

## Potential Strukturgeologie und Tektonik Student Projects @ Uni-Mainz

### Master

Project Title: Pressure variations around fractures in the lower crust; Implications for mineralization and melting.

*Types of work:* EMPA and fluid inclusion analyses; thermobarometric calculations; rock mechanics calculations (see Moulas paper cited below); possible fieldwork

*Skills needed:* Petrology, moderately advanced mathematical skills, bravery to tackle a problem that isn't very clearly defined.

*Relevant literature:* Moulas, E., Burg, J.-P., Podladchikov, Y. 2014. Stress field associated with elliptical inclusions in a deforming matrix: Mathematical model and implications for tectonic overpressure in the lithosphere. *Tectonophysics* 631, 37-49, DIVE workshop report (<https://www.sci-dril.net/23/47/2017/>), TeMaS proposal (available from VT).

*Logistics:* You would need to join more fieldwork in Balmuccia in Aug/Sept/Oct 2020. This is a slightly risky project because we are not 100% sure the samples contain what we need. Co-supervised by Prof. Moulas.

Project Title: Change in grain boundary decoration with depth in Earth's crust

*Types of work:* Electron microscopy, particularly SEM and/or TEM, thin section analysis.

*Skills needed:* Ability to prepare samples carefully. Good descriptive abilities.

*Relevant literature:* <https://doi.org/10.1007/s004100050379>, <https://doi.org/10.1016/j.tecto.2019.228242>, Emmermann, R., Wohlenberg, J. (eds): The German Continental Deep Drilling Program (KTB) (site-selection studies in the Oberpfalz and Schwarzwald):1-4

*Logistics:* We will either request samples via ICDP from the KTB borehole. You could also potentially gather your own samples from the forthcoming COSC drilling project if you went and worked as a Science Team Member. However, you would have to help to find funding to participate in that project.

If started in 2020, SEM work would be done during a visit to ETH Zürich .

Project Title: Exploring fluid compositions and fluid-rock interactions in the Alpine Fault Zone from fluid inclusion analyses

*Types of work:* Fluid inclusion analysis by (micro)-Raman, electron microscopy

*Skills needed:* Careful sample preparation and analytical skills, understanding of phase equilibria, interest in microstructures.

*Relevant literature:* Toy, V.G., Craw, D., Cooper, A.F., Norris, R.J., 2010. Thermal regime in the central Alpine Fault zone, New Zealand: Constraints from microstructures, biotite chemistry, and fluid inclusion data. *Tectonophysics* 485, 178-192., Menzies, C.D., Teagle, D.A.H., Niedermann, S., Cox, S.C., Craw, D., Zimmer, M., Cooper, M.J. & Erzinger, J. (2016). [The fluid budget of a continental plate boundary fault: Quantification from the Alpine Fault, New Zealand](#). *Earth and Planetary Science Letters* 445: 125-135.

*Logistics:* Slight possibility of a field visit to NZ.

Project Title: Origin of hydrothermal graphite in fault zone rocks, based on samples from the Alpine Fault and Hyde-Macraes shear zone

*Types of work:* Isotopic analyses. Fluid inclusion analyses via Raman?

*Skills needed:* Chemistry, microscopy/microstructure, electron microscopy

*Relevant literature:* Menzies, C.D., Wright, S.L, Craw, D., James, R.H., Alt, J.C., Cox, S.C., Pitcairn, I.K. & Teagle, D.A.H. (2018). [Carbon dioxide generation and drawdown during active orogenesis of siliciclastic rocks in the Southern Alps, New Zealand](#). *Earth and Planetary Science Letters* 481: 305-315., <https://doi.org/10.5382/econgeo.2018.4553>, <https://doi.org/10.1007/s00126-016-0648-x>, <https://doi.org/10.1016/j.oregeorev.2016.08.011>

*Logistics:* Slight possibility of a field visit to NZ

Project Title: Cambrian/ Neoproterozoic burrows in slate from the Pyrenees. Which animals made them. What can we learn about strain and volume loss in the slate in which they lie?

*Types of work:* Microscopic analysis by optical and electron microscope. Calculation of strain.

*Skills needed:* You should have some interest in both palaeontology and structural geology. Mathematical skills needed.

*Logistics:* A potential JSG paper. Co-advised by Prof. Passchier. Combined palaeontology/ structure

*Project Title:* The Goethe breccia, Bingen.

In 1808 Goethe visited Bingen and wrote: "Nun ist es Zeit! Auch wir sind mitten auf dem Flusse, Segel und Ruder wetteifern mit Hunderten. Ausgestiegen, bemerken wir sogleich, mit geologischer Vorliebe, am Fuße des Hügels wundersame Felsen. Der Naturforscher wird von dem heiligen Pfade zurückgehalten. Glücklicherweise ist ein Hammer bei der Hand. Da findet sich ein Konglomerat, der größten Aufmerksamkeit würdig. Ein im Augenblicke des Werdens, zertrümmertes Quarzgestein, die Trümmer scharfkantig, durch Quarzmasse wieder verbunden. Ungeheure Festigkeit hindert uns, mehr als kleine Bröckchen zu gewinnen. – Möge bald ein reisender Naturforscher diese Felsen näher untersuchen, ihr Verhältnis zu den altern Gebirgsmassen unterwärts bestimmen, mir davon gefälligst Nachricht nebst einigen behelrenden Musterstücken zukommen lassen! Dankbar würde ich es erkennen"

We have some samples and would like to answer Goethes question after 212 years.

*Types of work:* A field visit. Microstructural analysis with both optical and electron microscopes (Microprobe, SEM).

*Logistics:* Would probably yield a publication in an IJES. Co-advised by Prof. Passchier

*Project Question:* Reduction spots = green spots in red slates. They formed during a oxygen rich period in Earth history which causes the red oxidised state of iron hydroxides. But why are reduction spots green? It cannot be reduced iron since this would not be stable. Some organic substance? We do not know. This is a riddle from the Triassic waiting to be solved.

*Types of work:* Chemical analysis and microstructural analyses

*Relevant literature:* <https://www.sciencedirect.com/science/article/pii/S004019519190012H>

*Logistics:* Co-advised by Prof. Passchier. Would probably yield a publication in JSG

*Project Question:* A strange "pseudotachylite" from the Sudbury impact structure in Canada, where quartz crystals grow in from the edge. How is this caused? Some unique mechanism associated with meteorite impact?

*Types of work:* Microstructural analysis

*Logistics:* Co-advised by Prof. Passchier. Would probably yield a publication in JSG.

*Project Title:* Did a big earthquake hit the Roman aqueduct of Cologne? Can we find evidence for this?

*Logistics:* Advised by Prof. Passchier and Dr. Surmelihi. Publication in QJES. Collaboration with Bonn University

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*Logistics:* Slight possibility of a field visit to NZ.

*Project Title:* Science team member for COSC drilling

*Relevant literature:* <http://cosc.icdp-online.org>

*Logistics:* We still have to see if there is any way to fund participation.