European Mineralogical Conference
Vol. 1, EMC2012-522, 2012
European Mineralogical Conference 2012

The applicability of the TitaniQ geothermometer in metamorphic rocks (case study Val Strona, Ivrea Zone)

M. Penders and R. Kleinschrodt

Institut füt Geologie und Mineralogie, Universität zu Köln, Greinstraße 4 - 6, 50939 Köln

The applicability of the Ti-in-quartz (TitaniQ) geothermometer was tested on a series of metamorphic rocks from the Ivrea Zone (Val Strona, northern Italy). Eleven metapelitic samples were collected along a profile that was expected to show a continuous increase of temperature and pressure and reaches from amphibolite to granulite facies.
Within this investigation two different calibrations of the TitaniQ geothermometer were verified. The first one was developed by Wark & Watson (2006) and is based on the temperature-dependent solubility of Ti in quartz. A further development of this calibration by Thomas & Watson (2010) additionally respects the pressure effects on Ti solubility in quartz. Reference values were determined by classical garnet-biotite-geothermometry in combination with GASP-geobarometry.
The application of the calibration from Wark & Watson (2006) shows a temperature increase along the profile from approximately 750°C – 860°C. In comparison to the reference values (550°C – 830°C), the temperatures at the beginning of the profile are much higher and become more equal towards the end. Obviously, this pressure-independent approach only fits well in the pressure range of the experimental calibration (10kbar).
The approach of Thomas et al. (2010) is pressure-dependent and was combined with the results from the GASP-geobarometry. It shows a temperature increase from approximately 600°C – 860°C along the profile. In comparison to the reference values the temperatures fit much better, especially in the lower pressure/ lower temperature part at the beginning of the profile.
Generally different measuring techniques were tested to get consistent and reproducible Ti contents. They primarily differed in the spatial arrangement, the beam diameter (5μm vs. 50μm) and the number of the measuring points. The result was that two rectangular lines of not more than 20 measuring points (5μm) are enough to get consistent Ti concentrations. This method also helps to find out about eventual zoning patterns and to detect exsolved rutile needles. Latter appeared in quartz grains of higher temperatures (approximately >800°C) and made it difficult to measure peak-equilibrium Ti contents. The observed average Ti concentrations were strongly affected by the number of needles within the excitation range of the electron beam which may be visible or not at the surface and may lead to erroneous high temperature assumptions.
In case of the Val Strona, the application of the TitaniQ geothermometer results in good and comprehensible temperature values, when using the pressure-dependent calibration of Thomas et al. (2010). In general this study confirms the usage of one-phase geothermometry, which could be an advantage over classical methods, especially in usability.

REFERENCES

Thomas, J. B., Watson, E. B., Spear, F. S., Shemella, P. T., Nayak, S. K., Lanzirotti, A. (2010): TitaniQ under pressure: the effect of pressure and temperature on the solubility of Ti in quartz. – Contributions to Mineralogy and Petrology 160, S. 743 – 759.

Wark, A. D., Watson, E. B. (2006): TitaniQ: a titanium-in-quartz geothermometer. –
Contributions to Mineralogy and Petrology 152, S. 743 – 754.