Detailed application of the microboudin palaeopiezometer: estimation of principal deviatoric stresses imposed on a metachert from the Warrawoona greenstone belt in East Pilbara Terrane, Western Australia

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The microboudinage structure of columnar mineral grain is used a passive marker for the palaeostress analysis of rock. In this presentation, we report a detailed application of the microboudin palaeopiezometer through the palaeostress analysis of an individual metachert specimen from the Warrawoona greenstone belt in East Pilbara Terrane, Western Australia. The metachert includes the microboudinaged tourmaline grains. We separately applied the microboudin palaeopiezometer to 3621 tourmaline grains divided into every 10˚ of their long axes on the foliation surface. The palaeostress analysis revealed that the far-field differential stress σ_0 is obtained the group of mineral lineation ±15˚ and perpendicular to the mineral lineation ±15˚ as 10.2 MPa and 5.3 MPa, respectively. Also, the values of σ_0 varied corresponding to the orientation of the tourmaline grains; relatively large value of σ_0 obtained from tourmaline grains oriented around the mean orientation defined as the mineral lineation, whereas relatively small value of σ_0 obtained from tourmaline grains oriented around perpendicular to the mineral lineation. Given that σ_1 - σ_3 and σ_1 - σ_2 are as 10.2 MPa and 5.3 MPa, respectively, magnitude of principal deviatoric stresses (σ'_1, σ'_2 and σ'_3) are obtained as σ'_1 = 5.3 MPa, σ'_2 = -0.1 MPa and σ'_3 = -5.1 MPa. In this stress state, the stress ratio $\phi = (\sigma_2 - \sigma_3)/(\sigma_1 - \sigma_3)$ is 0.48 that indicates typical triaxial compression. As the microboudinage is considered to have occurred immediately before the rock encountered the brittle-plastic transition during the plastic deformation, these values correspond to conditions at approximately 10–15 km depth and 300˚C within an Archaean greenstone belt.

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