

Yellowstone Field Trip

May 23-25, 2024

After more than two years of hard work by Bob Tilling, 23 members of the Geologists or Jackson Hole gathered at the south entrance of Yellowstone NP for a special field trip of the park led by the top three USGS Yellowstone scientists: Lisa Morgan, Mike Poland and Pat Shanks. Unfortunately, it was snowing hard and the south entrance to Yellowstone was closed. After contacting our leaders who were inside the park waiting for us, we drove back through Jackson over the pass to Victor and up to West Yellowstone and into the park.

About five hours late, we met with our guides while it was snowing at Terrace Springs and started the field trip. Terrace Springs sits at the northern boundary of the recent caldera. It discharges 24 gallons per second of what appears to be boiling water, yet the water temperature is only 147 degrees F. The bubbles are CO₂ being emitted from degassing magma.



We stopped at Beryl Springs which emits 3 to 16 times more He than is present in the atmosphere. At Norris Geyser Basin we walked to Steamboat Geyser (the world's tallest) in hopes that it would erupt, but no luck. After walking the southern loop in Norris Basin, we drove past Mammoth Hot Springs to Gardiner for the evening.

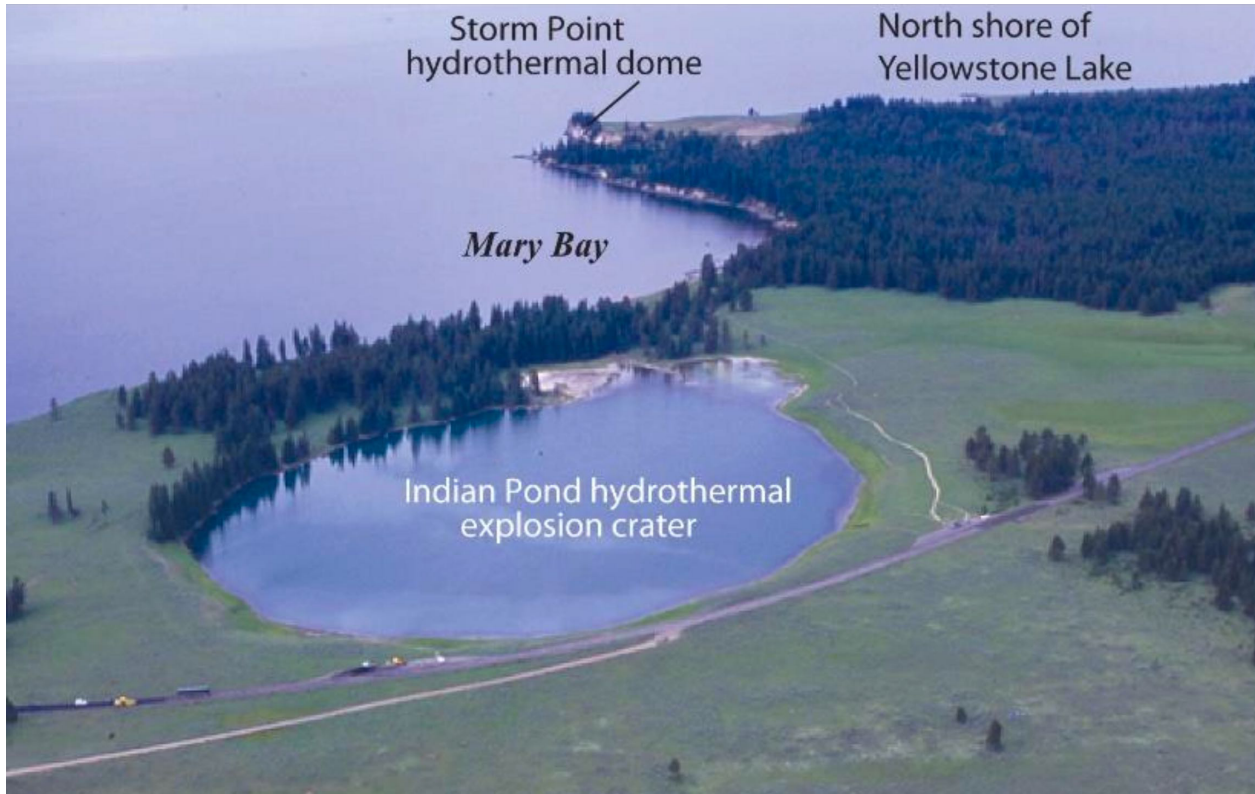
The next day we met at the Roosevelt Arch to a was beautiful. The first stop was at the Grand Canyon of the Yellowstone. The canyon is 17 miles long and 800 to 1100 feet deep. The canyon walls are 484,000-year-old rhyolite. The dramatic yellow, orange, and red rocks and sediments in the canyon are a result of hydrothermal alteration of post-caldera volcanic rocks. The Canyon was cut 13,000 years ago when a significant Yellowstone Lake wide seismic event, resulting in a

