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Microscopic observations of the fault rocks from Chegualin fault zone, southwest Taiwan

Presenter: Cheng-Jia Jhuang

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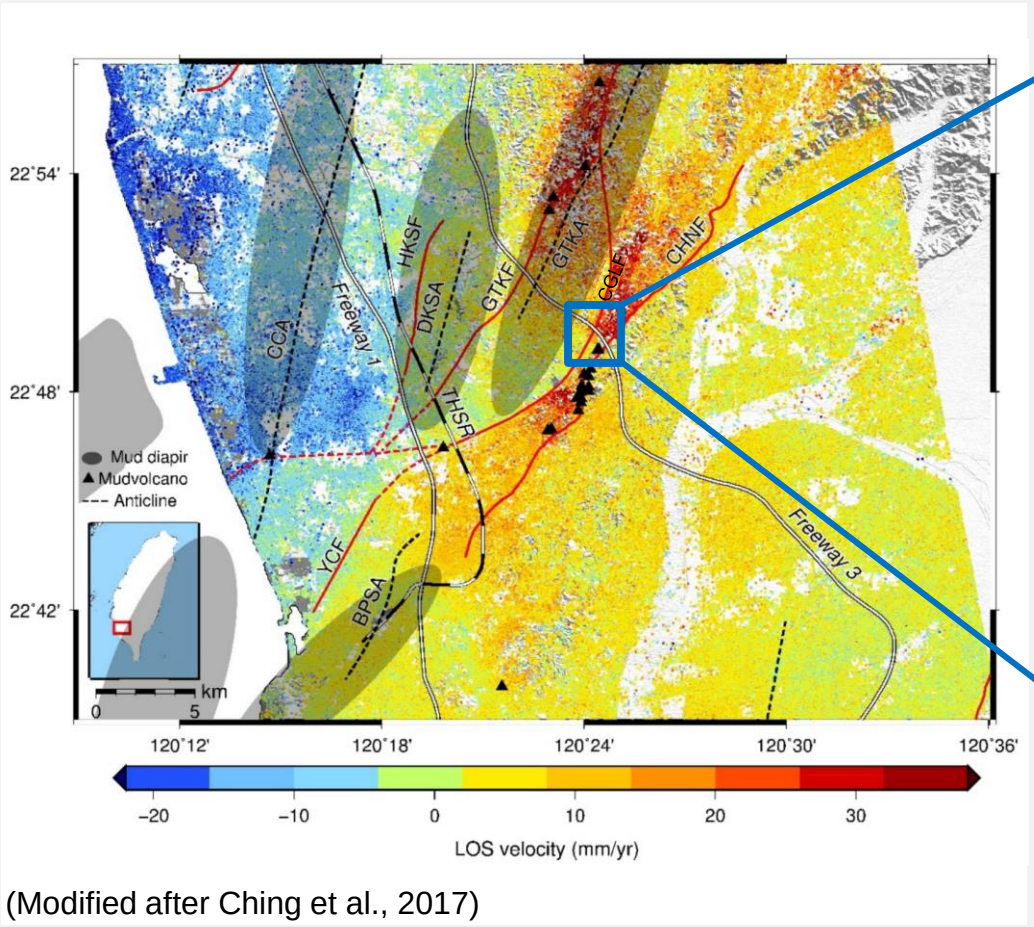
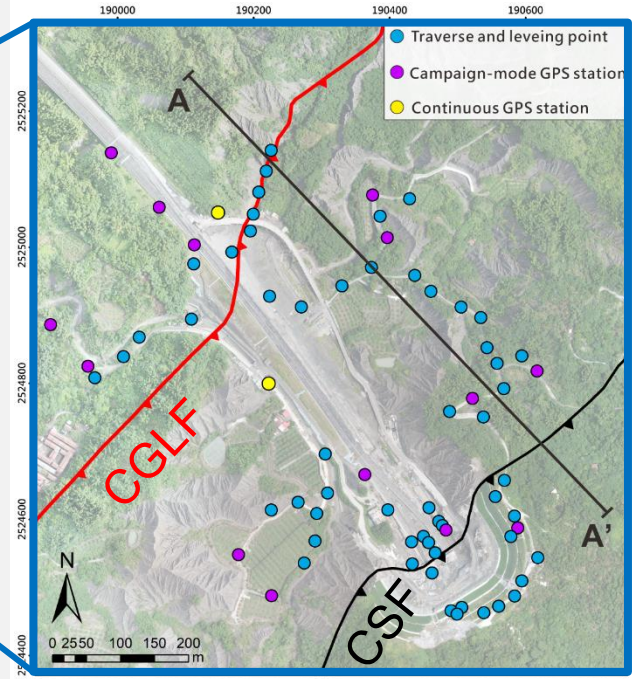
Introduction



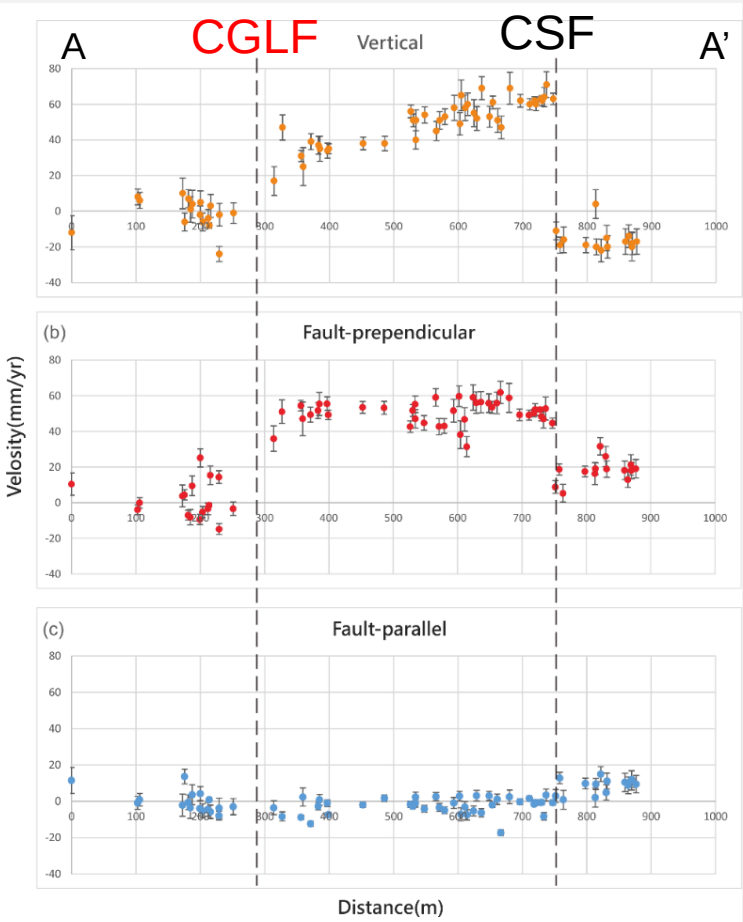
(Modified after Ching et al., 2017)



