for its emplacement would have had a $\delta^{18}O$ value of approximately +12 ‰. These data suggest that the mineralized quartz veins formed from fluids derived from the Valdez Group during metamorphic dewatering.

PLUMLEY, PETER W., Univ. California, Santa Cruz, CA, and I. L. TAILLEUR, U.S. Geol. Survey, Menlo Park, CA

Paleomagnetic Results from the Sadlerochit and Shublik Mountains, Arctic National Wildlife Range (ANWR), and Other North Slope Sites, Alaska

Carboniferous through Triassic sedimentary units exposed in the Shublik and Sadlerochit Mountains were sampled in an attempt to obtain reliable primary magnetic components. Reliable pre-Cretaceous paleomagnetic poles from this area would greatly advance the understanding of the rotation and latitudinal displacement history of the North Slope.

Carbonate rocks of the Carboniferous Lisburne Group were drilled in south-dipping units of Katakturuk Canyon, Sadlerochit Mountains, and in the north-dipping Fire Creek section, Shublik Mountains. Magnetic cleaning involved stepwise thermal demagnetization to 550°C. Principal component analysis of the demagnetization results defines two major components of magnetization. The secondary component is steep and down (inc = 87°), but the characteristic component (325°C-500°C) is reversed. The secondary magnetization postdates Cretaceous and younger folding, whereas the characteristic component was acquired before folding. The components may have recorded two phases of overprinting: a Late Cretaceous into Cenozoic normal overprint and a predeformation remagnetization episode during a time of reverse polarity. However, the reverse component more likely is primary remanence. If so, it would suggest little latitudinal displacement but 40° of clockwise rotation with respect to North America.

The Devonian Nanook Limestone, sampled in the Shublik Mountains, also reveals two major components of magnetization; however, the characteristic component is isolated at blocking temperatures greater than 500°C and is shallower in inclination than expected from the Devonian reference pole for North America.

The recovery of the reversed characteristic component in this study is a significant result by itself. It is good evidence that at least part of the northeast Brooks Range has escaped the thorough Cretaceous normal-polarity overprinting that has been observed in the north-central Brooks Range. We hope that analyses of additional samples from the Katakturuk Dolomite, Nanook Limestone, Lisburne Group, Sadlerochit Group, and Shublik Formation in ANWR and from the Triassic and Jurassic Otuk Formation in the east-central foothills will also discriminate pre-Cretaceous magnetizations and will provide constraints on the time they were set.

PRINDLE, DAVID B., Geoph. Inst., Univ. Alaska, Fairbanks, AK

Marine Magnetic Survey of Kachemak Bay, Alaska

Kachemak Bay in south-central Alaska is approximately 38 mi (60 km) long and 13 mi (20 km) wide at the mouth. Geologically, Kachemak Bay marks the boundary between the Mesozoic rocks of the Kenai Mountains and the low-lying Tertiary sediments of the northwestern part of the Kenai Peninsula. The Border Ranges fault is believed to traverse the bay, though the fault's exact location is not known. In the summer of 1981, a marine magnetic survey was carried out to locate the fault and/or other geologic boundaries. The magnetic data indicate that a fault, presumed to be the Border Ranges fault, traverses the bay between the Seldovia and Homer areas. The location of what is inferred to be the contact between the Mesozoic and Tertiary rocks can also be seen in the magnetic data. The data also suggest the existence of an ultramafic body beneath the bay.

RAFFALDI, FRANK, Shell Oil Co., Houston, TX, and DAVID LOVENVIRTH, Exploration Logging, Sacramento, CA

Satellite Transmission of Geologic Data from the Ocean Odyssey

Current satellite communications technology makes it possible and practical to transmit geological and other information from remote oil rigs, under adverse environmental conditions. Under such critical conditions, the ability to provide experts, who are at a significant distance from the rig, with the information necessary to understand what is happening and to carry out timely interpretations has an important impact on successful exploration and economic objectives.

The Ocean Odyssey, operated by Shell in Alaskan waters, provides a practical example of the benefits of satellite communications. From locations in the Bering Sea, Shell is transmitting information to its offices in both Anchorage and Houston for review and analysis. Digital information, suitable for detailed processing and analysis by a mainframe computer is also transmitted. Transmissions designed for managerial and specialist review include periodic reports and tabular printouts, as well as selective color plots of key parameters. The latter are being sent at key points in the drilling process and in response to specific office-based requests for information. Examples of useful transmission formats are provided.

A close relationship exists between the status of well-site operations and the manner in which data communications are carried out. Operational schedules are normally keyed to the work schedule on the rig. But as office-based users become accustomed to examining timely information, additional transmissions are requested. With the present satellite communications configuration the operational schedule is also constrained by the availability of the satellite link. Data communications are based upon batch transmission in which digital information, prints, plots, and reports are accumulated according to the operational schedule and then transmitted, via the Inmarsat satellite. Automatic error correction assures that the information arriving at each office is reliable. Automatic data-encryption assures that the information is properly secured against unauthorized access.

