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Studying the origin of deep ocean microseisms using teleseismic body waves

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Recent studies of oceanic microseisms concentrated on fundamental-mode surface waves. One of the reasons for this is that extraction of fundamental-mode Rayleigh and Love wave Green functions from station-station correlations of ambient seismic noise has recently been demonstrated to be a very powerful tool for imaging of the Earth's crust and uppermost mantle. Extracting body wave Green functions from noise cross-correlations remains however problematic. In this study we concentrate on energetic relatively short-period (5-7 s) arrivals that appear at near-zero times in noise cross-correlations. First, we demonstrate their clearly seasonal behavior. For stations located in the Northern hemisphere, relative amplitudes of these arrivals are significantly stronger during the summer. Then, we study origin of this signals by analyzing the noise cross-correlations between stations of seismic arrays located in the Yellowstone area and in Turkey. We define apparent slowness of the studied arrivals by applying seismic beamforming to inter-station cross-coorelations. We then use the beamforming results obtained at the considered arrays to locate the regions where the signals were generated. Our results show that the energetic arrivals seen at near-zero times in seismic noise cross-correlations are formed by teleseismic P, PP, and PKP waves. Similar to noise-forming surface waves, generation of this ambient body waves is strongly seasonal with sources located in southern and northern oceans during the summer and the winter, respectively. Moreover, body wave array analysis results in source locations accurate enough to unambiguously demonstrate that significant amount of the microseism energy is generated far from the coast in deep oceans.