Scaly fabrics and veins of the Mugi and Makimine mélanges

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Ancient subduction fault zones provide a microstructural record of the plate boundary deformation associated with underthrusting. The Mugi and Makimine mélanges of the Shimanto Belt exhibit many of the characteristics associated with exposed ancient subduction fault zones worldwide, including: (1) σ_1 that is near orthogonal to the deformation fabric (2) microstructurally pervasive veins that record hydrofracturing and act as sinks for silica, calcite, and albite (3) cyclic fracturing and sealing recorded through crack-sealing and (4) evidence for local diffusion of silica sourced from web-like arrays of slip surfaces (i.e., scaly fabrics). We present microprobe observations of scaly fabrics and veins from two ancient subduction-related shear zones that represent the full temperature range of the seismogenic zone: 1) Mugi mélange lower (~130-150˚C) and upper (~170-200˚C) sections and 2) Makimine mélange (peak temperatures of ~340˚C). The Mugi mélange is an underplated duplex consisting of two horses separated by an out of sequence thrust fault. The upper section is bounded at the top by a pseudotachylite-bearing paleodécollement. The Makimine mélange was underplated at the downdip limit of the seismogenic zone. The scaly fabrics and veins associated with these shear zones exhibit evidence for different geochemical reactions occurring as a function of depth and temperature. Upper Mugi (170-200 ˚C) has evidence for the incongruent pressure solution reaction of coarse grained albite in the matrix breaking down into illite in the shear zone (i.e. scaly fabric). Makimine (up to ~340 ˚C) has evidence for a different set of reactions that result in rutile and iron-oxide phases concentrated in the shear zone. Microstructural analyses of ancient subduction-related faults show differences with temperature that highlight the importance of establishing the geochemical processes and activation energies that contribute to slip, fracturing, and healing of rocks that underthrust the subduction interface.

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