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

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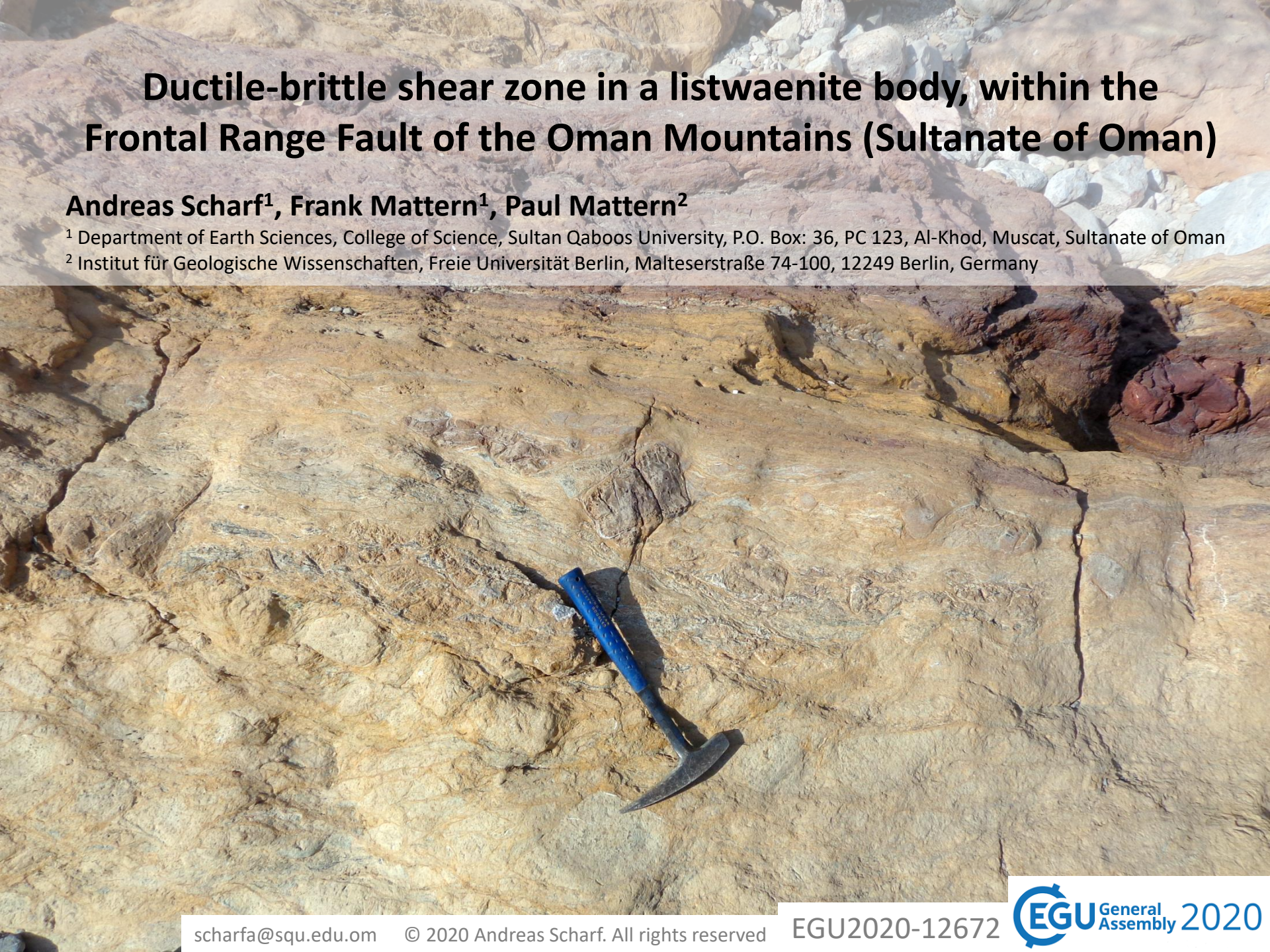

