ESMERALDA COUNTY (continued)

Travertine deposit [88]

A mound of calcareous spring travertine occurs in C NW/4 S5,T1N,R43E, near the south end of the Klondyke Hills. There are no known hot springs in the vicinity. The mound is about 600 feet in diameter, and occurs in an area of Tertiary welded tuffs and Paleozoic limestones.

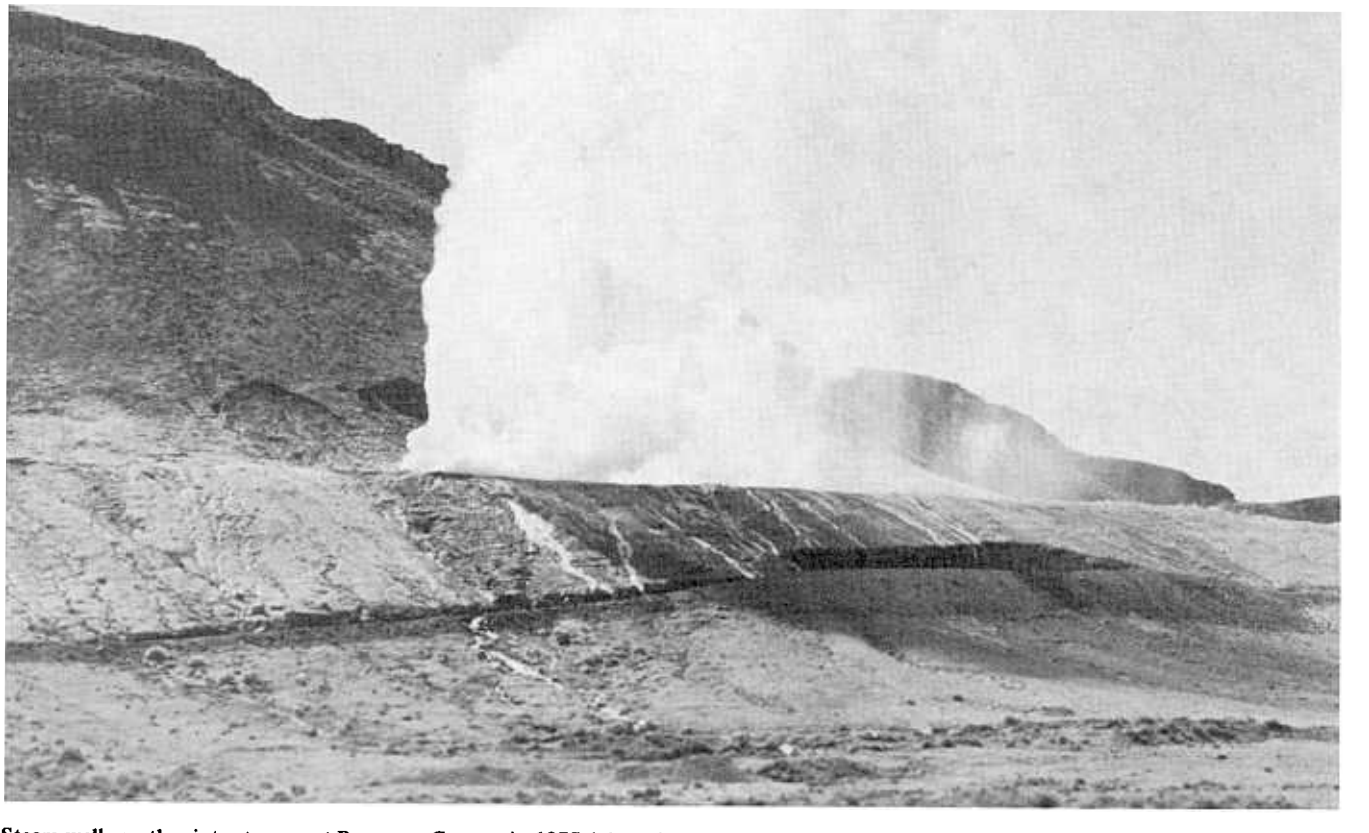
EUREKA COUNTY

Beowawe Geysers [94]

