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**IDENTIFICATION OF
SHALLOW BIOGENIC GAS SYSTEMS
IN EASTERN NORTH DAKOTA**



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PROJECT SUMMARY

The purpose of the project described in this summary is to generate information that will enhance exploration for and development of shallow biogenic gas in North Dakota east of longitude 100° W. Specifically, a five-county sweetspot with shallow biogenic gas potential is identified in the southeastern part of the state. Two important components of late generation biogenic gas systems are documented in eastern North Dakota and particularly in the multi-county sweetspot: regional fracture systems are mapped on satellite images and patterns of methane occurrences are related to the grid of lineament zones. This work was accomplished in close cooperation with the North Dakota Geological Survey (NDGS), especially their program of field screening observation wells for high levels of methane.

Linear features visible on nine scenes from the Landsat 7 satellite are the basis for interpretation of regional lineament zones within the study area. Eight distinct lineament zones generally trending northeast and northwest are mapped and related to a variety of published data sets. The lineament zone grid has expression on geophysical, stratigraphic, geologic, and structural maps. These concordant data sets provide a ranking for the eight individual lineament zones. Two particularly significant lineament zones are found in the southern two-thirds of the study area, along with three of intermediate significance. Three lineament zones in the northern one-third of the area are not well developed and the overall geologic framework in the north is definitely different than in the south.

Thousands of observation wells in more than 50 counties across North Dakota have been monitored for methane by the NDGS. Three clusters of counties are identified using information extracted from this important published record. Seven counties in the northwestern part of the state and seven counties in the central part of the state appear to be associated with migrated thermogenic and early generation “old” biogenic gas, respectively. The third cluster of counties is in southeastern North Dakota and its gas potential is believed to be based upon the existence of a late generation biogenic gas system that is currently active in the area.

The sweetspot cluster of five counties in southeastern North Dakota is clearly related to the grid of Landsat lineament zones. Zones with particularly high methane levels in a glacial outwash aquifer are concentrated in the sweetspot. An initial analysis indicates that the population of linear features within the sweetspot is different than in the surrounding counties. Along with fractures and methane, preliminary water chemistry in eastern North Dakota and data on organic carbon in Cretaceous host rocks in eastern South Dakota are important additional components of the late generation biogenic gas system currently at work in the sweetspot. A critical next step will be to document the presence of methanogenic microbes in water samples from observation wells with high methane concentrations and optimal water chemistry.

The most obvious potential application of this project is the exploration insight it provides for the entire subcrop belt of the Niobrara Formation that extends from Kansas into Canada. However, the most important exploration applications should focus specifically on the five-county sweetspot in southeastern North Dakota. Eventually, it will probably become economically viable to produce shallow gas in this area of the state where hydrocarbon development has been only minimal.