American Mineralogist, Volume 102, pages 1696–1708, 2017

Ilmenite breakdown and rutile-titanite stability in metagranitoids: Natural observations and experimental results

Samuel Angiboust[1,2,*] and Daniel Harlov[1]

[1]Deutsches GeoForschungsZentrum, Telegrafenberg, D-14473 Potsdam, Germany
[2]Institut de Physique du Globe de Paris, Sorbonne Paris Cité, University Paris Diderot, CNRS, F-75005 Paris, France

Abstract

Rutile and titanite commonly form by replacement of ilmenite in metamorphic rocks. Exhumed orthogneiss from the Western Alps show that titanite is mostly stable below 1 GPa while rutile seems to dominate within rocks recrystallized under higher pressures. We herein investigate phase relationships for four granitic compositions with variable CaO content at medium to high-pressure conditions (0.7–1.6 GPa, 450–650 °C) with a focus on ilmenite breakdown and Ti-bearing species formation. Our piston-cylinder experiments show that, in the investigated *P-T* range, ilmenite reacts during metamorphism above 1.2–1.4 GPa to form rutile. Below this pressure, titanite is the dominant Ti-bearing species for most granitoid compositions. We also show that the position of this reaction curve is strongly influenced by the whole-rock Ca activity. For low-Ca activities, rutile may be stable down to 0.7 GPa (and below) within ilmenite pseudomorphs while the titanite stability field may extend to pressures >1.3 GPa for Ca-richer compositions. Both species may be stable in one single sample depending on the local Ca activity gradients. The finding of metamorphic rutile within metagranitoids with CaO contents >2 wt% can be considered, under certain conditions, as a reliable indicator of high-pressure metamorphism. This study also highlights the importance of improving our knowledge of the phase relationships between rutile and titanite as a function of *P-T-X* to better interpret the textural and tectonic history in natural samples as well as the meaning of age values yielded by rutile and titanite geochronometers.

Keywords: Rutile, titanite, ilmenite, experimental petrology, metamorphic petrology, granite