Stratigraphic Characterization of the Mountain Home Bore Hole, Western Snake River Plain

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Abstract:

From 2010 to 2012 Project HOTSPOT completed three drill holes in the Snake River Plain to depths of ~2 km each. The three drill sites (Kimama, Kimberly and Mountain Home) were strategically chosen to sample a nearly continuous chronologic record of emplacement and deposition of the northeast migration of the Yellowstone Hotspot relative to the North American Plate. The objective of the drilling project was to investigate geothermal potential in three distinct regimes of the SRP. We characterize the flow-unit scale stratigraphy of whole-rock core from the western-most drill hole (Mountain Home) and identify and describe outcrop analogs. The methods used for this characterization include identification of volcanic facies observations, stratigraphic and textural relationships, and sedimentary and volcaniclastic marker horizons. We correlate the lithologic logs acquired at Mountain Home to the borehole geophysical data in an effort to identify signatures that represent fine-scale variations in stratigraphy, composition and/or alteration.

Flow boundaries are identified by key flow-units. Major flow units include vesicular oxidized flow tops, massive flow interiors, and rubbly flow bases. Periods of non-emplacement are marked by sedimentary deposition. Hyaloclastites indicate rapid quenching and proximal water sources or sub-aerial emplacement. The oldest basalts are highly fractured, and the flow units are more difficult to discern. Fractures and vesicles are filled with calcareous and zeolitic alterations, indicating a history of hydrothermal fluid-rock interactions.

