Windy River placer deposit at Red Mountain and inferred reserves at the Halibut Bay complex on Kodiak Island. Seventy less-accessible deposits in the remote western Brooks Range contain between 0.6 and 1.4 million tons of high-chromium chromite. The Rampart, Yukon-Koyukuk, and Alaska Range trends and the southeast Alaska region contain deposits with minor production potential.

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Neogene Drape Folding Over Pre-Neogene Flexural-Slip Movements in Western Transverse Ranges, California

In several locations in the western Transverse Ranges of California are folded Neogene sedimentary sequences that unconformably overlie homoclinal sequences of pre-Neogene rocks. To accomplish the folding of the rocks above the unconformity without apparent deformation of those below the unconformity, a mechanism other than simple crustal shortening is required. It is proposed that differential flexural slip along bedding planes in the limbs of large-amplitude pre-Neogene folds produced drape folds of small amplitude in the unconformably overlying Neogene rocks. This drape mechanism implies that the Neogene rocks were folded while they were still in the soft-sediment stage and that they were lengthened parallel to bedding during the process. Procedures that use the length of folded beds to determine the amount of crustal shortening, therefore, may indicate a greater amount of crustal shortening than actually occurred.

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Seastacks Buried Beneath Newly Reported Lower Miocene Sandstone, Northern Santa Barbara County, California

Three large, isolated exposures of a light-gray, coarse-grained, thick-bedded sandstone unit occur in the northern San Rafael Mountains of Santa Barbara County, California. These rocks are moderately fossiliferous and contain *Vertipecten bowersi, Amussiopecten vanvlecki, Aequipecten andersoni, Otrea howelli,* shark teeth, whale bones, and regular echinoid spines. The fossils indicate that the sandstone unit, although previously reported as upper(?) Miocene, correlates best with the lower Miocene Vaqueros Formation.

This unit was deposited in angular unconformity on a Cretaceous, greenish-gray turbidite sequence of interbedded sandstone and shale, and onlaps the unconformity erosion surface from west to east, the unit being thicker in the west and older at its base. The underlying Cretaceous sandstone beds are well indurated, and during the eastward transgression of the early Miocene sea, they resisted wave erosion and stood as seastacks offshore of the advancing coastline, thus creating a very irregular topographic surface upon which the Vaqueros Formation was deposited. Some seastacks were as much as 4 m tall, as indicated by inliers of Cretaceous rock surrounded by 4-m thick sections of the Vaqueros Formation.

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Smectite Diagenesis in Bentonites of Shale Wall Member of Seabee Formation, North Slope, Alaska

The Upper Cretaceous Colville Group is present over much of the north-central North Slope and includes the Seabee Formation, a part of a progradational clastic wedge derived from the ancestral Brooks Range. The lower member of the Seabee Formation, the Shale Wall Member, contains thin to moderately thick bentonite beds. Biotite separated from bentonite from the Shale Wall Member in the northwestern subcrop area yielded K/Ar ages of about 92 Ma, dating the origin of these pyroclastic deposits as early Turonian. In the northern part of the National Petroleum Reserve in Alaska (NPRA) and in the vicinity of Prudhoe Bay field, the less than 2-millimicron fraction of Shale Wall bentonites consists predominantly of smectite with trace to minor amounts of kaolinite. Eastward along the Barrow arch, the depth of burial of the Shale Wall Member increases from less than 300 m in the NPRA to at least 3,855 m in the vicinity of Mikkelsen Bay as a result of downwarping of the Barrow arch and thick Tertiary deposition. At a depth of burial of about 3,600 m, the smectite-rich bentonites are replaced by rectorite, an ordered mixed-layer illite/smectite (I/S). With increasing depth of burial, the percentage of expandable layers in the ordered I/S decreases from about 45% to 20%. K/Ar dating of the ordered I/S phase places the time of formation in the mid-Miocene, in close agreement with predicted timing of clay diagenesis based on burial history/thermal gradient considerations.

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Effect of Geothermal Pore-Pressure Conditions and Natural Gas Composition on In Situ Natural Gas Hydrate Occurrences, North Slope, Alaska

The factors controlling the distribution of natural gas hydrates (solid compounds composed of natural gas and water) in the earth include mean annual ground temperatures, geothermal gradients, subsurface pressure conditions, gas composition, and pore-fluid salinity. A thorough analysis of the effect of these parameters on thickness and depth of hydrate stability zones has been conducted. A thermodynamic model has been used to compute depth and thickness of zones of stability of gas hydrates in 34 representative wells on the North Slope. Several well logs in these depth ranges have been analyzed to determine hydrate zone thickness, porosity, and hydrate saturation. In well log analysis, the hydrate presence has been indicated by the following evidence: increase in acoustic velocity, strong resistivity deflection, small spontaneous potential deflection, gas shown on mud log, oversized caliper increase in the neutron porosity, separation of long normal from short normal, and decrease in drilling rate. In several of these wells, multiple zones of hydrates have been detected.

In the Prudhoe Bay and Kuparuk fields, hydrates are expected to occur primarily in six stratigraphic horizons, mostly in an unconsolidated unit characterized by a poorly sorted sandstone and conglomeratic lithology. Detailed examination of the neutron porosity and sonic velocity responses within one hydrate horizon in six wells in Kuparuk field indicates an average porosity of 44% and hydrate saturation of 93%. Such information is extremely relevant to quantification of gas hydrate deposits.

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Genesis of Gold Deposits in Chugach Terrane of South-Central Alaska—Evidence from Fluid Inclusions

Gold-bearing quartz veins occur in shear zones, faults, and joints within the Upper Cretaceous Valdez Group flysch in the Kenai and Chugach Mountains of south-central Alaska. The veins are regionally restricted to areas of medium greenschist-grade metamorphic rocks and are notably absent in lower and higher grade metamorphic rocks.

Fluid inclusion studies were conducted on samples of gold-bearing quartz from the Moose Pass, Hope-Sunrise, Port Wells, and Port Valdez districts. Ice and clathrate melting temperatures indicate that the ore-forming fluids had low salinities, ranging from 0 to 5-equivalent wt.% NaCl. These fluids contain appreciable amounts of dissolved gases, as shown by the nearly ubiquitous formation of clathrates during inclusion freezing and by the common presence of three-phase inclusions consisting of aqueous fluid, liquid CO_2, and vapor. Total gas content varies from essentially nondetectable to as much as 10 vol.%. Freezing measurements on the inclusion fluids show the gas composition to vary from nearly pure CO_2 to mixtures dominated by CH_4 and N_2. Inclusion data indicate minimum trapping pressures of 1.5 kbar and corrected homogenization temperatures ranging from 260°C to 330°C.

We believe that the gold-bearing veins represent pathways for the escape of metamorphic fluids during rapid uplift of the Chugach and Kenai Mountains. The veins are believed to have formed along hydraulic fractures or along dilated preexisting fractures, created when fluid pressure exceeded load pressure.

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Relative Motions between Eurasia and North America in Bering Sea Region