Extensive planning is necessary to allow for special problems that arise in establishing a satellite communications link from offshore rigs. These range from technical considerations in providing effective satellite coverage over a wide geographical area in which the offshore rigs may range, to equipment placement and operation, to the development of effective training programs for personnel on the rig and in the office. The elements of the plan are discussed, and examples drawn from the Ocean Odyssey are reviewed. Estimates of actual communication-time requirements are provided along with some of the cost and benefit considerations.

RAO, P. D., J. S. YOUTCHEFF, and J. E. SMITH, Univ. Alaska, Fairbanks, AK

Chemical and Petrographic Characterization of Drill Core from Beluga Coalfield.

Chuitna River field is part of the Beluga-Yentna field in the upper Cook Inlet basin. Coal occurs in the Tertiary rocks of entirely continental origin. In order to characterize the vertical variation of coal more completely and to understand the environments of coal deposition, a drill hole was cored to a depth of 290 ft with the help of Diamond Alaska Coal Co. The core included five coal beds: Blue (bottom 15 ft), Red 3 (13 ft), Red 2 (26 ft), Red 1 (16 ft), and Purple (5 ft). These beds were sampled foot by foot and were characterized for ash, moisture, ash fusibility, ash composition for major oxides and trace elements, vitrinite reflectance, and petrographic composition under normal incident light as well as fluorescent illumination. A palynological evaluation is in progress. Ultimate analyses were made for 5-ft intervals.

Ash composition of foot-by-foot samples varied widely. For example SiO_2 ranged from 0.58 to 65%, Fe_2O_3 from 1.97 to 57%, CaO from 2.5 to 35%, P_2O_5 from 0.07 to 17%, and Ba from 0.19 to 3.7%. Petrologic analyses showed less drastic variations within a seam. The wide variation in ash composition, particularly of iron and silica, among others, is indicative of periodic changes in pH of the swamp environment. Lack of high inertinite zones within the seams studied shows that the swamp was not subjected to drastic changes in the water table and that the subsidence kept pace with peat accumulation during the formation of each of the seams.

RATTEY, R. P., BP Explor. Inc., San Francisco, CA

Northeastern Brooks Range, Alaska: New Evidence for Complex Thin-Skinned Thrusting

Extensive fieldwork has shed new light on the style of deformation in the Franklin, Romanzof, and British Mountains of the northeastern Brooks Range. Bedding-parallel thrusting controls the structure, and two major decollements are recognized. In the mountain belt, the lower one lies in the Lower Carboniferous Kayak Formation but often steps down to the base of the Upper Devonian Kanayut or Lower Carboniferous Kekiktuk Conglomerates. Near the Sadlerochit and Shublik Mountains, it steps down to its deepest level to the base of the Cambrian to Middle Devonian Katakturuk Dolomite. The upper decollement is poorly exposed in the mountains and lies in the Jurassic Kingak Shale. Locally, these are removed by Early Cretaceous erosion and the decollement steps upsequence.

The two decollements separate three tectonic sequences that deform differently. First, basement below the lower decollement deforms into a set of thrust duplexes. The core of these is well exposed in the Franklin Mountains. The Sagavanirktok sidewall ramp is a major basement structure that causes the northern swing in the mountain front between the central and northeastern Brooks Range. Second, the lower cover between the two decollements deforms more complexly than basement by both passive drape over the underlying duplexes and by active thrust stacking. Large-scale buckle folding occurs in a shear zone above the Sagavanirktok sidewall ramp. Third, the upper cover above the upper decollement is poorly preserved in the mountains as allochthonous klippe in depressions in the basement and lower cover duplexes.

Crustal shortening across the eastern Brooks Range is estimated by two-dimensional section balancing at over 400 km. This is substantially more than previous estimates and is comparable to those for the western Brooks Range. The inferred lack of relative rotation between the western and eastern Brooks Range does not substantiate a rotational opening for the Arctic Ocean.

REININK-SMITH, LINDA M., Univ. Alaska, Fairbanks, AK

Description and Mineralogy of Tertiary Volcanic Ash Partings and Their Relationship to Coal Seams, Near Homer, Alaska

Outcrops of Tertiary coal-bearing units in sea cliffs of the Kenai Peninsula provide an excellent study area for volcanic ash partings in coals. Twenty mid- to late-Miocene, 50-cm to 3-m thick coal seams exposed in the sea cliffs about 10 km west of Homer contain an average of 10 volcanic ash or lapilli tuff partings each. The bedding relationships of the coal with any one parting cannot be predicted, and the contacts of the partings with the coal range from very sharp to predominantly gradational. These bedding relationships provide clues about the surface on which the ashes fell and on which the coal was accumulating. For example, some ashes fell in standing water, others on irregular subaerial surfaces.

The partings are in various stages of alteration to kaolinite and bentonite, and vary in thickness from a few millimeters to about 10 cm. The consistency and texture of the partings depend on the degree of alteration; the less altered partings display visible pumice fragments and euhedral feldspars, commonly within a finer grained matrix. Separate pumice fragments, excluding matrix, can also occur as partings in the coal. The more altered partings may be wet and plastic, or they may be well indurated claystones; the colors range from gray-yellow to dark brown. The indurated partings are more common in the older part of the section. The coal seams may be capped by volcanic ash partings and are commonly underlain by a pencil shale of nonvolcanic origin.