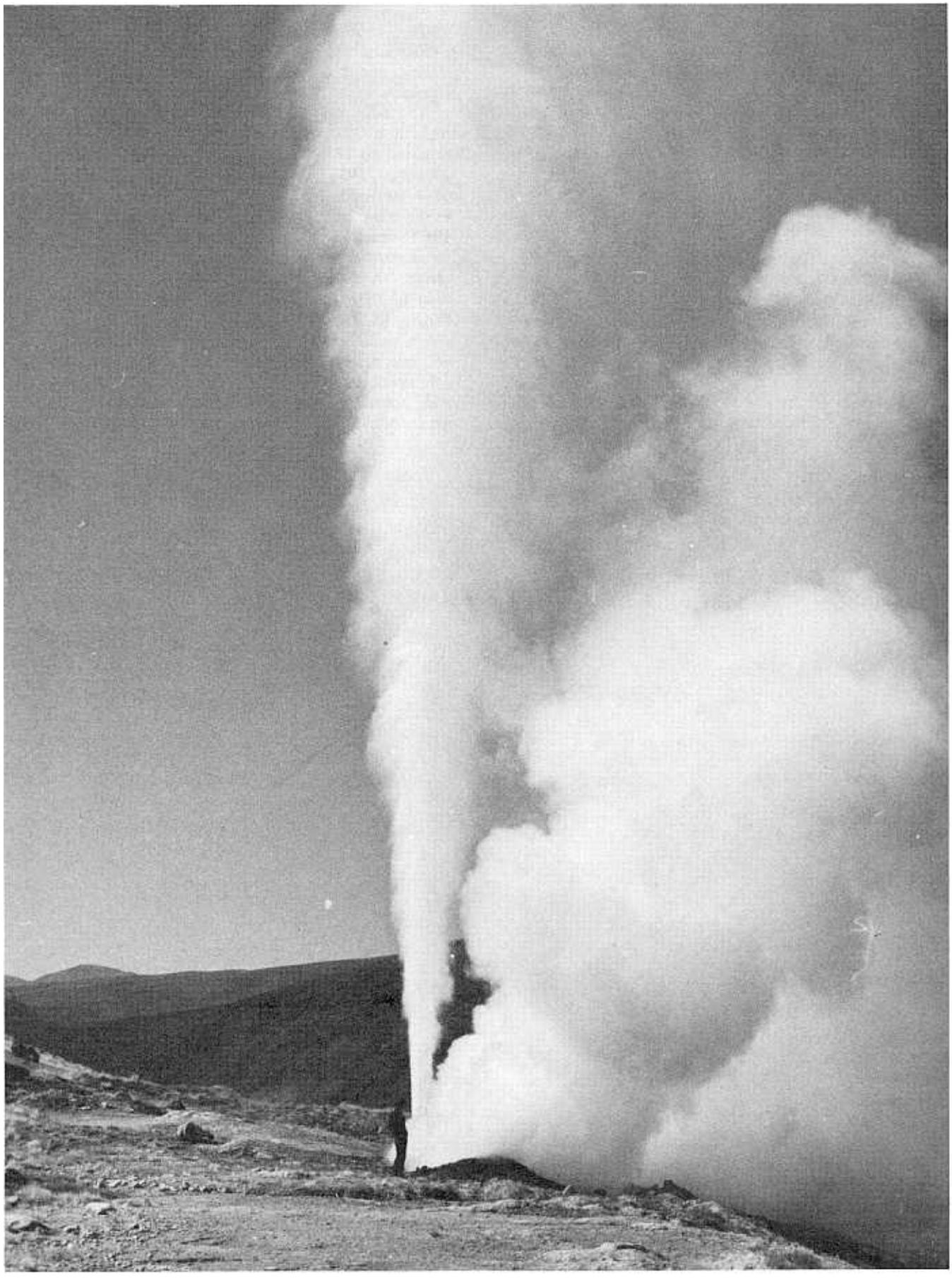
The geothermal area at Beowawe Geysers has the highest reported subsurface temperatures in Eureka County, and, with the Brady's Hot Spring area in Churchill County, has the highest steam-well temperatures in Nevada. It is one of the most drilled geothermal areas in the State, and has been actively investigated by several energy companies over the past 15 years.

The surface geothermal activity at the Beowawe Geysers area is mainly confined to S8,17,18,T31N,R48E. This area is mainly in Eureka County, although S18 is in Lander County. For simplicity, this description is included in Eureka County. The Geysers is in southwestern Whirlwind Valley, about 6 miles west of the small community of Beowawe.

