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PII: S0191-8141(14)00128-X

DOI: 10.1016/j.jsg.2014.05.023

Reference: SG 3076

To appear in: *Journal of Structural Geology*

Received Date: 7 December 2013

Revised Date: 20 May 2014

Accepted Date: 31 May 2014

Please cite this article as: Law, R.D., Deformation thermometry based on quartz c-axis fabrics and recrystallization microstructures: a review, *Journal of Structural Geology* (2014), doi: 10.1016/j.jsg.2014.05.023.

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Deformation thermometry based on quartz c-axis fabrics and recrystallization microstructures: a review

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ABSTRACT

For quartz-rich tectonites two types of deformation thermometer are currently commonly employed: 1) The quartz *c*-axis fabric opening-angle thermometer that provides an estimate of deformation temperatures when fabrics were 'locked in' during dislocation creep and dynamic recrystallization. 2) The quartz recrystallization thermometer that indicates a range of likely deformation temperatures based on observed microstructures and inferred mechanisms of dynamic recrystallization. A critically important caveat in applying both thermometers is the assumption that deformation temperature is the primary controlling factor in recrystallization mechanisms and fabric development. However, fabric opening-angles and recrystallization mechanisms are also sensitive to other variables such as strain rate and water weakening. In this paper the development of these thermometers is reviewed, and their potential sensitivities to competing factors such as temperature, strain rate, water weakening and (in the case of opening-angles) 3D strain type are discussed. Examples of the application of these potential thermometers to naturally deformed quartz-rich rocks are given, and case studies of correlations between deformation temperatures estimated by these thermometers and temperatures of synkinematic metamorphism determined by petrology-based thermobarometers are highlighted. In the review, attention is focused on problems associated with applying these thermometers to natural deformation, and examples of such problems are discussed.

Keywords: quartz c-axis fabric; fabric opening-angle; dynamic recrystallization; deformation temperature; strain rate; water weakening; hydrolytic weakening

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