CGLF: Chegualin fault

CSF: Chishan fault

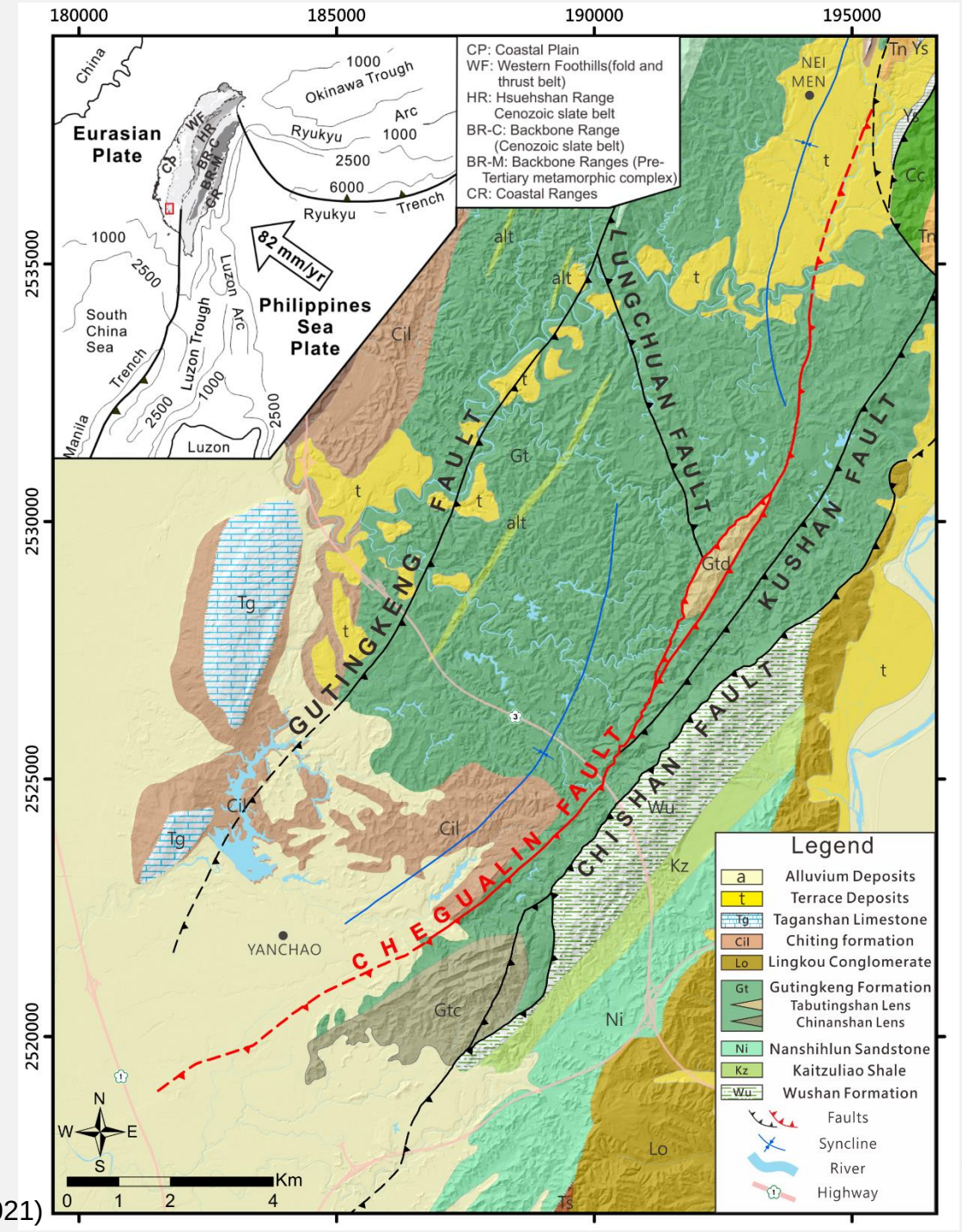
(Modified after Chun et al., 2014)



- Fault trace of Chegualin fault is consistent with the deformation boundary revealed by the InSAR, GPS, Leveling data.
- The recent movement of the fault is within 7500 years, based on the dating result of the samples from a CGS borehole.

Introduction

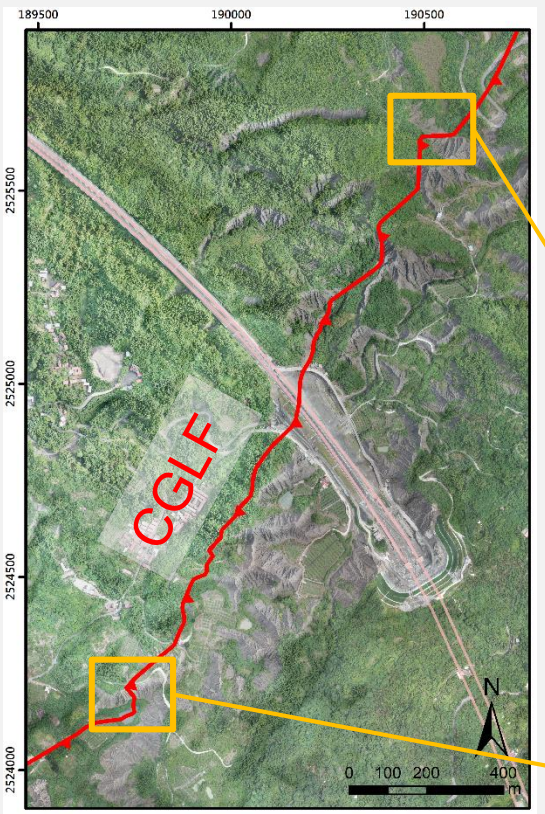
- Chegualin fault is a thrust fault with left lateral component, striking NE-SW and dipping 30º to the east.
- Most of the fault trace is located within the Gutingkeng Formation.
- Gutingkeng formation is mainly composed of massive mudstone

