Abstract

Olivine hosted melt inclusions are widely used to constrain the primitive melt composition, unaffected by superficial processes. However, melt inclusions always show larger compositional variations than lavas or glasses. Moreover, the idea of how olivine grows has been largely revisited since the discovery of phosphorus (P) zonation in otherwise compositionally homogenous olivine. Understanding the process of melt inclusion entrapment is thus essential to better constrain what melt inclusion composition represents. Coupling structural observations (elemental X-ray maps, especially from P and NanoSIMS profiles) with in–situ compositional data (major, trace, volatiles, P contents and oxygen isotope ratios) of melt inclusions and olivine from two different samples from the Atlantic ridge, we show that olivine might be polyphase modified by dissolution and re-precipitation after their formation and melt inclusion entrapment and prior to the eruption. This process is probably due to adiabatic decompression melting. Melting of olivine, which encompass a rapid growth event and has thus entrapped boundary layers enriched in incompatible elements, can lead to melt inclusions with a modified composition. The new melt inclusion will thus have a composition, at least for P, that is not representative of the primary melt. NanoSIMS profiles in olivine allows calculating their residence time within the magmatic system, which is in the order of a few days to a few weeks. Melt inclusions from the studied MORB samples have large oxygen isotope variations (>2.5‰) uncorrelated with other geochemical indicators. The origin of these variations is not totally understood yet, but they can represent local, grain scale processes rather than mantle source heterogeneity. In subduction zones, these processes might be overprinted by the influence of slab fluids. As chlorine isotopes do not fractionate at magmatic temperatures, they should retain the source signature and can thus help to identify the respective contribution(s) of different lithologies to the Cl enrichment of the mantle. We developed a method and a set of standards to measure chlorine isotope in glasses with SIMS and analysed melt inclusion from 3 different volcanic arcs (Vanuatu, Aeolian and Lesser Antilles). We show that the different arcs have a different δ^{37}Cl signature, which is possibly due to a different geometry in the subduction zone (e.g. different dip angle of the subducting plate), causing different depth of fluids release and thus different origins of fluids (sediments, serpentinites or marine pore fluids for example).