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Co-Variations of δ^{30}Si and δ^{18}O during metamorphism of the Mid-Proterozoic Adirondack Mountains, New York, USA.

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We present Si isotope data for silicate minerals from the Mid-Proterozoic Adirondack Mountains of the Grenville Province in northern New York, USA, including samples from the Marcy anorthosite massif of the central highlands and the marbles of the Grenville Group. These samples allow examination of Si isotope variation caused by fluid interaction during contact metamorphism.

To constrain the end-member Si isotope composition we analysed separated silicate mineral samples from the anorthosite and the marble. In addition, silicate samples from the contact skarn zone, between the anorthosite intrusion and marble, were analysed to check for Si isotope mixing between the two end-members. All silicates were fused with an alkaline flux and dissolved in weak HCl acid. The dissolved Si was then separated by cation ion-exchange chromatography. The relative Si isotope compositions were measured using a high-resolution MC-ICP-MS (NuPlasma 1700 at ETH Zürich) and are reported in δ notation relative to the international Si standard NBS28.

Si isotope analyses reveal two distinct end-members: 1) the anorthosite body with a typical igneous δ^{30}Si of –0.1$\permil$ and 2) sediments with an average δ^{30}Si of +0.8$\permil$. Calc-silicates of the skarns display intermediate δ^{30}Si with an average of +0.4$\permil$, indicating mixing of Si between both end-members during contact metamorphism. This relation is, in part, mirrored by δ^{18}O, giving an end-member with high δ^{18}O around +20.4$\permil$ VSMOW, typical for silicates in metamorphosed limestones and an igneous end-member with an average δ^{18}O of

+8.1$\permil$ .....(Valley and O'Neil 1984). Calc-silicates of the contact skarn, however, have low δ^{18}O around +2.7$\permil$ indicating the mixing of low δ^{18}O meteoric and intermediate δ^{18}O magmatic waters .....(Valley and O'Neil 1982) during contact metamorphism in a manner that would not be expected to yield Si isotopic effects.

Our results allow for two preliminary conclusions; (i) the δ^{18}O composition shows that the positive δ^{30}Si end-member is of sedimentary origin. (ii) Calc-silicates of the contact skarn were formed by transfer of silicon from the anorthosite to the marble during contact metamorphism.

References:

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