Facies Control of Upper Cretaceous Cleary and Gibson Coal Members near Gallup, New Mexico

The Upper Cretaceous Point Lookout Sandstone separates the Cleary Coal Member of the Menefee Formation from the Gibson Coal Member of the Crevasse Canyon Formation in much of the Chaco slope and southwest San Juan basin. These coal-bearing members merge as the intervening Point Lookout Sandstone pinches out to the southwest in the direction of the Nutria monocline and Gallup coal field. The deposits of the merged coal interval supported widespread mining activity northwest and north of Gallup, New Mexico, near the turn of the century; however, renewed mining of these coals for the past few years has concentrated northwest of the town. Closely spaced outcrop sections provided data from which to infer the depositional settings of the merged coals.

Northwest of Gallup (Enterprise mine area), an alluvial facies of channel sandstones, deposited by northward-flowing streams is complexly interspersed with interfluvial siltstones and with laterally discontinuous coal deposits. North of Gallup (Gibson and Heaton mine areas), better integrated sandstones deposited in north-to-northeast flowing distributary channels, subordinate crevasse-splay sandstones, more widespread coal zones, and common bioturbations in laminated carbonaceous siltstones suggest coal accumulation in a deltaic to lagoonal transition environment. Further northeast of Gallup, where the Nutria monocline changes to an easterly strike toward the Chaco slope, well-developed coals remain associated with the deltaic and lagoonal environments. However, these coal-forming environments grade northeastward into the Point Lookout back-barrier to lagoonal transition environments, where coal deposits are poorly developed.

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Unconformity-Related Uranium Deposits in Upper Cretaceous Sandstones, Datil Mountains Area, West-Central New Mexico

The north flank of the Datil Mountains is underlain by gently south-southwest dipping strata of the Late Cretaceous Crevasse Canyon Formation, which is unconformably overlain by the Eocene Baca Formation. This erosional unconformity is well exposed where the upper 30 to 60 m of the Crevasse Canyon forms a 15-km-long belt of mesas, which probably represents an east-trending, fine-grained, meander-belt complex.

Numerous uranium anomalies and several small orebodies (Red Basin area) generally form a coaxial uranium belt within (and below) a 20 to 30-m-thick, intensely bleached zone at the top of the Crevasse Canyon. In drill cuttings and canyon walls, the light-gray sandstones and light-purplish-gray shales of the bleached zone grade downward into the dark-gray sandstones and carbonaceous shales typical of the Crevasse Canyon Formation. Tabular uranium deposits commonly occur in bleached channel sands where they are in contact with carbonaceous shales. Thin laminae of black hematite are common along the mineralized contacts. Carbonized wood and pyrite concretions, common in the lower Crevasse Canyon, occur as silicified logs and limonite concretions in the bleached zone.

The basal 0 to 10 m of the Baca Formation is usually a light-brownish-gray conglomeratic sandstone containing abundant hematite flakes, broken limonite concretions, and bits of silicified wood, suggesting that bleaching (and mineralization?) may have predated Baca deposition.

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Disequilibrium and Possible Origin of Uranium Deposit in Cretaceous Lower Dakota Scour Channel, Church Rock District, McKinley County, New Mexico

Uranium mineralization has been intersected in a Cretaceous Dakota fluvial channel in the Church Rock district of the Grants mineral belt, New Mexico. This channel scours into the Brushy Basin Member of the Jurassic Morrison Formation and contains the only mineralization discovered in the Dakota Sandstone on the property. Two hypotheses may explain the source of the uranium: (1) a reworking of the Westwater Canyon sediments south of the orebody where the Brushy Basin is absent, and (2) the expulsion of uranium-bearing waters from the underlying Brushy Basin mudstone.

A Laramide uplift created a hydrologic gradient which resulted in the encroachment of oxidizing ground waters upon the orebody. The southern half of the orebody exhibits a limonitic(?) staining and paucity of actual uranium compared to radiometrics whereas the northern half lacks obvious iron staining and possesses an abundance of uranium over the associate radiometrics.

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Tartaric Acid Leaching of Selected Ore Samples, Grants Mineral Belt, New Mexico

Composite samples of high-grade ore samples from the Doris and Johnny M mines were leached under controlled laboratory conditions to determine which elements are more mobile in the presence of organic acids. The samples selected consisted of $-2\text{-}\mu$ composites of kaolinite + mixed layer smectite/illite + U-mineral + accessory organic matter and sulfides; and chlorite + mixed layer smectite/illite + U-minerals + accessory organic matter and sulfides. These samples were leached with 0.01 molar tartaric acids in tightly sealed Erlenmeyer flasks, with constant agitation, for 100 hours and the leachates and insoluble residues were analyzed by neutron activation analysis. Uranium, Th, and the REE (rare earth element) were strongly leached and presumbably form chelates with the tartaric acid; Na, K, and Ba were also leached but Rb and Cs were either not leached or else fixed on the outer armor of the insoluble residue. Fe and Hf were also leached but Cr, Co, Sb, and Ta concentrated in the insoluble residues. The distribution patterns for the REE for leached and untreated samples are parallel, but the amount of REE leached is proportional to U leached, thus suggesting that organic transport of the REE with U (and Th?) may account for the high REE contents common in many uraniun deposits of the Grants mineral belt. The source for the REE and for at least some of the U may have been the Brushy Basin Member (Morrison Formation) for deposits in the underlying Westwater Canyon Member.

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Effects of Mining and Reclamation on Hydrologic Parameters

Studies in west-central New Mexico show that the hydrologic parameters of a coal sequence do not change appreciably as a result of strip mining or by erosion and deposition.

The Dilco, Gibson, and Cleary coal deposits are part of an intertonguing sequence of Upper Cretaceous marine and nonmarine deposits consisting principally of fine-grained clastics. Aquifer tests have established a range for the hydrologic parameters of strata in the coal sequence. