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Fracture Processes in Sandstone: Insights to Guide Prediction and Characterization

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Fracture systems reflect interactions among mechanical and chemical processes integrated over geologic timescales. In tight gas sandstones, the effects of diagenesis on fracture attributes and mechanics are significant, controlling both the development of fracture system connectivity and porosity and its destruction. Insights from coupled mechanical and diagenetic modeling of fracture systems and new approaches to observing and quantifying fracture attributes allow for much more reliable and accurate predictions of fracture attributes and more robust diagnostic methods.

This presentation will focus on new insights into basic processes of fracture growth and decay in tight gas sandstones and how these insights lead to new methods to predict and verify natural fracture contributions to producibility that are applicable to Algerian tight gas sandstones. Profound effects on fracture mechanics arise from cement precipitation within the growing fracture system. Porosity, roughness, sensitivity to effective stress changes, and aspect ratio are among the fracture attributes modified by diagenetic reactions in the growing fracture system. One manifestation of diagenetic processes within growing fractures is crack-seal texture and associated fracture porosity. Crack-seal texture is a widespread attribute of opening-mode fractures in flat-lying and nearly flat-lying sedimentary rocks as well as in fractures associated with faulting and folding. Where regional opening-mode fractures are unrelated to faults and folds, crack-seal texture reflects episodic fracture growth driven by interplay of cementation, compaction, and pore pressure changes associated with burial and remote tectonic loads. In moderately to deeply buried sandstones, crack-seal texture is most frequently associated with quartz cement precipitation, possibly because throughout much of a sandstone's burial history, rock-dominated fluid and substrate chemistry dictates that this cement is most likely to precipitate.