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**TITLE:** Influence of lithologic variability on the rheology of granitic rock deformed near the brittle-ductile transition *(Invited)*

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**ABSTRACT BODY:** Examining fault-related deformation under brittle-ductile conditions and across different lithologies has implications for seismic hazard analysis, since earthquakes are thought to nucleate near the brittle-ductile transition and fault slip distributions are influenced by lithologic variations. This presentation focuses on two outcrops containing lithologic heterogeneities – the Seven Gables (SG) outcrop and the Sheared Schlieren (SS) outcrop – to investigate the relationship between lithology and deformation. This is accomplished through a combination of field observations, micro-structural/-chemical analyses, and mechanics-based finite element models.

The SG and SS outcrops are located in the Bear Creek field area (central Sierra Nevada, CA), which consists of a medium- to fine-grained biotite-hornblende granodiorite with a weak regional foliation trending approximately northwest. The field area contains abundant faults, which microstructural observations suggest were active near the brittle-ductile transition. Furthermore, leucocratic dikes, volcanic xenoliths, and schlieren are abundant throughout the granodiorite, making it lithologically heterogeneous at the decimeter- to meter-scale.

The SG outcrop allows comparison of granodiorite rheology to that of a leucocratic dike, both of which are ductilely deformed within a contractional fault step. Both lithologies contain plagioclase, K-feldspar, and quartz, with the granodiorite also containing biotite, hornblende, and sphene. The 10 cm wide right step occurs between two left-lateral faults, measuring 1 and 2 m in length, respectively. A 4 cm thick leucocratic dike runs directly through the center of the step at an angle of 70° to the faults, as measured in the plane of the outcrop. Microstructural analysis indicates that the dominant quartz slip system within the center of the step is basal <a>.

The SS outcrop contains a schlieren that is ductilely sheared in the near-tip region of a left-lateral fault. The schlieren consists of three zones of varying composition, ranging from mafic to felsic. The trend of the schlieren, which is approximately 30 cm wide (as viewed on the outcrop surface), is at an angle of 71° to that of the fault. During fault slip, the schlieren deformed ductilely and accumulated approximately 25 cm of offset and 46° of rotation in the plane of the outcrop.

Mechanics-based finite element models are constructed for each outcrop using Abaqus. In each case, the model geometry and boundary conditions are based on the observed field relations and kinematic models of the deformation. The mechanical models employ an elastoviscoplastic constitutive equation, in which the rock properties are taken from the experimental rock mechanics literature. Faults are modeled as overlapping planar sets of nodes that obey a Coulomb criterion for fault slip with $\mu$=0.4. Not only do these models provide insight into the predicted stress and strain fields, they also allow for numerical experimentation with the properties assigned to each lithology.

**KEYWORDS:** 8159 TECTONOPHYSICS Rheology: crust and lithosphere, 8020 STRUCTURAL GEOLOGY Mechanics, theory, and modeling, 8010 STRUCTURAL GEOLOGY Fractures and faults.

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## Additional Details

**Previously Presented Material:**

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