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A NEW EMPIRICAL CALIBRATION OF THE QUARTZ C-AXIS FABRIC OPENING-ANGLE DEFORMATION THERMOMETER

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RESUMO: During crystal-plastic deformation of quartz the opening-angle of c-axis fabric increases with rising temperature and hydrolytic weakening and with decreasing strain rate, as indicated by numerical simulations, experimental and natural deformation. Numerical simulations also indicate that the opening-angle is sensitive to the 3D strain geometry. In a compilation of data of samples with c-axis fabrics and independent petrological determinations of temperature Kruhl (1998) observed a positive linear correlation between the opening-angle and temperature for rocks naturally deformed within the range of approximately 250-800°C, and proposed that the opening-angle can be used as a deformation-related thermometer with an uncertainty of ± 50 °C. Law *et al.* (2004) made minor modifications to this thermometer by adding some published data. Several reasons place the quartz c-axis texture opening-angle thermometer as a potential analytical method to quantify temperatures in rocks that underwent crystal-plastic deformation, among which: (i) quartz is one of the most common rock-forming minerals of crustal rocks, (ii) its deformation behavior generally dominates the rheology of the crust, (iii) it is stable over the full range of crustal metamorphic conditions and can accommodate crystal-plastic deformation since low-temperature (ca. 200 °C) to ultra-high temperature conditions (up to 1150 °C). However, since its proposition the opening-angle thermometer was not subjected to further validation based on additional data, and the relationships between opening-angles and temperatures higher than 650 °C are poorly constrained. This contribution enhances the quartz c-axis fabric opening-angle deformation thermometer by means of additional data from samples in which accurate temperatures were calculated either by classical thermometry or pseudosection. The original dataset of opening-angle versus temperature used in the previous versions of the thermometer, containing 17 data, was expanded to 41 data, with special reference to rocks deformed under temperatures between 660 and 1100 °C. The expanded dataset indicates that, within the metamorphic range of 250-1100 °C, the opening-angle has a logarithmic relationship with temperature, resulting in the fit: T (in °C) = 437.4 ln (*opening-angle*, in degrees) – 1305.5. A faster increase of opening-angles for rocks deformed under rising temperatures, ranging from 500 to 1100 °C, correlates to a change in the dynamic recrystallization mechanism from subgrain rotation to grain boundary migration, and it is partially related with a progressively increasing importance of prism [c] slip relative to <a> slip. The expanded dataset reinforce the validity of the opening-angle thermometer as a reliable analytical method to quantify deformation temperatures. The temperature range covered by newly formulated thermometer ($\Delta T \sim 850$ °C) is the largest temperature spread of any geothermometer calibrated on natural rocks. A case study of the application of the newly calibrated thermometer is presented by Moraes *et al.* (this volume). Kruhl, J.H., 1998. Reply: Prism- and basal-plane parallel subgrain boundaries in quartz: a microstructural geothermobarometer. *Journal of Metamorphic Geology* 16, 142–146. Law, R.D., Searle, M.P., Simpson, R.L., 2004. Strain, deformation temperatures and vorticity of flow at the top of the Greater Himalayan Slab, Everest Massif, Tibet. *Journal of the Geological Society of London* 161, 305–320. Apoio FAPESP, processo 02/13654-4.

PALAVRAS-CHAVE: C-AXIS FABRICS, DEFORMATION, GEOTHERMOMETER.

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