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Investigation of the bedrock (metamorphic basement) geometry of Santorini island using single-station ambient noise data

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We investigate the geometry of the metamorphic basement of the Santorini volcanic island using ambient noise data to determine the pre-Alpine/pre-volcanic bedrock structure. The geometry of pre-volcanic Santorini is important in order to constrain the recent volcanic history of the island and also to study the site-effect of the volcanic formations on seismic motions. Santorini is the most active volcano of the Southern Aegean Volcanic Arc and is the southernmost island of the Cyclades islands metamorphic complex. As a result, the volcanic material that has accumulated during the last 600+ Kyr has been superimposed on the pre-volcanic Santorini (Cycladic) island. To map the thickness of volcanic material, we have performed a large number (>200) of single-station noise measurements in the Santorini area. Measurements were mainly performed using conventional acquisition systems (Guralp-40T 30sec seismometer and Reftek-130A digitizer). We also employed additional single-station noise data from several previous studies (Dimitriadis et al. 2006, PROTEUS Project 2015), as well as permanent stations from the Hellenic Seismological Network in the same region. HVSR curves were calculated using single-station noise data and were used to estimate the fundamental frequency, f_0 , as well as the corresponding maximum HVSR amplitude, A_0^{HVSR} . The majority of HVSR curves showed prominent peaks (A_0^{HVSR} locally larger than 7-8), indicating a clear impedance contrast between volcanics and metamorphic formations. To map the bedrock depth, we estimated the thickness of the upper volcanic formations using the quarter-wavelength approximation for each site. For this assessment, the average shear-wave

velocity (V_s) of the volcanic formations was estimated from the inversion of several passive ambient noise array data, as well as additional constraints from selected MASW measurements. Where possible, the reliability of the spatial variation of volcanic formation thickness was checked with independent geological information. Using the digital elevation model and the volcanic formation thickness for each site of the single-station noise data, we estimated the spatial distribution of the pre-Alpine, metamorphic bedrock depth. The resulting geometry of the pre-volcanic Santorini island shows very deep basins (now filled with volcanic formations) around the pre-Alpine bedrock outcrop in the southern part of Santorini (Profitis Ilias), increasing to 100+ meters in the Kamari-Perissa basin area (southeastern Santorini) and to more than 400+ in the central (Fira-Imerovigli) and the north Santorini areas (Oia), in agreement with recent larger-scale tomographic results (Heath et al., 2019). The results are also in very good agreement with the pre-Alpine bedrock geometry independently inferred from gravity data inversion (Tzanis et al., 2019.)

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