ST. GEORGE BASIN GEOTHERMAL AREA

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The St. George basin geothermal area covers roughly 250 mi^2 (650 km^2) in extreme southwestern Utah and includes the Santa Clara and Virgin River Valleys in Washington County. The area coincides with the St. George basin subprovince of Stokes (1988). The Pine Valley Mountains to the north, the Beaver Dam Mountains to the west, the Hurricane Cliffs to the east, and the Utah-Arizona state line to the south border of the basin. The basin lies along the western margin of the Colorado Plateau, just east and south of the Basin and Range - Colorado Plateau Transition Zone.

Sedimentary strata folded along northeast axes characterize the St. George Basin, although many consider the basin as part of the Colorado Plateau. Strata in the region generally dip gently northeastward, and the basin is bordered structurally on the east by the Hurricane fault, and on the west by the Grand Wash-Gunlock fault (Petersen, 1983).

The basin is underlain by a thick sequence of Paleozoic and Mesozoic strata, sandwiched between Precambrian metamorphic rocks, exposed in the Beaver Dam Range, and a series of Tertiary intrusive and volcanic rocks exposed in the Pine Valley and Bull Valley Mountains, respectively. Hamblin (1970) described four stages of Late Cenozoic basalt flows and cinder cones in the St. George Basin that form many elongate eroded ridges.

Two major structural trends include northeasterly aligned folds and faults of Laramide age, and post-Laramide north-south oriented extensional faults. The Virgin Anticline, a major Laramide feature, extends northeasterly across the center of the basin for about 17 miles (27 km). The Hurricane fault, a post-Laramide feature, is an active normal fault that extends for over 300 miles (480 km) from Cedar City through northwestern Arizona. The Grand Wash-Gunlock fault, which was active during Pleistocene time, can be traced from Gunlock, Utah southward for about 100 miles (160 km) into Arizona. The Washington fault, an active normal fault extending southward from the foothills of the Pine Valley Mountains across the Virgin Anticline and into Arizona, nearly bisects the St. George Basin (Sommer and Budding, 1994).

Veyo and Pah Tempe Hot Springs resorts in southwestern Utah offer swimming and therapeutic baths, through the latter is temporarily closed. At Veyo Hot Springs Resort, located southeast of the town of Veyo along the Santa Clara River canyon, spring flows are channeled to a swimming pool at a temperature of about 32°C (89°F). At the Pah Tempe Hot Springs Resort springs flow from a number of vents along the Virgin River at about 42°C (108°F) near where the river crosses the Hurricane fault between the towns of Hurricane and La Verkin. The thermal water is channeled into a swimming pool and therapeutic baths.

VEYO HOT SPRINGS RESORT

Veyo Hot Spring is located southeast of the town of Veyo along the Santa Clara River. Here the river has incised 1 and 2 million-year-old basalt flows to form a steep-walled canyon. Mundorff (1970) reported that spring temperatures ranged from 90° to 97°F (32° to 37°C), TDS values ranged from 389 to 402 mg/L, and the flow rate was constant at 120 gpm (8 L/s). Budding and Sommer (1986) reported a temperature measurement of 85°F (29.5°C).

PAH TEMPE HOT SPRINGS RESORT

Pah Tempe Hot Springs, also known as La Verkin or Dixie Hot Springs, are located along the Virgin River where the river cuts through Timpoweap Canyon along the Hurricane Cliffs. The north-trending Hurricane fault lies a short distance west of the springs. The springs issue from multiple vents in fractured Permian Toroweap Limestone. Widespread basalt flows ranging in age from 2 million years B.P. to 1,000 years B.P. lie in the vicinity of the springs, possibly relating to local heat sources for the thermal water.

In the mid-1980s, construction of a water pipeline for the Quail Creek (off-line storage) reservoir reportedly disrupted the discharge of existing hot springs and new springs emerged at lower bank-levels along the Virgin River (Ben Everitt, Utah Division of Water Resources, verbal communication, 1993). Flows to the original springs were partly restored after installation of a clay and cement seal in the construction area. In September 1992, a 5.8 magnitude earthquake evidently contributed to another disruption of spring flows as discharge decreased and again new springs emerged at lower bank- levels along the Virgin River (Ken Anderson, Pah Tempe Resort, verbal communication, 1993). Available analyses for the springs, done prior to the earthquake, are variable and possibly reflect differences in sample collection points. Blackett (1994) obtained a post-earthquake spring sample collected from one of the new spring orifices where the Quail Creek pipeline crosses the Virgin River. The post-earthquake sample results were similar to the previous analyses. The water is a sodium calcium-chloride, sulfate, and bicarbonate type. Geothermometers suggest equilibration temperatures between 167°F and 176°F (75°C and 80°C).

Flow rate, chemistry, and temperature have varied through time. Mundorff (1970), and Sommer and Budding (1994) reported that temperatures recorded at the springs have varied over the last 100 years from 100° to 133°F (38° to 56°C). It is not clear whether the spring temperatures have declined over the past century or if the earlier temperatures recorded were inaccurate. Recent measurements have shown the springs to issue at temperatures near 108°F (42°C). Flow rates measured by several workers suggest that the combined flows for all of the vents range between 4,500 and 5,000 gpm (280 and 315 L/s). Pah Tempe Springs are relatively high TDS content, ranging between 8,390 and 9,340 mg/L. See the article by S. Lutz, this issue, for more details.

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