Evidence of post-obductional, brittle and transtensional deformation: the lineamentary Issmaiya Fault Zone – insights from kinematic analyses and remote sensing data interpretation (Semail Ophiolite near Ibra, Oman Mts., Sultanate of Oman)

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The main Meso-Cenozoic tectonic event that affected northern Oman was the obduction of allochthonous Hawasina Basin-derived sedimentary and volcanic rocks as well as the Semail Ophiolite during the Late Cretaceous. The allochthonous units were thrust onto the passive Arabian margin and platform. Obduction was followed by immediate uplift (doming) of the Saih Hatat Dome in the Southeastern Oman Mountains. The present work relates to the postobductional tectonic development of the Semail Ophiolite in the Ibra region southwest of the Saih Hatat Dome. The main aim of this work is to develop a regional brittle deformation model using structural field data comparing with borehole wireline log structural data from the Oman Drilling Project (ODP) wells sites, drilled in the same area for the investigation of active serpentinization in the peridotite aquifers.

The study area of ~100 km² contains a brittle fault zone of ~3 km kilometers in width and ~30 km in length herein called the “Issmaiya Fault Zone (IFZ)”. Along the IFZ, a structural field analysis and eleven structural survey stations using the 1-D scanline method for the kinematics elements were realized. In particular, the structural stations were chosen close to the ODP wells sites location, in order to compare the field survey with the borehole logging data.

The IFZ is characterized by sub-vertical faults within the mantle part of the Semail Ophiolite which also partially affected latest Cretaceous to Paleocene/early Eocene sedimentary rocks. The latter are also mapped within a structural basin, 25 km NE of Ibra (the so called “Ibra Basin”). Our field work and satellite imagery interpretations demonstrate that most faults are within the Semail Ophiolite and few affecting the postobductional sedimentary rocks. This indicates that the ILS was mostly active immediately after the Late Cretaceous emplacement of the Semail Ophiolite.

The IFZ strikes NW and forms an acute angle of ~30° with the southwestern margin of the Saih Hatat Dome which strikes WNW-ESE. The LFZ is a transtensional fault zone as indicated by the
coexistence of sub-vertical fault planes, with mainly sinistral strike-slip kinematic indicators, and from medium to high angle fault planes with dip-slip movement. The IFZ seems to end towards the NW at the tectonic contact with the Mesozoic sedimentary rocks of the Arabian Plate (Hajar Supergroup). The southwestern margin of the Saih Hatat Dome is marked by a major sinistral transtensional fault (Wadi Mansah Fault Zone; Scharf et al., 2019). This shear zone was active during the Eocene to Miocene and postdates the IFZ.

This work provides key insights on the effect of the fault zone to the hydrogeology of the ODP multi-borehole site, in terms of anomalies in the hydrogeochemical log and intervals of high transmissivity.