Site Description

Beowawe

(updated 2010)

Geologic setting: Beowawe Geysers are located at the southern edge of Whirlwind Valley along a major fault zone, at least 56 and possibly up to 113 km long. The zone extends from the central Shoshone Range in southern Whirlwind Valley to the central Tuscarora Mountains (Stewart and Carlson, 1976b). 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 that cut the sinter terrace (Oesterling, 1962; figure). Surface thermal activity is mainly confined to a 915-m segment of the Terrace Fault and a 395-m segment of the Horst Fault (figure). The rocks exposed along the Malpais ridge, south of Beowawe Geysers, are predominantly basalts and andesites. The underlying Ordovician Vinini Formation outcrops in several locations, and was encountered in several drill holes (figure).

Geothermal features: The geothermal area at Beowawe has the highest reported subsurface temperatures in Eureka County, and, with the Bradys Hot Spring area in Churchill County, has the highest steam-well temperatures in Nevada. It is one of the most drilled geothermal areas in Nevada and had been actively investigated by several energy companies throughout the late 1960s and early 1970s.

Horseshoe Ranch Springs: Two hot springs (55-58°C) are located at Horseshoe Ranch 1.5 km NE of Beowawe town (Sec. 32, T32N, R49E). The flow from these springs is about 114 L/min; they are reportedly used for bathing and irrigation (Roberts and others, 1967; Stearns and others, 1937). Reed and others (1982, p. 40) reported the discharge to be 4 L/min. These springs are probably on an extension of a N70°E fault that runs along the south side of Whirlwind Valley. This fault localizes the surface geothermal activity at the Beowawe Geysers 11 km to the southwest in Eureka County near the Eureka-Lander county line.

Beowawe Geysers: The surface geothermal activity at the Beowawe Geysers area is mainly confined to Secs. 8, 17, 18, T31N, R48E. This area is mainly in Eureka County, although Sec. 18 is in Lander County. The Geysers is in southwestern Whirlwind Valley, about 10 km west of the small community of Beowawe.

The hot springs, geysers, and fumaroles have temperatures up to 94-95.5°C, and in 1932 several geysers were reported to erupt to heights of a meters or more (Nolan and Anderson, 1934). One geyser reportedly played to a height of 1 m and another to 1.1 m. Drilling of geothermal exploration wells on the main sinter terrace in the early 1960s resulted in the disruption of natural geyser activity.
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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 1 to 2 m. 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). White (1998) and Roberts (1989) have described the history of geyser activity at Beowawe. The "best guess" estimates of thermal reservoir temperatures are about 196°C for a sample from a spring, and 226-238°C for a sample from a steam well (Mariner and others, 1974). Since temperatures of over 204°C are reported in 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 75 m high. The top of the terrace, which measures 30 m wide and 850 m long, is remarkably level (Oesterling, 1962). The flowing springs and geothermal wells are located along a narrow band of older sinter that is present between the main terrace and outcrops of Tertiary andesite to the south (Hose and Taylor, 1974, figure). 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 commun., 1970); tungsten is also high in the geothermal fluids (Wollenberg and others, 1975).

Twelve exploratory geothermal wells were drilled in Sec. 17, 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 625 m; several of the wells had temperatures of 208-212°C at depths of 213-244 m. Between 1974 and 1978, three more wells were drilled, two of them to about 1,675 m, and a third to 2,915 m. The Magma Energy, Inc. Batz No. 1 was drilled to 1,661 m in Sec. 17, 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 about 2.4 km 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 1970s.

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 this figure. Some of the wells apparently produced at least 181,000-227,000 kg/hr (400,000 to 500,000 lbs/hr) of fluid, with 10 to 15% steam flashover. Middleton (1961) reported about 680,000 kg/hr (1.5 million lbs/hr) of fluid at 172°C from the Vulcan No. 4 well, with 18,800 kg/hr (41,500 lbs/hr) of that being steam. The wellhead pressure was reported to be 116 lbs/in2 (8.1
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kg/cm²) absolute. Static pressure in several of the wells is apparently in the 2.8 to 7 kg/cm² range, and flow pressure is reportedly 1.4 to 2.1 kg/cm². 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-1970s.

Following exploration drilling in the 1970s and early 1980s, the Beowawe flash power plant came on line in 1985, producing 16.7 MW from a 200°C resource. Initial temperatures were as high as 215.6°C (Benoit and Stock, 1993). The field is located within the northern Nevada rift, a long, narrow, north-northwest trending zone of middle Miocene volcanic and hypabyssal rocks. The geothermal reservoir is associated with the Malapis fault, an east-northeast striking, down to the northwest, normal fault that cuts across the northern Nevada rift. The Malapis fault is parallel to graben-bounding faults to the north in the Midas trough and at the Argenta Rim, which are thought to have begun to form at about 8 Ma (John and others, 1999). In the subsurface, Miocene volcanic rocks overlie Paleozoic chert, shale, and quartzite of the Valmy Formation. Production is from highly fractured and permeable zones in the Valmy below 2,040 m; initial reservoir temperatures were 213-216°C (Benoit and Stock, 1993). The ultimate deep reservoir is believed to be Paleozoic carbonate rocks below the Valmy (Layman, 1984).

Injection of spent brine outside of the Beowawe reservoir caused the reservoir pressure to reduce by 110 psi during the first year of plant operation, which allowed cold ground water to flow in to cool the geothermal reservoir. The cold water inflow tended to stabilize the reservoir pressure but over a period of eight years it reduced the fluid-entry temperatures of the production wells by as much as 21°C (Benoit, 1998, p. 574). The drilling of a large new production well temporarily restored full plant output but accelerated the reservoir pressure and power plant output declined. New injection strategies reduced the gross megawatt decline rate of the power plant over a period of two years (Benoit, 1997, p. 569). More data on the geothermal resource at Beowawe is summarized in GeothermEx (2004).

Leasing information: Beowawe Power LLC signed a 29-year power sales contract with Sierra Pacific Power Co., which took effect January 2006. In 2006 electrical production at the plant was 132,747 MWh gross and 113,935 MWh net (Nevada Division of Minerals, 2007). Nameplate capacity for Beowawe power production is given as 16.6 MW with 17.7 MW actually produced (Nevada Division of Minerals, 2010).
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Magma's 1,735 acres are contiguous with Terra-Gen Power’s 16.6 MW dual flash plant. Proposed work includes seismic reflection, gravity, magnetics, and electrical field surveys followed by TG drilling. In 2010, Terra-Gen received a ~$2m DOE grant to install a bottoming cycle to their existing dual flash plant (http://www.unr.edu/geothermal/explactivity.htm).

Bibliography: