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Change in deformation mechanisms from pressure solution to brittle faulting at shallow subduction interfaces: lithificat

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Tectonic melanges predominantly composed of sheared, fluid saturated, trench-fill sediments, and have been considered to be formed along subduction plate boundaries. Those tectonic melanges can include a wide range of seismic deformations as well as aseismic deformations, as geological evidences. While pseudotachylytes are the direct evidence for seismogenic faults, the change in deformation mechanisms from pressure solution cleavage to brittle faulting is also a significant geological evidence for variety of displacement along subduction plate boundaries. In this study, we focused on pressure solution cleavages and micro-faults within melange zones to understand processes in shallow brittle-ductile transition along subduction interfaces.

Occurrences commonly observed in tectonic melanges that the extension cracks only formed in sandstone blocks and injected by shale matrices in part suggest that competence contrast existed at the time of the melange formation. The matrix flow might be accommodated by dissolution-precipitation creep, representing pressure solution cleavages. Observation by secondary electron microscope (SEM) shows that the pressure solution cleavages are composed of relatively heterogeneous size of grains of illites with authigenic pyrite.

Micro-faults are also commonly observed in melagne zones almost parallel to melage foliation but clearly cut the shale matrices in some parts. Most of micro-fault are accompanied with mineral veins composed of quartz and/or calcite, and slicken lines and mirror surface are also commonly found on the fault surface, indicating the fault displaced in brittle manner. SEM observations provide that the mirror surface are composed of very fine grained (<1 micron) clinochlore with homogenize grain size.

Pressure temperature conditions for melange formation and micro-faults using fluid inclusion thermometry from some melange zones, corresponding ~100 degree C - ~210 degree C / ~80MPa - ~150 MPa, and ~180 degree C - ~250 degree C/ ~150MPa - ~300 MPa, respectively. The brittle-ductile transition can ranges from ~180 degree C to ~210 degree C in temperature. Those results indicate that the deformation mechanisms are divided by P-T conditions with the transition zones and change can be one-way to deep in broad sense. In addition to that, the authigenic minerals were also distinguished with the deformation mechanisms.

Change in deformation mechanisms can be related to lithificaion, strain rate and fluid pressure. In the way from ductile to brittle, from shallow to deep, lithification can be a significant process. In this process, pressure solution is a role to make shale matrices lithified. In the brittle-ductile transition zones, the heterogeneous lithification state can be existed.

Change in strain rate can affect on the deformation mechanisms in the transition zone. The seismic cycle model by Wang and Hu (2006) expects a change in strain rate along subduction interface and a change in stress within the front of accretionary wedges. Stress changes reported from Yokonami melange and the Nobeoka thrust (Eida and Hashimoto, Yamaguchi et al., this meeting) indicate the consistency with the model. The seismic cycle model can adapt not only to accretionary margins but also to erosional margins such as Costa Rica.

Keywords: deformation mechanisms, accretionary complex, seismogenic zone along subduction interface, seismic cycle, tectonic melange