The hot springs, geysers, and fumaroles have temperatures up to 202° to 204°F, and in 1932 several geysers were reported to erupt to heights of several feet (Nolan and Anderson, 1934). One geyser reportedly played to a height of 3 feet and another to 12 feet. Drilling of geothermal exploration wells on the main sinter terrace in the early 1960's resulted in the disruption of natural geyser activity there, but geysers on the valley floor to the west of the terrace were considerably more thermally active in 1968 than in 1932 (Rinehart, 1968). These geysers erupted to heights of 3 to 6 feet. Vandals blew the caps from four steam wells on the main terrace sometime prior to 1972, and one of these released steam and water in rather large volumes. One of the notable effects of this release of fluid and possibly the original drilling was the cessation of geyser activity (Hose and Taylor, 1974). The "best guess"



Steam wells on the sinter terrace at Beowawe Geysers in 1977 (photo by Dennis Trexler).



Steam well at Beowawe Geysers, Eureka County (photo by Dennis Trexler).

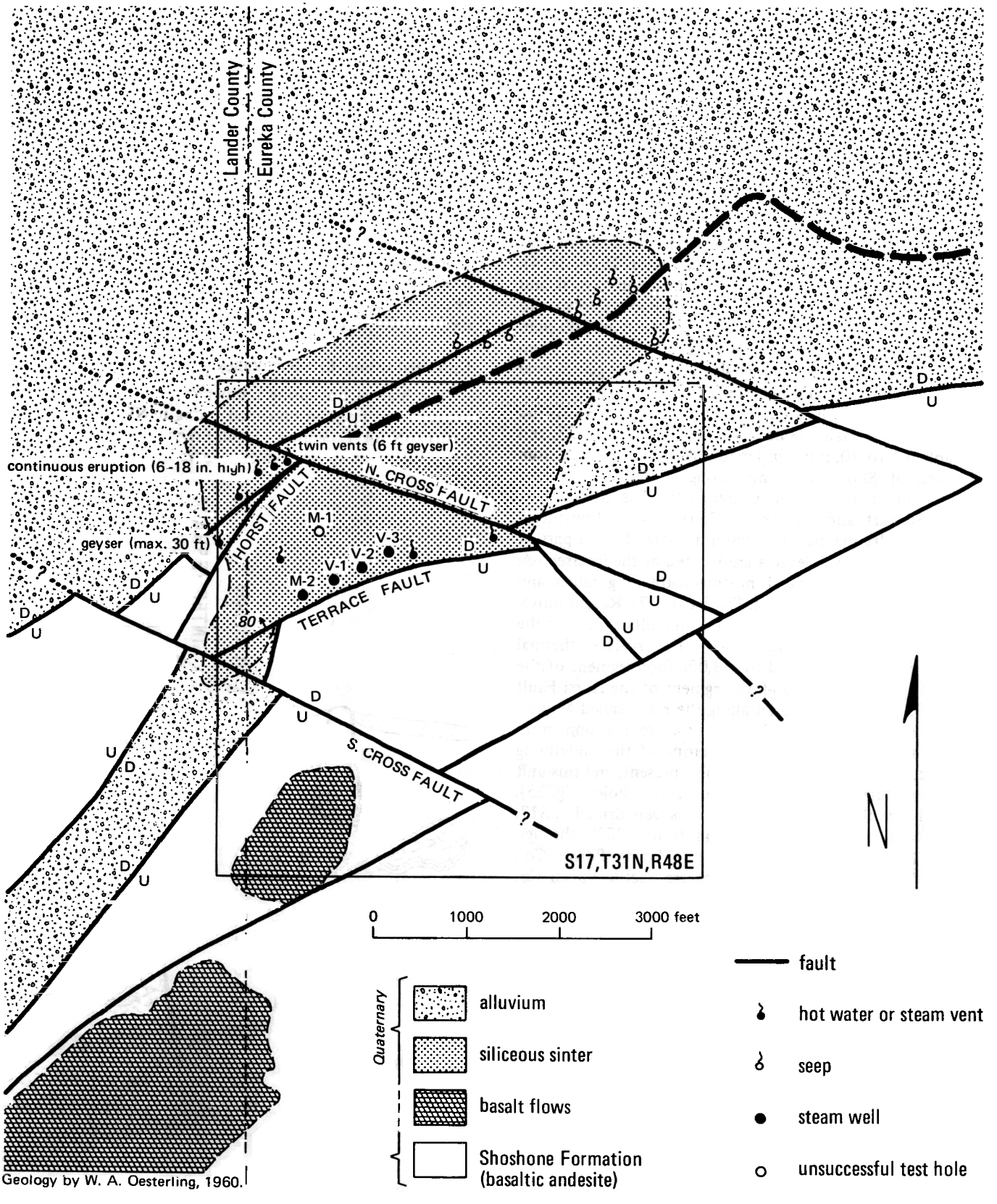


FIGURE 24. Geologic map of Beowawe Geysers, Eureka and Lander Counties (from Oesterling, 1962).

estimates of thermal reservoir temperatures are approximately 385°F for a sample from a spring, and 440° to 460°F for a sample from a steam well (Mariner and others, 1974). Since temperatures of over 400°F are reported from shallow depths, the higher estimates seem likely to be realized.

