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A micro-mapping strategy to investigate mechanical and chemical mass transport in migmatite

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Migmatites are fantastic objects to study both mechanical and chemical mass transport occurring at mm to cm-scale. However, migmatitic outcrops are the result of complex space and time interactions between (i) melt producing reactions, (ii) melt gain/loss and (iii) retrograde reactions. This succession of events is recorded in the minerals and microstructures of migmatites, and accounts for their apparent complexity. In order to explore the controlling parameters of these chemico-mechanical mass transport, it is thus necessary to characterize in great details the compositional changes between the different migmatitic domains, such as between leucosome and residuum. In this contribution we show how suitable local effective bulk (LEB) compositions can be derived by means of standardized microprobe X-ray images, using the program XMapTools. For chemically heterogeneous samples, such as migmatites, these LEB allow to forward model the stable mineral assemblages for each domain. Those thermodynamic models are used to investigate the conditions of leucosome-residuum separation.

The studied sample is a metapelite embedded within a metasedimentary xenolith in the Marcabeli pluton, El Oro Complex, Ecuador. The sample exhibits complex mineral patterns due to local melt redistribution (at mm to cm-scale). Such physical mass transport involves major changes that affect the local chemical composition observed today. At the same time gradients in chemical potential can be established between adjacent domains such as residuum and leucosome, thus triggering chemical interaction. Diffusive transport between domains aims to reduce such chemical potential gradients. Along a modelled P-T path the chemical and mineralogical evolution of micro-domains can be reconstructed for (at least the reactive parts of) the crystallization history.