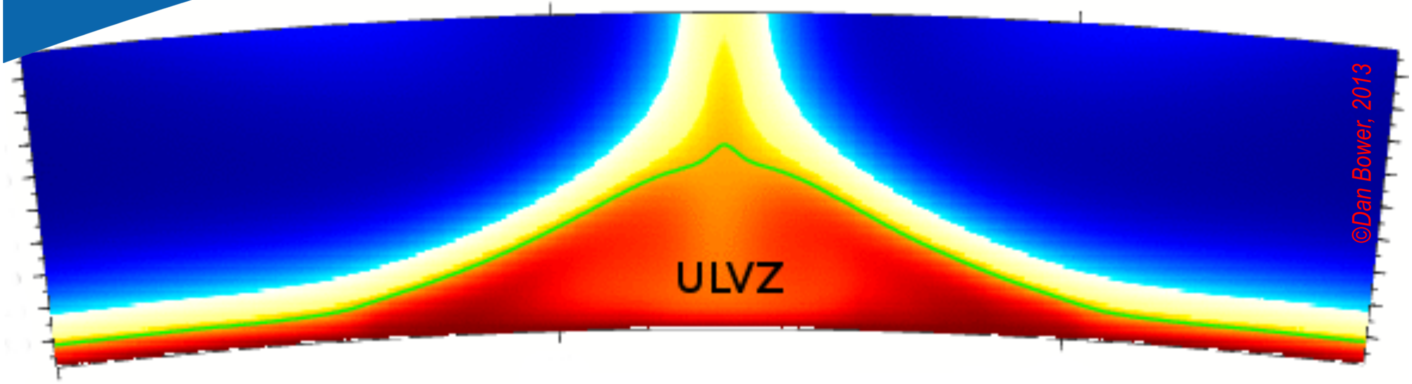
Grand Séminaire 2013

ISTerre
Institut des Sciences de la Terre



Ultralow velocity zones at the base of the mantle

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Ultralow-velocity zones (ULVZs) are isolated patches of very low P- and S-wavespeed at the core-mantle boundary (CMB) with a relief of approximately 10 to 100 km. The canonical partial melt model for ULVZs, developed from mineral physics theory, remains difficult to test experimentally and has recently been challenged based on dynamic considerations. Meanwhile, iron-rich oxides in the deep Earth are postulated by partitioning data and are compatible with theoretical models of magma ocean crystallization. Furthermore, high pressure and temperature experiments using a diamond anvil cell demonstrate that iron-rich magnesiowustite (Mw) has very low P- and S- wavespeed at CMB conditions. We therefore investigate if assemblages containing a small fraction of iron-rich Mw could be the origin of ULVZs through an integrated mineral physics and geodynamic modeling approach.
Our solid-state model for ULVZs is dynamically stable at the CMB and produces structures with a range of morphologies that depend on the chemical density contrast. It is compatible with seismic models that constrain the wavespeed reduction and height of ULVZs and has structural characteristics necessary to explain SKS-SPdKS travel times and PKP precursors. Furthermore, the density anomaly of ULVZs, which is often relatively difficult to constrain from seismology, can be estimated from the height and width (aspect ratio) of the structures. Unfortunately this is difficult to test at present because there are few 2-D or 3-D seismic models of ULVZs available. Recent seismic detections of `rolling hills' and `ridges' at the CMB with small aspect ratio and low-velocity (rather than ultralow-velocity) may provide evidence for a new class of CMB structure, which we name `basal low-velocity regions'. These regions may have reduced iron-enrichment in (Mg,Fe)O (relative to ULVZs) and/or less iron-rich Mw in the assemblage.

Jeudi 12 septembre 2013 à 11h

Salle de conférences d'ISTerre

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