The most conspicuous feature of the Beowawe Geysers is an enormous, symmetrical spring-sinter terrace which stands some 250 feet high. The top of the terrace, which measures 100 feet wide and 2,800 feet long, is remarkably level (Oesterling, 1962). The flowing springs and geothermal wells are located along a narrow band of older sinter which is present between the main terrace and outcrops of Tertiary andesite to the south (Hose and Taylor, 1974, fig. 4). The siliceous sinter is almost entirely made up of opal, and it is presently forming around certain pools (Nolan and Anderson, 1934). The sinter reportedly contains 300 ppm tungsten and high beryllium (R. Erickson, personal communication, 1970); tungsten is also high in the geothermal fluids (Wollenberg and others, 1975).

The Geysers are located at the south edge of Whirlwind Valley along a major fault zone which is at least 35, and possibly up to 70, miles in length. The zone extends from the central Shoshone Range along southern Whirlwind Valley and then across the center of the Tuscarora Mountains (Stewart and Carlson, 1976b). The east-northeast trending faults mapped by Oesterling (fig. 24) are part of this zone. Beowawe Geysers are located at the intersection of this zone with several northwest-trending faults and lineaments (Oesterling, 1962; Trexler, 1977). Recent movement is believed to have taken place on faults which cut the sinter terrace (Oesterling, 1962). The surface thermal activity is mainly confined to a 3,000-foot segment of the Terrace Fault and a 1,300-foot segment of the Horst Fault (fig. 24). The rocks exposed along the ridge called Malpais to the south of the geothermal area are predominantly basalts and andesites. A few outcrops of the underlying Ordovician Vinini Formation are also present, and this unit was encountered at depth in some of the drill holes (fig. 25).

Twelve exploratory geothermal wells were drilled in S17, T31N,R48E at Beowawe Geysers from 1959? through 1965. These wells were drilled by Magma Power Co., Vulcan Thermal Power Co., and Sierra Pacific Power Co. The deepest well drilled during this period was 2,052 feet; several of the wells had temperatures of 407° to 414°F at depths of 700 to 800 feet. Since 1974, three more wells have been drilled, two of them to approximately 5,500 feet, and a third to 9,563 feet. The Magma Energy, Inc. Batz No. 1 was drilled to 5,447 feet in S17,T31N,R48E, near the previous wells. Two wells, the Chevron-American Thermal Resources Ginn No. 1–13 and the Chevron U.S.A., Inc. Rossi No. 21–19, were drilled in an area approximately 1.5 miles to the southwest of the Geysers. These wells reportedly encountered high-temperature fluids in faulted zones near the bottom of both wells. Little data are available for any wells drilled in the 1970's. Names and detailed location data for geothermal wells are given in Appendix II.

The earlier wells at Beowawe Geysers underwent considerable testing shortly after drilling and for several years thereafter (Middleton, 1961; Oesterling, 1962; Allen, 1962). Although some of the data are confusing or conflicting, it seems clear that several of the steam wells did produce large flows of steam and hot water from shallow depths. Temperature-depth curves for some of the wells are reproduced in Figure 26. Some of the wells apparently produced at least 400,000 to 500,000 lbs/hr of fluid, with 10 to 15 percent steam flashover. Middleton (1961) reports approximately 1.5 million lbs/hr of fluid at 342°F from the Vulcan No. 4 well, with 41,500 lbs/hr of that being steam. The wellhead pressure was reported to be 116 lbs/in^2 absolute (psia). Static pressure in several of the wells is apparently in the 40 to 100 psia range, and flow pressure is reportedly 20 to 30 psia. Problems of cold water inflow have been reported because the holes were not cased deeply enough. Scaling in the wells can also be a problem (Koenig, 1970). These problems may have contributed to the general lowering of productivity indicated in test results over a period of several years. No data are available on the productivity of the deeper wells drilled in the mid-1970's.

