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Shallow Gas Reservoirs of the Milk River Formation of SE Alberta and SW Saskatchewan: Perspective from Geomechanics

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Summary

Shallow gas development in southeastern Alberta and southwestern Saskatchewan has been a mainstay of the gas industry for more than a decade, although massively overshadowed by more glamorous activities such as deep gas development, recent shale gas plays in British Columbia, and growing interest in coal bed methane (CBM). This study focuses on shallow reservoir productivity in the Upper Cretaceous Milk River Formation in the southeastern Alberta and southwestern Saskatchewan.

The Upper Cretaceous Milk River Formation, Santonian – Campanian Stage, ~ 85 – 81 MMybp is one of several prolific formations producing natural gas (~98% CH_4) of biogenic origin from relatively shallow depth in southeastern Alberta and southwestern Saskatchewan. The shallow marine successions of the Milk River Formation comprise three Members i.e. the Telegraph Creek Member, the Virgelle Member, and the Deadhorse Coulee Member. These shallow transitional deposits grade into deeper distal marine sediments toward southwestern Saskatchewan where they are also known as the Alderson Member. The Milk River Formation conformably overlies the First White Speckled Shale of the Colorado Group but its upper contact with Lea Park Formation is unconformable and marked by a lag deposit of chert pebbles.

The productivity of shallow gas wells in low to moderate permeability reservoirs in southeastern Alberta and southwestern Saskatchewan appears to be a complex issue that depends not only on the lithostratigraphic disposition, but also on the geomechanical characteristics of the area e.g. how the current stress fields affect hydraulic fracture orientation (whether an induced fracture is vertical or horizontal), and the relationship of permeability to confining stress.

The vertical stress, S_v, and the minimum horizontal stress, S_{Hmin}, are calculated in the study area, indicating a clear stress cross-over between the vertical and horizontal minimum stresses at around 400 m depth, and the role of the stress data in recognizing fracture's orientation of an induced fracture whether induced hydraulic fractures are vertical or horizontal. Regional stress map is generated for the Milk River Formation and interpreted to identify the sweet spots.