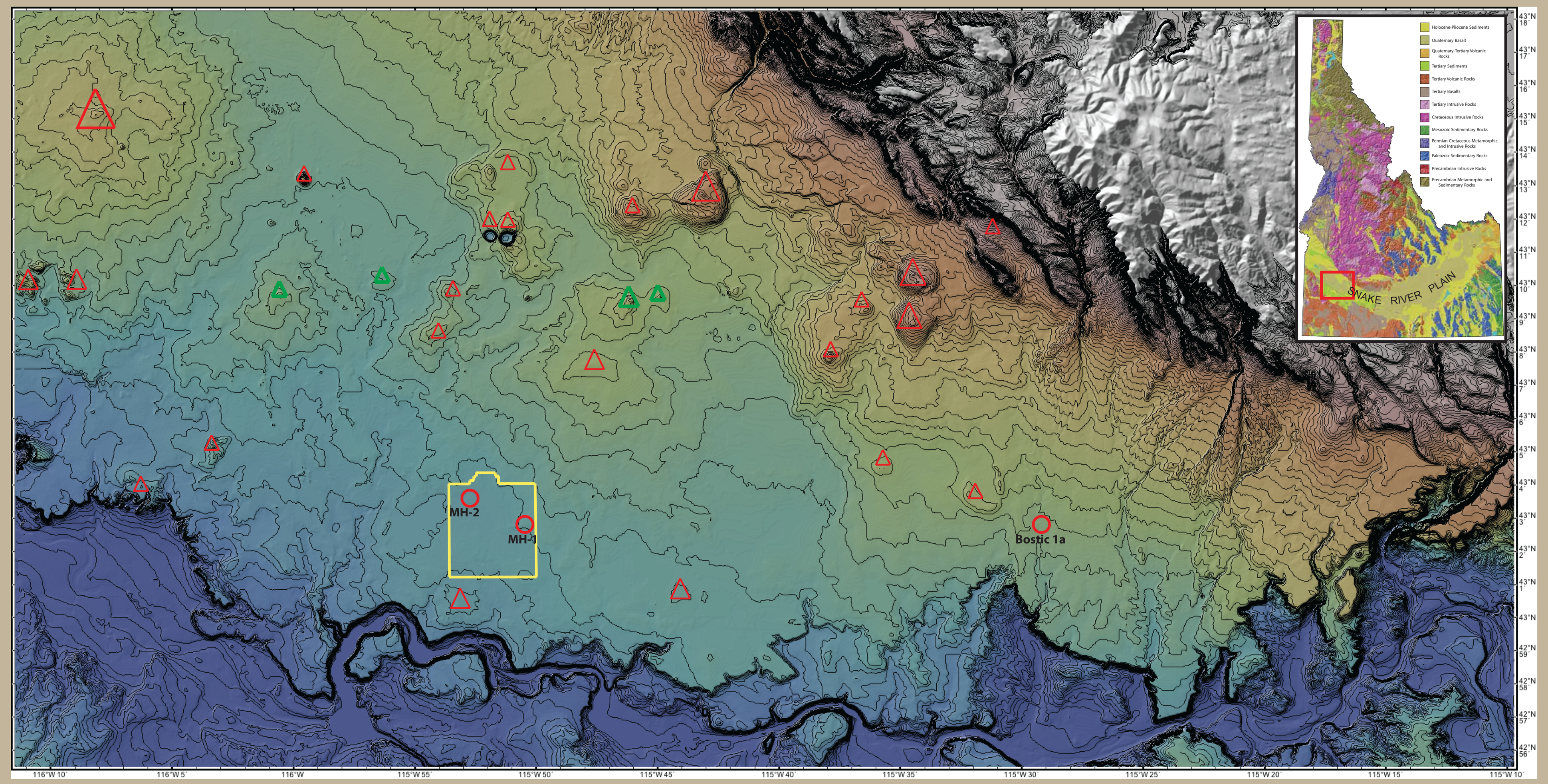
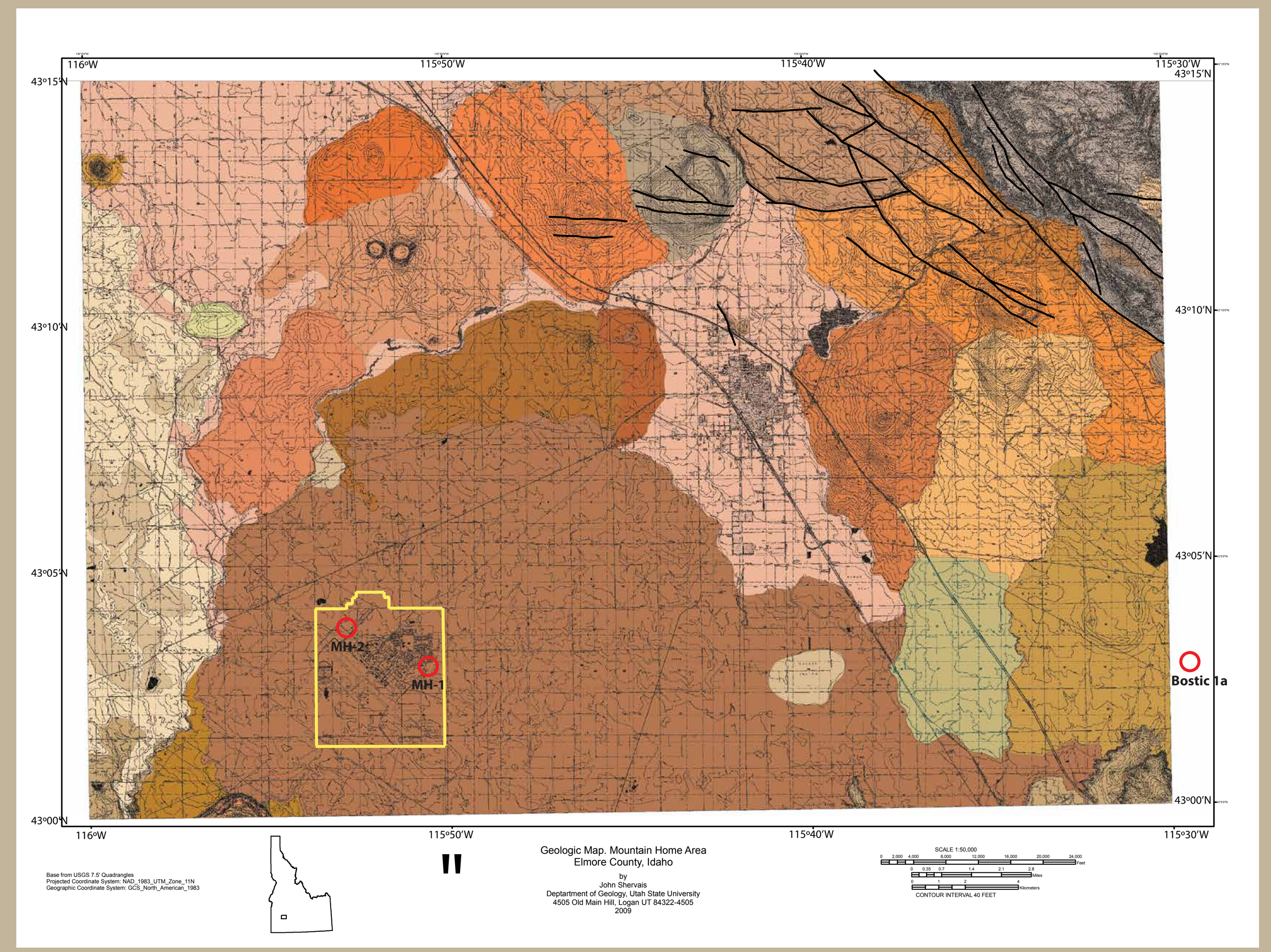