Unnamed spring, Crescent Valley [97]

The highest hot-spring temperatures in Eureka County are reported from an unnamed spring in NW/4 NW/4 NE/4 S10,T28N,R49E. Wilson (1960a) reports a temperature of 186°F for this spring, which occurs along a major basin–

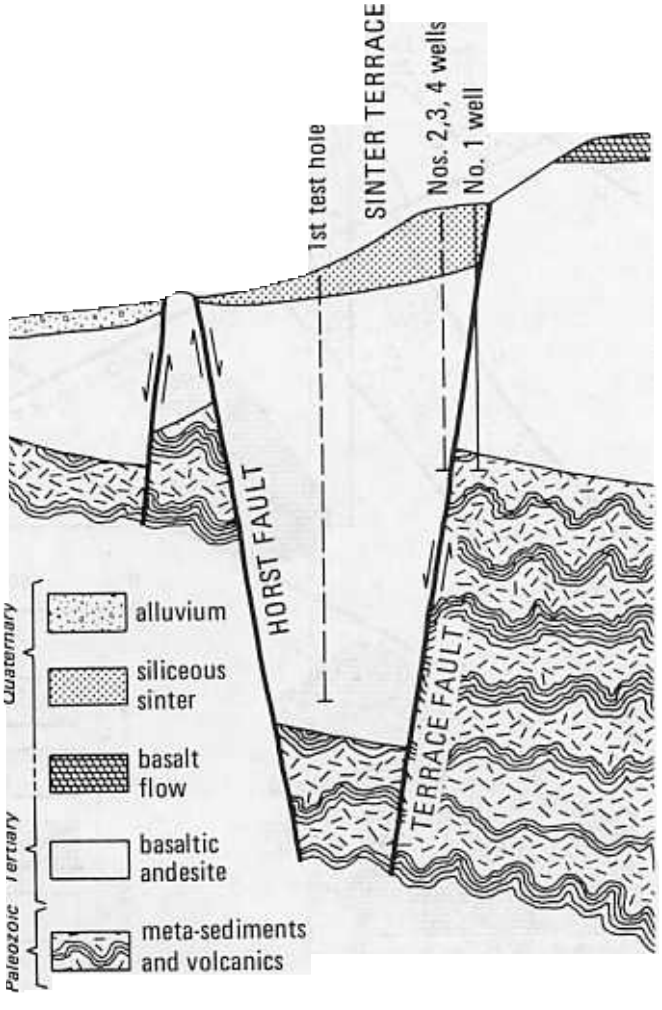


FIGURE 25. Diagrammatic cross section, looking east-northeast, at Beowawe Geysers, Eureka County (after Oesterling, 1962).

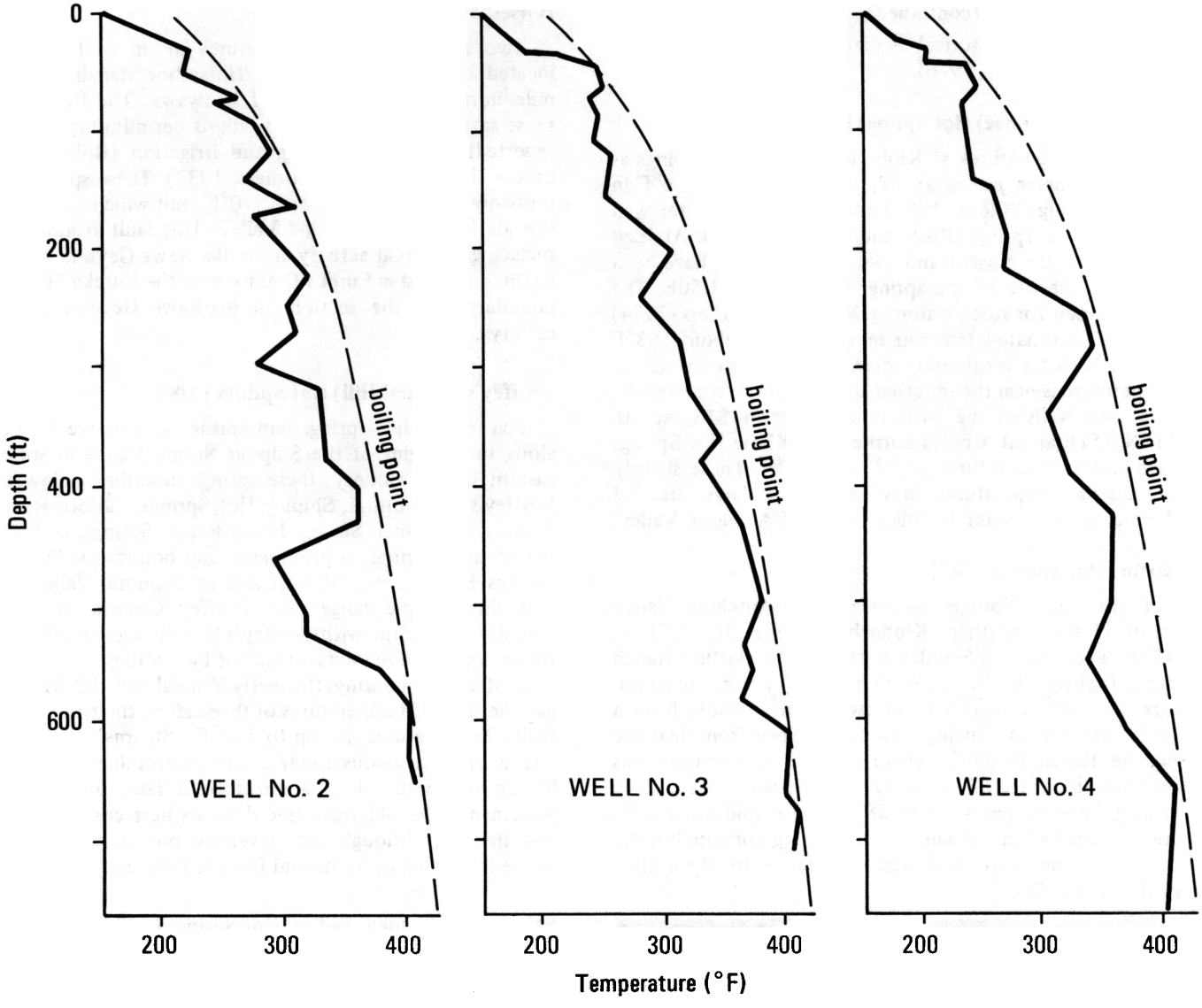


FIGURE 26. Temperatures recorded during drilling of Vulcan Thermal Power Co. wells by cable tool rig at Beowawe Geysers, Eureka County (from Middleton, 1961).

range fault (the Crescent Fault) which has significant displacement.

Hot Springs Point (Crescent Valley) [96]

At least five hot springs are found at Hot Springs Point in Crescent Valley. These are located near the corner of S1, 2, and 11,T29N,R48E and arise from alluvium and bedrock in a line 1.5 miles long. Native sulfur occurs in the Ordovician Valmy Formation along a northwest-trending, nearly vertical fault zone (Keith Papke, personal communication, 1975) just southeast of the hot springs. Hot Springs Point itself is bounded on its northwest and southeast sides by faults. The hot springs fall along the trace of the Dry Hills fault, which extends northeast along the northwest side of Hot Springs Point for about 8 miles. The deposit of native sulfur appears to be associated with the hot-springs activity, and small amounts of cinnabar and antimony occur sporadically throughout the sulfur (Olson, 1964). Spring temperatures fall between 122° and 138°F, except for one spring on the valley floor which is 79°F. A 410-foot-deep geothermal well drilled by Magma Power Co. encountered subsurface temperatures up to 166°F. The estimated thermal-aquifer temperature for this spring system is 239°F (Mariner and others, 1974). Spring sinter and caliche are reported from along nearby northeast-trending faults which cut Tertiary andesites (Wilson, 1960b). These deposits are in the north half of S6,T29N,R49E. Also, calcareous sinter is reportedly being deposited at the hot springs. Young north- and northeast-trending faults are also common in the alluvial deposits of Crescent Valley in this area.

Walti Hot Springs [102]

Walti Hot Springs in Grass Valley have the third highest reported water temperatures in Eureka County. Several springs are presently depositing siliceous spring sinter (Roberts and others, 1967). Mariner and others (1974) estimate that the reservoir temperature of Walti Hot Springs is probably about 179°F according to a Na-K-Ca geothermometer. The springs lie near a major fault along the west margin of the Simpson Park Mountains (Roberts and others, 1967, plate 3). An alligator is reported to have survived in the hot-spring waters for 16 years in the early

