

Evidence for Potential Methane Sourcing and Methanogenesis in Late Cretaceous Shales along the Eastern Flank of the Williston Basin in North Dakota

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Methane (CH₄) is frequently found to occur in ground-water wells within shallow aquifers above Late Cretaceous marine shales of the Dakota, Colorado, and Montana Groups on the eastern flank of the Williston Basin in North Dakota. Shallow gas flameionization detector (FID) field screening has revealed 144 CH₄ occurrences in ground-water wells, completed in aquifers with reservoir-style architecture, along the eastern flank (east of -100 deg. west longitude) of the Williston Basin in North Dakota. CH₄ is found predominantly in wells completed in shallow bedrock and surficial aquifers above subcrops of shales belonging to the Late Cretaceous Skull Creek-Mowry-Belle Fourche (undifferentiated), Greenhorn, Carlile, Niobrara, and Pierre Formations. Methane concentration [CH₄], from FID field screening values, ranges from 0.1 to 6,087 parts-per-million (ppm), with a mean of 121 ppm (as CH₄ in air). Overall, the areal CH₄ occurrence density is 0.29 per township (36 square miles). The presence of CH₄ in shallow ground-water systems above Cretaceous shales suggests potential sourcing from these units. Preliminary analysis of CH₄ as a shallow natural gas exploration indicator in southeastern North Dakota shows that mean CH₄ is highest in wells above the Niobrara Formation (182 ppm), followed by the Pierre Formation (120 ppm), the Skull Creek-Mowry-Belle Fourche (94 ppm), the Greenhorn Formation (69 ppm), and the Carlile Formation (46 ppm), which, assuming vertical migration, suggests a higher degree of methanogenesis within the Niobrara Formation.