Early mantle evolution influenced by the crystallization of a basal magma ocean

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Partial melting at the base of the Earth's mantle has been proposed to explain the presence of ultra low velocity zones. The cooling of the core necessary to have mantained the geodynamo for the last 3.2Gy implies that the present-day melt pockets are the remnants of a crystallizing basal magma ocean formed within the first 50My of Earth's history. The slow cooling of the overlying mantle allowed fractional crystallization. As a consequence, the melt constitutes a hidden reservoir containing a large fraction of incompatible elements that explains the Sm-Nd difference between Earth samples and chondrites. Thermal evolution and crystallization models show that the crystals formed out of the basal magma ocean where mixed back in the mantle early on. However, some of these crystals have left fingerprints in Archean rocks. Around 3.5Gy, the crystals became dense enough to form piles overlying the melt which are modestly entrained in mantle plumes.

Mantle heterogeneity from South Patagonia, Argentine: Evidence of depletion and metasomatism from slab derived and OIB-like fluid

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Studying the subcontinental lithospheric mantle evolution and heterogeneity can be very complex for many reasons: in addition to the complex history of its own origin, after being formed, it can be exposed to different processes related or not to the crust formation as: re-melting, delamination from the crust, re-fertilization with fluids from different origins. Timing the depletion event can be glanced with Re/Os analysis, but metasomatism can play some role giving difficulties to the straightfoward conclusion. Noble gases, together with trace element chemistry, can give some information about the origin of the mantle and the events of metasoamtism, but timing each event for a very complex area can be very challenging. We performed several trace element, Re/Os and noble gas analysis in an important set of mantle xenoliths from Patagonia, Argentine, brought to the surface by Eocene to recent alkaline basalts from ten different localities widely dispersed in southern South America (36º-52ºS). Nb/Th, Pb/Ce, Ta/Hf ratios and spidergrams whole rock analysis suggest that these xenoliths are depleted, compared to the primitive mantle, and were undergone to, at least, two metasomatism events: one related to carbonatites and/or OIB-like akaline melts; and another event related to slab derived fluid. Separate mineral noble gas analysis support the idea that an OIB-like melt, or the presence of a plume-like environment is associated to this xenoliths. Whole rock Re/Os analyses suggest that the most ancient xenolith are also the more plume-like related lithosphere. Geographical analysis of these set of xenoliths does not give any conclusion related to the geochemical characteristics of these xenoltihs to the spatial distribution. Age of different events could be more important than ultramafic xenolith spatial distribution.