An Oxygene Isotope Traverse through the High Himalayan Crystallines (HHC) (Langtang Valley, Central Nepal)

TALK

J.A. MASSEY*

Although several Himalayan studies have considered stable isotopes, most have concentrated on the High Himalayan Leucogranites (HHL), with only token analyses made of the underlying HHC, the proposed source of these granites. In this study, a comprehensive traverse through the HHC is reported with analyses from both the metamorphic material and, at the top of the section, the Langtang HHL, with the aim of providing constraints on the metamorphic and magmatic history of the HHC, and in particular to constrain fluid processes.

Most HHL, Langtang included, show $\delta^{18}O_{(whole\text{-}rock)}$ 11-13‰ and $^{87}Sr/^{86}Sr_{20Ma}$ 0.74-0.77, although a few cases show $\delta^{18}O$ down to 9‰ (Mustang and Bhutan) and higher $^{87}Sr/^{86}Sr_{20Ma}$[1]. In the case of the Makalu and Mustang HHL a correlation between lower $\delta^{18}O$ and increased $^{87}Sr/^{86}Sr_{20Ma}$ may exist. HHC analyses are rare although ranging from ~9-13‰[1]. Analyses of the HHC in Langtang again reveals a range of $\delta^{18}O$ from ~8.5-13‰, and with a correlation between low $\delta^{18}O$ and high $^{87}Sr/^{86}Sr_{20Ma}$. However this range is not found throughout the section, and indeed the HHC can be divided into blocks which are isotopically distinct for both O and Sr. Correlation of these distinctions with metamorphic and structural variations supports the suggestion that the HHC in Langtang consists of tectonically separated blocks of crust, and allows delineation of the possible contributions of different parts of the HHC to Himalayan magmatism.

More detailed consideration of mineral separate material provides further information on temperature, equilibrium and fluid effects. In the lowest part of the HHC (kyanite-grade), the small variation in lithologies and hence in expected initial isotopic variations, limits the usefulness of isotopes in constraining prograde processes. However heterogeneity of $\delta^{18}O_{minerals}$ suggests largely internal buffering of isotope compositions. In addition, high temperature fractionations (in agreement with temperature estimates using mineral chemistry methods) combined with the observation of common muscovite, preclude any extensive fluid influx which would have resulted in melting at such temperatures (>700°C). Quantitative diffusion modelling indicates that uplift must have taken place in an anhydrous, closed system.

At the top of the section (sillimanite-grade), isotopic concordance between varied lithologies (metabasites, pelites, calc-schists) suggests substantial isotopic homogenisation to values in equilibrium with either metamorphic or magmatic fluids. In addition disequilibrium fractionations recorded in the granites are not explicable by simple diffusional exchange and may require the presence of fluids during retrogression. At the very latest stages meteoric fluids have locally percolated along

*) Department of Sciences, Open University, Milton Keynes, MK7 6AA, United Kingdom

brittle chlorite-grade fractures. The upper parts of the section also contrast with the base in showing evidence for a much more prolonged syn and post-peak deformation history[2] and hence a connection between fluid processes and deformation may be inferred.

[1]summary in : France-Lanord & Le Fort 1988, Trans.Roy.Soc.Ed. 79,183-195 (& refs therein).
[2]Reddy et al.1993, Spec.Publ. Geol.Soc.London, in press.

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Autor(en)/Author(s): Massey J. A.

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