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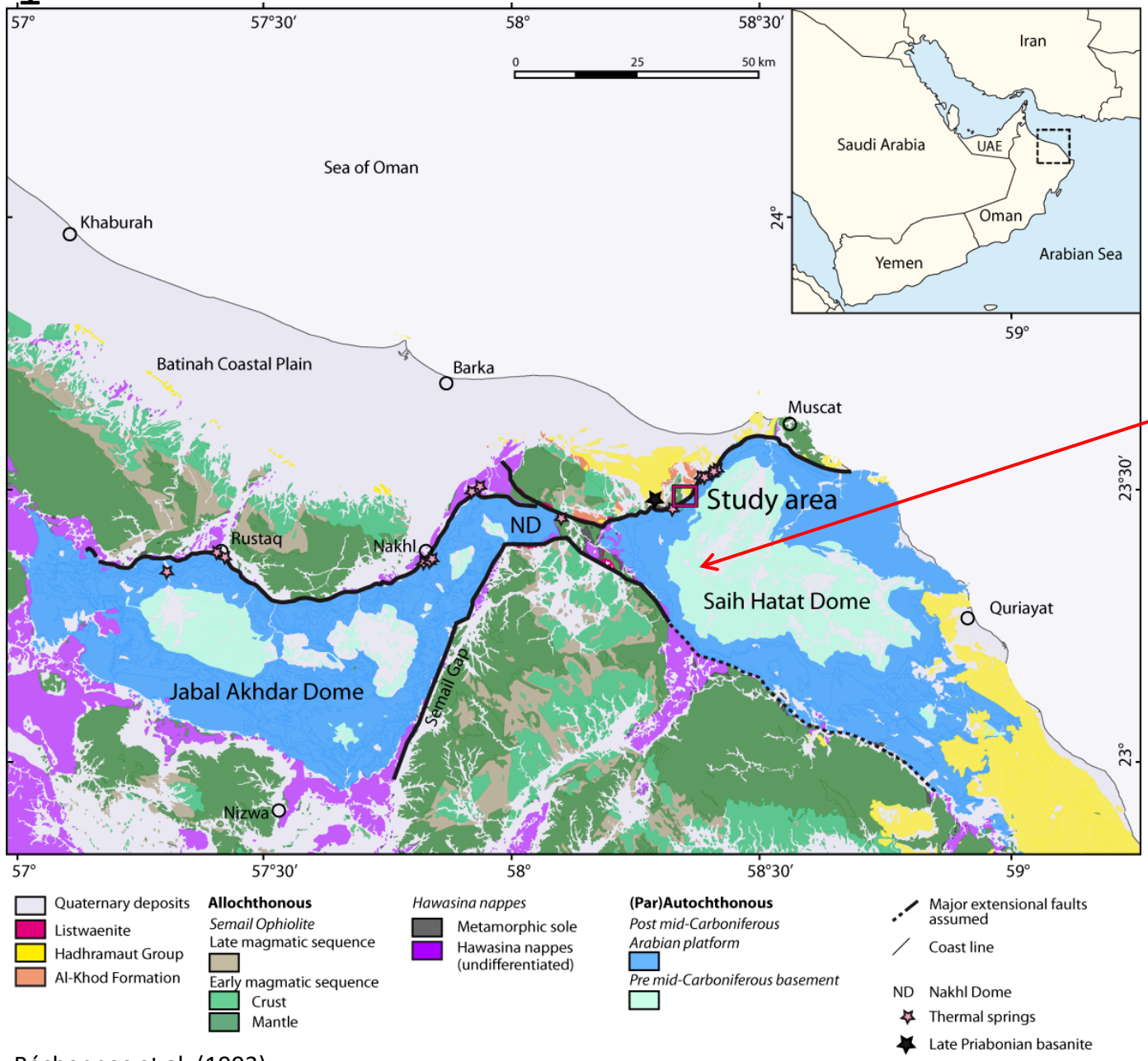

Quaternary deposits
Listwaenite
Hadhramaut Group
Al-Khod Formation

Allochthonous
Semail Ophiolite
Late magmatic sequence
Early magmatic sequence
Crust
Mantle

Hawasina nappes
Metamorphic sole
Hawasina nappes (undifferentiated)

(Par)Autochthonous
Post mid-Carboniferous Arabian platform
Pre mid-Carboniferous basement

Major extensional faults assumed
Coast line

ND Nakhl Dome
Thermal springs
Late Priabonian basanite

Béchennec et al. (1993)

Study area

The study area is very near the Frontal Range Fault (FRF), a major extensional shear zone at the northern margin of the Saih Hatat Dome

Age of the FRF:
Phase I: Latest Cretaceous to Paleocene/Eocene boundary (major phase)

Phase II: Late Eocene to Miocene (minor phase)

