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.

MOMPER, JAMES A., Amoco Production Co., Tulsa, OK

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.

MOORE, CLYDE H., and YEHEZKEEL DRUCKMAN, Louisiana State Univ., Baton Rouge, LA

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 anomaly maps, has been identified in the central part of the Powder River basin, Wyoming. By comparing productive areas and sandstone trends to the high, it is apparent that it has affected deposition of sedimentary units since at least Lower Cretaceous time and conceivably since marine foreland deposition began.

Sandstone sequences, such as the Muddy Formation, deposited in a primarily fluviodeltaic environment were deflected around the flanks of the high whereas units deposited in a predominantly marine system, such as the Shannon, had their best sandstone development on top of the high. Understanding the relations between the positive element and sandstone distribution is an obvious aid to exploration.

Similar highs in other Rocky Mountain structural basins are identified and exploration targets discussed. These highs provide early migration paths for hydrocarbons, platforms for the development of porosity in clastic rocks, and in some places, can be shown to be areas unfavorable for exploration because of the absence of sandstone.

MORRISON, LAWRENCE S., Lamima Corp., Ardmore, OK

Oil Production from Fractured Cherts of Woodford and Arkansas Novaculite Formations, Oklahoma

The chert section of the Woodford Formation has been known to be productive of oil and gas for at least 30 years. However, little was known about the chert as a reservoir until 1969 when Jones and Pellow Oil Co. and Westheimer-Neustadt Corp. jointly developed the Northeast Alden pool extension in T7N, R13W, Caddo County, Oklahoma. Cores, thin sections, X-ray analyses, and combustion tube studies indicate that the Woodford Chert is a prime source bed for hydrocarbons, and when fractured is an excellent reservoir.

In February 1977, Westheimer-Neustadt Corp. drilled the No. 1 Wallace in Sec. 2, T8S, R5E, to test the Arkansas Novaculite, which is similar to the Woodford Chert, and completed the well for a potential flow of more than 1,000 bbl of oil per day. The significance of the discovery has not been fully realized by industry in that it may have opened a new petroleum province in the Ouachita facies that extends from southeastern Oklahoma in a broad arch for over 600 mi (966 km) to the Marathon Mountains near the Mexican border.

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Getting the Most Out of Radon Geochemistry

Radon and radium are specific indicators of uranium. Radon in particular is easily analyzed in the field or in a portable lab. For this reason and because of its mobility as a soluble noble gas, radon has received considerable attention in exploration. The mobility of radon is complicated by its short half-life (3.8 days) and by movements of earlier members of the decay series.

Claims of the successful application of radon geochemistry to detect uranium deposits beneath several tens of meters of cover (including shale and coal beds) seem extravagant but may warrant further study. In areas of shallow overburden, radon in soil gas can extend evaluation to depths beyond reach of the scintillometer. Radon to thoron ratios are useful in this work as well as radon content itself. Day-to-day variations of radon content in soil gas are confusing, but seldom obscure trends and anomalies.

Lake-water radon anomalies are associated with two recent major uranium discoveries in the Canadian Shield. In both discoveries, the radon anomalies were detected in the earliest stages of exploration in the area.

Radium, the parent of radon, also can be readily determined in a portable laboratory. In an example from southeast Texas, a dramatic reduction in radium values has been measured in groundwater within a few hundred feet of an orebody. Anomalous radium measurements other than those associated with uranium mineralization or geothermal waters are extremely rare.

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Cementation, Diagenesis, and Paragenetic Sequence in Biyad-Wasi Sandstones (Lower-Middle Cretaceous) of Central Saudi Arabia

Although most of the Biyad-Wasi sandstones are friable and poorly cemented, some specimens reveal some cementation principally by secondary silica (or quartz), carbonate, or ferruginous material. The Biyad-Wasi sandstones have undergone several important diagenetic changes during their postdepositional history. The full paragenetic sequences commence with primary partial silica cementation, which was followed by precipitation of iron solutions in the remaining pore spaces; both these stages involved quartz overgrowths, produced as a result of pressure solution. Later stages resulted in precipitation of iron-rich clays and carbonate in new pore spaces created by partial replacement and corrosion of detrital quartz grains. The lack of quartz overgrowths is believed to be due to inhibition of pressure solution in these stages. The final diagenetic stages include weathering, which has created new pore spaces, and precipitation of silica dust (probably of aeolian origin) in such pores, and the formation of secondary silica overgrowths in the form of microcrystalline quartz. This process gives rise to the "quartzitic" crusts developed on many elevated outcrops of the Biyad and Wasi sandstones.

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Evolution of Brooks Range Thrust Belt and Arctic Slope, Alaska

Rotation of a small continental lithospheric plate in Early Cretaceous time formed the southern part of the Canada basin of the Arctic Ocean and an Atlantic-style extensional plate margin underlying the continental shelf north of Alaska. Simultaneously a compressional margin formed to the south, causing over 500 km of crustal shortening and large-scale obduction of ophiolitic rocks over the leading edge of the Arctic alaska plate. An asymmetric foredeep north of the thrust belt is filled with Neocomian to Albian lithic flysch derived from the imbricated sedimentary and mafic-ultramafic igneous terranes. Middle and Late Cretaceous isostatic rebound of the depressed sialic crust resulted in several kilometers of vertical uplift in the southern Brooks