2006 Fall Meeting
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HR: 08:45h
AN: **NS21A-04**
TI: The Origins of the Self-Potential Response During Hydraulic Fracturing

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AB: The self-potential (SP) response during hydraulic fracturing of intact granite specimens was investigated in the laboratory. Excellent correlation of pressure drop and SP suggests that the SP response is created primarily by electrokinetic coupling. For low injection pressures, the variation of SP with pressure drop is linear, revealing a constant coupling coefficient (Cc) of -200 mV/MPa. However for radial pressure gradients > 80 MPa/m, the magnitude of the Cc increases in an exponential trend by up to 80% preceding hydraulic fracturing. This increasing Cc is related to increasing permeability at high pore pressures caused by dilatancy of micro-cracks, and is explained by a decrease in the hydraulic tortuosity. Other variables which may also effect the Cc include: a) decreasing specimen resistivity, b) increasing porosity at high pore pressure, c) increasing zeta potential of fresh microcrack surfaces, d) increased effective viscosity by electroviscous effects, and e) flow separation at high fluid velocity. Additional source mechanisms such as piezoelectricity and co-seismic electrokinetics are considered and are shown not to contribute significantly to the SP response during hydraulic fracturing. At the moment of fracture initiation, injectate rushes into the new fracture area where the zeta potential is likely greater than in the preexisting rock porosity, and an anomalous SP spike is observed that may represent the transient SP response to a changing Cc. Finally, during tensile cracking of wet granite specimens in a point load device with no water flow, a SP transient is created by contact electrification. However, the time constant of this

event is much less than that for transients observed during hydraulic fracturing, suggesting that SP created solely from material fracture does not contribute to the SP response during hydraulic fracturing.

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