On the origin of OIB and LVZ – Some new perspectives

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Island-averaged OIB data show systematic compositional variation as a function of the lithosphere thickness [1]. Si2, and Al2 decrease whereas Fe2, Mg2, Ti2, P2, La/Sm and Sm/Yb increase with increasing lithosphere thickness. These systematics suggest a first-order control on the global OIB geochemistry by lithosphere thickness variation that limits the final depth of melting. OIB source materials rise to a shallow level and thus melt more by decompression beneath thin lithosphere, but have restricted upwelling and thus melt less by decompression beneath thick lithosphere. This required decompression demands dynamic upwelling of OIB source materials, and has critical implications for the mantle plume debate. OIB sources are more enriched in incompatible elements than the primitive mantle (PM) and more so for the more incompatible elements. This requires that OIB sources be pre-enriched by low-degree melt metasomatism. The apparent coupling between radiogenic isotopes and incompatible elements in many OIB suites suggests that the metasomatism be ancient. Recycled oceanic lithosphere [2] and mantle wedge [3] are good candidates. On the other hand, most OIB melts have radiogenic isotopes more depleted than the PM despite their incompatible element enrichments. Such first-order decoupling requires that OIB sources also undergo recent enrichment. The major melting event for the OIB genesis is inadequate to account for this enrichment. The presence of an incipient melt in the LVZ is required [4,5]. This has implications for the LVZ debate [4-7]. Presence of a small melt fraction due to volatiles (e.g., H2O, CO2) may be the cause of the LVZ. Low-degree melt metasomatism is widespread in continental and oceanic lithospheric mantle.