Title: **Watershed scale seismic imaging and porosity estimation with the seismic land streamer in the Upper East River, Colorado**

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Project Abstract:

The East River Watershed Science Focus Area is a DOE funded experimental watershed dedicated towards developing a predictive understanding of hydrologic and biogeochemical processes within mountain watersheds. Bedrock in the watershed is composed of Mancos Shale and younger crystalline intrusions. Hillslopes are mantled with weathered bedrock, moraines, landslides and colluvium. During October of 2018 we conducted a watershed scale seismic survey of the drainage. The dataset includes ~12 km of data collected along roads with a 72-channel, 1.25m spaced streamer and ~3km of planted geophone data. P-wave (Vp) and shear wave (Vs) results reveal a sharp transition between regolith/sediment deposits and bedrock throughout the watershed. This sharp velocity contrast produces a high amplitude secondary arrival, which travels at the expected bedrock Vs. We interpret this arrival as a vertically polarized shear wave and use it to constrain bedrock Vs. Mancos Shale Vp anisotropy is measureable in some parts of the watershed and notably absent in the vicinity of crystalline intrusions. This suggests contact metamorphism influences bedrock hydrology. Hertz-Mindlin derived porosity estimates measurements show relatively high porosities within alluvial and colluvial (up to 0.5) deposits compared to bedrock (less than 0.05), in agreement with borehole observations. Localized, low Vp anomalies in the bedrock correlate with regional fracture sets visible in Lidar data, however their limited vertical extent suggests that permeability along these fractures decreases rapidly with depth. We also observe bedrock Vp trends that correlate strongly with local shale dip, bedrock Vp is slowest where the Mancos Shale dips into hillslopes and fastest where the shale dip is parallel to the hillslope. These results suggest shale structure strongly influences bedrock hydrology.