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# Clays, Cations, and Geophysical Log Response of Gas-Producing and Nonproducing Zones in the Gammon Shale (Cretaceous), Southwestern North Dakota

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**Abstract:** The Upper Cretaceous Gammon Shale has served as both source bed and reservoir rock for accumulations of natural gas. Gas-producing and nonproducing zones in the Gammon Shale are differentiated on the basis of geophysical log interpretation. To determine the physical basis of the log responses, mineralogical, cation-exchange, textural, and chemical analyses were conducted on core samples from both producing and nonproducing portions of a well in the Gammon Shale from southwestern North Dakota. Statistical treatment (2 sample t-test and discriminant function analysis) of the laboratory data indicate that the producing and nonproducing zones differ significantly in mixed-layer clay content (7 vs. 12%), weight proportion of the clay-size (0.5– 1.0  $\mu\text{m}$ ) fraction (5.3 vs. 6.3%) ratio of  $\text{Ca}^{2+}$  to  $\text{Na}^{+}$  extracted during ion exchange (1.4 vs. 1.0), and abundance of dolomite (10 vs. 8%). The geophysical logs apparently record subtle differences in composition and texture which probably reflect variations in the original detrital constituents of the Gammon sediments. Successfully combining log interpretation and clay petrology aids in understanding the physical basis of log response in clay-rich rocks and enhances the effectiveness of logs as predictive geologic tools.

**Key Words:** Exchange cations • Geophysical log • Mixed layer • Natural gas • Shale • Statistical analysis

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