Residual Stress and Strain Rate Measurements on Deformed Quartz using High Resolution X-ray Diffractometry

DINESH PANDIT

LAM-MC-ICP-MS Laboratory, National Geophysical Research Institute, (Council of Scientific and Industrial Research), Uppal Road, Hyderabad-500 606, India
email: dpandit@hotmail.com

The High Resolution X-ray Diffractometry is a versatile method widely used for characterization of synthetic and natural materials. Residual stress measurements by X-ray diffractometer are commonly employed in the analysis of polycrystalline materials. This technique is successfully applied on naturally-deformed quartz samples collected from the Malanjkhand Copper Deposit (MCD), Central India. The Central Indian Suture zone occurs along the NW margin of the Malanjkhand granitoid that hosts the arcuate-shaped MCD. In polished thin section, stretched and elongated large quartz grains (2-3 mm) were observed. Boundaries of such grains display imprints of ductile deformation in the form of smaller (< 5 μm) recrystallised grains indicating dynamic recrystallization within a temperature range of 250° to 400° C. The X-ray residual stress measurements were carried out on the quartz using the "$\sin^2\psi$ technique" [1] and strain measurement procedures of [2]. The estimated strain on the quartz sample is in the range of 8.75×10^{-3} to 1.28×10^{-2}, which corresponds to the residual stress of about 31.98 MPa. Deformation textures in quartz can also be used for stress analysis in space and time. Abundant aqueous bi-phase inclusions observed in the Malanjkhand quartz also suggest that the deformation took place in wet condition. Strain-rate measurements at wet conditions following other standard procedures [3] give values of 7.06×10^{-12} s^{-1} at 250° C and 6.46×10^{-7} s^{-1} at 400° C. This indicates Malanjkhand quartz reef is deformed at moderate temperature with a higher natural strain rate in the presence of water. The technique applied in this study therefore proves to be useful for estimation of stress and strain rates in polymineralic rocks over a wide range of pressure and temperature.

Keywords: High Resolution X-ray Diffractometer, Stress, Strain rate.

References

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