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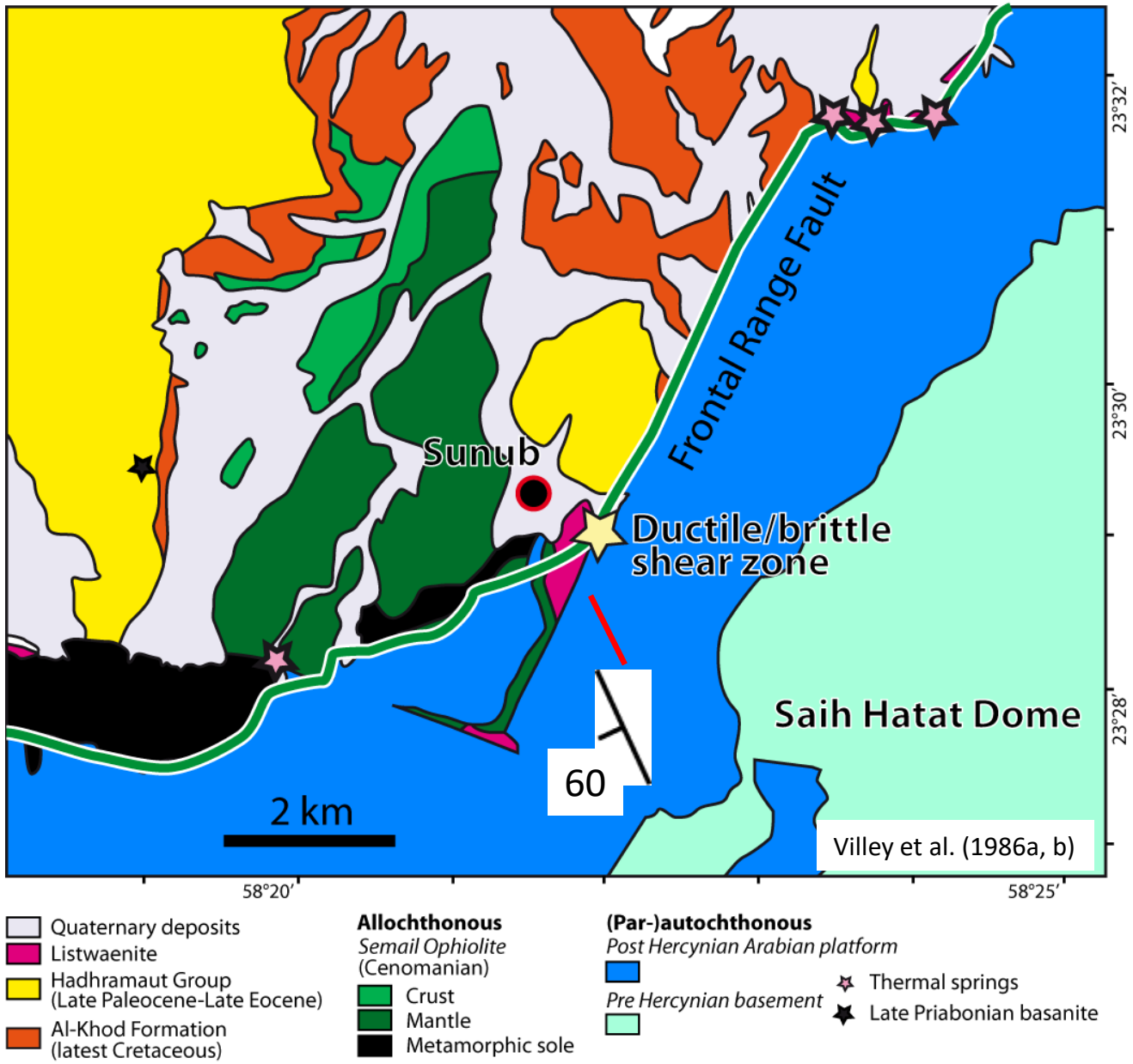

Study area

The Study area is located at a bend of the FRF from WSW-ENE orientation in the west to NNE-SSW orientation in the east.

The shear zone is at the base of a listwaenite body.

Ductile and brittle shearing affected the shear zone, both within the listwaenite and serpentinite.

Orientation of the shear zone: 245/60
It is a strike-slip fault

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Listwaenite

Most of the numerous SiO_2-rich listwaenite bodies near Fanja display 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 ductile-brittle shear zone at the surface, exhibiting a width of 5m and a length of at least 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 different angels of about 50-80°.

