Garnet-perovskite transformation and the dynamics at 660km depth

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High pressure phase relations of pyrolite have been determined at pressures corresponding to the depth of 660km. Garnet-perovskite transformation occurs at similar pressure range to the post-spinel phase transition in the pyrolitic mantle (KLB-1). The authors will report the results of high pressure experiments on this garnet-perovskite transformation in the end-member systems of MgSiO3 and Mg3Al2Si3O12, and in the multi-component systems of pyrolite and basalt.

High pressure phase relations of pyrolite has been determined at pressures corresponding to the depth of 660km. Garnet-perovskite transformation occurs at similar pressure range to the post-spinel phase transition in the pyrolitic mantle (KLB-1). The pressure-temperature slope of the former transition boundary was determined to be about +0.0018GPa/C, and that of the latter transition boundary was -0.0026GPa/C. Both curves cross each other about at 1800C and 21GPa, using Au pressure scale proposed by Anderson et al. (1989). Within the hot mantle plume with temperature higher than 1800C, garnet and magnesiowustite are the post-spinel phase assemblage, and garnet transforms to perovskite at higher pressures. In this case, density does not change much by the post-spinel phase transition. The plume upwelling is accelerated by the phase transition around 660km depth, because garnet-perovskite transformation boundary has a positive P-T slope. On the other hand, at 1600C, which is likely the normal temperature at 660km depth, most of garnet already transforms to perovskite at lower pressures than that of post-spinel phase transition. And garnet is absent when all the spinel decomposes. The expected density jump due to the post-spinel phase transition is about 5%, which is much lower than that in the PREM model.