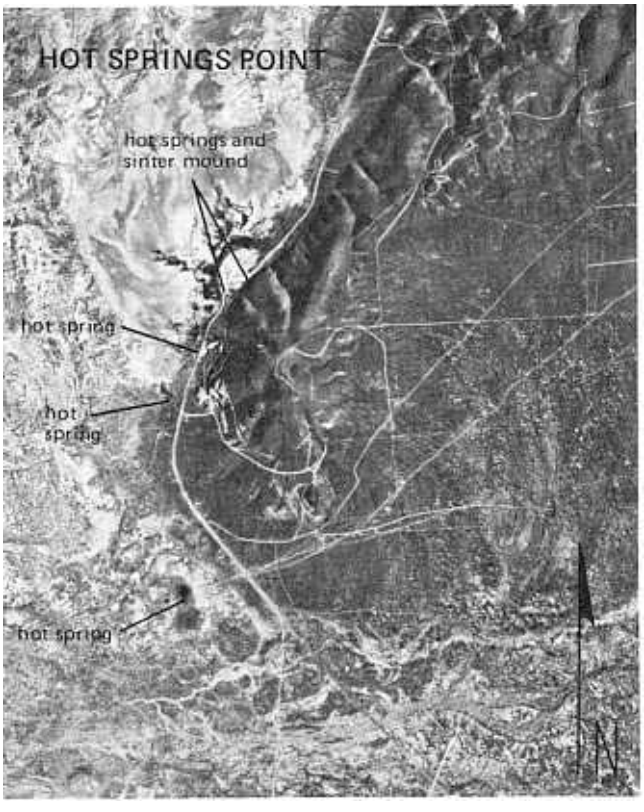
1900's (Nevada Historical Society *in* the Nevada State Journal, October 17, 1976).

Klobe (Bartholomae) Hot Springs [108]

Water temperatures at Klobe (or Clobe) Hot Springs at the Bartholomae Ranch are reported as high as 156°F in flowing springs (Fiero, 1968) and 158°F in a water well drilled in the spring (Rush and Everett, 1964). At least two springs are present and two or more wells have been drilled at the site of the springs in S28,T18N,R50E. The water is used for stock watering. Mariner and others (1974) report an estimated reservoir temperature of about 163°F from a Na-K-Ca geothermometer. This estimated reservoir temperature is near the reported surface spring temperature. Also, two wells of the Bartholomae Corp. in S18 and 30, T18N,R51E about 4 miles northeast of Klobe Hot Springs have water temperatures of 72° and 74°F. These slightly anomalous temperatures may indicate a large area of thermal ground water in this portion of Antelope Valley.

Bartine Hot Springs [107]

Bartine Hot Springs are located in Antelope Valley about 11 miles north of Klobe Hot Springs, in S5,T19N, R50E, and about 2.5 miles north of the Bartine Ranch along Highway U. S. 50. Waring (1965) reports temperatures of 105° and 108°F for two springs issuing from a "tufa" mound. A flowing well is described from near the Bartine Ranch in S17?, where a 116°F temperature was reported by Fred Bartine. Other artesian wells in the vicinity have temperatures of 58°F. These cold-water wells are probably all in the same water-bearing horizon, but the flow of the hot-water well was not affected by the drilling of the cold wells.



Horseshoe Ranch Springs [93]

Two springs having temperatures of up to 136°F are located in S32,T32N,R49E at Horseshoe Ranch about 1 mile northeast of the town of Beowawe. The flow from these springs is only about 30 gallons per minute; they are reportedly used for bathing and irrigation (Roberts and others, 1967; Stearns and others, 1937). These springs are probably on an extension of a N70°E fault which runs along the south side of Whirlwind Valley. This fault localizes the surface geothermal activity at the Beowawe Geysers 7 miles to the southwest in Eureka County near the Eureka–Lander boundary (see the section on Beowawe Geysers in this county).

Bruffey's (Mineral Hill) Hot Springs [100]

Five or six hot springs and spring systems are located along the margins of the Sulphur Spring Range in southeastern Eureka County, these springs described below are Bruffey's Hot Springs, Shipley Hot Springs, Carlotti Ranch Springs, Siri Ranch Spring, Flynn Ranch Springs, and possibly Sulfur Springs. A prominent fault bounds the Sulphur Springs Range along the west side of Diamond Valley and cuts through the range near Bruffey Canyon; it is apparently coincident with Bruffey's Hot Springs and Carlotti Ranch Springs along the east side of Pine Valley.

Bruffey's Hot Springs (formerly Mineral Hill Hot Springs) has the highest temperatures of those along the trace of the fault. Temperatures are up to 152°F, (Stearns and others, 1937), and calcareous sinter occurs as prominent terraces. Six springs occur along a north-south fault of large displacement. The old travertine deposits here contain barite and fluorite, although the travertine presently being deposited is devoid of barite and fluorite (White, 1955a).

