Oceanic crust-like structures in the mid-mantle below subduction zones seen by source-sided S-to-P conversions.

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The fate of a subducted slab is a key ingredient in the context of plate tectonics, yet it remains enigmatic especially in terms of its crustal component. In this study, our efforts are devoted to resolve slab-related structures in the mid-mantle below eastern Inonesia, the Izu-Bonin area, and the Solomon-Tonga region by employing seismic array analysing techniques on high frequency waveform data from F-net in Japan, the Alaska regional network in North America and NECESSArray in Northeast China. A pronounced arrival after the direct P wave is observed in the recordings of eight deep earthquakes (greater than 400 km) mostly sourced from western Pacific subduction systems. This later arrival displays a slightly lower slowness compared to the direct P wave and its back-azimuth deviates somewhat from the great circle direction. We explain it as an S-to-P conversion at a deep scatterer below the sources in the earthquake regions. In total nine scatterers are seen at depths ranging from ~700-1110 km. Our waveform forward modelling reveals that those scatterers are characterized by an ~ 7 km thick low-velocity layer compared to the ambient mantle. Combined evidence from published mineral physical analysis suggests that past subducted oceanic crust, possibly fragmented, is most likely responsible for these thin-layer compositional heterogeneities trapped in the mid-mantle beneath the study regions.

Keywords: Oceanic crust, Seismic array, S-to-P conversions, mid-mantle