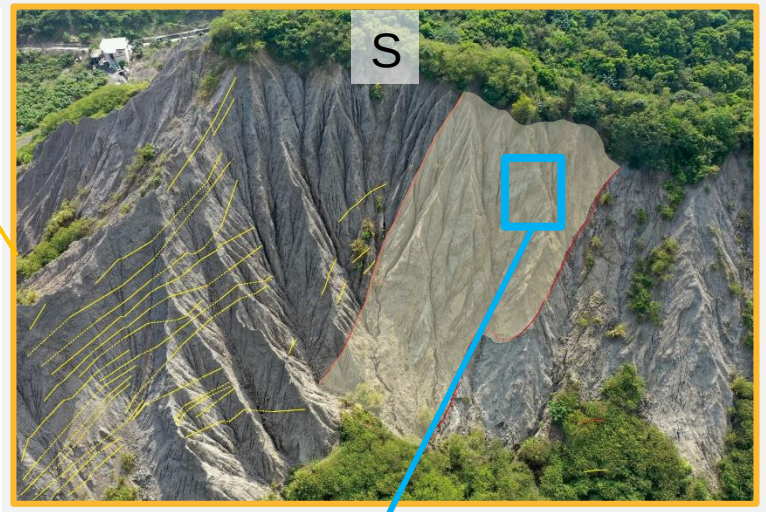


(Modify after CGS, 2013; Lin et al., 2021)

Introduction

- The fault zone of CGLF (Chegualin fault) is 10 to 30 meters wide and its appearance is characterized by yellowish color. (Chen, 2021)
- Yellow brown and black stripes within the fault zone was observed. (Chen, 2021)
- Microscopic and composition analysis of samples from Lungchuan fault reveal that the black band is the product of strain localization in the mudstone fault zone. (Huang, 2015)
- Amorphous materials was found within the argillaceous Chihshan fault and considered as an indicator for the on-going movement of the fault. (Wu et al., 2020)





(Modify after Chen et al., 2021)

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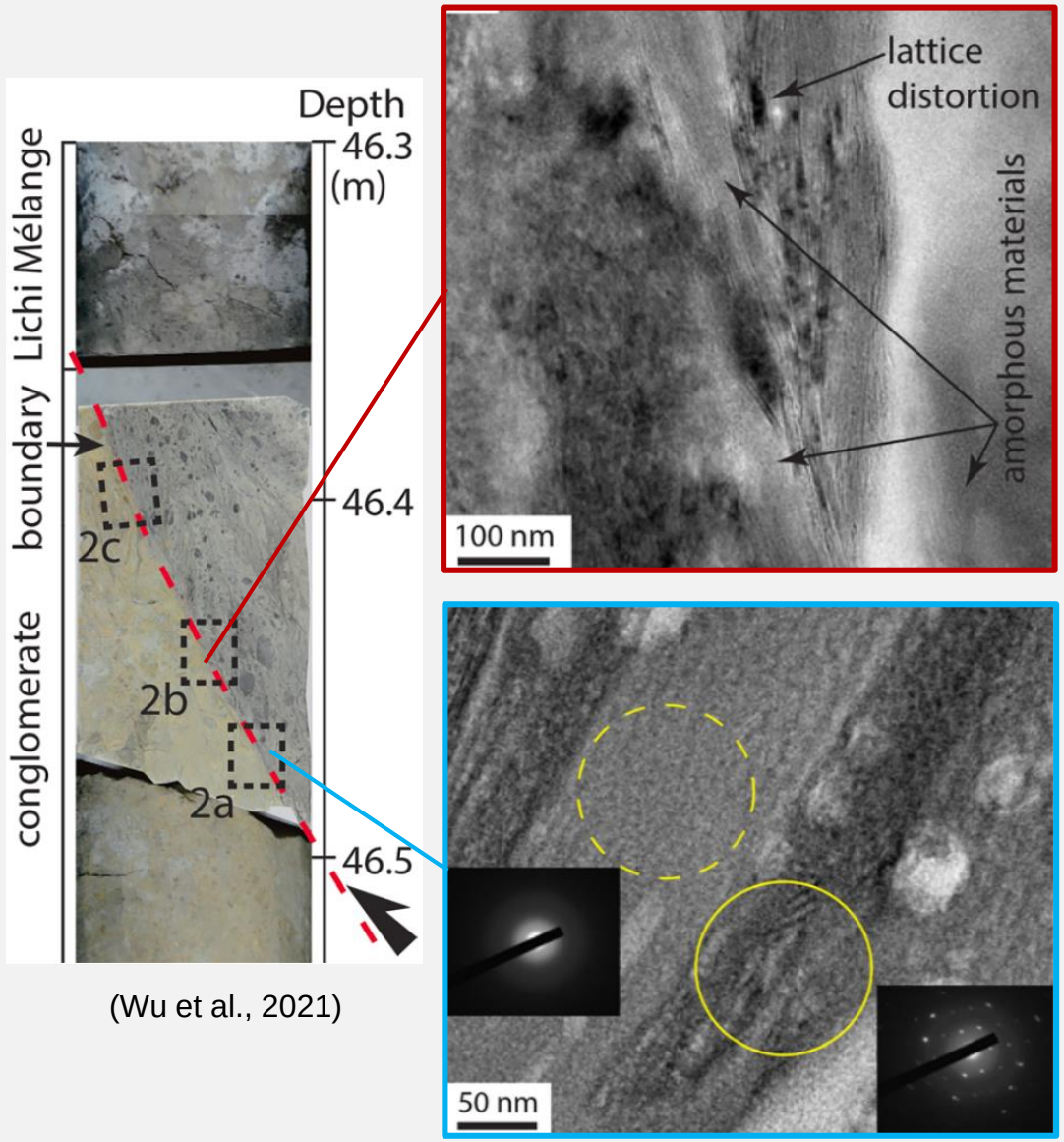
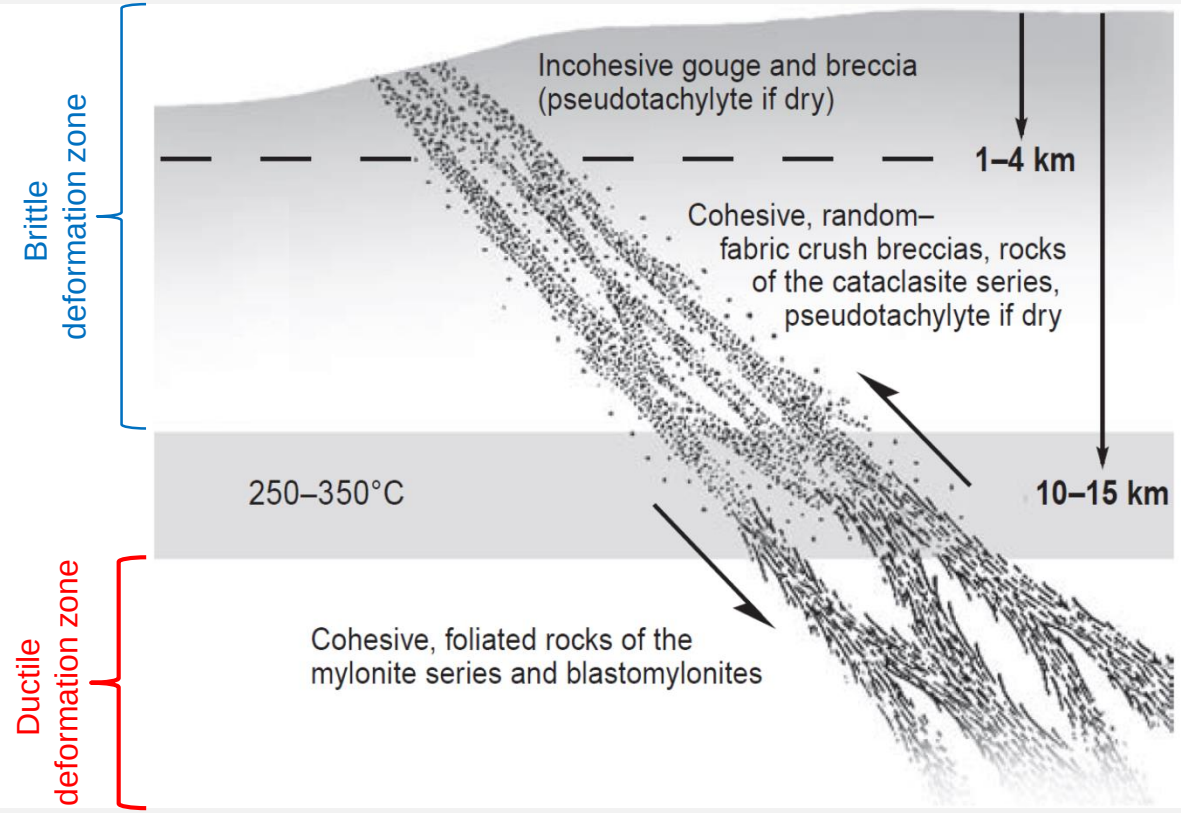


