Title:	Analysis of hydrologic structures within Mauna Kea volcano using diamond wireline core drilling
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Abstract

The Humu'ula Groundwater Research Project was undertaken on the Island of Hawaii in an effort to characterize the hydrologic structures controlling groundwater movement and storage within the dry (~430 mm/year annual rainfall) saddle region between Mauna Loa and Mauna Kea volcanoes. The project drilled a 1764 m, continuously-cored, borehole from an elevation of 1946 m amsl. The shallow stratigraphy consisted of alluvial outwash of clastic debris, of both volcanic and glacial origin, from the upper slopes of Mauna Kea, and was underlain by highly permeable post-shield lavas to depths of a few hundred meters. Below this depth, shield stage lavas were dominated by highly-fractured and permeable pahoehoe lavas and (less common) a'a flows and occasional soil and ash accumulations at flow boundaries. As depths increased below 1000 m, progressive compaction of fragmental material was found at the flow boundaries and, by depths of ~1500 m, much of the void space in the flow boundaries had been collapsed and compacted. Increasing secondary mineralization was observed below about 1000 m depth that was

exacerbated by rising temperatures and temperature gradients toward the bottom of the hole. Hydrologic conditions were strikingly different from those predicted by conventional models for ocean islands: the formation was dry down to only ~150 m where the first, thin, perched aquifer was encountered; a second, more substantial, perched aquifer was reached at only ~220 m depth that extended to ~360 m where a sequence of (remarkably thin) perching formations were recovered in the core down to about 420 m where unsaturated rocks were again encountered. Saturated conditions resumed at 550 m depth that continued to the total depth drilled; this latter zone is inferred to be the basal aquifer for Mauna Kea within this region of the island. Our initial analysis of the core suggests that thin, clay-rich, perching formations in the shallow stratigraphic column play a much larger role in groundwater transport than has generally been recognized; in the deeper interior of the volcano, compaction of flow boundaries (the major water carriers in the shallow stratigraphy) leads to a progressive decrease in permeability and reduction in the transport rates of recharge toward the shoreline aquifers.