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GARNER VALLEY DOWNHOLE ARRAY: A CASE STUDY OF SITE EFFECTS

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ABSTRACT

Garner Valley downhole array is located in southern California (33° 40.127'N, 116° 40.427'W, NAD 83 coordinate system) only 7 km from the San Jacinto fault and 35 km from the San Andreas fault. It consists of 7 dual-gain three-component accelerometers at depths of 6, 15, 22, 50, 220 and 500 m plus 5 dual-gain accelerometers in an equally spaced (61 m) surface array. All of the accelerometers have a flat response to acceleration from 0-100 Hz; all channels are digitized at 500 s/s using a 16-bit A/D. More than 900 earthquakes have been recorded since its installation in 1989. The local site geology is 20 m of water saturated soil overlying about 75 m of weathered granite before reaching granite bedrock at 95 m. Garner Valley is a typical class C soil site with average shear wave speed of 254 m/s in the upper 30 m. Comparing downhole recordings with uphole we have found that the spectral amplification is about 8 over the frequency range 2-20 Hz with resonances around 1.9, 3.1, 6.0 Hz. The general site response is well matched using the geotechnical measured values for the elastic wave velocities and assuming quality factors from 10-30 in the upper 20 m. We have compared downhole records from GVDA with nearby surface rock recordings and other borehole recordings to examine the question of reference sites. We find that surface rock sites do not have a flat spectral response for frequencies above 2 Hz. We do find that borehole recordings from as far away as 20 km can be used to accurately predict the surficial response at GVDA. We have also used aftershock recordings to predict mainshock recordings for surficial peak accelerations less than 0.1g, indicating that the response is linear to this level.