with minor textural variations, but transgressive biomicrite facies occur locally. Mud texture, scarcity of fossils and other allochems, thin lamination, and probable algal-mat structures suggest sedimentation in a tidal-flat environment; dolomitization was pervasive and probably before lithification.

Fracture- and breccia-controlled pitchblende-coffinite ores are associated with epigenetic pyrite and marcasite; magnesium, iron, sulfur, molybdenum, and lead are enriched in the ore and uranium is independent of organic carbon. One surface expression of ore is ocher-colored, leached, porous gossan, characterized by residual silica and limonite and by high radioactivity but low uranium.

Guides to this type of deposit appear to include upthrust faulting, a thick section of brittle rocks attached to the basement, nearby radioactive plutonic or volcanic rocks, and presence of anomalous iron, magnesium(?), sulfur, and molybdenum. Sulfides, carbon, or hydrocarbons are possible reductants.

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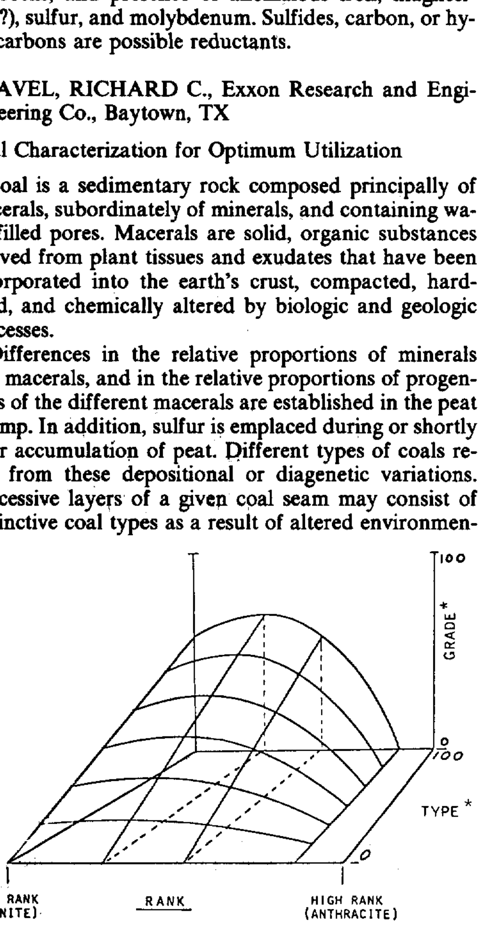
Coal Characterization for Optimum Utilization

Coal is a sedimentary rock composed principally of macerals, subordinately of minerals, and containing water-filled pores. Macerals are solid, organic substances derived from plant tissues and exudates that have been incorporated into the earth's crust, compacted, hardened, and chemically altered by biologic and geologic processes.

Differences in the relative proportions of minerals and macerals, and in the relative proportions of progenitors of the different macerals are established in the peat swamp. In addition, sulfur is emplaced during or shortly after accumulation of peat. Different types of coals result from these depositional or diagenetic variations. Successive layers of a given coal seam may consist of distinctive coal types as a result of altered environmental conditions. Thus, it is necessary to sample a coal seam carefully to avoid obtaining a biased sample.

Following deposition, relatively mild diagenetic and metamorphic processes alter the composition of the maceral progenitors, leading to increasing rank of the coal. The metamorphic alteration results largely from thermally induced chemical reactions which increase in severity with increasing depth of burial. Concomitantly, pressure reduces porosity and moisture-holding capacity, and increases hardness. Differences in type are retained irrespective of rank.

Both rank and type influence coal grade (value) orthogonally. Thus, though the rank of a coal may be suitable for a particular use, the type may be entirely unsuitable; the reverse may also be true.



* GRADE = Yield of Liquids as % of D.A.F. Coal

* TYPE = Reactive Ingredients as % of D.A.F. Coal

GENERALIZED SURFACE RESPONSE INDICATING HOW COAL RANK AND COAL TYPE INFLUENCE COAL GRADE (here expressed as yield of liquids from liquefaction)

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Carbon Isotopic Signature as Criterion for Interpreting Origin of Synsedimentary Cements, Patch Reef Facies, Enewetak Atoll

Data collected from Enewetak Atoll suggest multigenerated synsedimentary cements of the patch-reef facies. The most common cement occurs as micritic aragonite in coralgal boundstones. Isopachous fibrous cements consist of parallel to subparallel crystals uniformly lining all sides of a cavity. These cements are present in subtidal marine environments and suggest early precipitation.

Organic matter occurs coincident with the precipitation of these marine cements. The source of the organic matter may be due partly to neomorphic replacement of aragonite to low Mg calcite. The $\delta^{13}C_{PDB}$ values range from -6 to -12 ppm. Previous work by Gross and Tracey concluded that abnormally light $\delta^{13}C$ values were produced by a 1:1 reaction of isotopically light ($\delta^{13}C - 22$ ppm) soil gases dissolved in meteoric water and transported throughout the rock with the cements. Our data suggest that soil gases in the carbonate soils of Enewetak are isotopically much heavier than terrigenous soils. We conclude that the isotopically light $\delta^{13}C$ values are partly attributed to the organic matter trapped in the aragonite lattice.

In contrast, radial fibrous aragonite cement occurs locally filling voids of mollusk shells. The cement consists of fibrous crystals radiating from a central point forming hemispherical nodules that are characterized by undulatory extinction. These cements are isotopically heavier than the above and do not contain organic matter. We conclude that they are inorganically precipitated synsedimentary cements.