Approximately 6km WNW of the sheared listwaenite, a mafic dike of Lutetian age (42.7±0.5Ma; Mattern et al., 2019) intruded Cenozoic limestone.

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.

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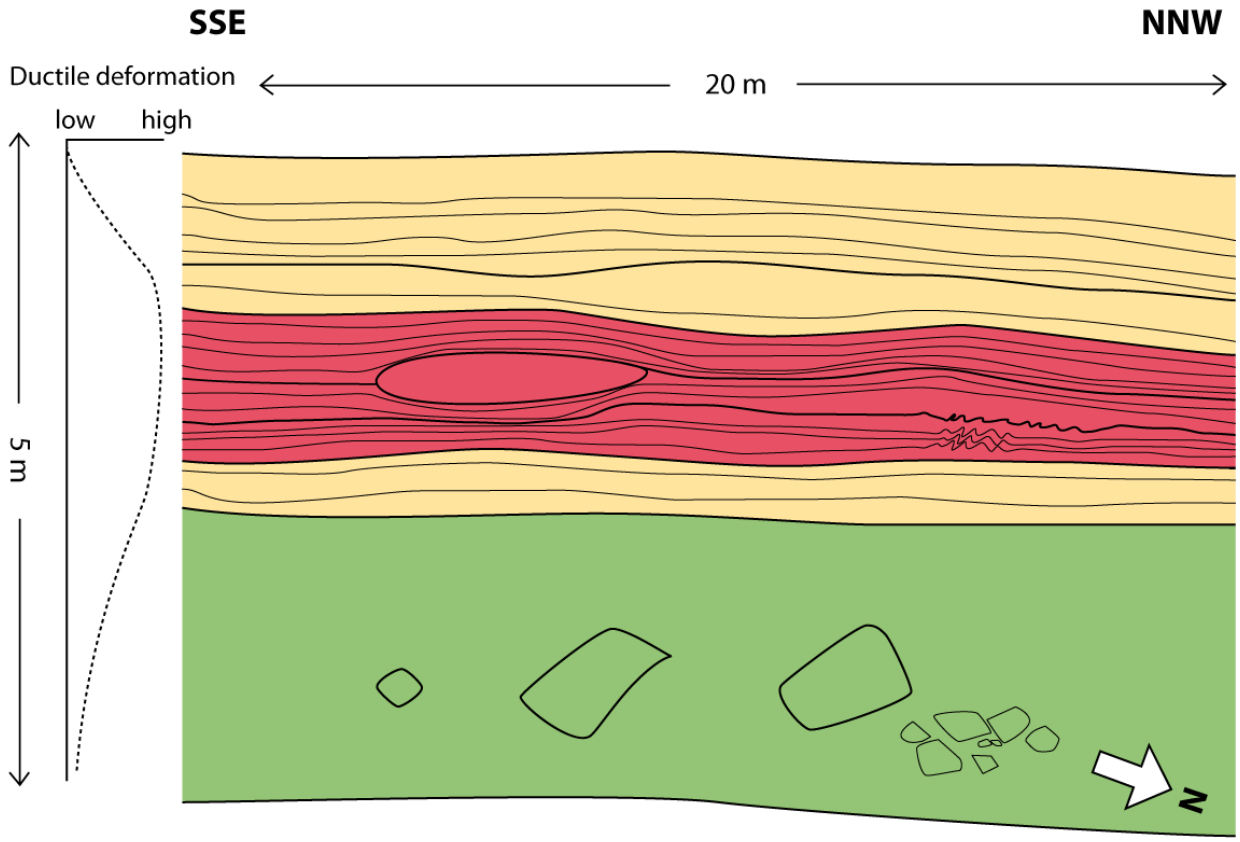
The shear zone

Schematic map view of the shear zone



Quartz-Listwaenite
- Non-sheared red quartz listwaenite

Sharp contact

Calcite-Listwaenite
- Multicolor layering (yellow, orange, red, green in places)
- Strongly-foliated calcite listwaenite
- Red layer consitent with boudins
- Small folds (no vergence)
- Yellowish layer

Gradual contact for 5 cm

Serpentinite
- Ductilely and brittlely sheared serpentinite
- Angular boudin-like structures (serpentinite)
- Cataclasites (serpentinite)
- Lower contact is not exposed (covered by wadi gravel)

