Oil-filled inclusions are characterized by fluorescence spectra. In many cases, different episodes of hydrocarbon migration are indicated by the occurrence in the same crystal of oil-filled inclusions whose fluorescence spectra are different.

The organic chemical compositions of aqueous and oil-filled inclusions are determined by decrepitation-gas chromatography. Those compositions are compared to organic compositions of whole reservoir rock, reservoir oils, and source rock to decipher the history of oil emplacement and maturation. Oil alteration effects, possibly induced during the early stages of migration, are also detected.

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Petroleum Resources of North American Arctic Basins

Seven geological provinces considered to be highly prospective for hydrocarbon accumulation are known to exist in the North American Arctic, extending from the Wandel Sea in the east to the Chukchi Sea in the west. Each of the provinces contains thick sedimentary sections, identified source rocks, and favorable trapping configurations that have known or probable hydrocarbon accumulations. Sediments range in age from the early Paleozoic rocks of the Arctic stable platform to the late Tertiary and Holocene sediments of the Beaufort Sea.

Active exploration to date has been limited to the Alaskan Arctic Slope, Mackenzie Delta-Beaufort Sea, and Sverdrup basin where exploration activity has been largely focused around several significant discoveries. Relatively sparse drilling has tested hydrocarbons in the Arctic stable platform and Franklinian geosyncline regions, although no major accumulations have been identified. Wandel Sea and most of the Baffin Bay basin have yet to be tested by drilling.

The range of estimates of undiscovered potential must reflect a high level of uncertainty for most of these provinces until such time as exploration drilling has tested not only the current targets but also some of the completely untested plays. Because of the constraints imposed by hostile environments, remoteness of location, and costs of operations, none of the provinces has received the exploration effort commensurate with their geological prospectivity.

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Late Tectonic History of Beaufort Sea-North Pacific Area

The Kaltag fault (and its northern associated splay, the Rapid fault array) is the sheared suture between the Eurasian-Alaskan plate and the North American plate in the area between the Mackenzie Delta and the Alaskan Border. This condition has been maintained throughout considerable additional phases of faulting and folding from mid-Cretaceous to the present. Previously, the Alaskan plate had been the northwestern nose of the North American plate. The interplate suture was deflected to the north as the Canadian Shield was approached. The Kaltag fault continued northeastward 2,000 km seaward of the Sverdrup rim, northwest of the Canadian Arctic Islands, and north of Greenland. The driving force was directed from the southwest by the Eurasian plate after its collision in Early Cretaceous (Hauterivian) with the North American plate and the docking of north-moving exotic terranes from the Pacific.

During the early Tertiary, perhaps in concert with the accretion of the Okhotsk block to the Asian plate north of Japan, the northern Pacific subduction zone jumped southward to the Aleutian Arc where it has persisted until today.

A distance of 800 km separates the stable shelf of the Canadian craton, at the Alberta Foothills thrust belt, from the subduction zone off Vancouver Island. The foreland thrust belt and the accretion of exotic terranes in Mesozoic and Tertiary times extended the continental crust of the North American plate westward to the present active transform margin with the Pacific plate along the Queen Charlotte fault zone.

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Regional Paleogeography and Habitat of Hydrocarbons in Ouachita Foredeep Basins

Nine present-day structural basins occur along the leading edge of the Ouachita thrust belt, a 1,400 mi (2,250 km) Paleozoic overthrust trend that extends from the Appalachians to Mexico. These basins, now separated by either subtle arches or pronounced basement uplifts, are components of a widespread late Paleozoic foredeep that formed in front of the Ouachita orogenic belt as a result of tectonic loading. This elongate depression filled during Pennsylvanian and Permian times with up to 15,000 ft (4,590 m) of sediment ranging in origin from alluvial to deep marine.

An estimated 10 tcf of commercially recoverable natural gas has been discovered to date in the clastics of this foredeep basin trend. Four basins contain the bulk of these known reserves.

The major conclusions of a study of late Paleozoic paleogeography, the structural style, and the habitat of hydrocarbons in this foredeep trend are:

1. The clastics were derived from cratonic or Appalachian sources, not from the rising Ouachita orogene. There appear to be a least 4 major entry points along the northern margin of the foredeep.

2. The facies range from coal-bearing deposits to deep-water turbidities. Fluvial and shallow-marine facies are found in the more stable areas; several turbidite depocenters occur in the areas of rapid, early subsidence.

3. The vast majority of the discovered hydrocarbons (gas) occurs in gas-saturated deep-basin traps. These very large fields occur in turbidites (Val Verde and Arkoma basins) and fluvial to shallow-marine deposits (Fort Worth basin).

4. Large undeveloped reserves can be documented in several basins in low-permeability reservoirs. In addition, there has been only rank wildcat exploration in 3 of the basins—Desha, Kerr, and Marfa.

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Quantitative Shape Analysis of Carbonate Sands by Use of Contour Registration and Template Matching

Carbonate sands are composed of relatively few particle types (e.g., *Halimeda*, coralline algae, corals, mollusks, and foraminifera). The shape of a particular sand grain is highly dependent on the particle type of which it is composed. Previous, studies of modern carbonate environments show that the composition of sand substrates from different subenvironments are dependent on the organisms that inhabit them. These depositional environments can thus be distinguished from each other according to their constituent particle compositions and, therefore, also by analysis of particle shapes.

Template (shape) matching can be accomplished only after the digitized shapes have been normalized to a unit-sized circle and registered. Registration involves the simple computation of shape-specific points within, on, or near the 2-dimensional contour of the sand grain. Shapes are subsequently rotated so that all of the shapes are in a similar position relative to their shape-specific points, allowing more meaningful comparisons between particles. After registration, 36 equi-angular radial lengths are calculated for grain from the center of mass to the boundary outline. A template-matching algorithm was devised in order to determine the relative percentages of several reference shape types, representing the constituents contained within 35 samples from 4 carbonate beaches and associated subtidal environments from the Florida Keys. Reference shapes may be chosen arbitrarily or obtained by computing average shapes of the various constituents. The precision of the shape classifications may be enhanced by adding supplemental reference shapes to the algorithm.

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Application of Structures Mapped from Landsat Imagery to Exploration for Stratigraphic Traps in Paradox Basin

Significant quantities of petroleum occur in algal buildups of Pennsylvanian age in the Paradox basin. Isopach and lithofacies mapping by others suggest that low-relief paleostructures appear to have controlled Pennsylvanian sea-floor topography and thus the distribution of the buildups. Several workers have reported that these paleostructures trend northwest and northeast. Therefore, the basin can be visualized as a