ABSTRACT

Through this study, the author addresses two fundamental questions regarding the relationship between anisotropy of magnetic susceptibility (AMS), shape preferred orientation (SPO) and crystallographic preferred orientation (CPO) in deformed quartzites with low magnetic susceptibility; (1) whether petrofabric data from AMS analysis of deformed quartzites gives information about SPO or CPO of quartz?, (2) is magnetic anisotropy of pure/nearly-pure quartzites a good measure of the rock petrofabric? A total of 19 quartzites with low magnetic susceptibility were chosen from Rengali (India), Naxos (Greece) and Ghatsila (India) regions for this study. After performing AMS analysis, electron backscatter diffraction (EBSD) analysis was done in thin sections prepared parallel to the K_1K_3 plane of the AMS ellipsoid. Results show that in negative susceptibility samples, quartz SPO is parallel/sub-parallel to the orientation of the magnetic foliation. In these samples, the orientation of quartz *c*-axis (easy axis of quartz) is not parallel to the longest axis of the AMS ellipsoid (K_1 direction). The quartz *c*-axis tends to be sub-parallel to K_1 only if quartz grains accommodated intracrystalline deformation by prism <c> slip. This establishes that AMS is a manifestation of the SPO of quartz grains and not their CPO in negative susceptibility quartzites. On the contrary in positive susceptibility samples, there is an obliquity between the quartz CPO, SPO and the trace of magnetic foliation, indicating that neither shape nor crystallography of quartz plays an important role in defining the magnetic fabric in them. However, it has been observed that the SPO defined by mica (biotite and muscovite) is sub-parallel to the trace of magnetic foliation in these samples. This indicates that the magnetic fabric in positive susceptibility samples is controlled by SPO of mica rather than CPO/SPO of quartz. To further investigate the relationship between the intensity of magnetic fabric (P_j) and the intensity of the quartz SPO the author has quantified the SPO intensity of quartz grains by determining the concentration parameter (κ_q) and the azimuthal anisotropy of fractal dimension (AAD) of quartz. Magnitude of 2D strain (E) is also estimated for each sample. Based on these data the statistical relationship between the various parameters is evaluated viz. P_j vs. κ_q, P_j vs. AAD, P_j vs. E, κ_q vs. AAD, κ_q vs. E, AAD vs. E. In the case of negative susceptibility samples a strong linear correlation between the above relations is established. Hence it is inferred that the intensity of magnetic fabric is a gauge of the intensity of quartz SPO in quartzites with negative magnetic susceptibility. However, in positive susceptibility samples, the relationship between the intensity of AMS, SPO and strain is found to be poor. Hence it is inferred that in these samples, the AMS is controlled the para/ferromagnetic phases present in the rock. Therefore, the present study firmly establishes that (a) in quartzites with negative magnetic susceptibility, AMS is a useful petrofabric tool and both the direction and magnitude of AMS are a manifestation of the SPO of quartz grains and not their CPO, (b) magnetic fabric of positive susceptibility samples is defined by the orientation of para/ferromagnetic phases in them and not the quartz SPO.

Keywords: Anisotropy of Magnetic Susceptibility; Shape Preferred Orientation; Crystallographic Preferred Orientation; Quartzite; Strain; Rengali