(13,716 m) thick. It is believed that these sediments range from Pennsylvanian through middle Cretaceous. We project these Sonora trough marine sedimentary rocks to the northwest under the thrust plates exposed in southwestern Arizona.

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Depositional Setting of Middle Dolomite Unit in Metaline Formation, Metaline District, Washington

The middle dolomite unit of the Cambrian Metaline Formation in the Metaline district, Washington, was deposited in a low-energy, shallow-water environment. Deposition occurred as a complex mosaic of subtidal, intertidal, and supratidal environments in a restricted lagoonal and broad tidal-flat setting.

Where primary depositional features have not been masked by intense diagenesis, the middle dolomite unit is characterized by seven distinctive lithofacies. The vertical succession of these lithofacies differs from locality to locality and is laterally discontinuous. The seven lithofacies and interpreted depositional environments are: (1) black, birdseye dolomite, deposited in the supratidal zone; (2) cryptalgalaminate dolobindstone, deposited in the upper intertidal and supratidal zones; (3) laminated, intraclastic dolofloatstone, deposited in the outer intertidal zone; (4) gray massive to mottled dolomite, deposited in the intertidal and subtidal zone; (5) intraclastic-oncolitic dolofloatstone, deposited as lag deposits in tidal-flat channels; (6) oncolitic dolofloatstone, deposited in shoal areas in the upper subtidal zone; and (7) lenticular-bedded dolomite, deposited in the subtidal zone.

Changes in lithofacies over narrow vertical ranges were due more to changing hydrographic and sediment-supply conditions than to numerous minor eustatic sea level changes. Through time, however, there was a gradual rise in sea level, and subtidal sediments became dominant in the upper middle dolomite unit.

The low-energy nature of the middle dolomite unit was the result of either a very long wave fetch, which extended across many kilometers of shallow water, or a remote barrier, which effectively reduced the hydrokinetic energy below that expected in open-marine conditions.

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Wamsutter Arch Tight Gas Play, Southern Wyoming—New Look at Old Area

Efficiently exploiting the natural gas from the Upper Cretaceous Mesaverde Formation in the Wamsutter area of southern Wyoming has depended on new applications of existing technology. An understanding of trapping conditions and reservoir performance has required determination of reservoir rock types based on depositional environments and regional stratigraphy.

Two types of traps were discovered: (1) updip shaleouts of sandstones in the upper Almond and Ericson Formations, and (2) increased gas and water interfacial tension in the lower Almond Formation on the cooler updip flanks of the area.

Reservoir performance is strongly influenced by rock types and reservoir geometries. These are controlled by depositional environments which were determined early in the play by examination of slabbed cores. Productive sandstones were observed from the following environments: nearshore marine (upper Almond), high-energy fluvial (Ericson), and low-energy fluvial (lower Almond). Upper Almond sandstones have the best production because of generally good pore geometry and great lateral continuity. Ericson sandstones produce at high rates in a few areas, but tend to produce water because of their great lateral extent. In contrast, lower Almond sandstones rarely produce water, but only flow gas at low rates due to their poor pore geometry and very limited extent.

Drilling plans, completion procedures, and formation evaluation methods all were influenced by the understanding gained from this integrated geologic and petrophysical study.

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Brae Field Area, North Sea

Several hydrocarbon accumulations were discovered between 1975 and 1977 in Block 16/7 in United Kingdom waters along the western edge of the Viking graben. By 1978, 13 exploratory wells were completed, and development planning focused on the southern part of the area.

The southern part of the Brae area is unique compared with other documented North Sea fields. An oil column of about 1,500 ft (457 m) is contained in Upper Jurassic conglomerate and sandstone shed off the Fladen Ground Spur as it was uplifted by faulting and as the Viking graben subsided. This major fault zone places Upper Jurassic against Devonian rocks and is the important seal along the west flank of the field. The cap rock and likely oil source are provided by the Upper Jurassic Kimmeridge Clay, which drapes a low anticline and dips eastward into the basin.

Stratigraphic changes within the reservoir interval are abrupt. The depositional setting is interpreted as coalescing fan deltas spilled into the basin from adjacent uplands. Conglomerate and sandstone were deposited mainly subaerially on fan-delta surfaces, whereas laterally adjacent siltstone was laid down as fringing marine foresets. Complex diagenetic events have overprinted these facies.

Other hydrocarbon accumulations similar in setting to the Brae field undoubtedly await discovery.

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Conodonts—Models of Pragmatic Paleontology

The composition, size, diversity, and distribution of conodonts make them unique and invaluable geologic tools. These marine apatitic microfossils that evolved and spread rapidly throughout the Paleozoic and Triassic undergo visible color changes from 50 to 500°C as a