Deep Seismic Profiling in Japan: Active Tectonics and Evolution of Arc Crust

SATOW, H., Earthquake Research Institute, The University of Tokyo, Japan

Crustal structure, especially the deep geometry of seismogenic faults, is a key to understanding on-going tectonic processes as well as effective monitoring seismicity, crustal deformation and the long-term behavior of active faults. Since the Kobe earthquake (M7.2) of 1995, new multi-disciplinary projects involving deep seismic profiling have been initiated across Northern Honshu (1997-98) and Hokkaido (1999-) to help reveal buried aspects of crustal activity.

In spite of the difficulties of deep seismic recording in Japan due to rough topography, excessive cultural noise and high attenuation, we have successfully obtained the deep crustal images using both dynamite (< 500 kg) and vibroseis sources. In Northern Honshu, the deep geometry of active reverse faults have been traced continuously by shallow to deep seismic reflection profiling down to a mid-crustal detachment. The top of a reflective lower crust (TWT 4.5 sec) is nearly coincident with the base of the seismogenic layer, and hypocenters of minor earthquakes are distributed along the fault and within the hanging wall.

A new wide-angle reflection profile across northern Honshu shows that the present crustal structure is strongly controlled by Miocene stretching associated with back arc spreading in the Japan Sea. The reactivation of Miocene normal faults as active reverse faults is common feature. Westward dipping reflectors in the lower fore-arc crust are probably remnants of Mesozoic accretionary processes. The deep seismic profiles across Hokkaido show an active "crocodile" structure produced by the plate convergence between the North American (or Okhotsuku) and Eurasian plates. Deep seismic profiling is thus providing essential new information on the evolution of arc crust, with important implications for such processes as continental growth, plutonism, back arc spreading and arc-arc collision.