Figure 1. Topographic map of the study area. The outline of the MHAFB is shown in yellow. Vents are shown as triangles, red are typical Snake River olivine tholeites, green are high in potassium. Locations of wells analyzed in this study are shown as circles. Geologic map of Idaho shown for context in upper right-hand corner.



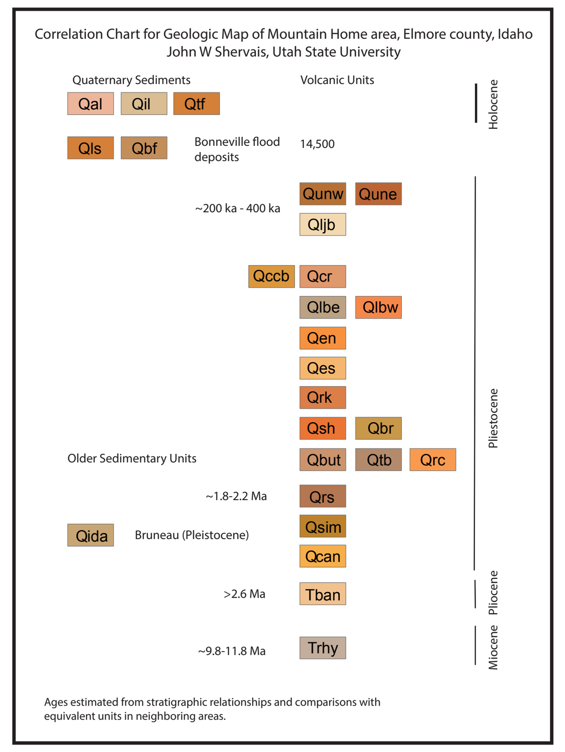


Figure 2. Geologic map of the study area. MHAFB is outlined in yellow. Lava flows are delineated and named after the vents from which they are believed to have erupted. A correlation chart for the corresponding map is shown above. Ages are estimated from stratigraphic relationships and comparisons with equivalent units in neighboring areas.

