5.1.P12

Global Precambrian Pb isotopic signatures: Implications for mantle reservoirs

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Precambrian age-provinces commonly have internally coherent Pb isotopic signatures. Compilation of whole-rock Pb isotopic compositions of Precambrian juvenile igneous rocks reveals that: 1) ca. 2.8-2.6 Ga, ca. 2.0-1.8 Ga and ca. 1.3-1.0 Ga age-provinces in eastern Laurentia (North America, Greenland, and northwestern Scotland) display a systematic variation in Pb isotopic signatures that indicate they were derived from a single, homogeneous mantle reservoir that evolved with a constant μ-value from 2.8 to 1.0 Ga, and 2) signatures of ca. 1.3-1.0 Ga age-provinces define two distinct, global Pb isotopic signatures, indicating that at least two, large, isotopically distinct mantle reservoirs existed during the Mesoproterozoic. Specifically, ca. 1.3-1.0 Ga rocks from the Grenville Province (eastern North America), Precordillera Terrane (Argentina), Sveconorwegian Province (Sweden), Dronning Maudland Province (Coatsland, Antarctica), Natal Province (South Africa), Mid-Continent Rift (United States) and southwestern diabase province (Arizona, United States) appear to have been derived from a single source. Similarly, ca. 1.3-1.0 Ga rocks in the Santa Marta and Garzón Massifs (Colombia), Rondonia-San Ignacío Province (Brazil), Oaxaca Terrane (Mexico), Shackleton Range (Antarctica), southwestern diabase province (California, United States) and southern and central Appalachian Mountains (United States) appear to have been derived from a single source. The Pb isotopic signatures of these two sources are different and distinct. Similar bimodal distributions of Pb isotopic signatures are apparent in rocks from Paleoproterozoic and Archean age-provinces.

Two Mesozoic/Cenozoic, isotopically-distinct mantle reservoirs, referred to as "normal" mantle in the northern hemisphere and DUPAL mantle in the southern hemisphere, have been inferred from Pb isotopic compositions of existing oceanic crust [1]. The Pb isotopic compositions of Precambrian age-provinces outlined above indicate that similar, distinct reservoirs existed early in Earth's history and were well-established by 2.8 Ga.

References

[1] Hart.S.R. (1984) *Nature* **309**(5971), 753-757.

5.1.P13

Pb isotope heterogeneity of the mantle beneath Iceland

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High-precision Pb isotope data on young basalts are proving to be an excellent tool with which to probe the nature of the mantle beneath oceanic islands in terms of the distribution and length-scales of compositional heterogeneities. We report high-precision Pb-isotope data for > 120 neovolcanic lavas from Iceland that were analysed on an Axiom double focusing MC-ICP-MS, using a ^{207}Pb-^{204}Pb double spike (DS) to correct for instrumental mass bias. The external reproducibility of Pb isotope ratios determined for the standard SRM981 was ±100 ppm (DS corrected) and replicate analyses of samples have a similar reproducibility. The study encompasses all the main compositional types (picrites, tholeiitic basalts, alkali basalts, rhyolites) and localities (neovolcanic rift, off-rift zones) in Iceland. It complements the high-precision DS Pb isotope data set recently published by Thirlwall et al. [1], which focussed on the neovolcanic rifts and the adjacent offshore spreading ridges. Where sample coverage overlaps, there is excellent agreement between the two data sets, which will allows us to combine the data sets to get an unparalled regional picture of the Pb isotopic variations in the mantle beneath Iceland.

For geographically restricted areas (e.g. Reykjanes, Theistareykir, each alkaline centres), we find coherent linear data arrays that are interpreted as binary mixing lines, although each array is offset from the others such that more than four end-members are required. The anomalously high ^{207}Pb/^{204}Pb values previously reported for Öraefajökull are confirmed here. One of the most striking features of these new data is the offset in $\Delta^{8/4}$Pb between lavas from localities NE and SW of the assumed plume axis. Our extensive high precision Pb isotopic data set resolves local mixing relationships, regional chemical provinces and correlations with ^{3}He/^{4}He, and demonstrate that the Pb isotope variations cannot simply be explained in terms of just two or three end-member components (see also [1]).

References

[1] Thirlwall et al. (2004) *GCA* **68**, 361-386.