warm spring (83°F) is reported in S19,T25N, R39E near the end of a long line of springs along a northwest-trending fault system which cuts the alluvium and intersects the McCoy Springs area approximately 4.5 miles to the northwest (Stewart and Carlson, 1976b; Cohen and Everett, 1963). Hot springs in southern Dixie Valley are described in the Churchill County section of this report.

Jersey Valley [242]

Springs in S28,29,T27N,R40E along the east side of Jersey Valley have temperatures of 84° and 135°F (Cohen and Everett, 1963; Mariner and others, 1974). The springs appear to lie along a possible projection of a mountain-front fault shown by Stewart and Carlson (1976b). A low hill of travertine and siliceous sinter over half a mile long is present in the spring area in SW/4 SW/4 S28,T27N,R40E (Ferguson and others, 1951b). Estimated thermal aquifer temperatures are 288° and 360°F for the silica and Na-K-Ca geothermometers respectively (Mariner and others, 1974).

Colado [239]

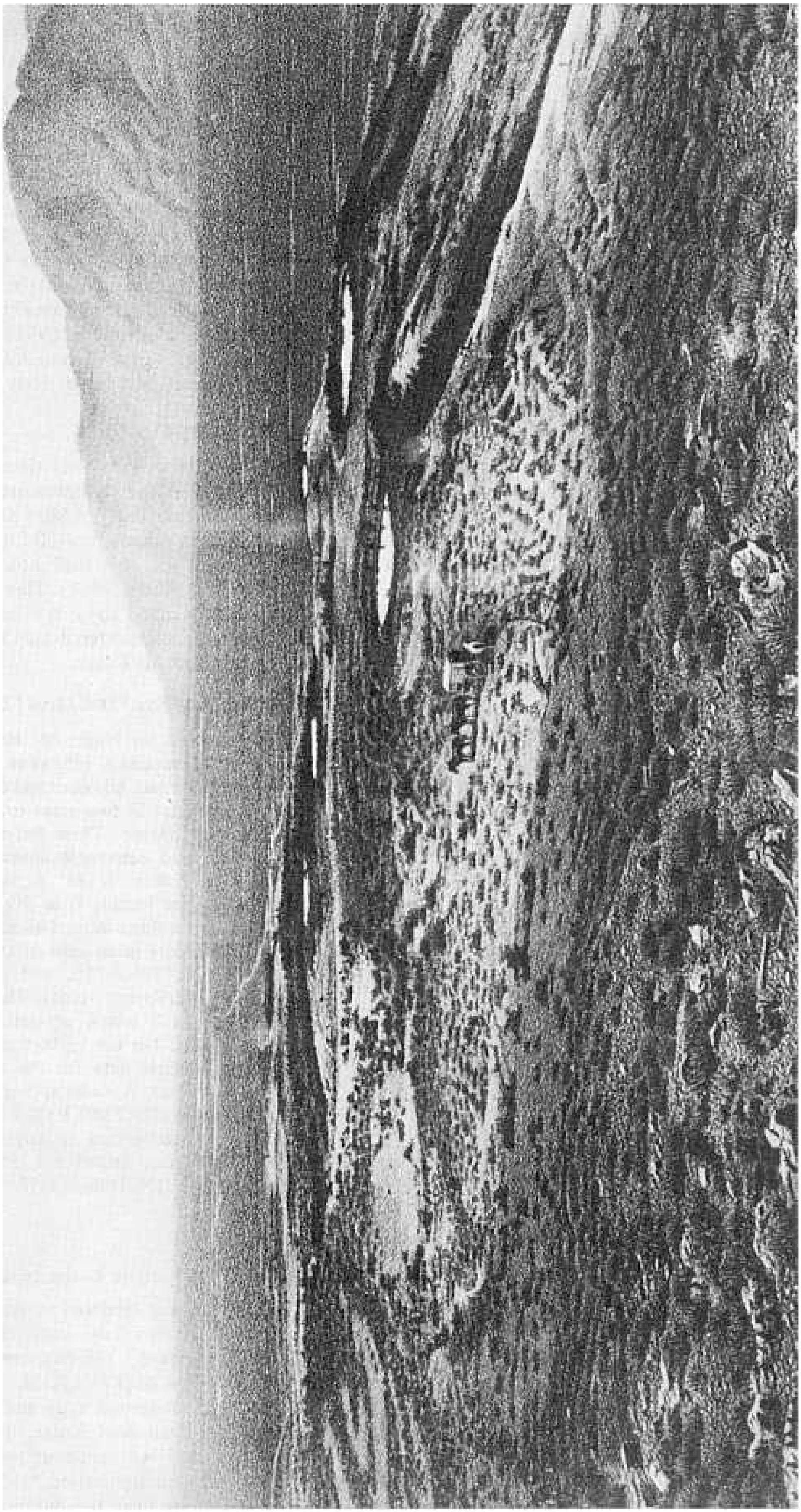
A water well (Mineral Materials well) in SE/4 S33,T28N, R32E has 150°F temperatures; 155°F water was reported in a drill hole in NE/4 SE/4 SE/4 S27,T28N,R32E, and hot water was noted in a 30-foot-deep shaft about 350 feet southwest of this drill hole (Everett and Rush, 1965; Pruss and others, 1961). This area is named for the railroad siding of Colado about 6 miles northeast of Lovelock. The hot waters encountered may be related to faults along the West Humboldt Range.