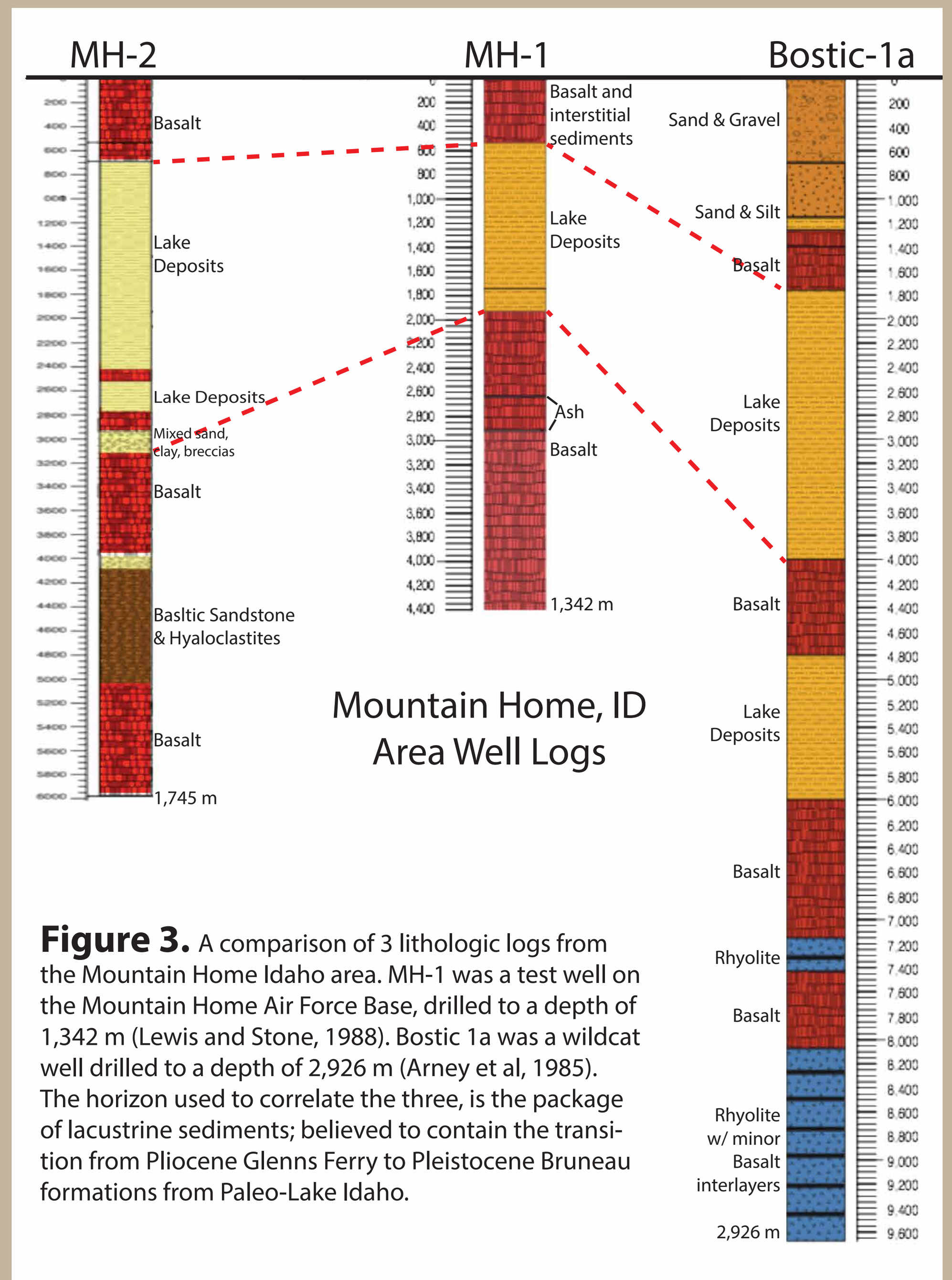


Figure 3. A comparison of 3 lithologic logs from the Mountain Home Idaho area. MH-1 was a test well on the Mountain Home Air Force Base, drilled to a depth of 1,342 m (Lewis and Stone, 1988). Bostic 1a was a wildcat well drilled to a depth of 2,926 m (Arney et al, 1985). The horizon used to correlate the three, is the package of lacustrine sediments; believed to contain the transition from Pliocene Glenns Ferry to Pleistocene Bruneau formations from Paleo-Lake Idaho.

