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Brief Reports

Geyser Activity near Beowawe, Eureka County, Nevada

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The Beowawe, Nevada, geyser areas was revisited in January 1968, and an attempt was made to establish seismic signatures and short time temperature histories of the water in the three now active geysers. One of the geysers has a distinctive seismic signature, but the other two exhibit only the background noise characteristic of bubbling springs. In one of the latter geysers, the water gushes up and recedes regularly between eruptions. The temperature of the water in the basins of the other two geysers fluctuates only a few degrees, but in a very regular manner from eruption to eruption.

Some years ago, *Nolan and Anderson* [1934] and later *Murbarger* [1956] described the geyser area near Beowawe, Nevada. Since that time commercial power interests have heavily worked the upper sinter terrace, disrupting all natural geyser activity there, but on the valley floor to the west of the terrace the geysers seemed to be considerably more thermally active now than in 1932.

At present there are three springs and three major geysers in the area, distributed as shown in Figure 1. The three springs are mildly bubbling hot pools a few feet in diameter and a few feet deep. The geyserite cones or platforms that surround them suggest that in the past they were more active. A small extinct geyser (see Figure 1), which left a dry geyserite cone 60 cm in diameter and 8 cm high with an opening 8 to 10 cm in diameter, lies a few feet northward. The boiling point at the 4760-foot elevation of the valley is 95°C. The water a few meters down within the pool is slightly superheated with temperatures ranging from 95° to 98°C. This superheating is possible because the hydrostatic head of the water in the pool supresses boiling.

The three active geysers are labeled in Figure 1 as South, Middle, and North. An attempt was made to establish the seismic signatures of the three geysers using a HS-10 geophone placed close to the geyser opening. Water temperature as a function of time was measured in each geyser by lowering a weighted thermistor in each basin and leaving it there during several eruptions.

South geyser has an opening about 30 cm in diameter. It emerges from a small geyserite cone surrounded by a shallow, irregular catch basin, about 4 meters across. The geyser was observed for parts of two days. At times it played regularly at intervals of 4 minutes with a duration of play of 1 minute; at other times the eruptions were much less regular and more widely spaced. During an eruption the water was thrown to a height of about 2 meters with a considerable overflow of water. Between erup-

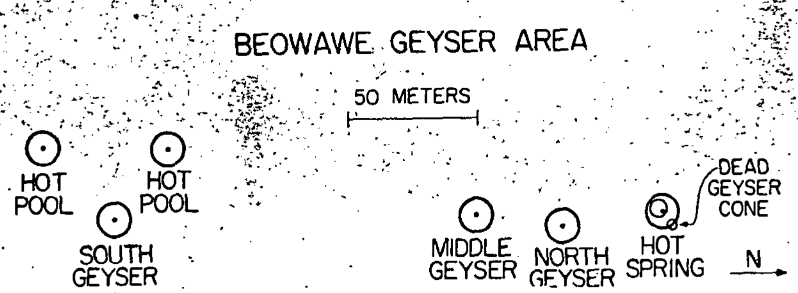

Fig. 1. Chart of Beowawe geyser area.

tions, the water in the pool stayed at a more or less constant level with occasional bubbles of steam and hot water welling up and bursting at the surface.

The temperature trace recorded by lowering a thermistor about 5 meters into the opening is shown in Figure 2. Between eruptions the temperature of the water remains essentially constant at 98°C, 3° above the ambient boiling point of 95°C, but 3° or 4° below the boiling curve for that depth. In this superheated condition, relief of the hydrostatic head by, for example, the bursting of a steam bubble, could initiate violent boiling leading to an eruption. The eruption has a cooling effect, energy being used up in converting water into steam, and the water at lower level drops momentarily to the ambient boiling point of 95°C.

South Geyser has the distinct and repeatable seismic signature shown in Figure 3. As the eruption time approaches, the background noise arising from boiling within the pool builds up and reaches a maximum just before the eruption. The eruption is followed by an abruptly initiated sustained upward motion of the ground, lasting for about one second, which stops suddenly only to begin again, but more slowly. The total upward motion lasts for about 45 sec. The upward displacement is followed by partial recovery and is probably generated by downward rushing water refilling emptied subterranean cavities with the initial sudden motion coming from slapping of the water against the roof of the cavity. The more sustained motion arises from later gradual filling of the cavern.

