The Effective Stress Law at a Brittle-Plastic Transition: Analogue Experiments with Halite Gouge Layers

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We investigated the effect of pore pressure P_f near the brittle-plastic transition (BPT) for a halite (NaCl) shear zone. Our series of precut friction experiments with a gas-medium apparatus with temperature $T \le 200$ °C, confining gas pressure $P_c \le 150$ MPa, and $P_f \le 140$ MPa revealed that a tanh connection between the brittle and plastic regimes works well even at elevated P_f , with a coefficient for P_f in an effective stress law α being unity. Plastic deformation around the real contacts independent of the mean stress results in $\alpha=1$ regardless of the ratio of the real contact area A_r/A . The functional dependency of the shear strength on the effective normal stress may deviate from a linear dependency with increasing A_r/A . The present findings support a smooth transition in a hypothetical steady-state strength profile around a BPT, providing new insights in geologically obtained paleo-stress data in exhumed mylonitic shear zones.

Keywords: Effective stress law, Brittle-plastic transition, Friction experiment