calcareous phyllites of the Hadrynian to Lower Cambrian Mt. Mye Formation and the Lower Cambrian to Lower Ordovician calcareous phyllites of the Vangorda Formation.

The Grum deposit is similar to other Anvil deposits and can be divided into four major ore facies. These occur in stratigraphic succession from a basal and marginal "ribbon-banded" graphitic quartzite (representing both sedimentary and hydrothermal inputs) upward through pyritic quartzites, massive pyritic sulfides, and finally baritic massive sulfides and sulfates. This zonation is well developed in one of the sulfide horizons at Grum, and could be caused by increasing fO_2 and pH or by decreasing temperature. A sericitized alteration envelope incompletely surrounds the ore horizons and is related to ore fluid influx. Deposition most likely occurred in localized sea-floor deeps from anoxic hydrothermal brines.

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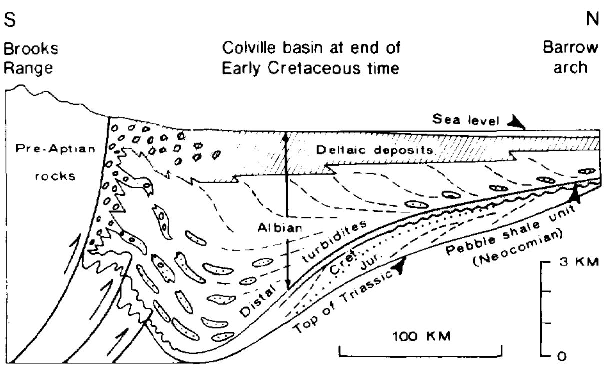
Depositional History and Seismic Stratigraphy of Lower Cretaceous Rocks, National Petroleum Reserve, Alaska and Adjacent Areas

Knowledge of depositional history of Lower Cretaceous rocks in the National Petroleum Reserve in Alaska is necessary for predicting the occurrence of potential sandstone reservoirs. These rocks range in thickness from 7,000+ m along the Colville basin axis to about 1,200 m on the Barrow arch. Lower Neocomian strata on the north flank of the basin consist of southward prograding marine shelf and slope deposits of shale and minor sandstone units. Uplift, erosion, and subsequent transgression on the northernmost flank of the basin resulted in deposition of the pebble-shale unit in late Neocomian time and termination of the northern provenance. Following this, the basin was downwarped, and little deposition occurred on the north flank until distal, deep-water deposits of the Torok Formation onlapped and downlapped the south-dipping flank of the basin in middle or late Albian time.



On the south flank of the basin, southern-source turbidites of the Okpikruak Formation (early Neocomian) accumulated in a subsiding foredeep and were subsequently thrust northward in late Neocomian or Aptian time. The Fortress Mountain Formation (early Albian), which consists of as much as 3,000 m of mainly deep-water deposits, unconformably overlies the Okpikruak and older rocks on the southernmost flank of the basin. Filling of the Colville basin occurred in middle to late Albian time as thick prodeltaic and deltaic deposits of the Torok Formation and Nanushuk Group, respectively, prograded across the basin from the south on the south side of the basin, but prograded principally from the west-southwest over most of the basin.

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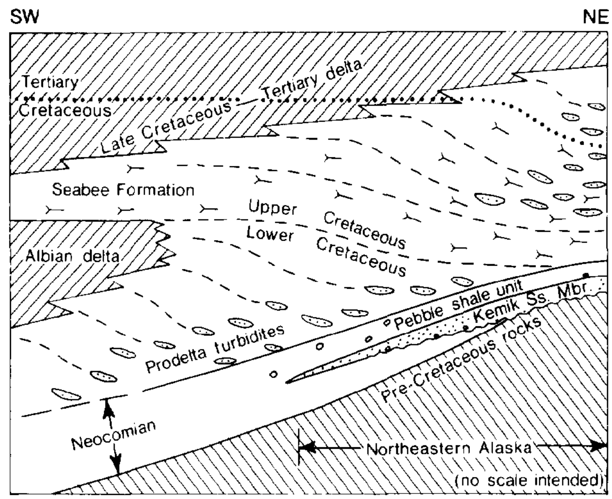
Cretaceous-Lower Tertiary Depositional Relations, Northeastern Alaska