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Sedimentary Characteristics and Processes of Current-Dominated Epicontinental Shelf, Northern Bering Sea, Alaska

The northern Bering Sea is a large epicontinental shelf area of less than 50 m depth that is dominated by a mean northward current toward Bering Strait. Bathymetric constrictions increase flow speeds to about 50 to 200 cm/sec causing the strongest currents on the eastern side of the straits. Geoprobe and current mooring stations show that tidal flows and storm-driven currents, including storm surge runoff, can significantly increase bottom current speeds in certain areas.

Topographic expression of the strong current regime occurs as ridges and swales in straits and scour depressions on shoal flanks. Large leeside shoals as much as 100 km long are constructed on the north side of islands and westward-projecting landmasses. These presently developing sand bodies are supplied with sand eroded from upcurrent beach and delta deposits. Strong currents presently remold the crests of the leeside and other relict offshore sand ridges into a complex series of small- and large-scale mobile bed-form fields.

Strong northward flow influences sediment composition and facies distribution over much of the region as well as the patterns of storm sand layers, ice scour marks, and large (25 to 150 m) scour depressions in modern sandy silt. The modern sedimentary facies on the western Yukon delta have been truncated by strong currents in eastern Shpanberg Strait. A substantial part of Yukon Holocene sediment has been displaced from Norton Sound by storm surge currents and the mean northward flow, bypassing Chirikov Basin, to be deposited 1,000 km to the north in Chukchi Sea. The increasing current speeds toward Bering Strait also control the offshore gradation of Holocene transgressive sand facies. The gradation to stronger currents in eastern strait areas results in coarser grain size and also increased concentrations of shell fragments and heavy minerals.

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Paleocene Time Scale for Rocky Mountain Region

A time scale for Paleocene rocks of the Rocky Mountain region has been constructed from provincial palynomorph biozones and vertebrate ages compared to worldwide planktonic foram ages and K-Ar boundary age estimates. As presently interpreted, the major elements of this time scale, from older to younger, are as follows. (a) Top of Cretaceous Maestrichtian foram age = top of *Triceratops* dinosaur age = top of concurrent-range zone of palynomorphs *Proteacidites,* most *Aquilapollenites, Cranwellia, Balmeisporites,* and several others: about 65 m.y. (b) Early Paleocene, early Danian foram age = Puercan and earliest Torrejonian mammal ages = assemblage zone of palynomorphs *Momipites coryloides* and *Ulmoidipites tricostatus:* about 65 to 62 m.y. (c) Early Paleocene, late Danian foram age = early and middle Torrejonian mammal age = concurrent-range zone of palynomorphs *Maceopolipollenites leboensis* and *M. amplus:* about 62 to 60 m.y. (d) Late Paleocene, early Thanetian foram age = late Torrejonian and early Tiffanian mammal ages = concurrent-range zone of palynomorphs *Maceopolipollenites amplus* and *Tiliaepollenites* sp.: about 60 to 57.5 m.y. (e) Late Paleocene, late Thanetian foram age = late Tiffanian and Clarkforkian mammal ages = assemblage zone of palynomorphs *Pistillipollenites* and *Caryapollenites:* about 57.5 to 53.5 m.y. (f) Base of Eocene Ypresian foram age = base of Wasatchian mammal age = base of concurrent-range zone of palynomorphs *Platycarya, Tilia,* and *Eucommia:* about 53.5 m.y.

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Distribution, Diagenesis, and Depositional History of Porous Dolomitized Grainstones at Top of Madison Group, Disturbed Belt, Montana

Dolomitized crinoidal grainstones locally form the upper part of the Mississippian Madison Group that unconformably underlies Jurassic strata in the Disturbed belt, northwestern Montana. Surface exposures of these grainstones exhibit a significant vuggy and intercrystalline porosity (4 to 12%) and are permeable (6 to 12 md). Many of the pores are filled with dead oil.

The porous crinoidal grainstone unit at the top of the Madison has undergone eogenetic secondary dolomitization, probably in Late Mississippian time, and hence prior to any significant erosional events. Porosity most likely resulted from solution effects during erosion and was fully developed before deposition of the Jurassic strata. Phreatic calcite cement partly occludes some of the pore space and developed after migration of liquid hydrocarbons into the grainstone unit.

Variations in thickness of the grainstone unit are mainly the result of pre-Jurassic erosion. In places the grainstones are completely eroded beneath the Jurassic rocks but, where present, they thicken to more than 100 m as observed in a north-south direction along the strike of imbricate thrust slices of the pre-Tertiary section. These thickness changes resulted either from broad warping of the Mississippian strata followed by planar erosional truncation, from erosional relief on the Jurassic erosion surface carved into unfolded Mississippian strata, or from some combination of these two effects which may have different geographic trends. Location of thickness maxima of the grainstone unit in each of several thrust plates enables correlation of the thickness patterns in an east-west direction from thrust sheet to thrust sheet. Projections of such patterns into the subsurface will be a valuable guide for exploration in the Disturbed belt.

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Depositional Environmental Analysis of Kaibab and Toroweap Formations in Southwestern Utah

The Kaibab and Toroweap Formations of southwestern Utah contain six members which represent transgressive and regressive cycles. The lowest member of the Toroweap Formation is the Seligman, which contains gypsiferous siltstone in the south and sandstone in the north. It represents a transition from a sabkha in the south to a beach in the north and marks the beginning of a marine transgression. Above the Seligman is the Brady Canyon Member which is a fossiliferous limestone containing broken and rounded fossils deposited in a marine environment. Overlying the Brady Canyon is the Woods Ranch Member consisting of gypsiferous siltstone at the bottom with oolitic fossiliferous limestone near the middle and silty limestone at the top. Its