Rock Core Preparation for Luminescence Dating of Hydrothermal Explosions

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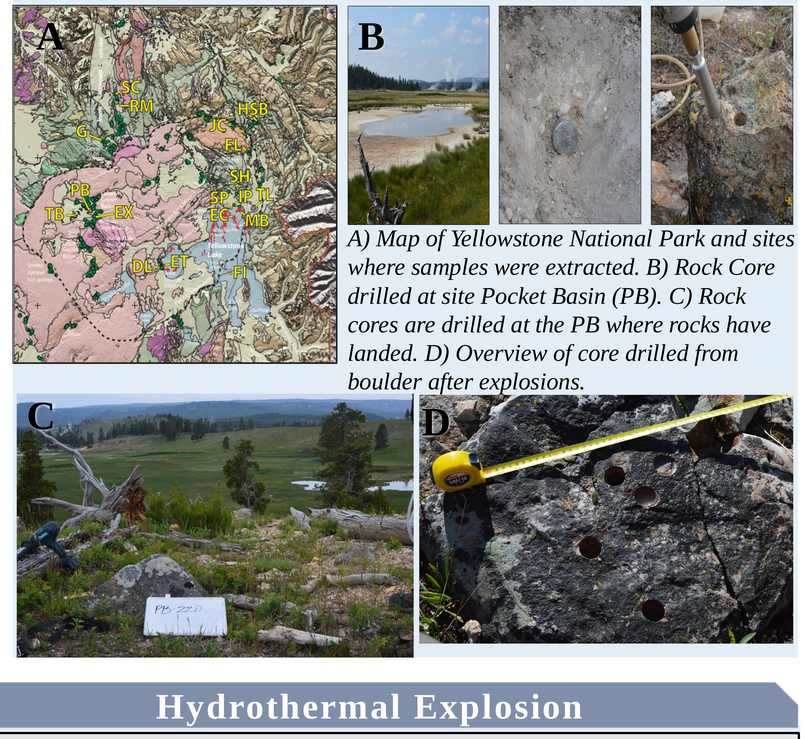
Abstract

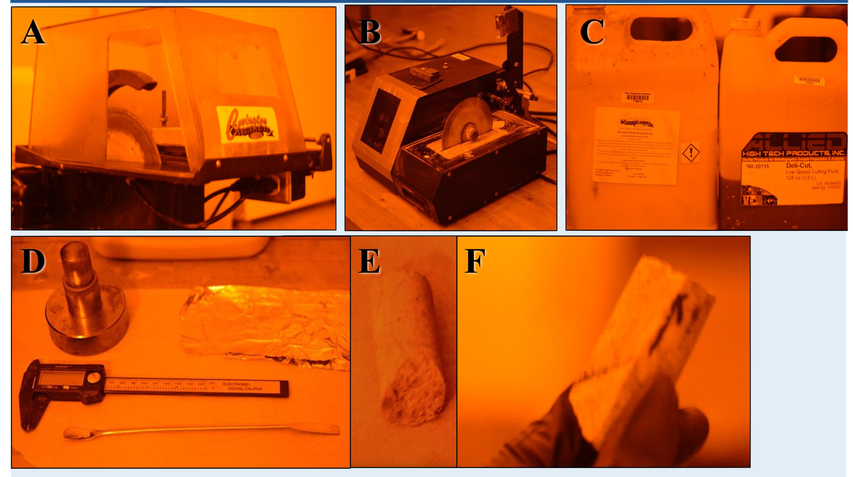
The Yellowstone National Park presents hydrothermal activity producing immensely hazardous hydrothermal explosions. Shallow reservoirs of water underground are heated by magma that can release boiling water, steam, and rock fragments. Hydrothermal explosions are triggered by seismic activity, the release of high amounts of pressure caused by deglaciation or changes in lake level. With the use of geochronology, luminescence dating is used to date explosion craters with rock core samples located in Yellowstone National Park. The duration of solar exposure samples is investigated by luminescence techniques to date rock samples measuring the photons that passes through the rocks. Rock cores are prepared and measured so luminescence signals can be interpreted to infer the history of hydrothermal explosions. Samples are prepared by slicing slabs and 16 wafers for each rock core sample from Yellowstone. The top half of the rock cores are prepared by slicing wafers, measuring each wafer's thickness, and are crushed so it is ready to analyze how much light penetrated those fragments. The lower half of the rock core samples are preserved for investigating cooling history. Rock core samples are, so proficient techniques in preparing slabs and wafers aids for luminescence analysis to be propitious.

