Contrasts in Faulting and Veining Across the Aseismic to Seismic Transition in a Sediment-Rich Accretionary Prism, Kodiak Islands, Alaska

Abstract

Subduction thrust systems produce the world's largest earthquakes. The transition from aseismic to seismogenic faulting occurs at a depth of ~10-12 km. Differentiation in mechanical behavior between high fluid pressures and low fluid pressures are inferred to control fault behavior where characteristic three-dimensional geometries exist. The GRF contains discrete, focused, short-wavelength fault systems that are inferred to control the location of the aseismic to seismogenic transition. In contrast, the SF contains multiple, long-wavelength, low-angle faults that are inferred to control the location of the aseismic to seismogenic transition. Our goal is to define the explicit differences in structural style and vein/cement precipitation accompanying this depth range. We will analyze vein crystallization textures to establish balance between rapid, episodic vein precipitation, obscurring temporal relationships.

Field Area

A: Densely veined zone at the Contact Fault. B: Outcrop photo of cross bedded sandstone showing mineralogical change from quartz at the top to calcite below. C: Angular brecciated fragments of Ghost Rocks Fm. D: At hand sample scale, massive quartz vein which includes multiple generations of crystallization is observed in the SF. E: Veins and cements may account for ~1% volume in extensional zones and fault zones. F: Diverse orientations of dilational veins. G: Fault surfaces preserve striated vein carbonates and zeolites, while calcite cements indicate high fluid pressures. H: Fault zone fractures are filled with calcite cement, which is later cut by fault surface. I: Veins and cements may account for ~1% volume in extensional zones and fault zones. J: In the GRF, 15 - 20% of quartz is observed in the GRF but not in the SF.

Conclusions

1. We will use microprobe and XRD to identify any deformation at depth.
2. We will analyze vein crystallization and texture to determine the modes of deformation at depth.
3. We will use geophysical methods to understand the structure and architecture of the aseismic to seismogenic transition.
4. We will use cross-cutting relationships to understand the timing of faulting and veining.
5. We will use a 3D model to understand the geometry of the aseismic to seismogenic transition.

References