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Passive seismic interferometry of the ultraslow-spreading Southwest Indian Ridge

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Passive seismic interferometry (ambient-noise seismology) is an increasingly popular, eco-friendly, relatively inexpensive exploration geophysics tool, to map S-wave velocity in the Earth's crust. This method has not yet been applied widely to marine exploration. The purpose of this study is to investigate the crustal structure of a quasi-amagmatic portion of the Southwest Indian Ridge by interferometry, and to examine the performance and reliability of interferometry in marine exploration. To achieve this goal, continuous vertical-component recordings from 43 ocean bottom seismometers (OBS) deployed during the SISMO-SMOOTH cruise (2014) were utilized. Recorded signals span frequencies between 0.1Hz and 3Hz. We show that reliable estimates of the Green's function are obtained for many station pairs, by cross-correlation in the frequency domain. The comparison of the cross-correlations with the theoretical Green's (Bessel) function provides one Rayleigh-wave dispersion curve per station pair; dispersion curves are then averaged, and inverted through a conditional neighborhood algorithm to determine a 1D S-wave velocity model, that we estimate to be well constrained within the crust. Our S-wave velocity model is analyzed and interpreted with geological information, and independent geophysical studies in the region of interest, as well as other areas characterized by similar tectonically-dominated, quasi amagmatic spreadings.