# The nature of the lithosphere-asthenosphere boundary (LAB) beneath ocean basins

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The oceanic lithosphere begins to form at ocean ridges, thickens with age, reaches its full thickness of ~ 90 km at the age of ~ 70 Ma, and maintains the same thickness independent of its further aging beneath much of the world ocean floor. The relationship, $L \propto t^{0.5}$, between the thickness (L) and age (t) of the lithosphere and the seafloor heat flow data are consistent with conductive heat loss being the primary control. However, conductive heat loss continues, yet the lithosphere does not grow any thicker when t > 70 Ma. Many models have been proposed to explain this puzzle, among which small scale convection at the lithosphere-asthenosphere boundary (LAB) is most popular because such convection is thought to supply heat to prevent the lithosphere from thickening. We consider this apparent puzzle may actually be a petrological problem. Petrologists consider the LAB as a solidus, whereas geophysical models treat the LAB as an isotherm (~ 1100°C). For both isotherm (~1100°C) and solidus to "coincide" and to explain $L \propto t^{0.5}$ for t < 70 Ma and $L \approx 90$ km for t > 70 Ma, the solidus must have a slope $dT/dP \approx 0$ at depths < 90 km, and $dP/dT \approx 0$ at a constant depth of ~ 90 km. All these are wholly consistent with the oceanic lithosphere being defined by the stability of pargasite (amphibole): P ≤ 3 GPa (~ 90 km) and T ≤ 1100°C. That is, the LAB is a pargasite dehydration solidus of volatile-bearing mantle peridotite.

**[1]** Green, D.H. & R. C. Liebermann, *Tectonophysics* **32**, 61-92, 1976 **[2]** Green, D.H., W.O. Hibberson, I. Kovacs & A. Rosenthal, *Nature* **467**, 448-451, 2010; **[3]** Niu, Y. & M.J. O'Hara, *Journal of Geophysical Research* **108**, 2209, doi:10.1029/2002JB002048, 2003; **[4]** Niu, Y. & M.J. O'Hara, *Lithos* **112**, 1-17, 2009 **[5]** Niu, Y., M. Wilson, E.R. Humphreys & M.J. O'Hara, *Journal of Petrology* **52**, 1443-1468, 2011.