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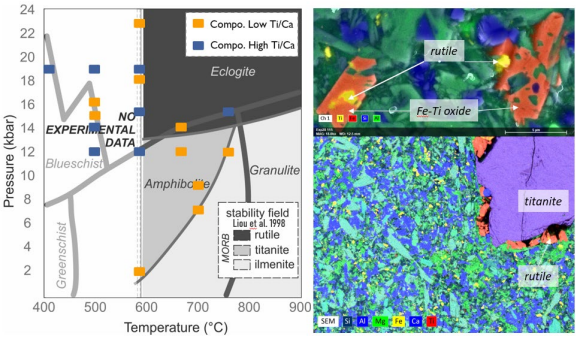


# Rutile and titanite phase stability constraints at subsolidus conditions in a mafic system: insights from experimental petrology

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Rutile and titanite are valuable petrochronometers, since both can be dated using U-Pb and Zr concentrations are calibrated as geothermometers. Previous experimental studies using MORB compositions [1] established that titanite is more stable at LT-LP and rutile at HP (> 12 kbar). Despite these, the natural occurrence of rutile at LP (< 12 kbar) and titanite at HP (> 20 kbar) indicates strong uncertainties on our current understanding about their stabilities, particularly under conditions typical of subduction zones. A non-trivial compositional effect on their stabilities, mainly driven by CaO content on the titanite-out reaction, has been demonstrated for granitoid compositions (2-4 kbar) [2]. For MORB compositions, experimental constraints are currently lacking in the 400-600 ºC temperature range. Here we present the results of a set of 30 experiments run in a piston-cylinder apparatus. These were conducted under water-saturated conditions, using a cold pressure-seal capsule technique, with pressures ranging between 12 and 23 kbar, and temperatures between 400 and 750 ºC (Fig.1). We tested multiple starting materials, with bulk rock powders yielding different Ti/Ca values, and resourcing to mineral seeds to work as nuclei for mineral overgrowth (e.g. rutile, titanite, kaersutite, wollastonite). Due to the challenging LT experiments, equilibrium is not attained, but dissolution and precipitation features are often observable (Fig.1). We show that when Ti/Ca is high, rutile is stable even at lower pressures, and when Ti/Ca is low, titanite seeds appear metastable even at higher pressures (19 kbar) and low temperatures. This is in agreement with petrological observations (i.e. peak titanite reported in blueschist rocks). At 600 ºC and 14 kbar, titanite seeds become unstable and start reacting with the basalt bulk rock powder. We found that water content as well as Ti/Ca ratios appear to influence the stability of these Ti-phases in a mafic system. These results can be used to better constrain the stabilities of rutile, titanite and ilmenite at low subsolidus conditions, elucidating the P-T conditions that these minerals record, including in subduction zone settings.

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