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Seismic structure of the mantle transition zone

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The two main global discontinuities in the mantle are located at depths of around 410 and 660km (called the 410 and 660 in this paper), though their depths vary slightly in different tectonic zones (e.g., Flanagan and Shearer, 1998). The 410 and 660 are considered to be due to the olivine to wadsleyite and postspinel phase transformations, respectively (e.g., Ito and Takahashi, 1989). The pressure of both transformations is thermally controlled because the olivine to wadsleyite and post-spinel phase

transformations are exothermic (positive Clapeyron slope) and endothermic (negative Clapeyron slope) reactions, respectively (e.g., Bina and Helffrich, 1994). In a cold (hot) environment such as a subduction zone, the 410 and 660 should be elevated (depressed) and depressed (elevated), respectively, which should generate temperature-related topography in the mantle transition zone (MTZ).

However, recent mineralogical studies suggest that phase transformations related to garnet, the other major component of the mantle, are involved, in addition to the olivine-related post-spinel transformation, at depths from 600 to 750km (e.g., Vacher et al., 1998), and should therefore appear as multiple seismic discontinuities in that depth range. Recent seismological studies have detected such multiple discontinuities (Simmons and Gurrola, 2000; Deuss et al., 2006; Tibi et al., 2007; Schmerr and Garnero, 2007; Andrews and Deuss, 2008). For subduction zones in particular, the relationship between subducted slabs and multiple phase transformations has been investigated in order to understand the fate of subducted slabs. In the session, I will review recent seismic results mainly on the 660.

Keywords: Mantle transition zone, the 660-km discontinuity