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High-resolution investigation of reflections from a deep mantle slab

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Subduction zones form dominant tectonic features on the Earth and it is clear that there is significant three-dimensional structure and complexity within them. Tomographic inversions for P- and S-wave seismic velocities in the Earth's mantle suggest that in several places, subducted oceanic lithosphere descends through the mantle transition zone and penetrates into the lower mantle. But tomography is not able to make a statement concerning structural differences within the slab and its behavior with depth. The main objective of this study is to investigate the geometry, physical parameters and structural differences of subducted slabs by closely investigating seismic P-wave arrivals that reflect off the base of the slab (e.g. the polarity, amplitude, frequency and waveforms of the reflected waves). We are focusing primarily on the Cocos plate that is subducted beneath the Caribbean, since previous migration results show reflections in the slab region from a reflector at the base of the subducted lithosphere. Yet, at that time, a high-resolution investigation of physical parameters was not possible. This is done now by using South American earthquakes recorded by North American networks (e.g. USArray and California broadband seismometers). The data cover a period from 1991-2009 with a minimum magnitude of 5.9 Mw and depths below 100 km. The great circle paths of the source-receiver combinations used here do not intersect the slab and serve as reference. We are looking for reflections from the slab region that would arrive at the stations with different back-azimuth. These arrivals can be observed in slowness-backazimuth diagrams as stacked energy of waves traveling out of plane. Information on slowness, backazimuth and travel time is used to backtrack the wave to its reflection point and can be compared to the results of previous migration results and tomography studies. In addition, beam-forming for the observed slowness and backazimuth of the out of plane reflections enables us to further analyze the arrivals in terms of polarity, amplitude and frequency. The results will provide information on the thermal behavior of slabs with depth (i.e. warming up), possible layering and other structural information.