A cross section of the geyserite basin of Middle Geyser is shown in Figure 4. The basin, about 4 meters in diameter at the top, slopes downward gradually for about 1 meter inward from the rim and then cups abruptly to a total depth of 1.8 meter.

A mild eruption, more like vigorous boiling with the water welling up to a height of 30 to 60 cm above the rim of the basin, takes place about every 23 min. The level of the water in the basin fluctuates in a cyclic fashion. Each eruption is followed by a drawing away of water from below, emptying the basin. It then gradually refills, preparatory to the next eruption.

A thermistor placed at the bottom of the basin and left there through several eruption cycles gave the temperature pattern shown in Figure 5. The water, initially at 89°C, is heated up over a period of about 5 min by short ejections of hot water from below to a temperature of 93°C, at which it stays for a few minutes. The eruption that then usually occurs is probably triggered by an infusion of hot water through the bottom of the basin. The water cools slowly down to 89°C by the time the basin becomes empty, the emptying taking 2 or 3 min.

The attempt to establish a seismic signature for Middle Geyser was unsuccessful, aside from noting that the background noise due to boiling fluctuated with the water level, being stronger when the basin was full than when it was empty.

North Geyser is quite different from the other two. The visible vertical section is L-shaped (Figure 6), about 1 meter long and 30 cm in diameter. The paucity and freshness of geyserite material suggest that its opening is new. The irregularly shaped embryonic geyserite cone or plate rests on loose soil and is about 0.7 meter across and 8 cm thick. Fresh grass is imbedded it it in many places.

The geyser erupts about every 2 hr, playing for 2½ to 3 min to a height of 1 meter. Between eruptions it fills and empties itself to the crook in the tube (the bottom of the rock in Figure 6) in a regular and periodic way about every 5 min stopping short of the lip of the geyser. A thermistor placed at the crook recorded the temperature profile plotted in Figure 7. The abrupt increases in temperature to 93°C occur when the water gushes up from below and surrounds the thermistor. It is conjectured that the periodic interim gushing is the direct result of multiple eruptions of a subterranean erupting geyser, as has been suggested by *White* [1967] for other geysers. The eruption of the surface geyser finally occurs after the water remains continuously above the crook for two or three surges. The temperature of the water is only 93°C, two degrees below the boiling point, suggesting that the final surge causing the eruption also comes from well down within the geyser.

The seismicity of the geyser was characterized primarily by background noise which increased and decreased in rhythm with the surges of water. The proximity of North Geyser to Middle Geyser plus the fluctuation of water levels in the two, suggested that they might be interconnected, but concomittant observations of the two did not support the idea.

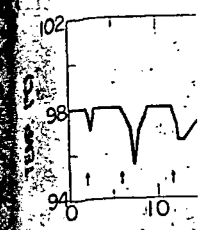

Fig. 2. Temperat
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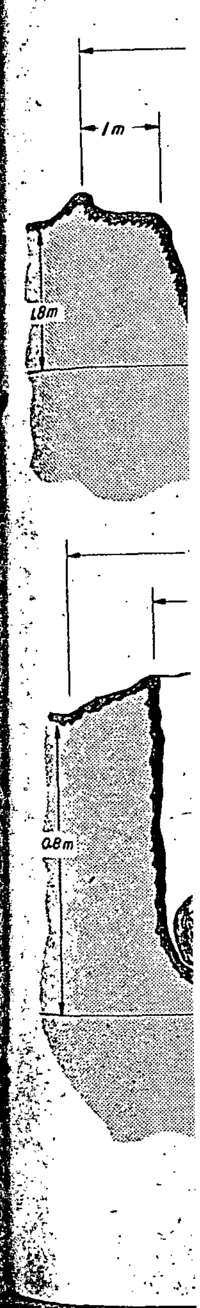
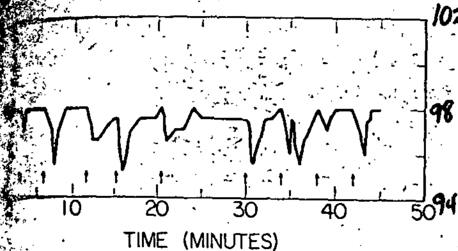




Temperature within South Geyser as a function of time.