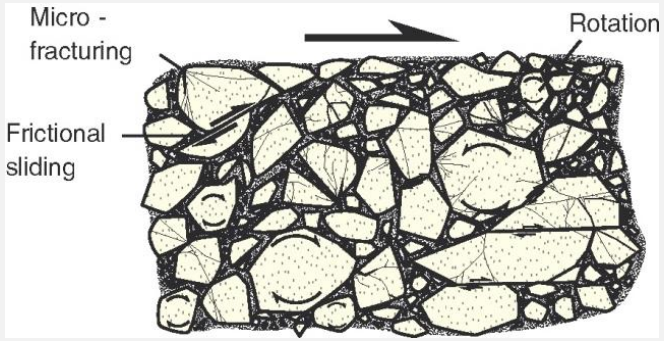
(Wu et al., 2021)

Research motivations

- Black bands were observed in the CGLF fault zone from mesoscopic scale observation but lacked the microscopic observations to determine their evolution and deformation mechanisms.
- Do amorphous materials exist in the black bands in that they are similar to fault gouge reveal by previous research?



(Modify after Davis et al., 2011)



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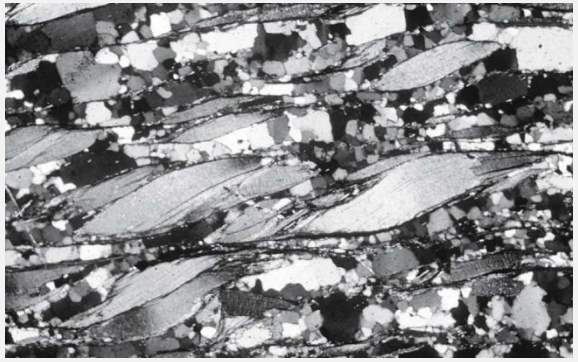
Rocks are deformed by fracturing and sliding associated with movement along the fault **at upper crust.**



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Rocks are deformed by intracrystalline deformation **in deeper crust.**

