# GILA HOT SPRINGS

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## INTRODUCTION

Gila Hot Springs, is located on the West Fork of the Gila River in the Gila National Forest about 40 miles north of Silver City, center of a major copper mining district in the U.S. in southwestern New Mexico. A popular tourist destination in the area, the Gila Cliff Dwellings National Monument is located four miles northwest of the Gila Hot Springs. The area in the vicinity of the Gila Cliff Dwellings has been occupied by various cultures as far back as 10 to 12,000 years. These various people started with Archaic cultures through Early- and Late-Pit House, and Classic Pueblo Periods to present Apache cultures. Most used the caves as temporary shelters by the nomadic people as indicated by campfire soot on the ceiling; however, from the 1280s through the early-1300s, the Mogollon culture built and lived in rock dwelling in the six caves in the cliffs. Over 100 prehistoric sites are scattered throughout the area of the headwaters of the West Fork and Middle Fork of the Gila River (National Park Service website, 2002). Gila Hot Springs and the Cliff Dwellings Nation Monument are virtually surrounded by the rugged forested canyons and mountains of the Gila Wilderness, the nation's first designated wilderness area.

The Gila Hot Springs are mentioned as "A small army camp established in the late 1800s, where the village of Gila Hot Springs now sits, to guard the settlers from the dreaded Apache." Another historical reference states: "Scattered through out the canyons is the old ranching community of Gila Hot Springs, settled in the 1880s by the Hills brothers. (Geronamo Trail Home Page, 2002). The first permanent adobe houses were built around 1890. In 1929, Doc Campbell moved to the area and ranched and led hunting trips in the area and built Doc Campbells's Post in 1963." The store has grown into the geothermally-heated "Doc Campbell's Post Vacation Center" (Photo 1). The present Gila Hot Springs community consists of about 20 homes and house trailers, and is a recreation area. There are several other hot springs in the area (see Figure 2), including Melanie Hot Springs (Waterfall Hot Springs) on the Gila River below the junction of the West and East Fork of the Gila River, Lyons Lodge Hot Springs on the East Fork of the Gila River, and Jordan Hot Springs and Lightfeather Hot Springs on the Middle Fork of the Gila River, all requiring access by hiking (see Bischoff, 2001 for additional details). An abandoned "Indian" bath surrounded by a low rock wall can still be seen in the community above the east bank of the Middle Fork of the Gila River (Photo 2).


***Photo 1.*** ***Doc Campbell's Store with geothermal floor heating.***

***Photo 2.*** ***Gila conglomerate over andesite above the hot springs.***

## GEOLOGY AND HYDRO-GEOLOGY

Gila Hot Springs is situated in a transition zone between the Colorado Plateau and the Mexican Highland section of the southern Basin and Range and Rio Grande rift (Figure 1). This zone is called the Datil-Mogollon section of the Basin and Range Province and is underlain by a thick pile of mid-Tertiary volcanics and volcaniclastic sediments. The Datil-Mogollon country is probably similar to the Transition Zone in Arizona in terms of the Tertiary subcrop. The Tertiary subcrop is probably characterized by Precambrian and Paleozoic rocks with the Mesozoic aquitards of the Colorado

