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Analysis of data from Passive Seismic Survey at Lancefield (Australia)

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Abstract: Lancefield Swamp, south-eastern Australia, is a site known for Pleistocene mega-faunal fossils deposition. The bones lying within clays in a dense, interlocked pile is known to be deposited by alluvial transportation and lie above extensive Quaternary basalt flows. Passive seismic (microtremor) methods have been applied to profile the basement in search of paleochannel with a purpose to suggest more bone bed sites for excavation purpose. Using horizontal/vertical spectral ratio methods (HVSR) we aim to get an accurate estimate of the fundamental frequency of resonance of soft sediments over hard bedrock. When low-velocity sediments are present, the propagation of seismic waves slows down and also results in ampli [U+FB01] cation of the surface motion at a frequency of resonance proportional to the shear-wave slowness and thickness of soft sediments above hard bedrock. Abrupt lateral variations of geology further result in amplification of the surface motion and shift the frequency of resonance, generating a different pattern of resonance than expected above a layered earth. In Lancefield Swamp, we obtain the passive seismic data from the two localities namely, the Mayne fossil Site and the Classic fossil Site using 1Hz seismometers with Echo Pro recorders. We design a MATLAB program to process the data and analyse the HVSR ratio 1) in order to acquire the resonance frequency (peaks), 2) investigate the similarities between the known sites of bone beds and other sites in terms of frequency of peaks, numbers of peaks etc, (3) gain 2-D information from the rotation of HVSR data progressively through 0 to 90 degrees. Two-station SPAC (spatially averaged coherency) method has been also employed with the same objective to map paleo-channels. Results from SPAC method shows that seismic data with a linear array of seismometer spacing 8m allows imaging of the earth in layers from a surficial depth of <1m, to a maximum depth of order 100m. The useful frequency range of coherency spectra is 5 to 40Hz, and in some cases up to 60 Hz. Interpretation by direct-fitting of observed and model SPAC spectra for the Rayleigh wave effective mode allows detection of a soft clay layer below the Mayne Site, which we interpret as the green clay basal to the Pleistocene bone beds known at this location. Cross validations of results from both the methods is suggestive of potential bone-bed sites for further excavation.