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Melt distributions in a convecting asthenosphere define the LVZ from oceans to cratons

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The top of the asthenosphere is imaged as a global layer of S-wave velocity reductions that is well seen underneath oceanic lithospheres and yields an increasingly weak signal underneath increasing old and thick lithosphere. It remains to be investigated whether this is broadly observed or not, but this region of the Earth's mantle also appears to be a very good electrical conductor in contrats with the resitive lithosphere. In this presentation, recent advances in petrology, physical properties of melts and melt-peridotite aggregates are gathered to demonstrate that such geophysical signals are compatible with a small fraction of volatile-rich melts embedded in the peridotite.
These incipient melts are triggered by small amounts of water and carbon dioxide contained in the peridotite. These melts are therefore extremely rich in incompatible and volatile elements, and are low in density and viscosity. They are formed at depths of ca. 300-150 km and are solidified at 50 km underneath young lithosphere and down to >200 km underneath cratons due to the well-known cooling with ages. Such a distribution of incipient melts perfectly matches the depths of the top of the asthenosphere identified by various geophysical surveys in different tectonic settings. Incipient melts therefore define a column of melting that varies from thick underneath oceanic lithosphere to very thin, almost elusive, underneath cratons, which is also what is deduced from geophysical observations.
Buoyant and low in viscosity, these melts can migrate at a rate faster than the convection of the solid mantle. Incipient melting in the convective asthenosphere must then naturally trigger melt accumulation at the upper bound of their stability, that is, 50-70 km underneath the oceanic lithosphere and 200 km beneath cratons. We expect enrichment in incipient melts at the Lithosphere-Asthenosphere Boundary at the level of the volume percent underneath oceanic lithospheres. In addition of providing a natural mechanism for melt ponding at the LAB, this process also enriches in CO_2 the source region of intraplate magmatism.