Research motivations

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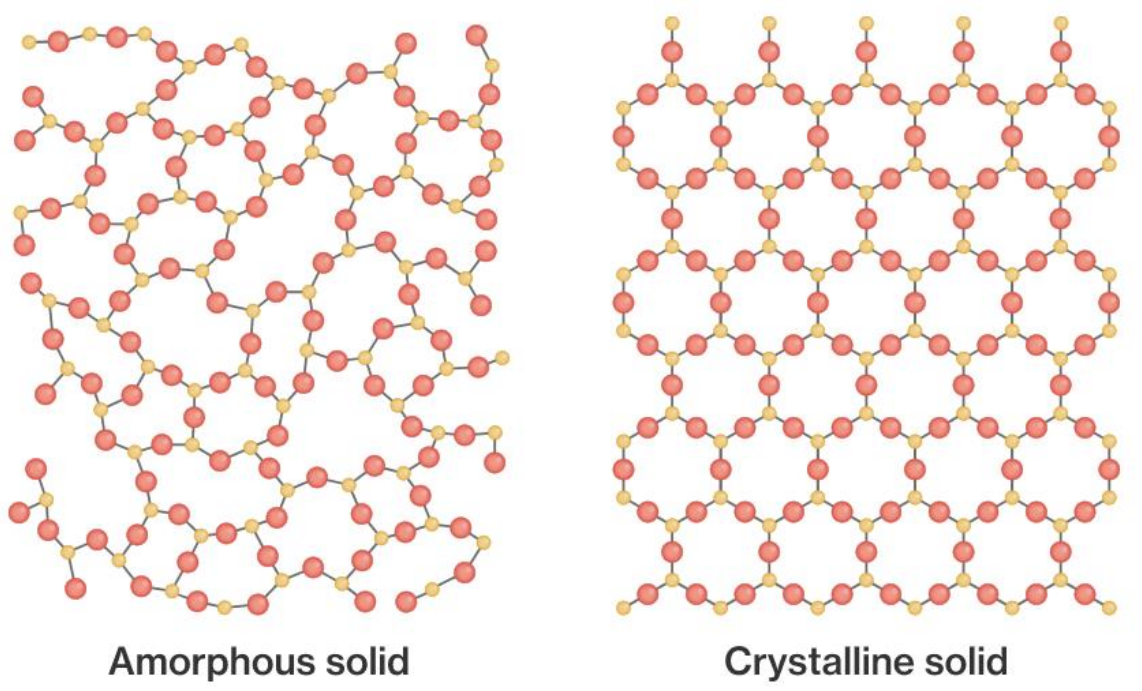
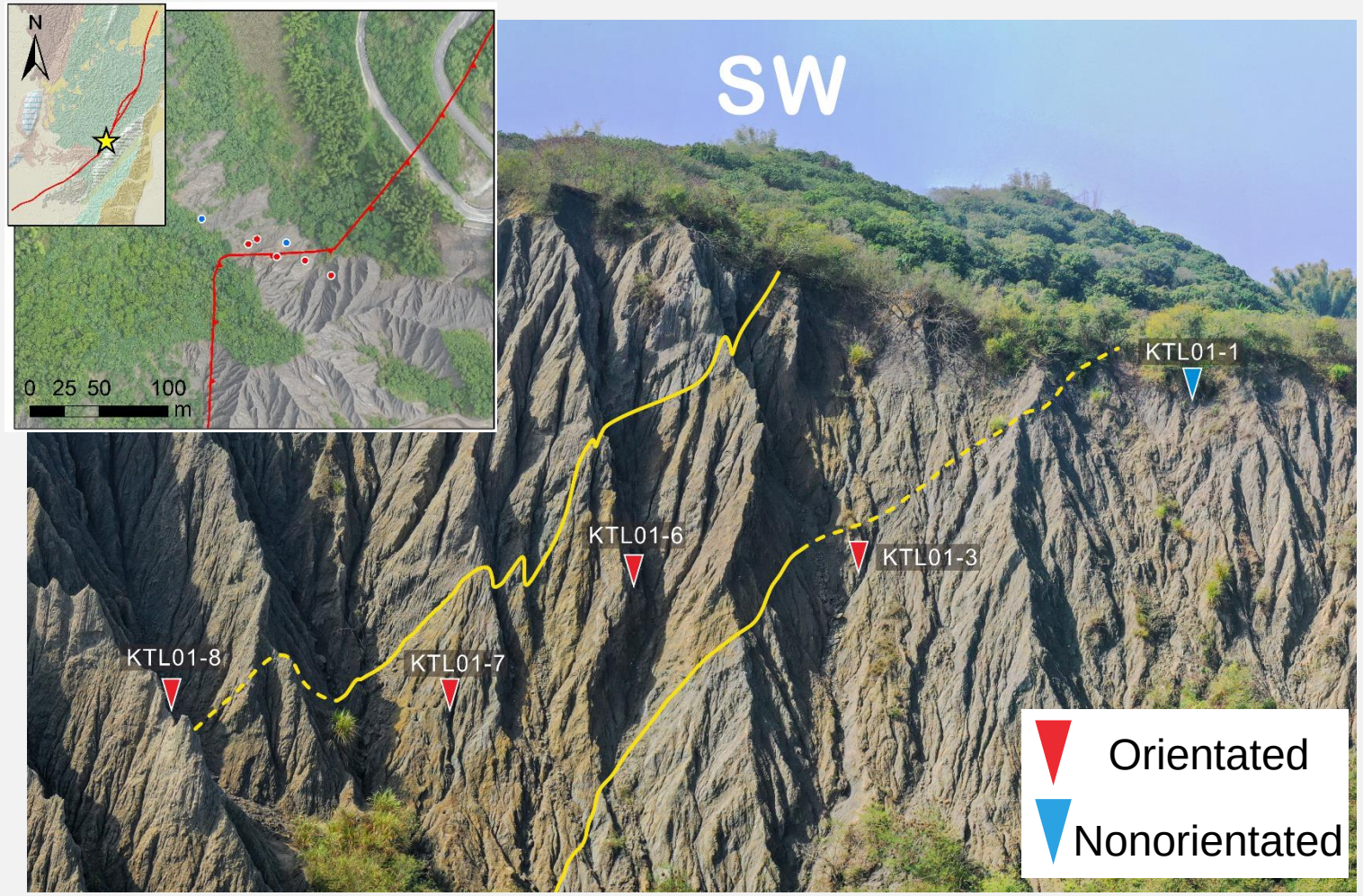


