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GPR Imaging of Lava Flows on Hawaii

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A series of exploratory ground-penetrating radar (GPR) surveys were carried out on the Big Island, Hawaii in March of 2004 to evaluate the efficacy of using GPR to address hydrological, volcanological, and tectonic issues in extrusive basaltic materials. These surveys were carried out with a Sensors and Software Pulse Ekko 100 equipped with 50, 100, and 200 MHz antennae. Both reflection profiles and CMP expanding spreads were collected at most sites to provide both structural detail and *in situ* velocity estimation. In general, the volcanic rocks exhibited propagation velocities of ca 0.09-0.10 m/ns. Penetration in the volcanics routinely achieved depths of 10 m or greater away from the coast, even at 100 MHz. Internal layering and lava tubes could be identified from individual profiles, the complexity of returns suggests that 3D imaging is required before detailed stratigraphy can be usefully interpreted. A pilot 3D survey over a lava tube complex supports this conclusion, although it was prematurely terminated by bad weather. Although analysis of the CMP data does not show a clear systematic variation in radar velocity with age of flow, the dataset is too limited to support any firm conclusions on this point. Unusually distinct, subhorizontal reflectors on several profiles seem to mark groundwater. In one case, the water seems to lie within a lava tube with an air-filled roof zone. Surveys over part of the controversial Hilana fault zone clearly image the fault as a steeply dipping feature in the subsurface, albeit only to depths of a few meters. The results suggest, however, that deeper extensions of the faults could be mapped by more aggressive surveying techniques (e.g. lower frequencies or higher levels of signal stacking). In summary, GPR clearly has substantial promise for mapping structure and stratigraphy in the Hawaii volcanic successions.