Humboldt (Rye Patch) area [236]

Humboldt or Humboldt House, 32 miles north of Lovelock, was founded in 1868 as an eating station along the Central Pacific Railroad. Siliceous and calcareous spring deposits occur as low domes in two areas to the south and to the west of Humboldt House. These hot-spring deposits contain sulfur, gypsum, and detectable amounts of mercury (Vanderburg, 1936, p. 17; Russell, 1885, p. 54, 55; Bailey and Phoenix, 1944, p. 107). One locality is in SW/4 SE/4 S33,T32N,R33E, and consists of a sinter mound about 1,000 by 700 feet. The second locality occurs in an area of Quaternary sandstone in NW/4 SW/4 S32,T32N,R33E, and is about 500 feet in diameter (Olcott and Spruck, 1961). The area is about 1 mile west of a major fault which separates Mesozoic rocks and surficial deposits. No hot springs are known in the area. Audiomagnetotelluric data for the area is available in Long and Batzle (1976c). A warm spring was reported from the site of Rye Patch (S20,T30N,R33E) by Crofutt (1872), but it has not been recognized in any more recent studies. Phillips Petroleum Co. drilled a 1,853-foot-deep geothermal test in SE/4 S21,T31N,R33E in 1977. Temperatures up to 325°F were reported.

New York Canyon kaolin deposit [245]

Steam was reported to issue from a development drill hole at the New York kaolin deposit in 1963. The drill hole is approximately 140 feet deep, and is located in the vicinity of SW/4 S1,T25N,R35E. The kaolin deposit is of the shallow, hot-springs type and contains irregular bodies of associated siliceous sinter. The sinter is exposed at the surface and was encountered during drilling (K. Papke, personal communication, 1977). The sinter and thermal water occur near the mountain front along a fault scarp



Sou Hot Springs in Dixie (Osobb) Valley, Pershing County (from lithograph, Hague and Emmons, 1877, plate 20).

which cuts the alluvium. This fault is probably part of a young Basin-and-Range fault shown by Stewart and Carlson (1974) cutting the alluvium in southern Buena Vista Valley.

STOREY COUNTY

Comstock mining district [252]

The silver-gold mines along the Comstock Lode were known for their extremely hot, difficult working conditions (Lord, 1883, p. 389–406); the miners commonly worked in temperatures ranging from 100° to 125°F. Church (1879, p. 289) considered the Comstock mines "to be the hottest in the world." Smith (1943, p. 245) states that "no other mines in the world have encountered such heat and such floods of scalding water."

Because of variations in ventilation, air temperatures in the workings varied considerably over short distances and are difficult to interpret. Rock temperatures also were modified by ventilation and water removal, thus temperatures taken in drill holes or immediately after a rock face was exposed are more useful. As Locke (1912) put it, the "temperatures are deranged by the presence of the mine workings which make possible the presence of the observer."

In a general way rock temperatures in these mines increase 3½°F for every 100 feet of depth (Becker, 1882, p. 230; fig. 42). This gradient persisted for some distance away from the Lode, but water temperatures taken at the face of the Sutro drainage tunnel while it was being driven showed that temperatures rose rapidly as the Lode was approached, even though the depth of the tunnel below the surface remained relatively constant (fig. 43). Water presently flowing from the portal of the tunnel in Lyon County is 83°F (Glancy and Katzer, 1975).

The highest rock temperature recorded was 167° from a dry drill hole on the 3,000-foot level of the Yellow Jacket Mine (diary, Superintendent Thomas G. Taylor). Mr. Cosgrove, foreman of the Yellow Jacket measured rock temperatures of 139½° and 136°F on the 2,200-foot level. Temperatures of about 130°F were recorded at numerous spots at depths of 1,900 to 2,000 feet in the Ophir, Chollar, Potosi, Crown Point, and other mines. All these temperatures were measured in drill holes immediately after a hole was finished. The rock surface temperatures of workings in the same area were 123°F or less.