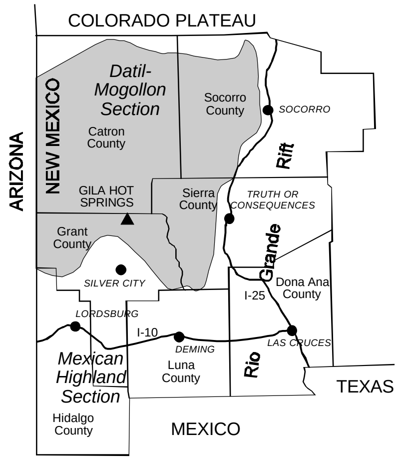


***Figure 1. Regional location map of Gila Hot Springs.***

Plateau stripped away. Several large silicic caldera complexes occur in Datil-Mogollon region as well as several large stratovolcano centers of andesite and basaltic andesite (Ratte, et al., 1979). Post volcanism deformation consists of several in echelon northeast and northwest-trending half grabens of Miocene age that were largely backfilled with basin fill sediment (Gila Conglomerate) by late-Miocene and early-Pliocene. Post early-Pliocene erosion and entrenchment of the Gila River and its tributaries have removed much of the graben basin fills, and have created the spectacular landscape the Gila Wilderness of deep rugged forested canyons (Photo 3). Gila Hot Springs and other hot springs in the area all occur within the Gila Hot Springs graben along normal faults (Ratte, et al., 1979) (Figure 2).

***Photo 3. The remains of the Indian bath on the east bank of the Gila West Fork.***

A geologic map and cross sections of Gila Hot Springs shows the stratigraphic and structural control on the shallow reservoir (Figures 3 and 4). Well logs and map data are from Summers and Colpitts (1980) and Witcher, unpublished data (fault dips and logs on Campbell 3 and 4 wells and the Doyle well). The shallow geothermal reservoir at Gila Hot Springs is the 600 ft thick Bloodgood Canyon Tuff

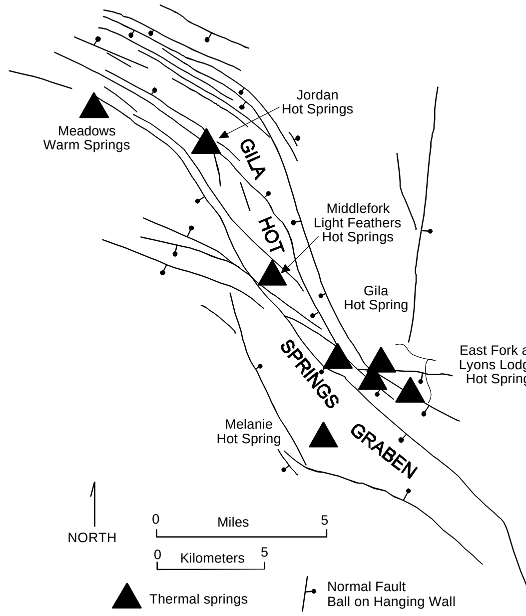


***Figure 2. Tectonic map of the Gila Hot Springs region.***

(rhyolite ash flow tuff) of Elston (1968). The Bloodgood Canyon (28.05 ma)(McIntosh, et al., 1990) is one of the most extensive units of the Datil Mogollon region and can reach up to 1,000 ft thickness west of Gila Hot Springs and it may represents an outflow ignimbrite from the large Bursum Caldera to the west in the Mogollon Mountains. The Bloodgood Canyon reservoir is confined by the Tertiary andesite. Gila Conglomerate overlies the andesite and represents graben basin fill remnants. Temperature isotherms drawn on the cross section from temperature logs of wells indicates that an east-to-west trending normal "cross" fault between two northwest striking normal faults provides important upflow permeability for the Gila Hot Springs geothermal system.

The Gila Hot Spring thermal waters are excellent quality with total dissolved solids between 620 and 659 mg/L. Chloride ranges from about 100 to 105 mg/L and silica ranges from 65 to 75 mg/L (Summers, 1976; Witcher, 1995). There is not a lot of variability between the wells and springs in terms of chemistry. There is some variability in temperature among the wells and the hot springs. Eight wells have been drilled in the immediate area of Gila Hot Springs. Only one of the wells, Campbell 4, is currently being used for geothermal direct-use heating and bathing. All of these wells have temperature logs and lithology information, and some have chemistry information. A step-pump test and a constant rate (52 gpm) 48-hr pump test of the Campbell 2 well indicates a transmissivity of about 12,000 to 14,000 gpd/ft and a storativity of about 0.05 (Schwab; et al., 1982). These values should be considered provisional as the well did not fully penetrate the reservoir host and the well had also caved back prior to pump testing. Natural total discharge of the Gila Hot Springs system is believed to be about 150 to 200 gpm (Summers, 1976).

