

Metamorphic Redox Partitioning in Subduction Zones: Insight from Alpine Corsica

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Context

Subduction zones are major pathways for the exchange of materials between surface and deep Earth (Evans, 2012; Galvez and Pubellier, 2019; Peacock, 1990). Serpentinite, formed by hydrothermal alteration of peridotites on the seafloor (Evans, 2008), conserve part of their reducing power as they are progressively subducted (Malvoisin et al., 2012). This reducing power may be redistributed in and around surrounding lithologies (marbles, basalts, evaporites etc), and promote metasomatic exchanges of reductant and oxidants. This is the reason why serpentinites are thought to exert a crucial control on the partitioning of C, Fe and S between rocks and fluids in subduction zones (Evans and Frost, 2021; Galvez et al., 2013a). Much remains to be understood about the nature, chronology and mechanisms of redox-driven metamorphic reactions.

Previous works have investigated a reactive contact between serpentinites (reducing) and marbles (oxidizing) in Alpine Corsica (Galvez et al., 2013a; Galvez et al., 2013b). At the interface, the marble has been reduced to an assemblage comprising graphite, wollastonite and grossular. The reaction occurred at a peak metamorphic T of around 400 °C and a pressure of 10 kbar (Chopin et al., 2008). This reaction has been used to constrain the magnitude of the redox gradient between the two contrasted lithologies (Malvoisin et al., 2012). It is not yet clear, however, what volumes of serpentinite and marble have been engaged in the redox exchange. This is a mass balance issue which cannot be resolved by conventional approaches such as equilibrium thermodynamics (Evans, 2006; Galvez and Jaccard, 2020). But it can be addressed by a quantitative approach of redox reactions using a metric such as the redox capacity ΔO_2 , which is the total amount of O_2 necessary to oxidize all redox-sensitive element within a given mass to their highest accessible valence state.

In this project, we will sample the reactive interface in the field. Back to the laboratory, we will study the compartmentalization of redox power across this reactive interface using a novel analytical approach giving access to the redox capacity of rocks (Galvez and Jaccard, 2020).

Objectives and Methods

The objective of this project is to resolve the mass balance problem associated with the metasomatic and redox-driven formation of graphite at a lithological interface in Alpine Corsica.

The project will involve field sampling in Alpine Corsica, and extensive laboratory work. This includes the preparation of rocks for thin sectioning, general petrographical description of thin sections, selected characterization with Raman spectroscopy, and laboratory redox titration.

Requirements for the project are a taste for the study of complex natural objects, and for quantitative laboratory work.

Literature

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1 photo dimension H5.5cm x L8.5cm



WEB sites

Choice of orientation : (supprimer les orientations qui ne conviendraient pas)

1) Sedimentary, Environmental and Reservoir Geology / 2) Geochemistry, Alpine tectonics, Ore Deposits