Can we apply the RSCM geothermometry approach to study the thermal history of a complex tectono-metamorphic context: the Jebilet massif (Variscan Belt, Morocco)?

Sylvain Delchini, Abdeltif Lahfid, Alexis Plunder, André Michard

Can we apply the RSCM geothermometry approach to study the thermal history of a complex tectono-metamorphic context: the Jebilet massif (Variscan Belt, Morocco)?

Sylvain Delchini[1,2,3], Abdeltif Lahfid[1,2,3], Alexis Plunder[4] and André Michard[5]

(1) BRGM, 3 avenue Claude Guillemin, 45060 Orléans, France
(2) CNRS, ISTO, UMR 7327, 45071 Orléans, France
(3) Université d'Orléans, ISTO, UMR 7327, 45071 Orléans, France
(4) Department of Earth Sciences, University of Utrecht, The Netherlands
(5) Em. Pr. Université Paris-Sud, 10, rue des Jeûneurs, 75002 Paris, France

Understanding the thermal evolution of rocks is a key parameter to reconstruct basins or mountain belts history for industrial purposes. Varied geothermometers such as mineralogy, isotopes or illite crystallinity are commonly used to estimate paleotemperatures. However, these methods are not easy to use in all metamorphic contexts. An alternative approach is based physico-chemical transformation of organic material originally present in the rock.

During geological time, the organic material undergoes two distinctive processes: (1) the carbonization during diagenesis and catagenesis and (2) the graphitization during metamorphism. Raman microspectroscopy is a suitable technique to study and measure these transformations.

Beyssac et al. (2002) established a correlation between the temperature and a Raman parameter of the CM called R2. This parameter R2 varies between 0 and 0.7 and shows a correlation with the peak temperature of the metamorphism in the range 330-640°C. The RSCM geothermometer has an absolute precision of ± 50°C due to uncertainties on petrological data used for the calibration. The RSCM calibration established by Beyssac et al. (2002) was extended towards low temperatures in the range of 200-330°C with an absolute precision of ± 25°C (Lahfid et al., 2010).

Until now, the reliability of the RSCM method has never been demonstrated for contexts with superposition of regional and contact metamorphism, such as many Variscan contexts. The present study aims at testing the applicability of the RSCM method to these polyphased metamorphism terrains and at investigating the cumulative molecular transformations of carbonaceous materials related to metamorphic superposition.

To address the above issues, samples were collected in the Variscan Jebilet massif of the Moroccan Meseta. Mineralogical, thermobarometric and RSCM methods have been used in this study to determine the peak T recorded by the analysed rocks. The results obtained for greenschist facies metapelitic rocks show a good agreement between the mineralogical assemblage Chlorite–Phengite–Felspar–Quartz and the

Raman temperatures ranging from 330 to 394 ± 50°C. In the metapelitic rocks that underwent higher metamorphism grades (hornfels/amphibolite facies), four dominant mineral assemblages were observed: (1) Chlorite–Biotite, (2) Cordierite–Biotite, (3) Andalusite–Garnet–Bt, (4) Andalusite–Cordierite–Biotite. The corresponding Raman temperatures vary respectively between 474 ± 50°C and 628 ± 50°C. The pseudo-sections generated for samples from the hornfels/amphibolite facies confirmed the peak temperatures measured by the RSCM method. Our results do not support clear evidence of potential molecular cumulative effect on CM triggered by overprinted metamorphism.

Therefore, the RSCM method is suitable to investigate the peak temperature within a polymetamorphic context.

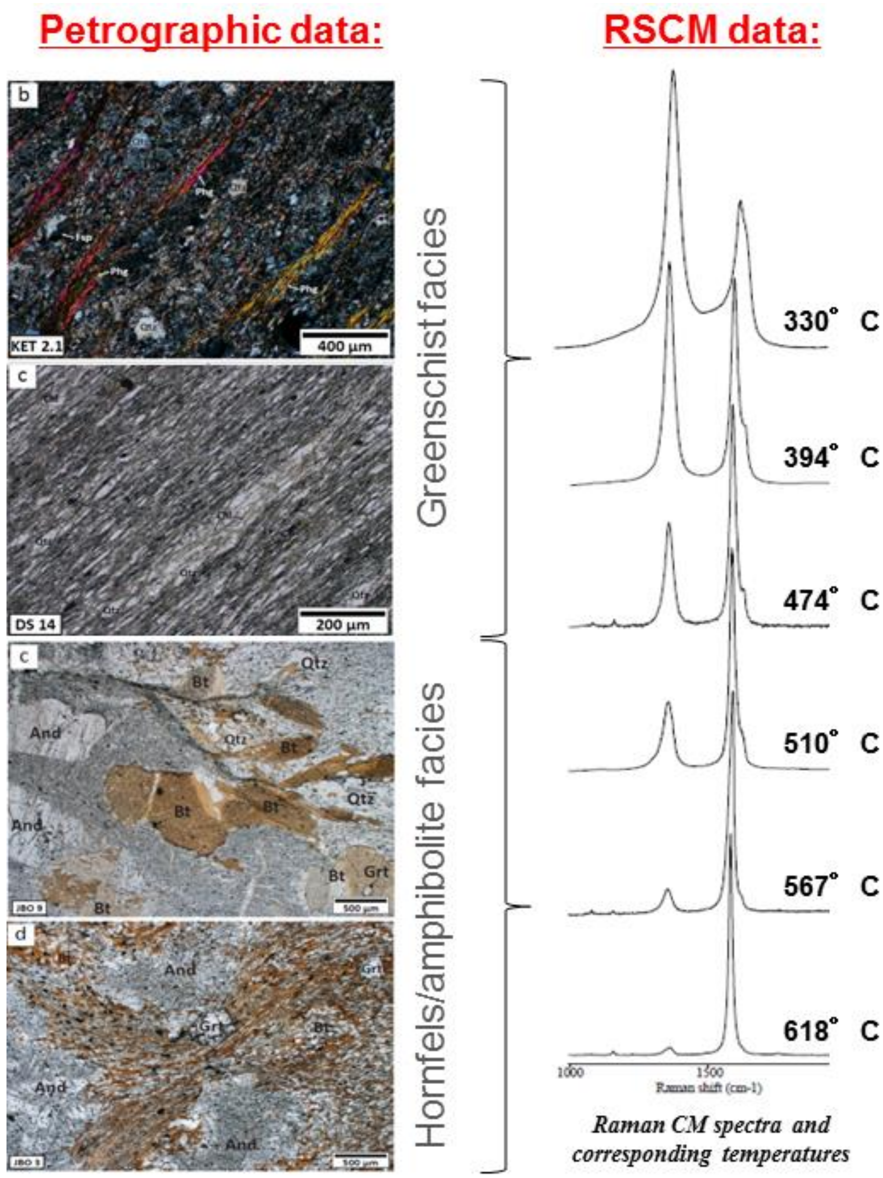

Figure 1 : Comparison between petrographic and RSCM data