Polished slickensides preserved in the Obir Caves (Austria) close to the Periadriatic Fault System

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INTRODUCTION

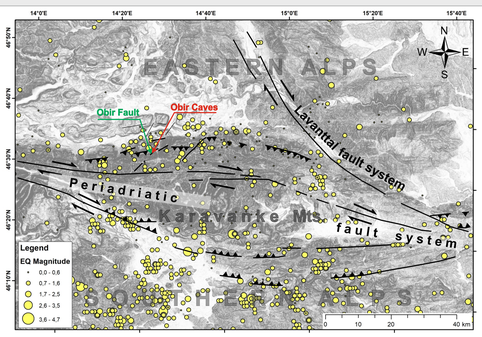
The seismogenic ESE-striking dextral Periadriatic Fault System is the border between the Eastern and the Southern Alps (Schönlaub & Schuster, 2015). The Obir Caves are located just to the north in the Hochobir massif, which is part of the Northern Karavanke mountains in the Austrian province of Carinthia. In the Wartburg chamber, a part of the Obir Caves, polished slickensides occur with distinct differences in size, lineation directions, roughness of the mirror-like surfaces and polishing grade.

This study investigates polished slickensides combining microstructural observation with field data from inside and outside the cave. A special emphasis is put on detailed microstructural description of the mirror-like fault surfaces using thin section analysis, high-resolution mosaics of photomicrographs, SEM and surface topography.

GEOLOGICAL AND TECTONIC SETTING

The Obir Caves are developed in Middle Triassic Wetterstein limestone and dolostone of the Hochobir massif (Poltnic & Herlec, 2012). Several cave chambers show evidence of seismic activity like broken speleothems and slickensides.

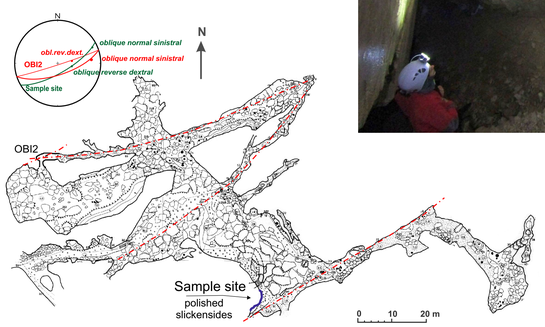
The sample site is situated next to the Obir Fault, which is a left lateral NE-SW striking strike-slip fault within the transpressional zone north of the fault core of the Periadriatic fault system (Baron et al., 2019a).



Above: Tectonic setting of the Eastern and Southern Alps transition with the Periadriatic fault system, modified after Baron (et al., 2019a). Yellow dots show earthquake epicentres between 2013 and 2016.

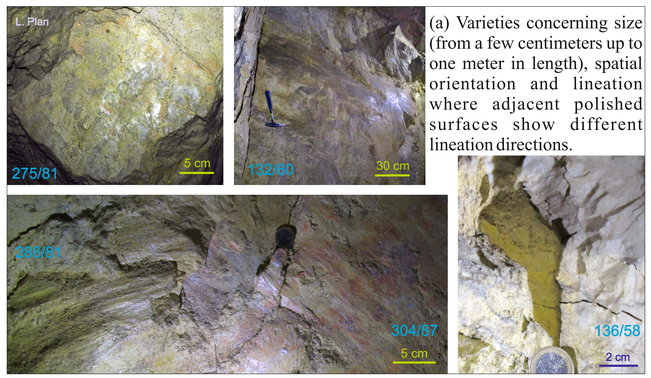
SAMPLE SITE

Right: Sample site in Wartburg chamber of the Obir Caves next to a major fault (140/74).
Photo: Harald Bauer.



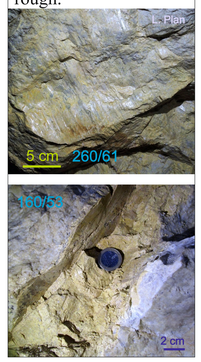
Left: Cave map modified after Baron et al., 2019b and Solar et al., 1970. Sample site in blue. Red dash-and-dot lines show the trace of normal faults.

DIFFERENCES OF THE POLISHED SURFACES

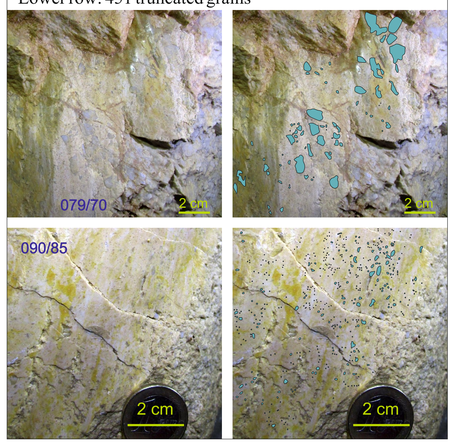


(a) Varieties concerning size (from a few centimeters up to one meter in length), spatial orientation and lineation where adjacent polished surfaces show different lineation directions.