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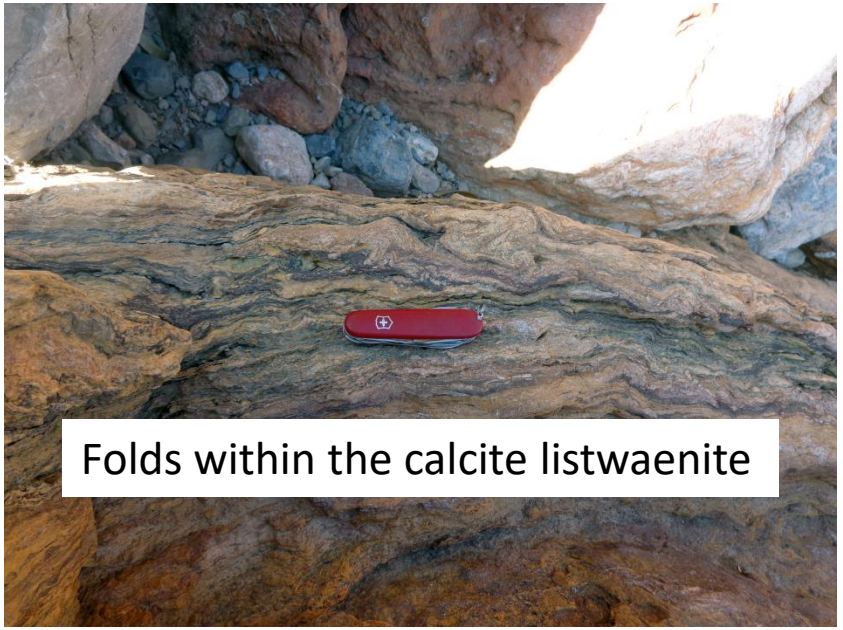
Ductile features in clacite-listwaenite

Boudin in calcite listwaenite



Folds within the calcite listwaenite

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Contact calcite-listwaenite/serpentinite

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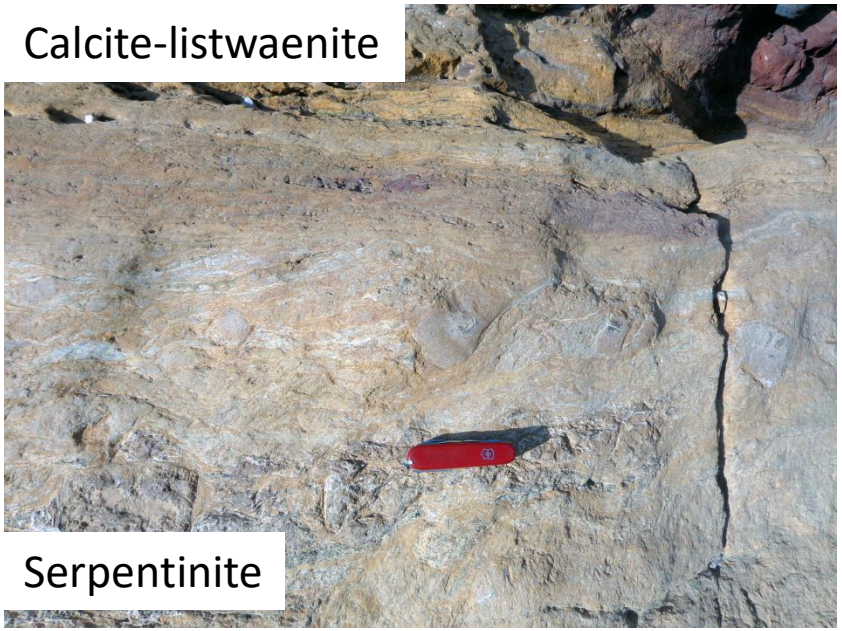
Calcite-listwaenite

Serpentinite

NNW

Calcite-listwaenite



Serpentinite

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Structures in the serpentinite

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Rotated serpentinite clasts

Cataclasite

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Future work

1. We will conduct thin section analysis to reveal the shear sense of the shear zone and the microstructures to obtain quartz/calcite deformation patters.

2. We will mineralogical and geochemically analyze the different parts of the shear zone in order to understand the color changes across the shear zone and their causes.

3. We will date the calcite listwaenite using the U-Pb technique to better constrain their tectonic implications.

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