

Experimental study of the reaction kinetics between CO₂-bearing solution and olivine

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Olivine, as one of the main constituents in mafic/ultramafic rocks, has been suggested as a promising candidate for trapping anthropogenic CO₂ permanently as carbonates because of its high dissolution and carbonation rates. In this study, we employed an experimental approach to quantitatively evaluate the carbonation reaction kinetics as CO₂-rich solution interacts with olivine (Fo₉₀).

Gem-quality olivine grains and olivine powders (<30µm or 50µm) reacted with CO₂-containing solutions (e.g., 0.25 to 3M NaHCO₃ solutions, fluid/rock mass ratio 5 to 10) in gold capsules placed in a hydrothermal autoclave over durations of 1-14 days at 200 °C and 150 bar. The carbonation fraction (CF, the percentage of carbonated olivine over original olivine) was determined by comparing the concentration of dissolved-inorganic-carbon (DIC) in the solution before and after carbonation reactions.

Our results show that the CF could increase by ~20 times using fine olivine powders (<30µm) relative to the larger grains (~0.18 g/each), and the CF has a positive linear correlation with the concentration of NaHCO₃. The maximum CF in our study reaches ~45%, obtained using <30µm olivine powders and 3M NaHCO₃ solutions within one day of the reaction. Further increase of experimental time, however, will not improve the CF, but result in the precipitation of secondary minerals (including talc), and sometimes the decomposition of the carbonates (i.e., magnesite). However, this scenario could be prevented by using less amount of solutions (fluid/rock_{mass} = 1); in which case, the carbonation reaction is much faster as SiO₂ precipitates as amorphous Si-layer without the formation of secondary minerals. The amorphous Si layers still have voids and channels for the fluid/rock interactions. These observations help constrain the kinetics of the olivine carbonation reactions.

Triplite in Baxiannao W deposit, southern Jiangxi, and its geological significance

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A pink mineral was newly found in the Baxiannao tungsten deposit, southern Jiangxi province, China. Analytical results from Laser Raman spectra shows that its Raman shift (425.34, 454.64, 601.12, 981.97, 1040.50, 1073.1 cm⁻¹) is in good concordance with that of sample Triplite R050186 from the ruff data base (432.08, 453.29, 611.42, 981.69, 1043.40, 1072.33 cm⁻¹). The d values of high peak of powder XRD analysis are 1.639, 1.759, 2.032, 2.110, 2.221, 2.517, 2.602, 2.690, 2.735, 2.864, 3.038, 3.278, 3.442, 3.660, 4.299, 5.668, respectively, which well fit the standard 25-1080 triplite. Chemical composition from electron-microprobe analysis is MnO 50.19%~50.96%, FeO* 7.74% ~7.78%, MgO 2.75%~2.89%, CaO 1.75%~2.12%, P₂O₅ 30.95%~31.51%, F 7.21%~7.94%, and H₂O 0.45%~1.02%, and hence the calculated chemical formula is (Mn, Fe, Mg, Ca)₂PO₄(F, OH). All these data prove that the mineral is triplite, the manganese end-member of triplite-zwieselite series. It occurs in the wolframite-bearing quartz vein and associated with quartz and fluorite, which indicates that the ore-forming fluid was rich in phosphor and fluorine. The triplite contains a lot of fluid inclusions of two phases. Almost all the fluid inclusions are aqueous-rich and many of them are larger than 150µm. Raman spectra show that the liquid phase is water while the gas phase contains not only H₂O, but also CH₄ and CO₂. The discovery of triplite together with quartz and fluorite in the tungsten deposit suggests that the related granite is most likely attributed to the fluorine-rich category.