6.2.P06

Mg isotopic composition of Middle Archean shelf sediments from Zimbabwe

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Shales are regarded as the best record of the composition of upper crust over time. The isotopic composition of Mg in shales should reflect the provenance components and formation waters, and the effects of weathering and diagenetic alteration. The Earth's mantle, and the rocks derived from it by melting, has δ^{26}Mg(DSM3) values that lie in a narrow range of about -0.09 ± 0.11‰ [1]. Marine carbonates today have δ^{26}Mg(DSM3) of -1.4 to -5.1 ‰ [2, 3]. The δ^{26}Mg of shales derived from a mixture of these two sources should lie at a composition intermediate between these two values. For example, the Eocene Green River Shale (USGS SGR-1) has a δ^{26}Mg(DSM3) of -0.43 ± 0.05‰. This could be due to the mixing of a low δ^{26}Mg component derived from carbonates and a high δ^{26}Mg component derived from magmatic additions to the crust.

In early Earth history, the isotopic compositions of end members are not as well known, although the mantle composition was similar (ca. -0.1, [1]). Abundant biogenic carbonate was probably absent. Samples of 3000 Ma marine shales from the Buhwa greenstone belt, Zimbabwe [4] (MgO = 2.0 to 4.1%), whose provenance includes 3800 to 3100 Ma tonalites, granites and mafic and ultramafic greenstones [4,5], have δ^{26}Mg(DSM3) ranging from -0.98 to -1.03 ‰. Their Pb isotopic systems [5] do not allow the compositions of the rocks to have been substantially changed between 2700 Ma (the time of diagenesis) and the present. It is possible that their Mg isotopic compositions are derived from the primary compositions of detrital materials at 3000 Ma, reflecting derivation from an unknown, low δ^{26}Mg component. Alternatively, the low δ^{26}Mg may reflect the effects of weathering or diagenesis. The processes that created such light Mg probably did not include mixing of substantial biogenic carbonate, as it is not present among the known provenance lithologies.

References

[1] Bizzarro M. et al., (2003) Goldschmidt Abstract.
[2] Chang V.C. et al., (2003) *JAAS* **18**: 296-301.
[3] Krogstad E.J. et al., (2003), AGU Fall Mtg. Abstract.
[4] Fedo C.M. et al., (1996) *GCA* **60**: 1751-1763.
[5] Krogstad E.J. et al., (2004) *GCA* **68**: 319-332.

6.2.P07

Oldest rocks of the Fennoscandian Shield: The 3.5 Ga Siurua trondhjemite gneiss in the Archaean Pudasjärvi Granulite Belt, Finland

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The U-Pb isotopic data available from the Fennoscandian Shield show that most Archaean rocks provide age estimates of ca. 2.70 – 2.83 Ga. Tonalitic gneisses with the bulk U-Pb ages exceeding 3.1 Ga have been found in four localities: 1) Tojottamanselkä, Central Lapland [1], 2) Lapinlahti, Eastern Finland [2], 3) Vodlozero, Russian Karelia [3] and 4) Pudasjärvi, northern Finland [4].

In the Archaean Pudasjärvi Complex the pyroxene-bearing rocks are considered to form a belt, the Pudasjärvi Granulite Belt (PGB). The major rock types of the PGB are meta-igneous mafic and felsic granulites, and trondhjemite gneisses. Ion microprobe (NORDSIM) U-Pb analyses on zoned magmatic zircons suggest an age of ca. 3.5 Ga for the trondhjemite gneiss in Siurua, considered the oldest rock so far identified in the Fennoscandian Shield. The old age is supported by the Sm-Nd depleted mantle model age of 3.5 Ga, and by conventional U-Pb zircon data [6]. The U-Pb sims-data on the Siurua gneiss are, however, heterogeneous and suggest several stages of zircon growth, mostly at 3.5-3.4 Ga. An inherited core in one crystal provided an age of 3.73 Ga, whereas two analyses yield ages of 3.1 and 3.3 Ga. Metamorphic monazite formed in the Siurua gneiss ca. 2.66 Ga ago, roughly contemporaneously with the high-grade metamorphism recorded by zircon in a mafic granulite. As a whole the PGB seems to be a tectonic block-mosaic containing rocks with Sm-Nd crustal formation ages ranging from 3.5 to 2.8 Ga.

References

[1] Kröner, A. and Compston, W. (1990) *Contributions to Mineralogy and Petrology* **104**, 348-352.
[2] Hölttä, P., Huhma, H., Mänttäri, I. and Paavola, J. (2000) *Lithos* **50** (1-3), 121-136.
[3] Lobach-Zhuchenko, S., Chekulayev, V., Sergeev, S., Levchenko, O. and Krylov, I. (1993) *Precambrian Res.* **62**, 375-397.
[4] Mutanen, T. and Huhma, H., 2003. *Bulletin of the Geological Society of Finland*, **75**, 51-68.