Field Site & Sampling



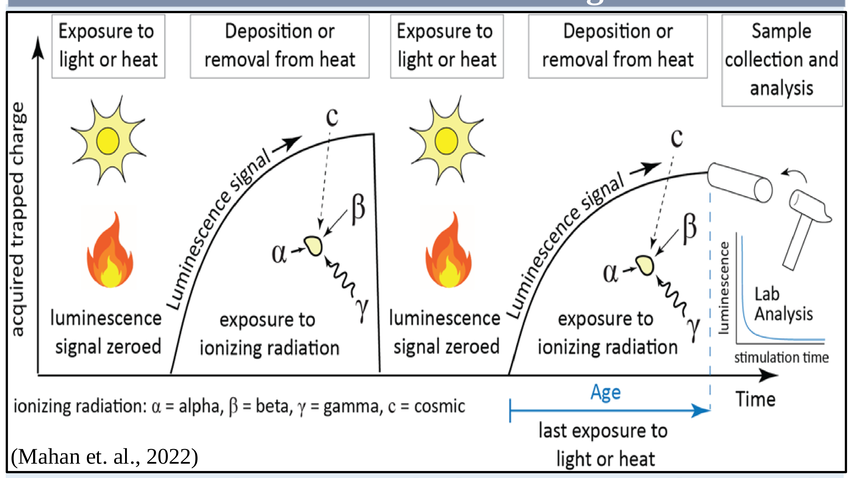
A) Map of Yellowstone National Park and sites where samples were extracted. B) Rock Core drilled at site Pocket Basin (PB). C) Rock cores are drilled at the PB where rocks have landed. D) Overview of core drilled from boulder after explosions.

Methods & Results



A) For slab cutting, a thin layer is sliced of the whole core and then core is cut in half. B) For deli cutting, each rotation is 0.5 mm, and three rotations is needed to achieve an average thickness of 1.5 mm for 16 wafers with each core sample with the blade's speed set at 400. C) Coolants are made for the saws to keep the core cool. Diamond Blade Koolant is used for slab cutting, and Deli Cutting Coolant is used for deli cutting. D) Electronic digital caliper is used to measure wafer thickness in millimeters. Wafers are then crushed and gently wrapped with aluminum foil. E) Rock cores are prepared gently. F) Saws would need to be sharpened frequently to avoid risk of breakage. All photos are taken in a dark room with an amber light.

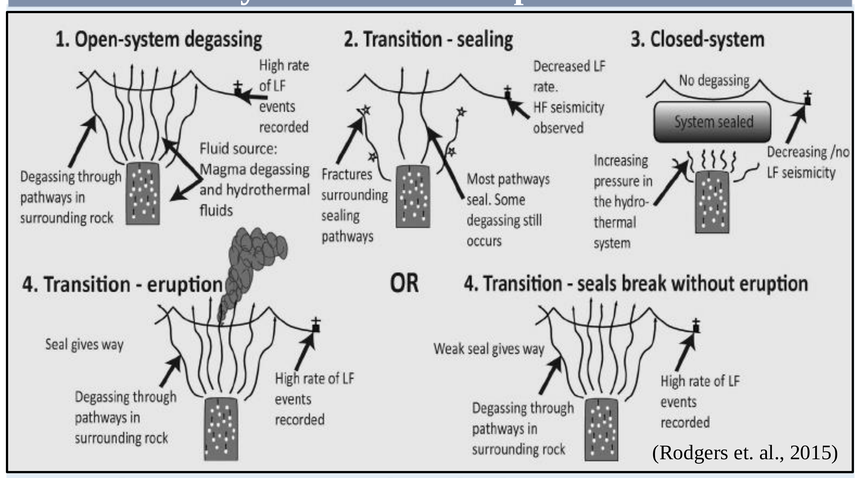
Luminescence Dating



(Mahan et. al., 2022)

Luminescence dating is used when examining how much light penetrates the rock when it was exposed.

Hydrothermal Explosion

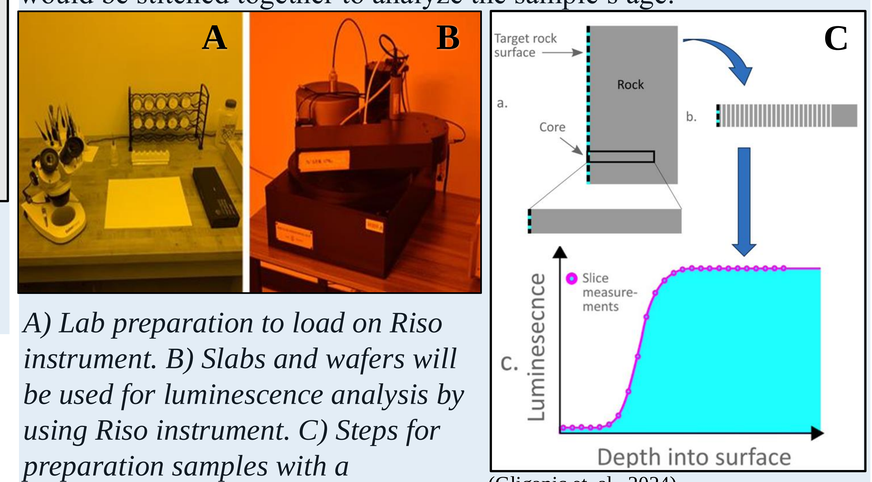


(Rodgers et. al., 2015)

An explosion can occur when deglaciation or seismic activity present. LF = Low frequency. HF = High frequency.

Future Direction

Any inferences on some of the errors made when scanning, images would be stitched together to analyze the sample's age.



A) Lab preparation to load on Riso instrument. B) Slabs and wafers will be used for luminescence analysis by using Riso instrument. C) Steps for preparation samples with a luminescence-depth profile.

(Gliganic et. al., 2024)

How does sample preparation effect luminescence analysis?

Viscous bubbles, crystallization, inclusions, and how fragile the rock cores are aligned with the rocks after the eruption.

References

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