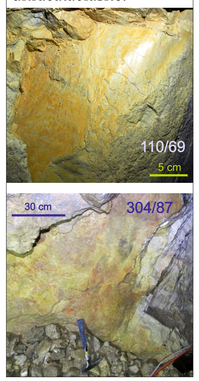
(b) A range of polishing from none to highly-reflective surfaces, which are even, bent, corrugated or rarely rough.



(c) Truncated grains differ in accumulation and size (up to a few millimeters).
Sizes from 0,25 mm up to 14 mm are coloured in the pictures.
Upper row: 75 truncated grains
Lower row: 451 truncated grains

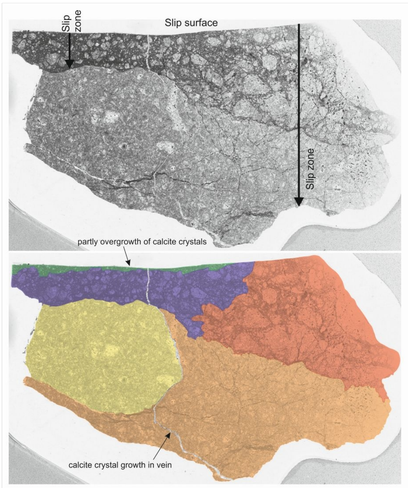


(d) Five different colours (from white to reddish-brown) of the ultracataclasite.



(e) Some fault surfaces exhibit speleothem overgrowth.
Red dashed line: thin section OB8

CATACLASTIC STAGES OF SAMPLE OB8

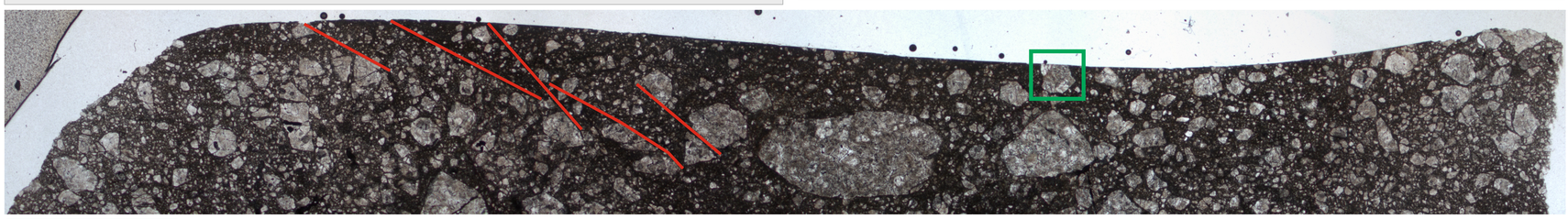


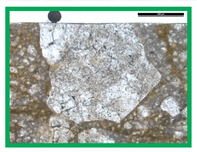
Various cataclastic stages are preserved in the thin section of sample OB8:
Besides the undeformed host rock four different stages (I-IV) of cataclastic deformation can be distinguished:
(0) undeformed host rock (yellow)
(I) Isolated fractures in the host rock with injected ultracataclastic material (orange)
(II) dilation cataclasites containing crackle breccia (red)
(III) ultracataclasite with angular-to-rounded host rock fragments and crackle breccia (blue)
(IV) ultracataclasite with isolated clasts and truncated grains close to the mirror surface (green).
Speleothem overgrowth on the slip surface and calcite crystal growth in the vein were left uncoloured.

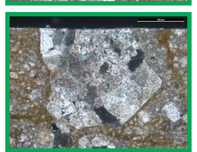
CONCLUSIONS

- During field work distinct differences of the polished fault surfaces have been observed in varying combinations.
- Microstructural analysis revealed knife-sharp principal slip surfaces and up to four different stages of cataclastic deformation developed as slip zones containing varying amounts of cataclasites and ultracataclasites.
- Microstructures including polished slickensides, injected cataclasites and truncated grains along principal slip surfaces as well as the geologic position close to the seismogenic Periadriatic Fault System suggest that the investigated fault surfaces in the Obir Caves formed during seismic slip.

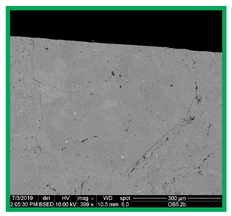
MICROSTRUCTURAL ANALYSIS OF SAMPLE OB5.2b







Above: Photo micrograph composed of 20 stiched pictures. The mirror-like fault surface shows up as a principal slip surface because of the knife-sharp localization in zones of ultracataclasites.
Truncated grains can also be found at secondary Riedel faults (marked in red).
Left: Truncated grain along the principal slip surface in PPL and XPL.
Right: the same grain in SEM.



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