Oxygen- and Carbon-isotope ratios in high-grade rocks from Sri Lanka as a monitor of fluid-rock interaction

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Stable isotopes represent a most powerful tool to monitor fluid-rock interaction processes. However, the reacting rock-system and the invading fluid must be in isotopic disequilibrium in order to produce significant isotopic shifts. The metasedimentary-metaigneous granulite-facies lithologies of the Highland Series of Sri Lanka represent an ideal region to prove whether influx of deep-seated CO_2 can be regarded as a possible mechanism for regionally extended granulite-facies metamorphism.

In order to address this problem, several hundred stable isotope analyses were carried out on whole-rock and mineral samples, covering a large part of central and southern Sri Lanka.

Pervasive influx of large quantities of mantle-released CO_2 should:

1. lower $^{18}O/^{16}O$ ratios of metasedimentary rocks,
2. homogenize isotopic differences in chemically different rocks on a small scale, and
3. buffer C-isotopic values of graphite to the equilibrium fractionation value CO_2-graphite at granulite-grade conditions.

None of these conditions is fulfilled in the granulites of Sri Lanka. In contrast, the preservation of near-surface acquired isotopic compositions and the lack of isotopic homogenization, even on a small scale, indicate that during granulite-facies metamorphism, any water-bearing fluid phase could only have been present for short periods of time.

During uplift, retrogression occurred due to influx of more H_2O-bearing fluids along localized channelways. The products of retrogression, the bleached charnockites, do not differ in their O-isotopic composition compared to their granulite-grade precursors. This indicates that the fluids which were responsible for the alteration equilibrated with or were derived from similar high-grade rocks.