Yellowstone Study Develops New Way of Estimating Magma in Park Supervolcano

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New research from the University of Idaho and Washington State University suggests previous studies have significantly underestimated the amount of heat escaping from the hot springs inside Yellowstone National Park.

"By learning about these processes, we will build on our understanding of the Yellowstone supervolcano's eruption cycle," said Peter Larson, a professor in the School of Environment at Washington State University.

A team of scientists — led by Larson and U of I's Jerry Fairley, a professor in the College of Science's Department of Geological Sciences — measured the volume of hot water flowing through several hot springs and estimated the heat loss from the springs. Their study is titled "Direct Measurement of Advective Heat Flux from Several Yellowstone Hot Springs, Wyoming, USA" and was published this week in the journal Geosphere.

Researchers have long struggled to quantify the heat loss from Yellowstone's hot springs. Heat from hot springs can be lost directly to the atmosphere from surface waters or transferred to the ground. In addition, warm groundwater can remove heat from the area by flowing away from the hot springs, a process that has been difficult to measure.

Fairley and his colleagues used a new measurement technique to account for heat loss from the hot springs in June 2014. The researchers "spiked" several hot springs in the Morning Mist Springs area of Lower Geyser Basin in Yellowstone National Park with a stable hydrogen isotope called deuterium. The researchers used the length of time needed for deuterium concentrations to return to background levels and the temperature of the hot springs to calculate the amount of water and heat flowing out of the springs. Using deuterium for estimating heat flow is safe for the environment and has no visual impact to distract from the park visitors' experience, Fairley said.

The team found previous studies significantly underestimated the amount of water coursing through the springs and the amount of heat leaving the springs. The data also allowed researchers to estimate the amount of magma entering the supervolcano from the mantle.

"We're finding that, if you extrapolate the data, about half of the amount of magma is coming up under Yellowstone as is coming up under Kilauea, Hawaii," Fairley said, referring to the recently volcano-struck area on the state's Big Island. By developing a better understanding of how much magma is rising up from the mantle at Yellowstone, the researchers hope to gain insight into the potential for future eruptions.

The study will help researchers understand the rate at which heat is transported to the Earth's surface from molten rock, an important factor in understanding geothermal energy resources. Fairley thinks – by narrowing down the amount of heat that feeds the park's geothermal system – researchers will someday understand the complex processes that drive the enormous Yellowstone volcano.

WSU graduate student Nick McMillan is lead author of the paper. Co-authors include WSU graduate student Joe Mulvaney-Norris and U of I graduate student Cary Lindsey.

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