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Dolomite-and magnesite-bearing pelites: poorly investigated, yet significant, sources of CO_2 in collisional orogens.

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Calcite-bearing sediments (calcareous pelites, marls, impure limestones) are among the most investigated sources of carbon in collisional settings (e.g. Groppo et al., 2017, 2021, 2022; Rapa et al., 2017). Dolomite- and magnesite-bearing sediments, however, can also be important constituents of evaporitic sequences deposited along passive margins and involved in collisional orogenic processes. So far, decarbonation reactions in dolomite- and magnesite-bearing rocks have been rarely investigated, and their contribution to the orogenic carbon cycle substantially neglected.

As a contribution to the understanding of the influence of dolomite- and magnesite-bearing lithologies on the global Earth's carbon cycle, a petrologic study was focused on the Lesser Himalayan Sequence (LHS) in central Nepal. The LHS is a thick Proterozoic sedimentary sequence originally deposited on the northern margin of the Indian plate, metamorphosed during the Himalayan orogeny. Abundant dolomite- and magnesite–bearing lithologies occur in 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). The magnesite deposits associated to dolomitic lithologies are interpreted as the evidence of evaporitic environments during the Proterozoic.

The 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. The schists derived from magnesitic pelites are, instead, characterized by uncommon assemblages such as orthoamphibole + kyanite + garnet + phlogopite. Thermodynamic forward modelling (P/T-X(CO_2) pseudosections) applied to these schists 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 dolomite/magnesite consumed during prograde metamorphism, and the correspondent amounts of released CO_2. The main results are:

- the observed assemblages formed during a heating decompression stage, at P-T conditions of 620 ± 20°C, 8.5 ± 0.2 kbar, consistent with those registered by the associated metapelites;
- the observed peak assemblages are predicted to be stable in equilibrium with a CO_2-bearing

fluid, even in those samples where carbonates are no more preserved;

- the overall results point to an internally buffered P/T-X(CO_2) evolution. The amount of carbonates consumed during prograde metamorphism varies in the range 7-20 vol%, corresponding to 3-10 wt% of CO_2 These CO_2 amounts are nearly double the CO_2 released by calcareous pelites (Groppo et al., 2021).

The main consequence of this study is that the CO_2 productivity of dolomitic and magnesitic pelites is significant and that these lithologies could be relevant sources of CO_2, possibly contributing to the diffuse Himalayan CO_2 degassing (e.g. Girault et al., 2014, 2018).

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