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Deep Seismic Reflectivity at Volcanic Margins: Reflections from the Petrological Moho or from within the Mantle?

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Advances in deep long-offset seismic-reflection acquisition and processing now frequently provide imaging of strong and laterally continuous reflectors in the TWTT range of 10 to 14 seconds. While an initial interpretation might be that these reflectors correspond to the crust-mantle interface, this interpretation may in some cases be incorrect or over-simplistic. Do these deep reflectors correspond to the petrological Moho or could they be located within the mantle? Examples of deep laterally-coherent reflectivity can be seen within the ocean-continent transition of the Argentine, Uruguayan and S Brazilian volcanic margins of the S Atlantic. An initial qualitative interpretation of the seismic data suggests the presence of deep crustal "keels" or crustal roots underlying well developed seaward dipping reflectors (SDRs). Joint inversion of the PSTM time-domain seismic reflection and gravity anomaly data has been used to determine the average interval density and seismic velocity between base sediment and the deep seismic reflectivity. Joint inversion densities and seismic velocities for this depth interval reach values in excess of 3000 kg/m3 and 7.0 km/sec for the entire thickness of the interval, substantially in excess of densities and velocities observed for normal oceanic and continental crust. The high densities determined from joint seismic-gravity inversion under the SDR regions are also consistent with results from flexural subsidence analysis. We consider two interpretations of these results. One interpretation is that the strong deep reflectivity corresponds to the base of the petrological crust and that the crust has an abnormally high average density and seismic velocity due to high-temperature mantle-plume-related magmatism. An alternative interpretation is that the deep seismic reflectivity is located within the mantle beneath the petrological Moho, and that the high density and seismic velocity result from averaging of both crustal basement (∼2850 kg/m3) and mantle (∼3300 kg/m3) values. In some examples, additional analysis of the deep seismic reflection data suggests that the latter interpretation is correct i.e. the strong deep seismic reflectivity is located within the mantle. The presence of well developed SDRs above suggests that the strong deep seismic reflectivity within the mantle may be magmatic in origin.