Geophysical Research Abstracts
Vol. 17, EGU2015-1277, 2015
EGU General Assembly 2015

Probing the transition between seismically coupled and decoupled segments along an ancient subduction interface

Samuel Angiboust (1), Josephine Kirsch (1), Onno Oncken (1), Johannes Glodny (1), Patrick Monié (2), and Erik Rybacki (1)

(1) GFZ Potsdam, Lithosphere Dynamics, Potsdam, Germany (samuel@gfz-potsdam.de), (2) Geosciences Montpellier, Univ. of Montpellier, France

Although of paramount importance for understanding the nature of mechanical coupling in subduction zones, the portions downdip of the locked segments of subduction interfaces remain poorly understood. These deep transition zones often are sites of megathrust earthquake nucleation and concentrated postseismic afterslip, as well as the focus sites of episodic tremor and slip features, recently discovered at several plate boundaries. The extensive, exhumed remnants of the former Alpine subduction zone found in the Swiss Alps allow analyzing fluid and deformation processes at the original depths of 30-40 km, typical for the depth range of such transition zones. We identify the shear zone at the base of the Dent Blanche complex (Dent Blanche Thrust, DBT) as a lower blueschist-facies, fossilized subduction interface where granitic mylonites overlie a metamorphosed ophiolite. We report field observations from the DBT region where a complex, discontinuous network of meter- to tens of meters-thick foliated cataclasites is interlayered with the basal DBT mylonites.

Petrological results indicate that cataclasis took place at near peak metamorphic conditions (450-500°C, c. 1.2 GPa) during subduction of the Tethyan seafloor in Eocene times (42-48 Ma). Despite some tectonic reactivation during exhumation, these networks exhibit mutual cross-cutting relationships between mylonites, foliated cataclasites and vein systems indicating multiple switching between brittle deformation and ductile creep. Whole-rock chemical compositions, in situ 40Ar-39Ar age data of newly formed phengite, and strontium isotopic signatures reveal that these rocks also underwent multiple hydrofracturing events via infiltration of fluids mainly derived from the ophiolitic metasediments underneath the DBT. From the rock fabrics we infer strain rate fluctuations of several orders of magnitude beyond subduction strain rates (c. 10-12s-1) accompanied by fluctuation of near-lithostatic fluid pressures ($1>\lambda>0.95$). We interpret the triggering of brittle deformation within DBT mylonites to reflect downwards propagation of megathrust events into the transition zone. Alternatively, these foliated cataclasites could also record the deformation associated with slow transients and other episodic slip events, reported by geophysical studies for several subduction zones worldwide for this transition zone.