

Post-perovskite phase transition in compositions related to mantle rocks

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Studies have shown that the D'' discontinuity is much more readily observed at high-velocity regions than low-velocity regions [1]. The variation has been attributed to the thermal response of the perovskite to post-perovskite (PPv) transition due to its positive Clapeyron slope. This assumes a narrow depth interval and a large Clapeyron slope for the PPv transition. However, our recent study on binary and ternary systems [2] showed that 10% Fe and 10% Al increase the thickness of the two-phase region to 400-600 km, making seismic detection of the PPv transition difficult. The buffering effects of ferropericlase (Fp) have been modelled [2], but not directly measured. We have determined the depth and thickness of the PPv transition in pyrolitic and San Carlos olivine compositions up to 170 GPa and 3000 K in laser-heated diamond cell. Both compositions produce Fp in the lower mantle. While pyrolite contains Al, San Carlos olivine does not. Our measurements on a pyrolitic composition indicate the PPv transition begins at a depths 100±100 km below the core-mantle boundary (CMB) and has a wide two-phase region of 800±200 km. In contrast, the PPv transition in a San Carlos olivine composition occurs at a depth 100±100 km above the CMB with a two-phase region thinner than 100±100 km. These are in good agreement with our predictions in [2] in that Al increases both depth and thickness of the PPv transition (as measured in pyrolite) while Fp (or high Mg/Si) decreases the thickness through buffering effect (as measured in San Carlos olivine). Harzburgite, existing in the subducting lithosphere, has much smaller amount of Al and higher Mg/Si ratio, making an ideal candidate rock for a sharp PPv transition. Therefore, the PPv transition may exist in harzburgite subducted into the deep mantle, while it does not exist in pyrolitic mantle.

[1] Wyssession *et al.* (1998) in *Core-Mantle Boundary Region* (eds Garnero *et al.*), pp.273–297 [2] Catalli *et al.* (2009) *Nature* **462**, 782–785.

Dispersed Fe/Mn ratios of lunar rocks: ALHA81005's view from the Farside

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Lunar meteorites come from random sites on the Moon (including areas not visited by Apollo or Lunar missions) and therefore are crucial for understanding the development of the whole moon. Their mineralogy and chemistry can also be used as ground truth for lunar remote sensing. We are re-investigating lunar meteorite ALHA81005 to help understand unsampled areas of the Moon, and enlarge our knowledge of lunar highland rock types, and place constraints on the Moon's early history.

ALHA81005 is a lunar breccia from the farside [1], which contains a wide variety of rock and mineral fragments, most of which are granulites and anorthosites [2, 3]. While other rock types are rare, some mineral fragments must represent lithologies other than granulites and anorthosites. Using mineral compositions and elemental systematics (specifically Fe/Mn ratios) we can place constraints on the chemical variation and evolution of the lunar crust and mantle.

We have focused on the Fe/Mn ratio of lunar minerals because it does not vary much during basalt genesis & fractionation. Fe/Mn is used to categorize the basaltic source composition (i.e. mantle) which reflects the planet's bulk composition, its oxidation state, extent and composition of its core and is used as a characteristic for particular planetary bodies, e.g. Moon versus Earth versus Mars [4-6]. However, lunar mafic minerals in fact have extensive variation in their Fe/Mn ratios. Karner [5] noted that olivines in high-Ti mare basalts have Fe/Mn ~ 87 (but with variation) and that low-Ti mare basalts had Fe/Mn ~ 115 (again with variation). In ALHA81005, olivines in anorthosites, granulites, basaltic clasts (low Ti and VLT) and isolated mineral fragments have Fe/Mn ~ 85-92 like high-Ti mare basalts [5] although they are not rich in Ti. The cause of these variations in Fe/Mn could suggest that the source regions of the samples (i.e. nearside vs. farside) have different compositions or oxidation states, and thus different geochemical histories.

[1] Korotev (2004) *Science* **305**, 622–623. [2] Goodrich *et al.* (1984) *J. Geophys. Res.* **89**, C87-C94. [3] Carlson & Lugmair (1988) *Earth Planet. Sci. Lett.* **90**, 119–130. [4] Papike *et al.* (2009) *Geochim. Cosmochim. Acta* **73**, 7443–7485 [5] Karner (2003) *Am. Mineral.* **88**, 806–816. [6] Drake (2001) *Meteoritics & Planet. Sci* **36**, 501–513.