Shipley (Big Shipley, Sadler) Hot Springs [103]

Springs in S23,T24N,R42E known as Shipley, Big Shipley, or Sadler Hot Springs have temperatures up to 106°F and issue from alluvium near the bedrock outcrops. The springs are probably supplied by water moving through secondary openings in Paleozoic rocks (Eakin, 1962a). Reported discharges range from 3,000 to 6,750 gallons per minute.

Carlotti Ranch (Sulfur) Springs [99]

Two springs a quarter of a mile apart have temperatures of 95° and 102°F (Stearns and others, 1937). The springs are used for irrigation. They are along the east side of Pine Valley 5 miles north of Bruffey's Hot Springs and are probably along the same fault reported there.

Siri Ranch Spring [104]

A warm spring and water well are found in S6,T24N, R53E at Siri Ranch along the west side of Diamond Valley north of Shipley's Hot Springs. A small pool in the alluvium is reported (Mifflin, 1968). The reported temperatures vary from 81° to 87°F for the spring, while the well is 95°F. Discharges reported are 5,800 and 300 gallons per minute (Mifflin, 1968; Stearns and others, 1937). These springs are probably associated with the range-front fault along the Sulphur Spring Range here.

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

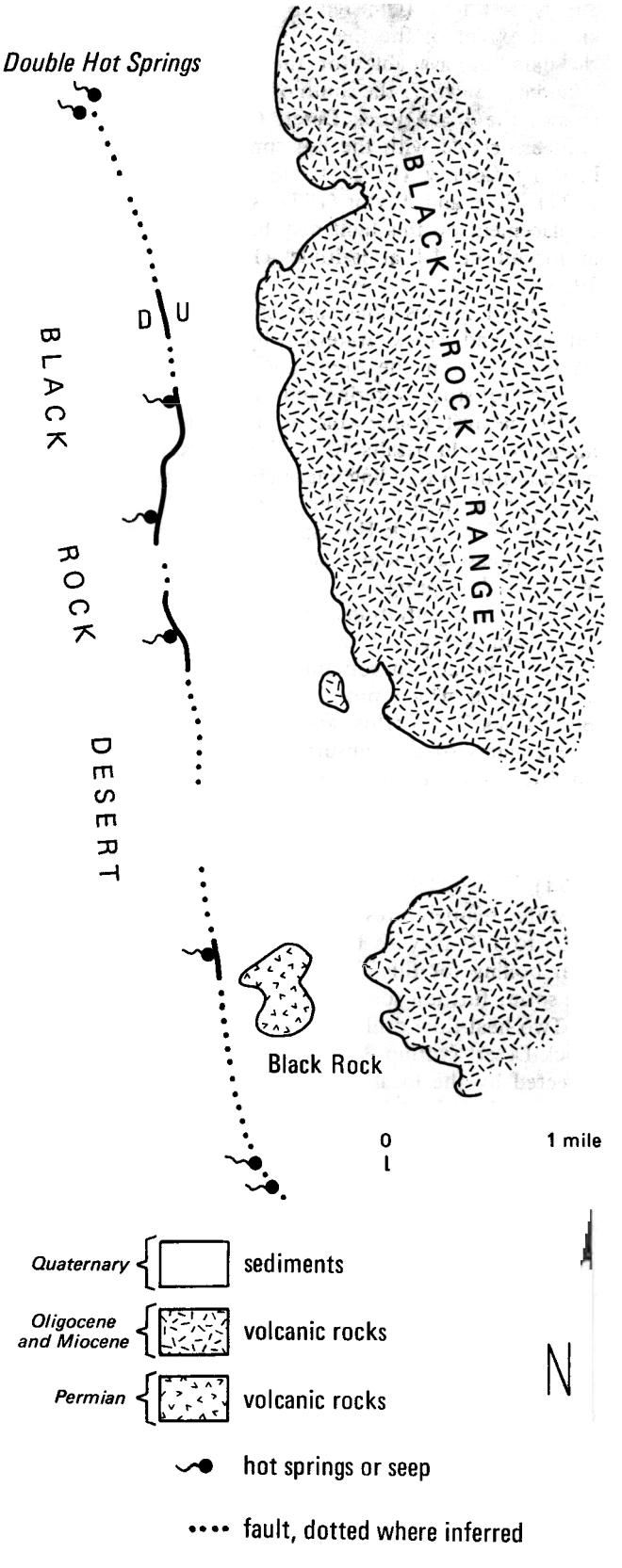


FIGURE 27. Geologic map of the Double Hot Springs–Black Rock area (after Hose and Taylor, 1974).