Effects of Tectonism on Facies, Geohydrology, and Biogenic Gas Distribution in the Upper Cretaceous Belle Fourche and Greenhorn Formations, Alberta, Saskatchewan, and Montana — Role of the Sweetgrass Arch and Bowdoin Dome

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Regional trends in facies, isotopes and composition of biogenic gas and its co-produced water, and distribution of shallow biogenic gas resources in the Upper Cretaceous Belle Fourche and Greenhorn Formations can be related to the effects of episodic tectonism in the area between the Sweetgrass arch and Bowdoin dome in Alberta, Saskatchewan, and Montana. Effects of syndepositional tectonics have been documented by lithostratigraphic correlation, micropaleontological studies, and $^{40}Ar/^{39}Ar$ dating of bentonites in the Belle Fourche and Greenhorn. Reservoir units in the upper part of the Belle Fourche are progressively truncated below the sub-Greenhorn unconformity from south-to-north on Bowdoin dome and from the Bowdoin dome west to the Sweetgrass arch as a result of syndepositional uplift. The distribution of facies and quality of reservoir units in the Belle Fourche and Greenhorn reflect not only the regional effect of syndepositional tectonics but also the modification by local movement on fault blocks that underlie the region.

Isotopes and compositions of biogenic gas and its co-produced water show differences between the upper and lower producing intervals in the Belle Fourche as well as between the Sweetgrass arch and Bowdoin dome areas for similar age strata. Local differences may reflect compartmentalization and influence of facies on permeability. Regional differences may be related to overlapping fluid flow events that were accompanied by a prolonged period of biogenic gas generation, as documented by gas-water equilibria. Integration of the geologic framework with the gas and co-produced water chemistry may better define the regional distribution of gas resources.