because they provide a rational basis for pedogeochemical sampling techniques applicable to the search for base metals, the detection of deep leads (buried stream channels containing placer deposits), and telethermal uraniferous deposits associated with calcreted valley fills.

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Geology of Norton Basin, Northern Bering Sea

The rocks that floor the Norton basin are most likely of Precambrian and Paleozoic age, like those that crop out around the basin. A maximum of 6.5 km of mainly Cenozoic rocks lies over basement in the basin. I believe that alluvial fans are present deep in the basin and border major basement fault blocks. These fans are the lowest units of the basin fill in many areas and probably consist of uppermost Cretaceous and Paleogene, coal- and volcanic-rich rocks. Mainly clastic nonmarine sedimentary rocks overlie the fan deposits. The Neogene and Quaternary basin rocks apparently were deposited in a marine environment.

The Norton basin comprises two structural areas that are separated by a major northwest-striking horst. The first structural area lies west of this horst, where major normal faults strike northwest to form local areas where the basin is as deep as 5.0 km. The second area, east of the horst, includes major normal faults that strike east and northeast; the deepest part of the Norton basin (6.5 km) lies there.

During the Late Jurassic and Early Cretaceous, basement rocks now beneath the Norton basin were affected by the orogeny that formed the Brooks Range. These basement rocks were metamorphosed and thrust, and then eroded deeply nearly 50 m.y. before the basin began to form. In the middle Late Cretaceous, the area of the eastern Seward Peninsula and eastern Norton Sound was subjected to east-west compression and consequent eastward thrusting. During the latest Cretaceous and early Paleogene, the compression gave way to regional extension that formed northeast-trending grabens onshore, east of Norton basin. I believe that the Norton basin most likely formed in response to this regional extension. Initial deepening of the basin was controlled by major normal faults and occurred rapidly, whereas later subsidence was slower and more regional in scale.

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Petrologic and Stratigraphic Controls of Secondary Porosity, "Second" Frontier Sandstone (Late Cretaceous), Moxa Arch, Wyoming

The "Second" Frontier sandstone along the Moxa arch, southwestern Wyoming, forms a progradational sequence of marginal-marine and paralic to fluvial deposits that host important gas reservoirs. Thickness trends indicate that the paralic or fluvial sands had different immediate sediment sources than underlying marginal-marine sands did. Environmental interpretations imply that both deltaic and interdeltaic sedimentation controlled the distribution of sand deposits. Storage capacity mainly is in secondary "intergranular" pores, many of which formed by dissolution of calcite replacements of interstitial clay.

The development and preservation of secondary porosity entailed a complex diagenetic paragenesis that was controlled by deep burial and compaction, by compositional and textural variations imparted by depositional environments, and by position on structure. Best effective porosity is in thick deposits of medium to coarse-grained paralic or fluvial sandstone that contained, prior to dissolution, less than 60% chert and from 10 to 30% interstitial clay, calcite, and other unstable components. Other effective porosity is in fine to medium-grained marginal-marine sandstone that likewise contained appreciable unstable constituents. The smectite content and ordering of mixed-layer illite-smectite are related to permeability (IM ordering and more smectitic clay in more permeable sandstone; IMII ordering and less smectitic clay in less permeable sandstone). Many of the diagenetic reactions, as growth of authigenic albite and recrystallization and authigenesis of clay, entailed components that already were available in the sandstone. Some diagenetic products suggest local kinetic controls that operated in realms nearly as small as single pore volumes.

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Sandstone Stratigraphy Using Core Description, Dipmeter Curves, and Other Available Logs

Smaller reservoir targets and enhanced recovery projects demand exacting stratigraphic interpretation to evaluate economic feasibility of a field. The stratigraphic interpretation of a formation requires an accurate geologic model and detailed rock information. Although detailed information may be obtained from cores, cores are not available in large portions of the reservoir rock being studied. Electric logs are available in most wells, but few logs provide the detailed information required for stratigraphic study. The dipmeter, electromagnetic propagation tools, and microresistivity devices can provide detailed data. Only the dipmeter makes high resolution measurements on different sides of the borehole and provides the orientation of the information in space. Using the dipmeter, the interpretations obtained can be projected into the region away from the borehole. The dipmeter has been capable of providing high resolution data from the resistivity curves for the last decade, but until recently only a few have used the curves.

The synergism of geologic models, dipmeter resistivity curves, core data, and other logs is an invaluable aid to the accurate interpretation of the stratigraphy of sand and shale units. Examples discussed include: a fluvial point bar of the Fort Union Formation in the Wind River basin, Wyoming; a Shannon Sand marine bar facies; and an analysis of the internal characteristics of a Tensleep Formation reservoir in an eolian system. These examples show that once the model is established and the dipmeter resistivity curve response is understood, the stratigraphy and some of the heterogeneous characteristics of these reservoirs can be more easily described.

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Secondary Porosity in Laumontite-Bearing Sandstones

Some sedimentary rocks, particularly those containing volcanogenic material, develop laumontite cements during burial with increasing temperature. The development of laumontite cements in sandstones is highly destructive to reservoir potential. As a result, in the search for hydrocarbons, laumontite-bearing sedimentary rocks commonly are considered economic basement. However, it is possible to develop secondary porosity after the formation of laumontite.

Theoretical considerations show that the stability of laumontite (Lm) is limited by the following equilibria: (1) Lm + CO_2 = Calcite (Cc) + Kaolinite (Kao) + 2 Quartz (Q) + 2 H_2O,