RYHERD, TIMOTHY J., Univ. Alaska, Fairbanks, AK, and CHESTER E. PARIS, ARCO Alaska, Inc., Anchorage, AK

Lower Paleozoic Carbonate Slope-Sequence, Northern Seward Peninsula, Alaska

Examination of a lower Paleozoic carbonate unit exposed along the northern coast of the Seward Peninsula revealed an undeformed section at Cape Deceit, greater than 160 m (525 ft) thick, that represents part of a prograding carbonate submarine-fan sequence. The top 60 m (200 ft) of the sequence is a massive, disorganized, carbonate conglomerate interpreted to be debris flows deposited in large feeder channels of an inner-fan complex. Stratigraphically below this interval are channelized conglomerates and calcarenites, 40-50 m (131-165 ft) thick. Overall, this section thickens and coarsens upward but is composed of many thinning- and fining-upward cycles, 2-8 m (7-26 ft) thick. This section probably represents channel deposits of the midfan complex. The bottom part of the sequence consists of a coarsely crystalline, thinly bedded limestone section overlying a calcareous shale section. The beds within this section are laterally extensive and represent outer-fan, fan-fringe, and basin-plain deposits.

Although no recognizable megafossils were found in the Cape Deceit section, Silurian conodonts have been reported by other workers. Rugose coral fragments of indeterminate age were found in an undeformed section, 19 km (10 mi) to the east, which appears to be correlative with the Cape Deceit section.

SABLE, EDWARD G., and GARY D. STRICKER, U.S. Geol. Survey, Denver, CO

Coal in National Petroleum Reserve in Alaska (NPRA): Framework Geology and Resources

The North Slope of Alaska contains huge resources of coal, much of which lies within NPRA. The main coal-bearing units, the Corwin and Chandler Formations of the Nanushuk Group (Lower and Upper Cretaceous), underlie about 20,000 mi^2 (51,800 km^2) of NPRA. They contain low-sulfur, low-ash, and probable coking-quality coal in gently dipping beds as thick as 20 ft (6.1 m) within stratigraphic intervals as thick as 4,500 ft (1,370 m). Lesser coal potential occurs in other Upper Cretaceous units and in Lower Mississippian and Tertiary strata.

The river-dominated Corwin and Umiat deltas controlled the distribution of Nanushuk Group coal-forming environments. Most organic deposits formed on delta plains; fewer formed in alluvial plain or delta-front environments. Most NPRA coal beds are expected to be lenticular and irregular, as they probably accumulated in interdistributary basins, infilled bays, or inland flood basins, whereas some blanket beds may have formed on broad, slowly sinking, delta lobes. The major controls of coal rank and degree of deformation were depth of burial and subsequent tectonism.

Nanushuk Group coal resources in NPRA are estimated to be as much as 2.75 trillion short tons. This value is the sum of 1.42 trillion short tons of near-surface (< 500 ft or 150 m of overburden) bituminous coal, 1.25 trillion short tons of near-surface subbituminous coal, and 0.08 trillion short tons of more deeply buried subbituminous coal. These estimates indicate that the North Slope may contain as much as one-third of the United States coal potential.

SCHOLL, DAVID W., ALAN K. COOPER, and MICHAEL S. MARLOW, U.S. Geol. Survey, Menlo Park, CA

Terrane-Capture Concept for the Origin of the Aleutian–Bering Sea Region—Implications for Petroleum Resources in the Deep-Water Aleutian Basin

Regional geological and geophysical relations support the notion that the basement of the Aleutian basin of the Bering Sea is a far-traveled terrane of oceanic crust. This terrane—named Aleutia—is probably a fragment of Pacific lithosphere (Kula plate?) that formed at an equatorial spreading center in the Early Cretaceous. Aleutia arrived in the Aleutian-Bering Sea region about 55 Ma and was accreted to the Alaskan-Siberian continental margin when a long-established subduction zone located there was abandoned and shifted southward to the present offshore position of the Aleutian Arc. Formation of the arc entrapped Aleutia in the Bering Sea and thereby formed the Aleutian basin, which has since accumulated a geosynclinally massive overlap assemblage of rise-prism and basin-plain deposits as thick as 12 km.

The capture concept of Aleutia introduces two speculative circumstances relevant to assessing the resource potential of the Aleutian basin. First, the likelihood that in the middle Cretaceous its relatively shallow submerged basement resided near an equatorial spreading center implies that younger basin-plain deposits of the overlap assemblage may have accumulated above oceanic pelagic beds rich in organic matter. Elsewhere in the Pacific, middle Cretaceous beds deposited on bathymetric highs are known to be uncommonly rich in organic matter (C_o = 1-9%). Second, if deposits of the global anoxic event accumulated on Aleutia, it is likely that large amounts of organic matter were conveyed to the now-abandoned Mesozoic subduction zone at the base of the Alaskan-Siberian margin. Pelagic source beds for hydrocarbons may therefore be stored within fossil subduction complexes buried beneath the present continental rise prism.