from west to east to as much as 6°.

The total incremental stratigraphic rise of the base of the Nanushuk is about 2,100 m from the westernmost well to the pinch-out on the east, a distance of 370 km. However, subsidence was not uniform throughout the basin, as indicated by less subsidence of the passive Barrow arch on the north side of the Colville basin.

Subcommercial amounts of oil and gas occur in shallow anticlinal and truncation traps in the Nanushuk Group, one of many objectives being evaluated by the current National Petroleum Reserve in Alaska (NPRA) drilling program.

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Depositional Environment of Clay Minerals from Northeast Gulf of Alaska

Analyses of more than 100 recent bottom samples from the northeastern Gulf of Alaska continental shelf between Icy Point and Prince William Sound show an average clay mineral assemblage of 61% kaolinite and chlorite, 37% illite, and 2% smectite. Organic content generally is less than 2%.

The clays being deposited today are predominantly glacially eroded, fluvially transported, and rapidly deposited. The present depositional environment is characterized by rapid mechanical erosion at the outcrop with little or no chemical weathering, rapid fluvial transport, and continental shelf sedimentation rates as high as 30 m/1,000 years. Of the 50 largest streams draining into the Gulf of Alaska, all are either glacially fed or drain a recently deglaciated area.

The Yakataga Formation of Miocene through Holocene age which underlies much of the continental shelf in this area, has many mud-rich units similar to the modern shelf sediment in clay mineralogy and mode of origin. The Yakataga Formation averages 60% kaolinite and chlorite, 27% illite, and 13% smectite. Differences in the smectite and illite content of the Yakataga Formation and the modern shelf samples may represent post-depositional diagenesis of the Yakataga Formation.

In climate, geography, and sedimentary regime, the northeastern Gulf of Alaska depositional environment has remained relatively constant since middle Miocene time. One question yet to be answered is whether the presently accumulating continental shelf sediment will prove to be a hydrocarbon source bed of the future. Drilling in the Yakataga Formation has failed to confirm its status as a major source unit.

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Generation of Abnormal Pressures Through Organic Matter Transformations

In argillaceous and carbonate-evaporite source beds, much of the oil-generating organic matter is concentrated along bedding surfaces (varves and laminae). During the principal phase of oil generation, when adequate thermal energy is available, 25 to 30 wt. % of the original organic matter commonly is converted to liquids, mainly bitumen, with a relatively small percentage of water. Part of the bitumen is then thermally cracked to crude oil before oil expulsion occurs. Substantial amounts of gas, principally hydrocarbons with some CO_2 and N_2, are also generated. Much of the water and CO_2 is generated before oil is formed.

The release of fluids from the organic matter causes a reduction in the volume of the residual solid organic matter; however, this volume decrease is offset by the considerably greater volume of the generated fluids. Thus, the volumes of generated products plus residual organic matter represent a substantial net volume increase relative to the volume of the organic matter at the start of significant oil generation. Consequently, very high pressures result locally along the bedding surfaces if the laminae are adequately sealed. Eventually, these localized, transitory, high fluid pressures will develop along the bedding in most parts of the source-rock sequence if the entire source-rock system is sealed and confined. This generated fluid pressure supplements aquathermal pressure caused by thermal expansion of water but is more focused in time and space and is, therefore, a more important factor in internal migration and expulsion than aquathermal pressure.

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Post-Compaction, Subsurface Secondary Porosity Generation, and Occlusion in Upper Jurassic Smackover in Southern Arkansas

The upper Smackover (Oxfordian) in southern Arkansas consists of a high energy, blanket sequence of ooid grainstones. It is a prolific gas and oil producer. Regional and field petrographic studies of reservoirs lead to the conclusion that porosity distribution is primarily controlled by post-compactional diagenetic processes. The most significant processes are calcspar cementation, occluding or reducing intergranular porosity, and dissolution, leading to evolution of vugs and enlargement of primary intergranular pores.

The calcspar cement occurs as large poikilitic crystals, cementing several grains, or as blocky crystals with straight "compromise" boundaries. The cement binds crushed grains and particles of spalled-off oolitic laminae. Pressure solution microstylolites between adjacent grains do not extend into the cement crystals; cement generally pre-dates hydrocarbon emplacement, although some cements do contain hydrocarbon inclusions indicating that the timing of migration and cementation was nearly coincidental.

The secondary pores consist of equidimensional or elongate vugs, from a few to several hundred microns in size. The dissolution post-dates all other diagenetic phases, excluding stylolitization.

Both the calcite precipitation and dissolution are related to hydrocarbon migration, as well as to the updip movement of deep-seated brines, originating from the Louann Salt basins, evolving finally to calcium chloride brines, commonly found in the Smackover reservoir.

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Powder River Basin "High" and its Implications for Future Exploration

A large basement "high," or structurally positive element, defined by isopach maps and Bouguer gravity