Dolomite-and magnesite-bearing lithologies from the Upper Lesser Himalayan Sequences: A petrological perspective in the framework of CO_2 degassing during collisional orogeny

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The Lesser Himalayan Sequence (LHS) is a thick Proterozoic sedimentary sequence originally deposited on the northern margin of the Indian plate, metamorphosed during the Himalayan orogeny. Abundant carbonatic lithologies occur in the Upper-LHS, in the Dhading Dolomite and Benighat Slates Formations. The lithostratigraphic features of these formations are relatively well-known; however, these lithologies have been rarely investigated from a petrologic point of view, and their metamorphic reaction history is fundamentally unknown.

Here we present the results of a detailed petrologic study on different carbonatic lithologies from the Upper-LHS, whose protoliths can be grouped in: (1) a dolomitic series (dolostones, dolomitic marls, dolomitic pelites), and (2) a magnesitic series (sparry magnesite ores, magnesitic pelites). In the dolomitic series: (a) impure dolomitic marbles contain variable amounts of quartz, phlogopite, and/or muscovite; (b) calcschists derived from dolomitic marls consist of carbonates (dolomite ± calcite), phlogopite, quartz and variable types of silicates among which hornblende or kyanite; (c) schists derived from dolomitic pelites show mineral assemblages similar to those of normal metapelites, but with significant amounts of Ca-rich minerals (e.g., plagioclase) and with biotite anomalously enriched in Mg. In the magnesitic series: (a) magnesite-rich rocks consist of coarse-grained magnesite partially replaced by talc + Mg-chlorite; (b) schists derived from magnesitic pelites are characterized by uncommon assemblages, such as orthoamphibole + kyanite + garnet + phlogopite.

Thermodynamic forward modelling (P/T-X(CO_2) pseudosections) applied to selected samples from each series allowed to: (1) understand the nature of the main decarbonation reactions; (2) constrain the P-T conditions at which these reactions occurred, and (3) estimate the amounts of carbonates consumed during prograde metamorphism, and the correspondent amounts of released CO_2.

The results of this study suggest that carbonatic lithologies from the Upper-LHS: (1) could have produced relevant amounts of CO_2 in the past, through metamorphic decarbonation reactions, and (2) they can still be an efficient source of CO_2, thus contributing to the diffuse Himalayan CO_2 degassing observed at present along the most important tectonic discontinuities.