Analysis of depositional environments and new paleontologic data indicate the need for a revised interpretation of Cretaceous and lower Tertiary stratigraphy in northeastern Alaska. A revision is important to the understanding of these rocks in unexplored areas to the north. In the Sadlerochit Mountains area, the late Neocomian transgressive Kemik Sandstone Member and pebble shale unit of the Kongakut Formation unconformably overlie Jurassic and Triassic rocks. The unconformity, which is present throughout northernmost Alaska, apparently grades to a conformable shelf sequence to the south. In the Sadlerochit Mountains area, Upper Cretaceous organic-rich shale and bentonite of



the Seabee Formation overlie the pebble shale unit; the intervening Aptian and Albian strata are either absent by nondeposition or are a thin, condensed section. Subsequent deposits of Late Cretaceous and early Tertiary(?) turbidites and shale were probably derived from east-northeasterly prograding deltas that are exposed west of the Canning River.

Cretaceous strata in the Sadlerochit Mountains area are about 700 m thick and contain no erosional unconformities. The comparatively thin section is attributed to the area being high (although still in deep water) relative to the Colville basin axis to the south, which was a sediment trap.

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Correlation of Thermal Conductivity with Physical Properties Obtained from Geophysical Well Logs

Thermal maturation studies of hydrocarbons in sedimentary basins require knowledge of the regional heat flow. Thermal conductivity data are necessary in deriving heat-flow estimates, but at present the only method available for obtaining conductivity values is by individual sample measurement in the laboratory. Many of the physical properties that are measured during geophysical well logging of petroleum boreholes are related to the same properties that determine thermal conductivity. The object of this study has been to derive an empirical relation in order to determine thermal conductivities from well-log data alone.

Three boreholes in New York State were investigated, all of which had porosity, sonic velocity, and electrical resistivity well-log data available. Thermal conductivities of drilling chips were measured on a needle probe apparatus. These data were correlated with the geophysical well-log data using multiple linear regression statistics.

An empirical relation for eastern New York State is $K = -42.5 \phi + 0.31 \times 10^{-1} \Delta t + 0.12 \times 10^{-3} \alpha + 3.24$ where K is thermal conductivity in watts/m°C, ϕ is porosity in percent, Δt is the interval transit time in μsec/ft, and α is electrical resistivity in ohms m^2/m. A goodness of fit of 0.885 and a multiple correlation coefficient of 0.941 indicate that the technique can be used for analysis of the variation in temperatures in the subsurface.

The data fell into two groups: (1) clastics with thermal conductivities ranging from 3.39 w/m°C to 3.92 w/m°C; and (2) nonclastics with thermal conductivities ranging from 3.04 w/m°C to 4.89 w/m°C.

The evaluation of temperatures in sedimentary basins can be greatly enhanced if empirical relationships are established for particular areas.

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Diagenesis of Sandstone/Shale Package, GCO/DOE No. 1 Well, Brazoria County, Texas

Petrographic analysis of closely spaced sandstone samples (GCO/DOE No. 1 well) of a sandstone/shale package from the Frio Formation (Oligocene) indicates that sandstone reservoir quality was influenced by shale diagenesis. Three alteration zones at increasing distance from the sandstone/shale contact are observed. This zonation may be explained as follows.

Organic and inorganic maturation processes modified shale fluids which, upon expulsion into the sand, resulted in the precipitation of thin, isopachous chlorite grain coatings in the contact sand. Late in the chloritization process and thereafter, unstable framework grain silicates began to dissolve within the sand. We believe that aluminum from framework grains was removed from the contact zone by mobile organic complexes. Silica released from grain dissolution reprecipitated as quartz cement. This contact zone is about 1-ft (0.3 m) thick.

