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Did it melt? Reaction microstructures in lower crustal olivine+spinel dolomitic marbles

ANDREA MARONI[1], DANIELE CASTELLI[1], VINCENZO FESTA[2], CHIARA GROPPO[1], FRANCO ROLFO[1], RICHARD SPIESS[3] AND FABRIZIO TURSI[1]

[1]University of Torino
[2]University of Bari Aldo Moro
[3]University of Padova

In the last decade, an increasing number of authors have suggested the possible generation of carbonatitic melts through partial melting of carbonatic metasediments (e.g. [1]) in the middle–lower crust of orogens subjected to high dT/dP ratios [2]. The (extremely) high-temperature conditions are not the only cause for melting of these lithologies, since the presence of an aqueous fluid, either internally derived or externally introduced, can significantly decrease the solidus temperature (e.g. [3]). However, despite the recently emerging interest, melt-producing (and melt-consuming) reactions and related microstructures in marbles *s.l.* are still largely unexplored.

Here we present evidence of the presence of melt and of melt-residue back-reactions in olivine+spinel dolomitic marbles from a Variscan metasedimentary migmatitic succession exposed in the Serre and Sila massifs of Calabria (Southern-Italy), which equilibrated under peak metamorphic conditions up to 800–840°C, at 0.9–1.0 GPa.

Calcite melt-pseudomorphs, calcites with peculiar crystal-chemical and microstructural characteristics, and potential two-liquids immiscibility microstructures bear evidence of partial melting possibly related to chlorite dehydration melting. Melt-residue back-reaction microstructures between the carbonatitic melt and the silicate fraction have been additionally identified, including coronas and symplectites composed of pargasite, diopside, and dolomite replacing olivine.

Finally, coarse-grained calcite crystals developed at the edges of prograde exsolution-bearing calcite, characterized by high and flat Mg-profiles may represent products of melt crystallization and subsequent re-equilibration during exhumation.

The observed microstructures pave the way for the identification of partial melting in metacarbonate rocks. Moreover, the obtained results demonstrate that partial melting can occur even in relatively pure carbonatic systems, at least on a local scale, due to the decreased solidus temperatures induced by presence of aqueous fluids internally released during breakdown of hydrous minerals.

[1] Su, Wang, Wang (2024) *Lithos*, 488-489.

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[3] Floess, Baumgartner, Vonlanthen (2015) *Earth and Planetary Science Letters* 409, 147-156.