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Evaluation of anisotropy in physical/mechanical properties of metabasalts from Gadag (Southern India) – implications for vein emplacement and gold mineralization

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Foliated rocks have anisotropic physical and mechanical properties. In the case of foliated metamorphic and bedded sedimentary rocks, it is easy to decipher this anisotropy. However, this is not readily possible in the case of massive rocks. Vishnu et al. (2010) used Anisotropy of Magnetic Susceptibility (AMS) analysis to identify magnetic fabric in massive quartzites and established that the rocks have a lower strength parallel to the magnetic foliation, than perpendicular to it. In the present study, the authors have extrapolated the same concept to the metabasalts of Gadag region (West Dharwar Craton, Southern India), which is replete with quartz veins that are gold bearing. These metabasalts are massive and are devoid of visible foliation. Mondal and Mamtani (2013, 2014) did AMS analysis of the metabasalts and showed that the magnetic foliation is NW-SE striking, and the quartz veins also have similar strike. It was inferred by the above authors that the magnetic foliation developed during D1/D2 deformation (regional NE-SW compression) and the veins emplaced during D3 (NW-SE compression). This implies (a) dilation of pre-existing anisotropic elements during D3 and (b) rock strength anisotropy must have been important in controlling this dilation. To test this oriented blocks (each approximately 50 $\times$ 40 $\times$ 25 cm in size) of metabasalts were collected. A portion of the sample was used for AMS analysis. Subsequently, the magnetic foliation identified from AMS analysis was marked on the remaining sample block, and NX size (Diameter = 54.7 cm) cylindrical cores were drilled parallel and perpendicular to the magnetic foliation for various rock physical/mechanical tests - uniaxial compressive strength (UCS), point load test (PLT), P-wave velocity and Brazilian tensile strength. Results so far indicate that average point load index parallel and perpendicular to the foliation is 8.47 MPa, and 9.93 MPa, respectively, while UCS is 172.77 kN and 212.95 kN, respectively. This anisotropy of strength is a proof of the difference in physical property of the metabasalts with respect to magnetic foliation. This is also manifested in the result of P-wave velocity measurements, which is lower perpendicular ($\sim$5000 m/s) to foliation than parallel ($\sim$5700 m/s) to it. These results imply that the foliation developed during D1/D2 regional deformation dilated during D3 and resulted in emplacement of quartz veins, some of which are gold bearing.

References:

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