As fluids passed into the second zone (about 1-ft (0.3 m) thick) the sandstone framework grain leaching continued but to a lesser degree. Kaolinite was produced from internal mass sources and from aluminum imported from the first zone. The net addition of alumina from the contact zone prevented development of quartz overgrowths in this zone and the third zone.

In the third zone, dissolution of framework grain silicates was least thorough because of greater distance from the shale and alteration appears to have been aluminum conservative.

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Dolomitization of Pleistocene Reef Sediments by Magnesium Leaching Out of Overlapping Volcanics, Mauritius Island, Indian Ocean

A hole drilled through basaltic rocks on the west coast of Mauritius Island encountered 3 m thick, partly dolomitized reefal deposits of middle Pleistocene age, 120 m below mean sea level. Above this carbonate bed is a sequence, about 50 m thick, of strongly weathered basalts and paleosoils.

The degree of dolomitization increases toward the overlying basalt. Low-magnesian calcite and dolomite are distributed along the core as follows: (1) entirely dolomite 0.5 m downward from the volcanic rock, (2) from 0.5 to 2 m below the base of the basalt, both calcite and dolomite, and (3) below 2 m only calcite. High calcium/magnesium ratios (1.2 to 1.4) indicate that protodolomite has replaced micrites (as 0.5 to 3 μm crystals) or sparites (as 10 to 30 μm, subhedral to euhedral crystals) and fills pores created by the dissolution of calcite, demonstrating the near contemporaneity of calcite solution and dolomite precipitation. The isotopic composition of the dolomite ($\delta O^{18} = +0.1$ to $+3.6‰$, $\delta C^{13} = -1.7$ to $+2.00‰$) and its relatively high strontium content (>500 ppm) suggest the system initially must have been partly closed in order to retain the O^{18}, C^{13}, and strontium of reef carbonates during dolomitization.

The calcium/magnesium ratio of the volcanic rocks decreases from the upper to the lower part of the series (0.66 to 0.075), confirming that higher magnesium contents present in the uppermost reef layers are derived from weathered basalts.

The chemistry of the dolomite and associated volcanic rocks strongly suggests that dolomitization was probably caused by leaching of magnesium out of the volcanic rocks and redistribution within carbonate sediments by descending waters.

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Depositional Environments and Processes of Calico Bluff Formation (Carboniferous), East-Central Alaska

The Calico Bluff Formation (Carboniferous) is an interbedded limestone and shale unit which is exposed along the Yukon River in east-central Alaska. A prograding submarine-fan model explains the observed lithofacies succession and sedimentary structures.

The rocks of the Calico Bluff Formation are subdivided into five lithofacies: (1) coarse-grained bioclastic limestone, (2) fine-grained bioclastic limestone, (3) platy micritic limestone, (4) calcareous shale, and (5) siliceous shale. Shallow-water fauna in the bioclastic limestones contrast with deep-water goniatites, straight cephalopods, and brachiopods found in the platy micritic limestone and calcareous shale. Sedimentary structures include graded bedding, sole marks, Bouma sequences, and soft-sediment deformation.

Depositional processes of the Calico Bluff Formation range from basinal pelagic sedimentation to sediment gravity flows. Both proximal and distal turbidites are recognized. Distal turbidites represent deposition in a lower-fan environment, whereas proximal turbidites are deposited in a mid-fan environment. Several thickening and coarsening upward cycles are recognized in outcrop. Individual cycles may represent shifting suprafan depositional lobes. Paleocurrent measurements indicate direction of transport to the south-southeast.

Micritic beds are probably calcareous pelagic oozes that have been transported downslope by turbidity currents and deposited in the basin. Calico Bluff Formation shales were deposited by suspension and weak suspension currents.

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Use of Computer Enhanced Landsat Imagery as Planning Tool for Resource Exploration

Computer-processed NASA Landsat data were used as an exploration planning tool in four potential hydrocarbon-bearing areas in the United States and Israel. The project areas are located in Montana, Washington, west Texas, and the Dead Sea (Israel).