Deformation timing and strain in Neoproterozoic strata, Jebel Akhdar, northern Oman

Christopher Bailey and Claire Rae
William & Mary, Geology, Williamsburg, United States of America (cmbail@wm.edu)

Neoproterozoic rocks exposed in the Jebel Akhdar massif of northern Oman preserve glaciogenic deposits associated with multiple Cryogenian glaciations. Although the depositional history of these rocks is well understood, the significance of post-depositional deformation is poorly constrained. In this study, we examine low-grade metasedimentary rocks exposed in the Ghubrah Bowl, an erosional window in the Jebel Akhdar massif, in order to quantify the 3D finite strain, understand deformation kinematics, and determine the timing of deformation/metamorphism.

In the Jebel Akhdar massif, the older Ghubrah (Sturtian glaciation) and younger Fiq (Marinoan glaciation) formations comprise a >1 km thick sequence of diamictite interbedded with sandstone, siltstone, conglomerate, volcanic rock, and minor carbonate. Diamictites contain abundant clasts of siltstone and sandstone, with lesser amounts of granite and metavolcanic rock in a fine-grained quartz + sericite ± chlorite matrix. Clasts range from granules to boulders. Harder clasts tend to be subangular and poorly aligned with low aspect ratios, whereas fine-grained rock clasts are well-aligned with large aspect ratios. Bedding generally dips to the NW, but is gently folded in accord with the overall structure of the Jebel Akhdar massif. A penetrative foliation strikes E-W and dips to the S. At some locations, a prominent elongation lineation/pencil structure occurs and plunges gently to moderately to the S.

R/phi strain analysis in the diamictites reveals a range of 3D strain geometries (apparent flattening to apparent constriction) with strain ratios up to 2.8 in XZ sections. Strain is strongly partitioned, as clasts of igneous rock have low aspect ratios and are only weakly aligned. Penetrative strain in clast-supported sandstones is negligible (XZ ratios of <1.2). Outsized clasts of granite and sandstone are mantled by distinctive symmetric pressure shadows (double-duckbill structures) that include more recrystallized minerals than elsewhere in the diamictite. $^{40}$Ar/$^{39}$Ar geochronology of sericite in pressure shadows yields ages as young as 90 Ma, which are interpreted as mixed ages containing an older detrital component and a younger fraction formed during growth. Deformation is associated with southward emplacement and loading by the Oman ophiolite & Hawasina Group sediments over the autochthonous sequence in the late Cretaceous.