Search for extraterrestrial components in ~3.8 Ga metamorphosed sediments from the Isua Supracrustal Belt (W Greenland) – No evidence from Cr isotopes so far

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The short-lived ^{53}Mn-^{53}Cr (half-life of 3.7 Ma) isotope system has been widely used in cosmochemical studies and excess ^{53}Cr relative to the terrestrial ^{53}Cr/^{52}Cr ratio has been detected in a variety of ancient solar system objects. Inspired by recent indications from W isotopes for a meteoritic component in ~3.8 Ga sediments from Isua [1] and the potential of the Mn-Cr extinct isotope system to trace extraterrestrial components in K-T sections [2], we have initiated a study of Cr isotope systematics in these sediments, from which Rosing [3] reported graphitic microparticles with isotopically light C, indicative of a biogenic origin. We report data of two slates from this very sedimentary succession, of two chromite and of one ultramafic rock from Isua and verify these with analyses of two samples from the Stevns Klint (Denmark) K-T section, from which Cr [2] and Os [4] isotopes indicate a component of extraterrestrial origin. Comparison of slopes and relative positions of fractionation lines of repeatedly measured samples compared to those of long-term repeated measurements of terrestrial Cr reference solutions allow to circumvent inaccuracies of the ^{53}Cr/^{52}Cr ratios by imprecise mass bias corrections [5]. While we are able to detect an apparent deficit of ^{53}Cr in the order of –0.4 ε units in samples from Stevns Klint and the carbonaceous chondrite Allende (and thus confirm results by [2]), the five samples from W Greenland are indistinguishable from the terrestrial standard which we presently reproduce at the level of ± 0.3 ε units in specific measurement periods. Although it is premature to argue against extraterrestrial input in the debated Greenland sediments (with expected anomalies of maximally 0.1-0.2 ε units) we hope that additional analyses will add to the understanding of extent and type of the meteorite impactor(s).

References

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Kerguelen plume: A 120 Myr record of volcanism

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Volcanic features in the Eastern Indian Ocean attributed to the Kerguelen Plume include the submarine Large Igneous Province (LIP) formed by the Kerguelen Plateau and Broken Ridge, possibly representing volcanism derived from a plume head; the 5000 km-long Ninetyeast Ridge inferred to be a hotspot trace resulting from volcanism derived from the plume stem; Cenozoic ocean island volcanism (Kerguelen, Heard, McDonald) constructed on the dominantly Cretaceous Kerguelen Plateau. The age and geochemical characteristics of these lavas lead to the following conclusions.

(1) The oldest lavas forming the surface of the LIP erupted at ~118-119 Ma on the Southern Kerguelen Plateau. This age postdates breakup of India from western Australia, but it coincides with eruption of the Rajmahal Traps in NE India.

(2) The upper part of the LIP is formed of tholeiitic basalt that is geochemically distinct from MORB. At some sites a continental component has contaminated the basalt. In particular, Elan Bank, a large western salient of the Central Kerguelen Plateau may be a microcontinent. Clasts of Proterozoic garnet-biotite gneiss occur as clasts in a conglomerate intercalated with basalt flows at this site.

(3) The Ninetyeast Ridge is composed of tholeiitic basalt whose eruption age increases from south to north (~38 to 82 Ma), as expected for a hotspot track. Although these lavas have diverse geochemical characteristics, there is no evidence for a continental component.

(4) Two sites on the northern Kerguelen Plateau recovered diverse basaltic suites, A 68-69 Ma alkalic basalt to trachyte suite erupted at Skiff Bank, a location erroneously proposed as the present site of the plume, and a 34-35 Ma tholeiitic basalt suite whose geochemical characteristics can be explained by mixing of MORB and plume-derived basalt.

(5) The Cenozoic islands, Kerguelen and Heard, are dominantly formed of transitional to alkalic lavas with diverse isotopic ratios of Sr, Nd, Hf and Pb. There is no evidence for a continental component in these lavas.

References

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