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Hydrothermal Systems

Section updated

Yellowstone's hydrothermal features would not exist without the underlying magma body that releases tremendous heat. They also depend on sources of water, such as the mountains surrounding the Yellowstone Plateau. There, snow and rain slowly percolate through layers of permeable rock riddled with cracks. Some of this cold water meets hot brine directly heated by the shallow magma body. The water's temperature rises well above the boiling point but the water remains in a liquid state due to the great pressure and weight of the overlying water. The result is superheated water with temperatures exceeding 400°F.

The superheated water is less dense than the colder, heavier water sinking around it. This creates convection currents that allow the lighter, more buoyant, superheated water to begin its journey back to the surface following the cracks and weak areas through rhyolitic lava flows. This upward path is the natural "plumbing" system of the park's hydrothermal features.

As hot water travels through this rock, it dissolves some silica in the rhyolite. This silica can precipitate in the cracks, perhaps increasing the system's ability to withstand the great pressure needed to produce a geyser. *(See description below.)*

At the surface, silica precipitates to form siliceous sinter, creating the scalloped edges of hot springs and the seemingly barren landscape of hydrothermal basins. When the silica rich water splashes out of a geyser, the siliceous sinter deposits are known as geyserite.

***Geysers** are hot springs with constrictions in their plumbing, usually near the surface, that prevent water from circulating freely to the surface where heat would escape. The deepest circulating water can exceed the surface boiling point (199°F/93°C). Surrounding pressure also increases with depth, much as it does with depth in the ocean. Increased pressure exerted by the enormous weight of the overlying water prevents the water from boiling. As the water rises, steam forms. Bubbling upward, steam expands as it nears the top of the water column. At a critical point, the confined bubbles actually lift the water above, causing the geyser to splash or overflow. This decreases pressure on the system, and violent boiling results. Tremendous amounts of steam force water out of the vent, and an eruption begins. Water is expelled faster than it can enter the geyser's plumbing system, and the heat and pressure gradually decrease. The eruption stops when the water reservoir is depleted or when the system cools.*

***Cone geysers,** such as Riverside in the Upper Geyser Basin (above), erupt in a narrow jet of water, usually from a cone. **Fountain geysers,** such as Great Fountain in the Lower Geyser Basin (right), shoot water in various directions, typically from a pool.*

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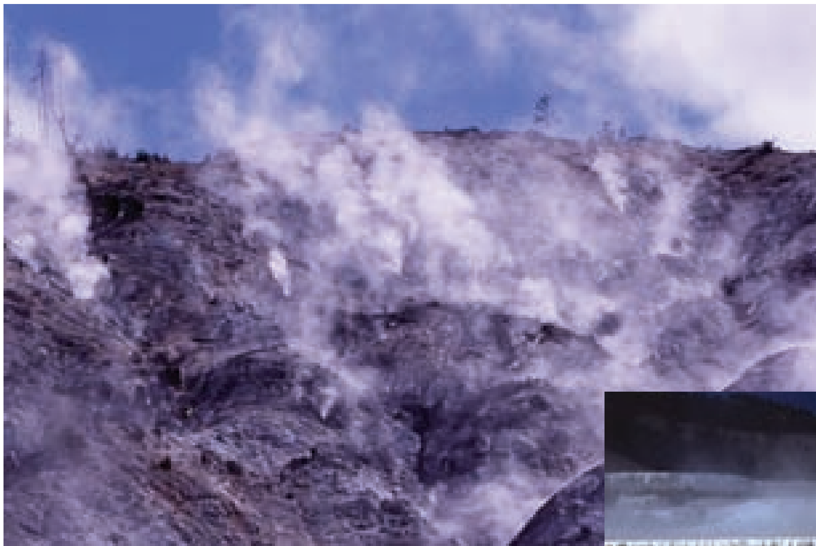

Fumaroles *or steam vents, are the hottest hydrothermal features in the park. They have so little water that it all flashes into steam before reaching the surface. At places like Roaring Mountain (left), the result is a loud hissing of steam and gases.*

Travertine terraces, *found at Mammoth Hot Springs (left), are formed from limestone (calcium carbonate). Water rises through the limestone, carrying high amounts of dissolved calcium carbonate. At the surface, carbon dioxide is released and calcium carbonate is deposited, forming travertine, the chalky white rock of the terraces. Due to the rapid rate of deposition, these features constantly and quickly change.*

Mudpots *such as Fountain Paint Pot (center, left) are acidic features with a limited water supply. Some microorganisms use hydrogen sulfide, which rises from deep within the earth, as an energy source. They help convert the gas to sulfuric acid, which breaks down rock into clay. Various gases escape through the wet clay mud, causing it to bubble. Mudpot consistency and activity vary with the seasons and precipitation.*

Hot springs *such as this one at West Thumb (left) are the most common hydrothermal features in the park. Their plumbing has no constrictions. Superheated water cools as it reaches the surface, sinks, and is replaced by hotter water from below. This circulation, called convection, prevents water from reaching the temperature needed to set off an eruption.*