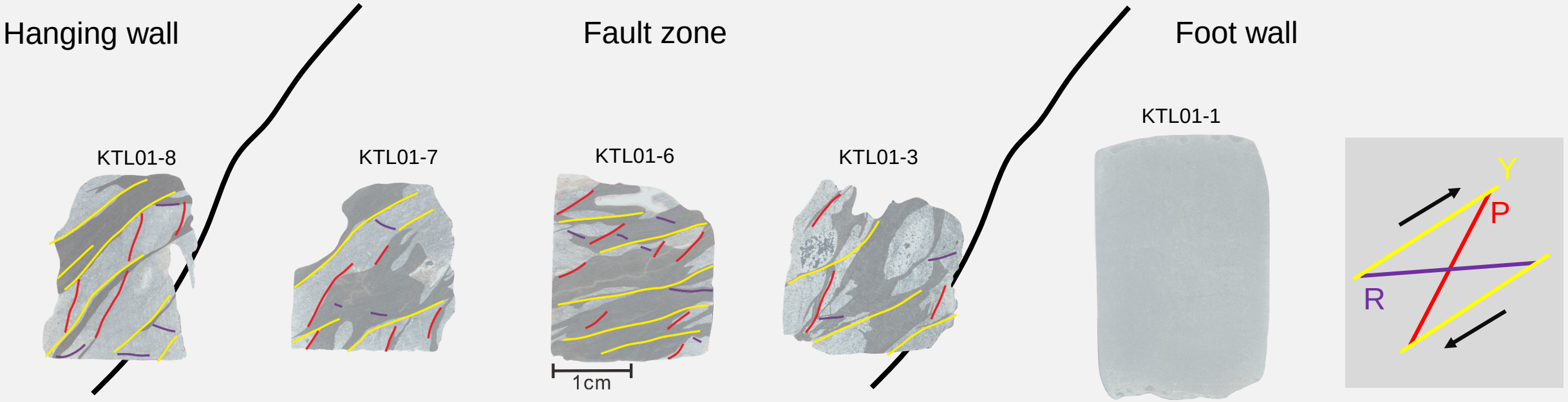
Amorphous materials are solids without crystalline structure that can be generated by frictional melting or comminution of clast. Amorphous materials are unstable in low-temperature environments therefore they are rarely exposed in natural faults.

Research method



- Five orientated and one nonorientated samples were collected from the fault zone and its footwall .
- Orientated samples were marked according to the attitude of the black band within and cut perpendicular with the strike to make petrographic thin sections.

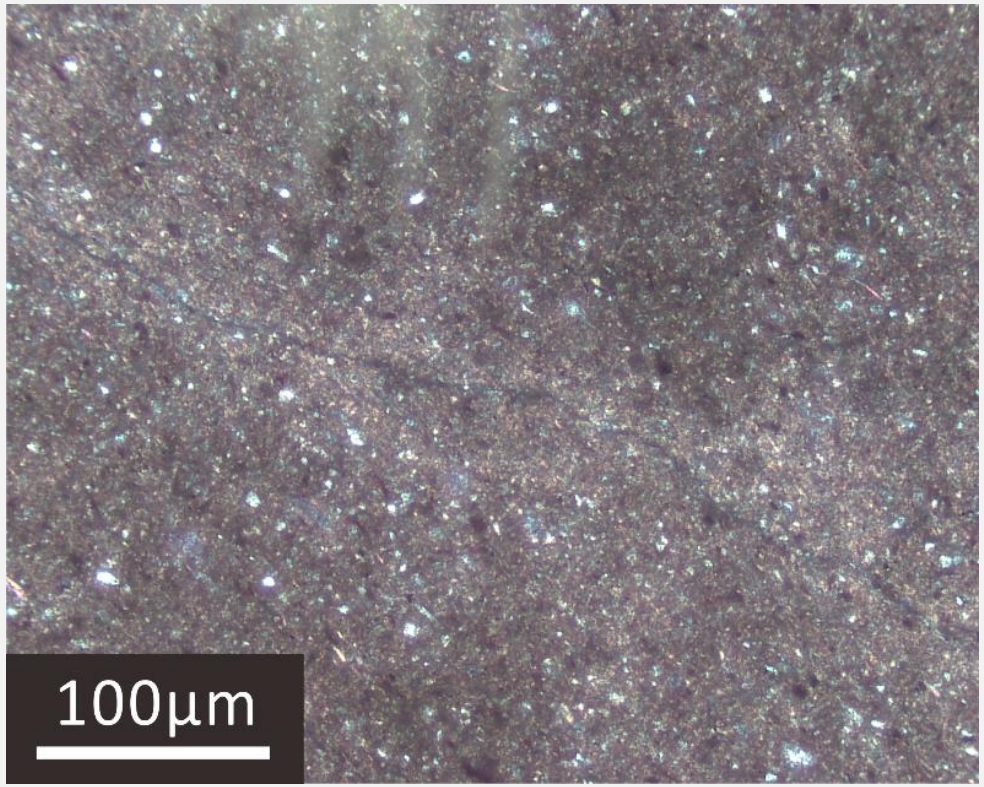
Primary result

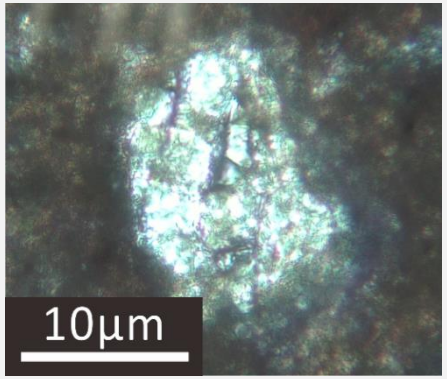


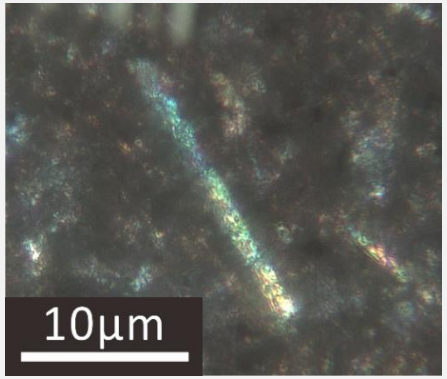
- The ratio of black bands on the thin sections may imply that the higher the strain is, the closer to the middle of the fault zone is.
- Riedel shear structure can be recognized and the shear direction, that is reverse, is consistent with the movement of Chegualin fault.