large lake outburst flood into Hayden Valley.



The next stop was Black Dragon' Cauldron mud volcano which was formed in 1948. It is one of the youngest large hydrothermal explosion craters in the park.

At the north edge of Yellowstone Lake, we explored Indian Pond, Storm Point and Mary Bay. 2,900-year-old Indian Pond is one of 20 large (>100-m-diameter) hydrothermal explosion craters that have been identified within Yellowstone caldera. Storm Point is a structural dome that is ~840 m long by ~795 m wide and has multiple craters exposed on its top. It is 10 to 20 meters above the Lake related to a large center of hydrothermal activity. Mary Bay event is 13,000 years old, 2.6 km in diameter and is the world's largest documented hydrothermal explosion crater. Hydrothermal explosions were first described in 1990 in Yellowstone and occur in near-surface environments where near-boiling water is present. If conditions in this type of environment suddenly change, resulting in a rapid pressure reduction, the contained fluids may flash to steam, resulting in a significant volume increase, fragmentation of enclosing rocks, and formation of large craters. They can be very dangerous and are not well understood. The most recent hydrothermal explosion in Yellowstone occurred this year in Biscuit Basin.



The last stop of the day was Mammoth Hot Springs. It is the only major thermal area in Yellowstone National Park dominated by hydrothermal CaCO_3 (travertine) deposition rather than siliceous sinter. Mammoth Hot Springs deposits have been active for 8,800 years and is an elongate NE-SW depositional mound with an area of nearly 250 acres that hosts approximately 100 active hot springs. The travertine deposits at Mammoth Hot Springs buildup up at a rate of 2.8 to 56.5 cm/y and are 250 feet thick sitting on Mesozoic limestone. After walking on the

terraces, we returned to Gardiner for the evening.



The last morning the drove past Norris Geyser Basin to Midway Geyser Basin. We walked to Excelsior Geyser which discharges about 4,000 gallons of boiling waters per minute into the Firehole River. The geyser exploded several times between 1878 and 1888 to create the current crater that is 150 to 250 feet wide and 350 feet long; it has near vertical 13-foot-high walls that expose older layered sinter deposits.

We walked around Grand Prismatic Spring which is the largest hot spring in the United States and the third largest in the world. It is 370 feet in diameter and over 120 feet deep in its central vent area. It discharges an estimated 550 gallons of water per minute. The striking prismatic colors that grade from the clear blue 190-degree waters in its center to 145 degree temperature bands around its margins.



We ended the field trip at Upper Geyser Basin and watched Old Faithful geyser which expels up to 8500 gallons of boiling water per minute to a height of up to 180 feet and last for 1.5 to 5

minutes. Intervals between eruptions can range from 45 to 125 minutes.



We then walked to Geyser Hill a 1000 foot-diameter sinter terrace that hosts many hot spring pools and geysers. It demonstrates a remarkable range of occurrence and behavior within a group of vents that emit silica-depositing, alkaline-chloride fluids that tend to be low in CO₂. Most are at or near boiling conditions.

If you would like to read about the geology of Yellowstone National Park use the link below to access the US Geologic Survey's Geologic field-trip guide to the volcanic and hydrothermal landscape of the Yellowstone Plateau,

https://pubs.usgs.gov/sir/2017/5022/p/sir20175022_p.pdf