The highest temperature of any considerable quantity of water was recorded during the flooding of the 3,000-foot level of the New Yellow Jacket shaft in November, 1880 (Becker, 1882, p. 230); 170°F water under considerable pressure was struck in a drill hole at a depth of 3,080 feet in the bottom of the shaft and soon flooded the mine. On February 13, 1882, a flood of 157°F water from the 2,800-foot level of the Exchequer Mine again drowned the pumps in the New Yellow Jacket shaft; all the mines in the vicinity were flooded, the water rising to the level of the Sutro drainage tunnel (annual report, Superintendent Thomas G. Taylor, July 1, 1882). A small flow of water in the east crosscut on the 2,000-foot level of the Crown Mine had a temperature of 157°F (Church, 1879, p. 291). The body of water that flooded the Savage and Hale, and Norcross Mines in 1877(?) still had a temperature of 154°F two years later

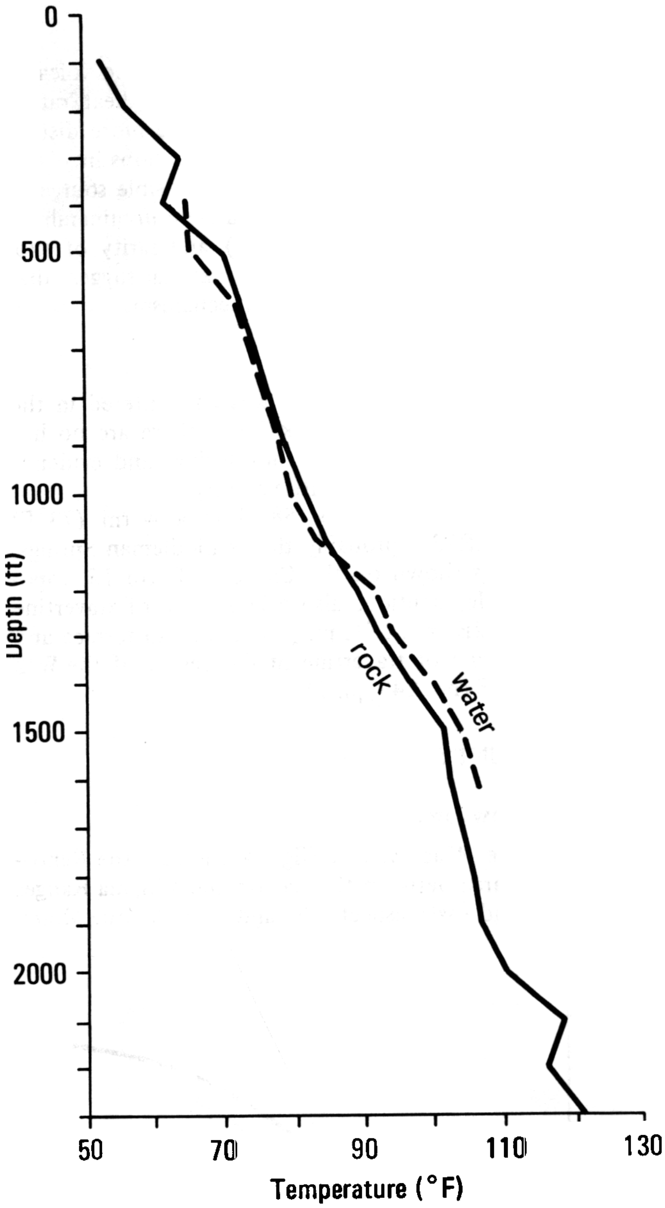


FIGURE 42. Temperatures in the Forman Shaft, Comstock Lode, Storey County (after Becker, 1888). Measured as the shaft was sunk.

(Church, 1879, p. 291) even though over a million tons of water had been removed.

As would be expected, the circulation of water was eccentric. Numerous clay seams sealed off the flow. Cutting such a clay seam frequently released dammed-up bodies of water which flooded the workings. The seams also appear to have greatly inhibited the upward convective flow of the hot water; there were no hot springs along the Lode's surface croppings, and the water encountered in the upper workings was cold, suggesting that the upward flow of hot water was feeble compared to the downward percolation of meteoritic water. The "perched," imprisoned nature of much of the water encountered is illustrated by the fact that once the water level was lowered below the Sutro tunnel, the water never rose to that level again (as long as the workings remained open to observation), even after pumping had stopped. The Comstock Lode obviously did not provide as easy a passageway for the upward flow of hot water as one might expect.