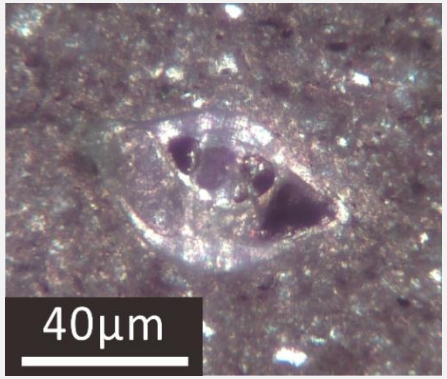
Optical microscope observations

Mudstone (KTL01-1)





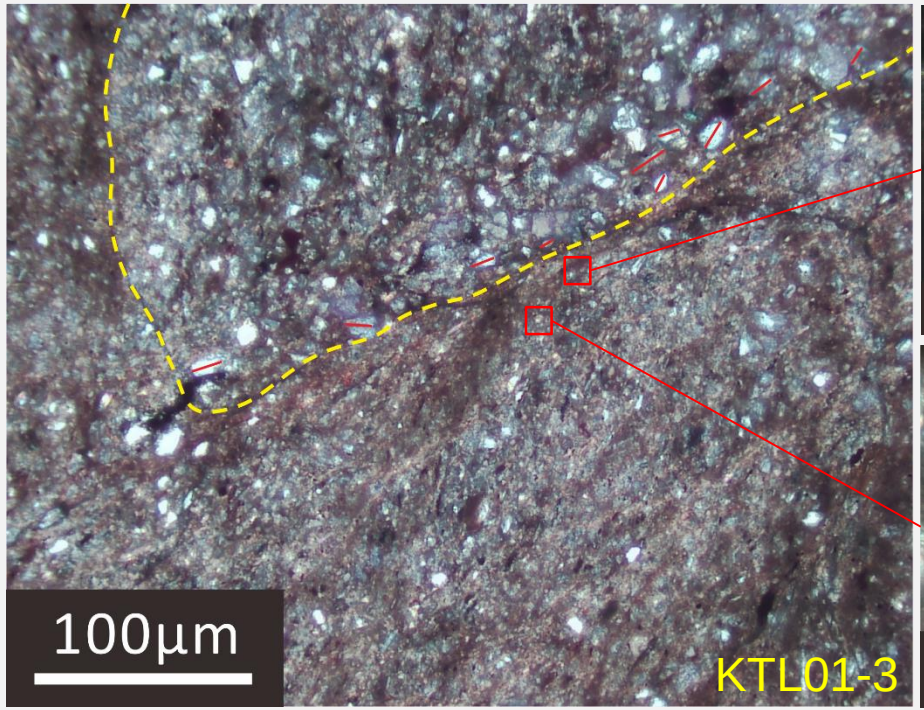


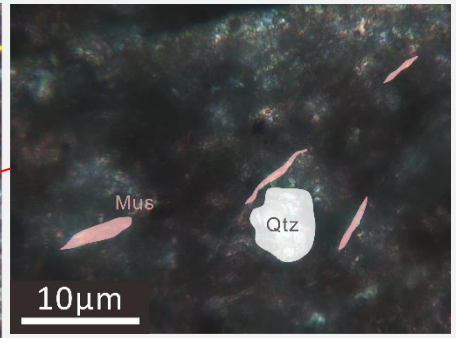


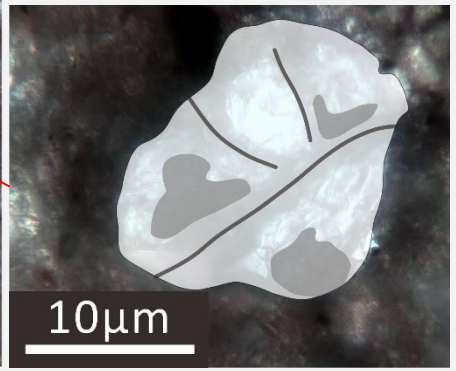
- Mudstone in the foot wall of the fault is mainly composed of clay matrix. Quartz grains and muscovite chips are distributed randomly in the clay matrix.
- Quartz grains with synchronous extinction and flat muscovite shows that the mudstone is not subject to strong deformation.
- Micro cracks can be observed casually.

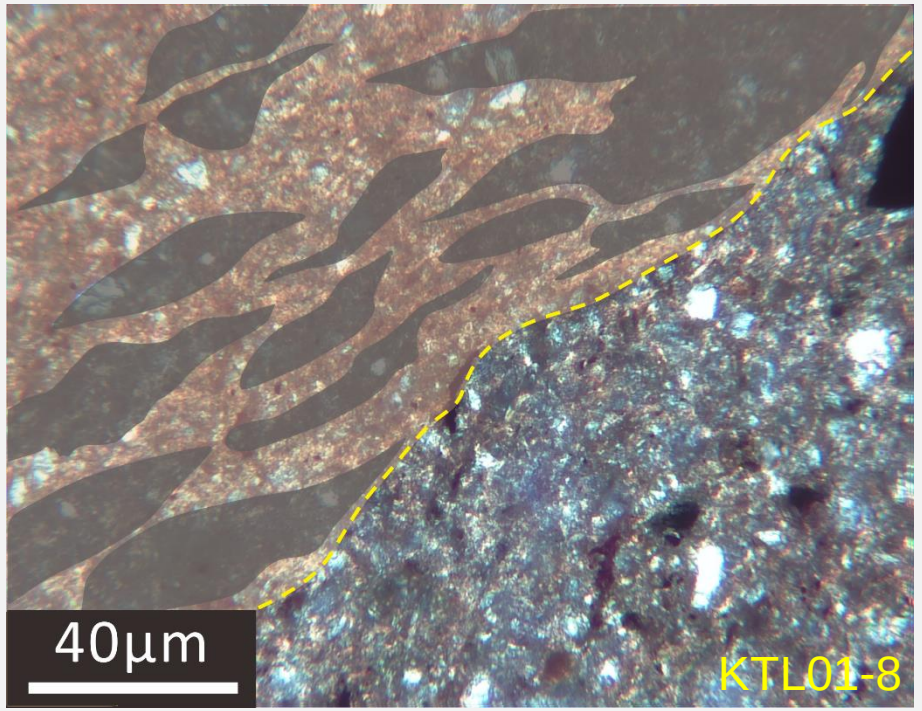
Optical microscope observations

Fault rocks close to the boundary of fault zone (KTL01-3 & KTL01-8)





