

3-D Geo-View of Subsurface conditions for Rapid Roadway Stability Assessment

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Abstract

Following a recent 5.5-magnitude earthquake that shook the Big Island of Hawaii, voids and several cracks were observed at various locations along Chain of Craters Road, Hawaiian Volcano National Park, Big Island, Hawaii. To assure public safety within the Park, Central Federal Lands engineers mobilized geophysical companies with state-of-the-art 3-D radar and 3-D seismic imaging methods to assess the near surface and deep conditions beneath the roadway.

Rapid roadway stability assessment within the volcanic geology of the Hawaiian Islands is highly dependent on accurate 3-D imaging of subsurface features such as lava tubes and large cracks migrating to the roadway surface. The safety of Park visitors is highly dependent on imaging accuracy since seismic activities or other ground altering events may lead to sudden catastrophic failures. Accurate 3-D subsurface views are therefore required to facilitate the best engineering analysis, operations procedures and mitigation methods.

This paper presents a case study where both 3-D ground penetrating radar (3D Radar DXG 0908) and 3-D seismic tomography were utilized in concurrence to image the subsurface at five impacted sites in HAVO. The five current sites included two sites where large cracks had previously been backfilled and covered with concrete and three sites where new cracks and one five-foot diameter hole had developed at the ground surface. The 3-D ground penetrating radar equipment utilized a series of seven antennae running concurrently to develop a depth profile with high resolution. The 3-D seismic tomography data was processed using a newly developed tomography code (GTomo by Olsen Engineering) that provides high resolution images to large depths. Several anomalies were detected with both methods and the data was used to develop remediation measures to assure Park visitor's safety. The survey results and the recommended short term and long term remediation recommendations will be discussed in this manuscript.