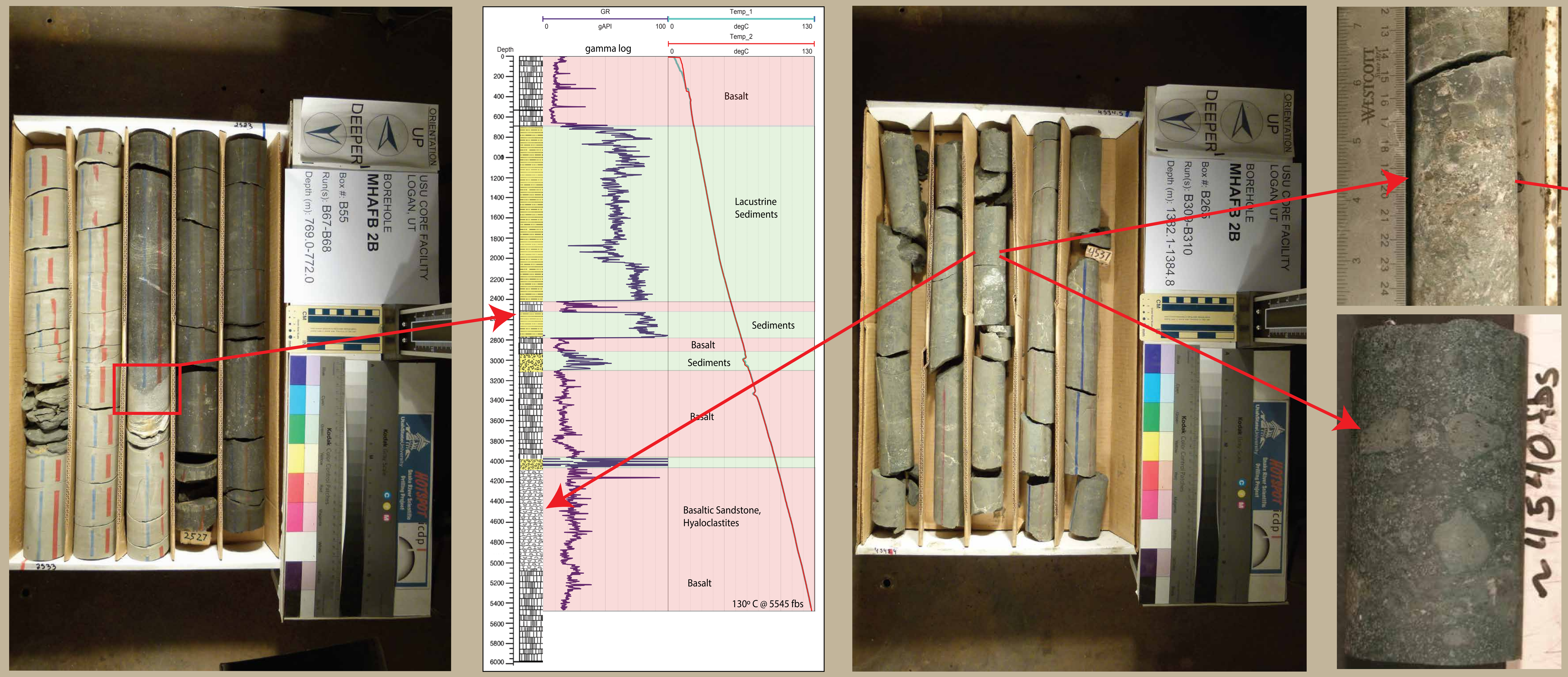


Figure 4. A lithology log, gamma density log, and core comparison. The gamma ray log is useful for distinguishing sediments from basalt flows. This is due to the relatively low abundance of radioactive elements in the basalts, as compared to the sediments. The core box on the left contains a contact between a basaltic flow group approximately 30 m thick and lacustrine sediments. This is shown in the gamma log as a relatively low gAPI for the basalt and then a jump in gAPI in the sediments. The core box on the right is an example of what hyaloclastites and epiclastics, which are the dominant lithologies in the MH-2 core from 1,280 m to 1,460 m, look like in core. Close-up photos are shown to the right and an outcrop equivalent is shown in Figure 5.

Figure 5. An outcrop exposure 1 mile north of C.J. Strike Dam. This outcrop is comprised of a single flow with three distinct flow facies or flow units. At the base of the flow is a glassy well consolidated breccia-like horizon, known as hyaloclastites. Hyaloclastites indicate lava flow/water interaction, mark the flow terminus, and indicate subaqueous solidification. This flow overlies a series of fluvial and lacustrine sediments. Soft sediment deformation has occurred in the lacustrine sediments, indicating dewatering, possibly as a result of the added overburden of the basaltic flow. The sediments are identifiable in the gamma density logs as radioactive isotopes of potassium, uranium and thorium, which are much more abundant in the sediments.

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