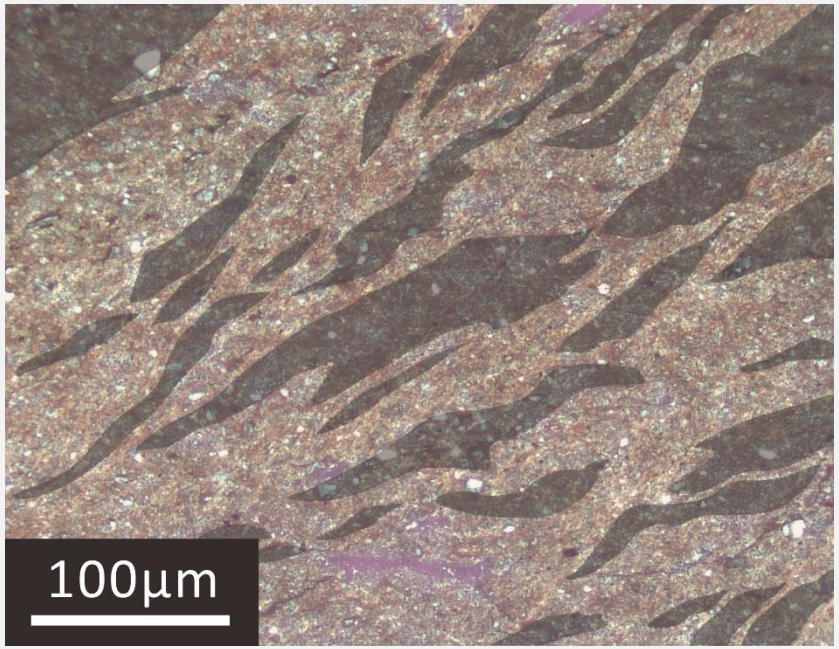


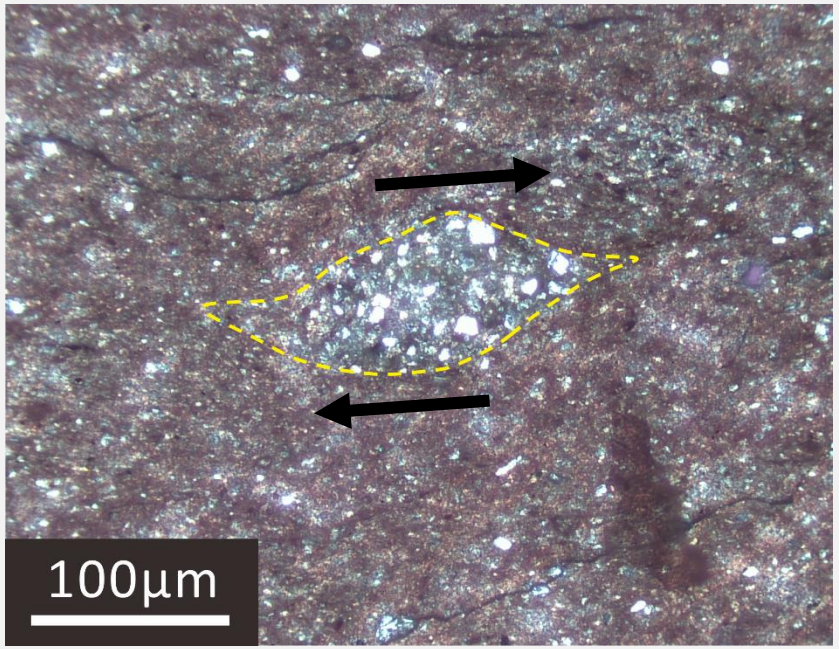


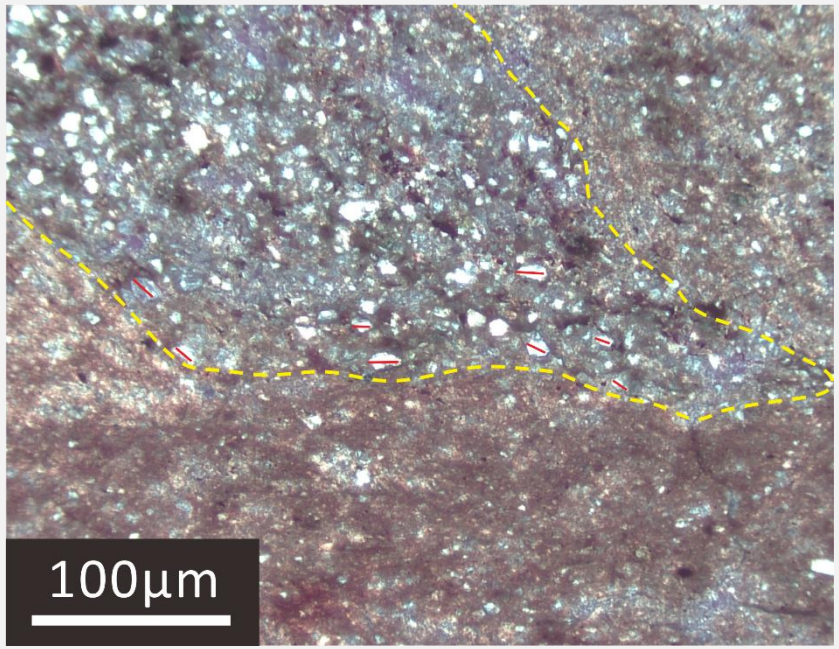
- The quartz grains in sand clast be deformed in preferred orientation along the contact with sand black bands.
- Quartz grains with undulatory extinction an bended muscovite chips can be observed commonly within the black bands.
- Scaly fabric and grain size reduction across the boundary between clay matrix and black shear band.

Optical microscope observations

Fault rocks in the middle of fault zone (KTL01-6)







- Fault rock from the middle of fault zone contains an abundance of microfracture and is generally characterized by scaly clay fabrics.
- Shear scene of the black band can be indicated by the sand-clast trail within.
- Preferred orientation of quartz grains at the boundary of sand clast implies that the grains rotated during the shearing.

Conclusions

- Mineral grains in the mudstone from the footwall of Chegualin fault are intact and randomly distributed, indicating that the area is not affected by the strain during fault slip.

- In the fault zone, black bands with scaly fabric are distributed along sand clast boundary and clay matrix. Grain size reduction can be observed between clay matrix and black bands. Mineral grains were cracked and rotated forming preferred orientation.

- The occurrence of the matrix and mineral grains under the optical microscope imply that the strain intensity is higher at the middle of the fault zone and the deformed mechanism is dominated by frictional sliding and comminution.

Future works

- Analyze the mineral assemblage of the fault rock samples by XRD to see the composition variation across the fault zone.

- Re-examine the rock core record and compare with the rock samples collected from outcrop and select samples for the Focused Ion Beam‑Transmission Electron Microscope to find out if the fault rock from the Chegualin fault contains amorphous materials.

Thank for listening !!