Seismological evidence for supraslab earthquake clusters above the subduction plate boundary of offshore Sanriku, NE Japan

Naoki Uchida[1]; Stephen Kirby[2]; Tomomi Okada[1]; Saeko Kita[3]; Yusuke Tsuji[1]; Yojiro Yamamoto[1]; Shantha S.N. Gamage[1]; Ryota Hino[1]; Toru Matsuzawa[1]; Akira Hasegawa[1]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.; [2] USGS; [3] RCPEV, Graduate School of Sci., Tohoku Univ

Onshore seismic stations and cabled OBS stations in NE Japan record hundreds of offshore repeating earthquakes with interplate thrust focal mechanisms (eg. Igarashi et al. 2003; Uchida et al. 2004). In addition to other plate-boundary events and intraslab earthquakes, double difference methods using P and S wave arrivals reveal clusters of events just above these repeating events which indicate the position of the upper surface of the Pacific slab. This finding is also consistent with the relative locations of repeaters and such clusters investigated by double-difference methods using waveform cross correlation techniques. These 'supraslab' earthquake clusters are regional features at depths of 25 to 50 km, just below the average depth of the Moho of the forearc. We do not see any seismicity over this depth range in the inland area of NE Japan except below the arc volcanoes. The morphology of the inner trench slope indicates that repeated collisions of seamounts have occurred in the past, as are occurring now at the northern and southern ends of the Japan Trench. Our preliminary interpretation of supraslab clusters is that they represent seismicity in seamounts detached from the Pacific plate during slab descent, driven by their resistance to subduction imparted by their elevation above the surrounding original seafloor and possibly their buoyancy relative to the forearc mantle. Detachment during descent probably occurs on the sedimented seafloor on which seamounts were originally constructed. If this process also occurs in other subduction systems, it may represent an important way that seamount crust is accreted to forearcs and could lead to a long-term component of coastal uplift. Geological studies has suggested that tectonic underplating of oceanic crust may be an important mechanism by which accretion of slab crustal material occurs at subduction boundaries. Supraslab earthquake clusters may be the most direct evidence that tectonic underplating is actively occurring in subduction systems.

Acknowledgement

We used seismic waveform data obtained by the off-Sanriku cabled ocean bottom seismic observation system operated by the University of Tokyo and arrival time data provided from Japan Meteorological Agency.