Ductile-brittle shear zone in a listwaenite body, within the Frontal Range Fault of the Oman Mountains (Sultanate of Oman)

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Listwaenite (fully serpentinized and carbonatized/silicified ultramafic rock) is common within the Oman Mountains near Fanja. The Oman Mountains formed during the late Cretaceous obduction of the Semail Ophiolite. Eventually, major exhumation and associated extensional shearing formed the Saih Hatat Dome during the latest Cretaceous to Paleocene. This dome displays rocks of the Arabian platform, framed by the Hawasina Allochthonous and the Semail Ophiolite. Post-obductional rapid exhumation/cooling of the Saih Hatat Dome is reflected by a major extensional shear zone at the northern margin of the dome (Frontal Range Fault, FRF; Mattern and Scharf, 2018). Shearing along the FRF with a throw of few to several kilometers, occurred within two intervals. The major first event occurred during the latest Cretaceous to Paleocene while the minor second event lasted probably from the late Eocene to Oligocene (Mattern et al., 2019). Along and within the FRF, major tabular listwaenite bodies occur displaying a lateral extend from few meters to hundreds of meters and a thickness of up to a few to tens of meters. According to Scharf et al. (2020), the listwaenite dates as latest Cretaceous to Paleocene.

Most of the numerous SiO₂-rich listwaenite bodies near Fanja preserve a brittle deformation pattern, indicating that the temperature during and after formation was less than 250°C. As an exception, we found one unusually well-developed, intensely foliated and wide strike-slip ductile-brittle shear zone at the surface, exhibiting a width of 5m and a length of a few tens of meters within a large listwaenite body near the community of Sunub. The foliation of the shear zone dips to the SW with about 50-80°. The shear zone intersects at a high angle with the FRF (strike SW-NE) and the listwaenite unit it contains. The shear movement is unrelated to that of the FRF. Approximately 6km WNW of the sheared listwaenite, a mafic dike of Lutetian age (42.7±0.5Ma; Mattern et al., 2019) intruded Cenozoic limestone. Intrusion is associated with the second shearing interval of the FRF. Because listwaenite bodies usually display brittle deformation, we tentatively conclude that the ductile-brittle shear zone formed during the late Eocene because of mafic intrusions. We assume that another mafic body is located near the shear zone and provided the heat for the ductile-brittle deformation conditions.

References:

Mattern, F., Sudo, M., Callegari, I., Pracejus, B., Bauer, W., Scharf, A., 2019. Late Lutetian \(^{40}\)Ar/\(^{39}\)Ar Age Dating of a Mafic Intrusion into the Jafnayn Formation and its Tectonic Implications (Muscat, Oman). AAPG Event, 2nd Edition, Structural styles of the Middle East, 9th-11th December 2019, Muscat, Oman.