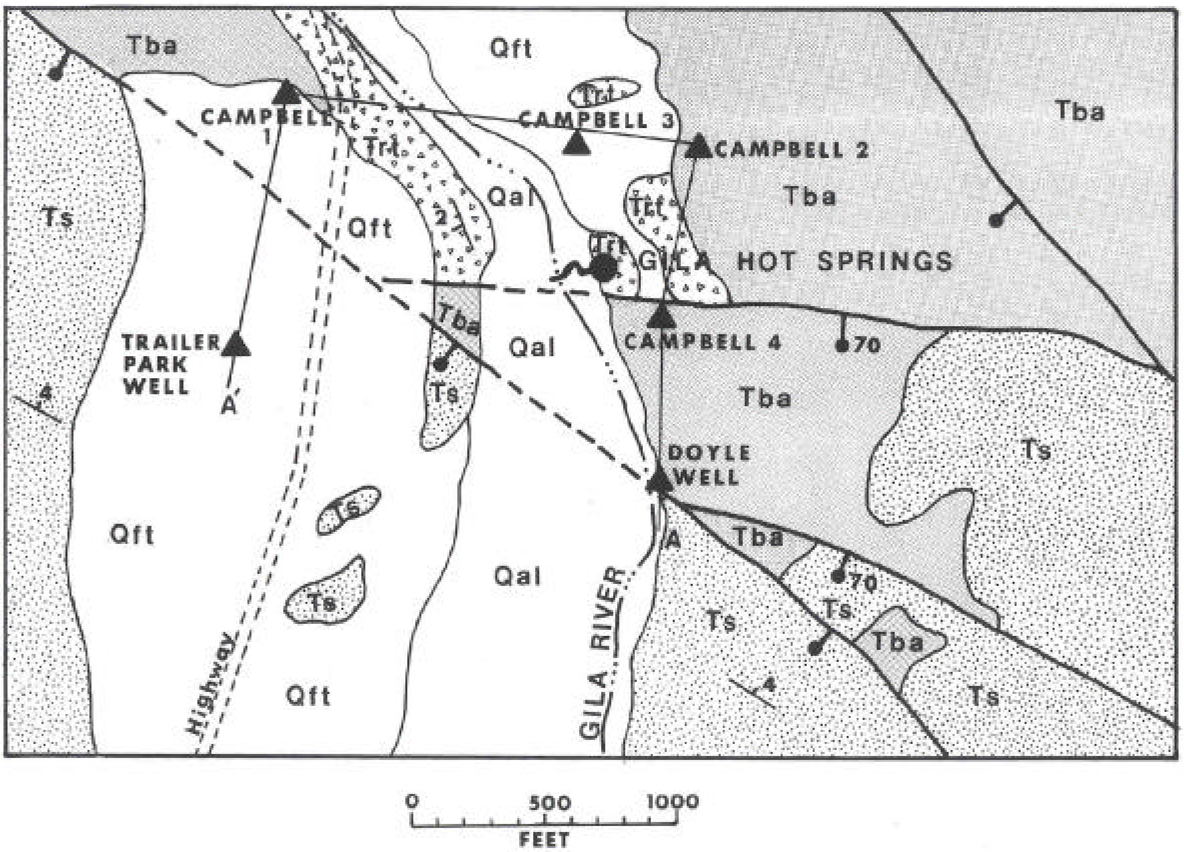


*Figure 3. Geologic map of Gila Hot Springs with key well locations.*

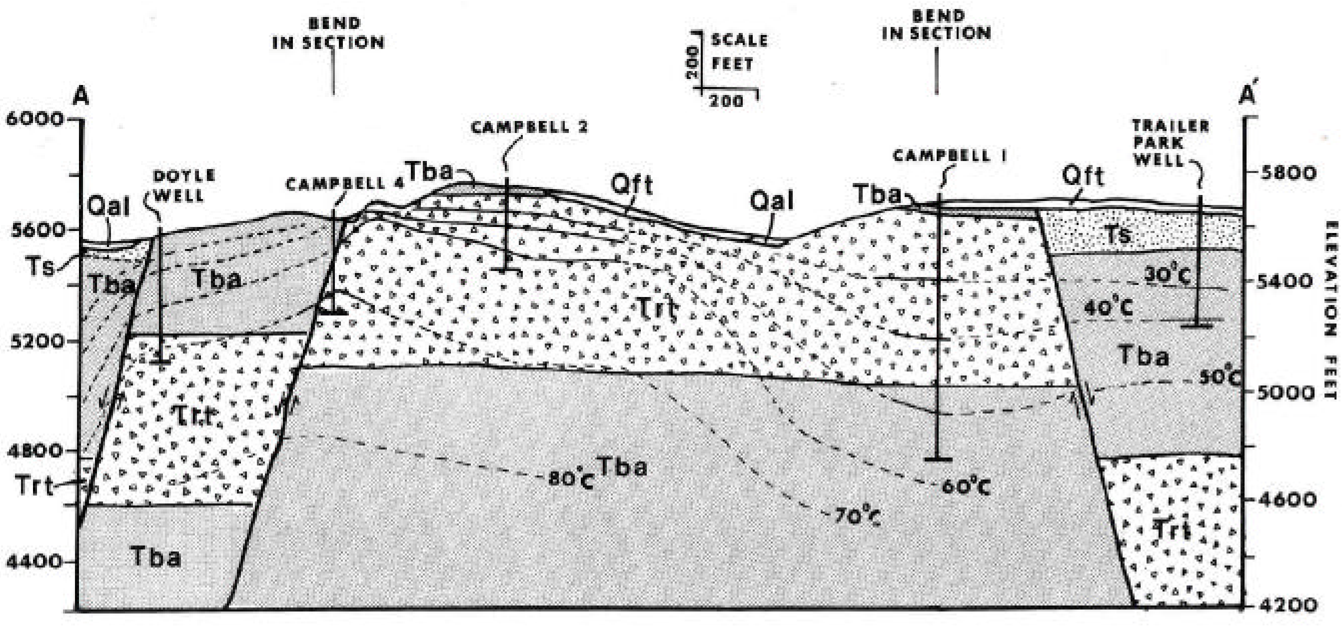


*Figure 4. Geologic cross section of the Gila Hot Springs area with actual subsurface temperatures.*

## GEOTHERMAL USE

The Campbell 4 artesian well on the hill slope above the hot springs on the east bank of the Gila West Fork, provides hot water to the community through a suspended pipeline over the river (Photos 4 and 5). Twenty buildings and two greenhouses are heated from this artesian well which flows water at 165°F. Approximately 40,000 $ft^2$ of floor space is heated with water at 135°F; 50% by floor radiant systems using copper pipes. The systems, installed 15 years ago, uses an average of 76 gallons per minute. There are four other systems in the community using spring water at 155°F, heating individual homes and two swimming pools. The artesian well also provides geothermal water through a two-pipe system to a home situated on a hill, approximately 200 feet above the well.

**Photo 4.** ***The Campbell 4 artesian geothermal well on the east bank of the Gila West Fork.***

**Photo 5.** ***The suspended pipeline across the West Fork of the Gila River.***

Allen Campbell, son of Doc Campbell, heats his home with a radiant floor system of copper pipes using one to two gallons per minute, in an open system supplying water at 145°F and rejecting it at 80°F (Photo 6). Allen also supplies hot water to bathing ponds for use in a primitive RV park next to the river (Photo 7).

**Photo 6.** ***Allen Campbell's controls for his home heating system.***

**Photo 7.** ***Bathing/soaking ponds in the Campbell's Gila Hot Springs RV Park.***

The estimated installed capacity of the systems is 0.4 MWt with an annual energy use of 2.5 billion Btu/year. They estimate their annual savings is $5,000 to $10,000 per year, compared to the alternate available energy source of propane and firewood. However, at today's prices for propane, their savings are probably closer to $25,000 per year.

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