Compaction History of Upper Cretaceous Shale and Its Relationship to Plate Margin Tectonics (Northeastern Oman)

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ABSTRACT

The study area is located at the Sunub Basin near Ansab, NW of the Saih Hatat Dome (SHD). This is the region's first shale compaction study. Our study is based on field work, XRF analyses of clay minerals and quantification of the amount of shortening of initially vertical calcite veins which have been shortened/folded by compaction. The folds are ptygmatic with (sub)horizontal axial fold planes. Shale of the Upper Cret. Al-Khod Fm. intruded younger conglomerates of the same formation. Nontronite is the shale's main clay mineral. It most likely derived from a source area of mafic to ultramafic rocks. Intrusion followed preexisting faults that had been widened by extension. The fissility of the shale structures mimics the contact contours of the conglomeratic host rocks. Sandstone clasts are "floating" in the shale. Vein shortening amounts to ~40%, showing that shale intrusion ensued with high water content, and that after vein formation an estimated amount of 35 to 45% of water content was expelled by later compaction. Countless calcite veins in the conglomerate at the shale contact point to fluid expulsion from the shale bodies into the conglomerate. Shale intrusion postdates the late Cret. ophiolite obduction, predates the deposition of Tertiary limestone and most likely occurred during the uppermost Cret. for which doming of the SHD was due to deformation, slab breakoff, possibly associated with gravitational collapse and isostatic/elastic rebound. At first, intrusion ensued at a limited overburden (100-200 m) by the upper part of the Al-Khod Fm., causing limited water loss of the shale. During the uppermost Cret.-late Paleocene stratigraphic hiatus which may be attributed to isostatic rebound, the shale retained much of its water as some of the overburden was reduced by erosion. Folding of the veins and the significant water loss was caused by compaction of the 1000-m-thick overburden of Eocene to Oligocene shallow marine limestones that accumulated during stable conditions during slow subsidence.