Deep seismic structure beneath the southwestern Japan arc, revealed by seismic refraction/wide-angle reflection profiling

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The Nankai trough region, where the Philippine Sea Plate is subducted beneath the SW Japan arc, is a well-known seismogenic zone of interplate earthquakes (e.g. the 1944 Tonankai Earthquake (M=7.9) and the 1946 Nankai Earthquake (M=8.0)). A detailed crustal and upper mantle structures of the subducted Philippine Sea Plate and the overlying SW Japan arc is inevitably important to constrain the physical process of earthquake occurrence as well as the evolution process of this margin. A series of onshore - offshore seismic refraction/wide-angle reflection studies were undertaken in 1999 and 2002 to obtain the crustal section from the Nankai trough to back-arc basin of the Japan sea crossing SW Japan arc. The 1999 experiment was focused to mapping a detailed crustal structure of a Nankai trough, rupture zone of the 1946 Nankaido earthquake and subducted Philippine Sea Plate. The 2002 experiment, on the other hand, was intended to reveal more detailed subduction structure from Shikoku to Honshu and structural variation from Honshu to the Japan Sea. In this experiment, about 2,300 seismometers were deployed on a 235-km-long onshore line with NS direction, on which 10 explosives shots were fired. On the northward extension (the back-arc side) of the onshore line, highly dense air-gun array shots (12,000 cubic inch) were recorded on 35 OBSs to reveal the crustal deformation associated with the back-arc spreading of the Japan Sea. Data collected from on the onshore line have high signal-to-noise ratios, from which we can easily recognize prominent wide-angle reflections from the deep crust and the subducted plate boundary. The seismic reflection method was applied to these data to obtain a detailed and clear image of deeper structure. The stacked image shows several features of the deeper part of the crust including the northward dipping plate boundary at 6-11 sec in TWT and reflective lower crust from 8 to 10 sec in TWT.