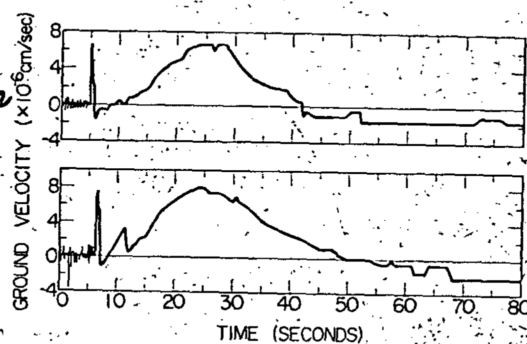
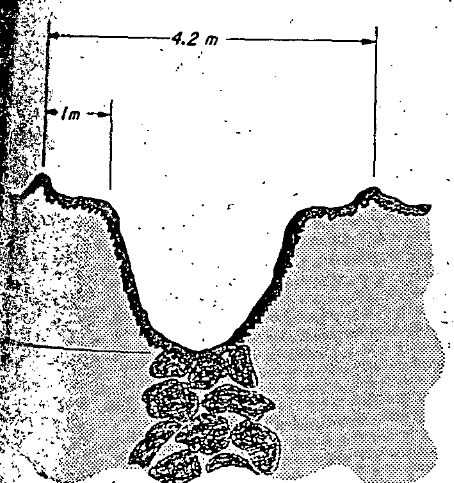


Fig. 3. Ground motion at South Geyser as a function of time.



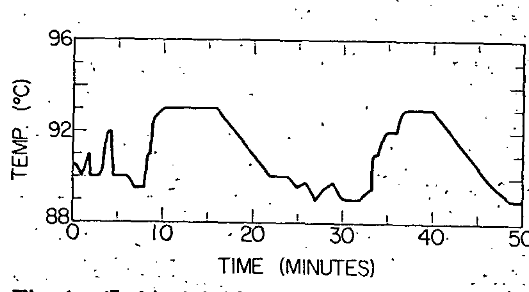
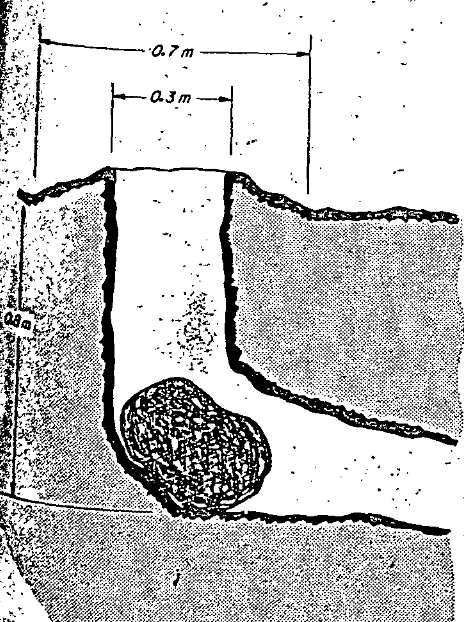


Fig. 4. (Left). Visible vertical cross section of Middle Geyser.

Fig. 5. (Above.) Temperature within Middle Geyser as a function of time.



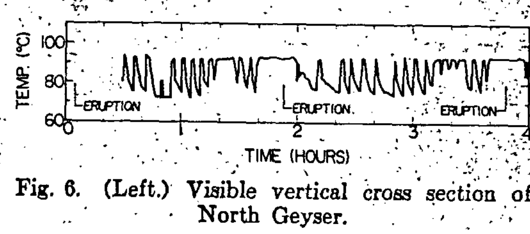


Fig. 6. (Left.) Visible vertical cross section of North Geyser.

Fig. 7. (Above.) Temperature within North Geyser as a function of time.

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