Multi-scale tomographyによるスラブの浅部と深部構造

Multi-scale seismic tomography of the subducting Pacific slab

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http://www.epsu.jp/jmoo2005/

A multi-scale seismic tomography approach is used to study the structure of the subducting Pacific slab from its entering the mantle at the oceanic trench to its reaching the bottom of the mantle. Recent local tomography of Northeast Japan has imaged the shallow portion of the slab from the Japan Trench down to about 200 km depth under Japan Sea. The 3-D P and S wave velocity structures of the forearc region under the Pacific Ocean are constrained by accurately located hypocenters with sP depth phases. Significant lateral heterogeneity is revealed along the main thrust zone between the subducting slab and the continental plate under the forearc region. Large slow anomalies are visible off Sanriku and Fukushima, where no large thrust-type earthquakes occur. These slow anomalies are considered to be associated with slab dehydration and serpentinization of the wedge mantle, which result in weak plate coupling. A joint inversion of local and teleseismic data imaged the subducting Pacific slab down to 500 km depth under the Japan Islands and the Japan Sea. The slab is 90 km thick and has a P-wave velocity 3-5% faster than the surrounding mantle. The subducting Philippine Sea slab is imaged down to about 200 km depth under the Japan Sea coast in Northern Chugoku. Regional tomography using a large number of travel time data recorded by hundreds of seismic stations in Mainland China revealed clearly the subducting Pacific slab that is stagnant in the mantle transition zone under Eastern China. The stagnant slab is considered to play an important role in the formation of the intraplate volcanism in NE China (such as the Changbai and Wudalianchi volcanoes) (Zhao, 2004). Global tomography shows that, under the subduction regions, strong and wide high-velocity anomalies exist in the mantle transition zone and pieces of fast anomalies are visible in the middle and lower mantle as well as in the D” layer above the core-mantle boundary (CMB) (Zhao, 2004). These results indicate that most of the slab materials are stagnant in the mantle transition zone before finally collapsing down to the lower mantle and CMB as a result of very large gravitational instability from phase transitions.

Zhao, D. (2004) Global tomographic images of subducting slabs and mantle plumes: insight into deep Earth dynamics. Phys. Earth Planet. Inter. 146, 3-34.