Timing and Rate of Fracture Opening in Sandstone: Implications for Basin Centered Gas Deposits

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Our reexamination of outcrop samples collected in the 1990's shows that localized quartz cement deposits with crack-seal texture and multiple fluid-inclusion assemblages are present in fractures in Mesozoic sandstones of the Western Canada basin. Recent work in East Texas tight gas sandstone fractures shows that such quartz cement deposits and associated fluid inclusion assemblages that record evidence of timing and rate of fracture opening (Becker et al., GSA Bull. 2010). Reconstructing fracture opening histories provides valuable insights to fracture generation, habit, and occurrence and allows more accurate fracture prediction. Studies similar to East Texas have been performed using core, but we have yet to do the study using outcrop samples. The patterns we see in the Canadian Rockies outcrop samples match the patterns we have seen in core samples from East Texas and North Eastern Mexico. We report initial results of an ongoing study of fracture opening histories for sandstones of Western Canada Basin. Fracture cement textures are strongly influenced by composition and grain size of host sandstone. Disseminated quartz grains provide nucleation surfaces for quartz cement to precipitate into an open fracture. Numerous generations of quartz can be identified in some fractures where deposits bridge across otherwise open fractures. Using SEM-based cathodoluminescence (CL) imagery, the relative ages of quartz precipitation can be mapped. As a test for accuracy, each generation of quartz and crack opening increment can be separately identified and the opening history reconstructed, allowing for restoration of original fabric and grains. Temperature and pressure histories can be obtained for each stage of precipitation by studying fluid inclusion assemblages present in the quartz cement. Being able to better understand the occurrence of fractures and fracture porosity evolution can help enhance production success in deep hydrocarbon reservoirs.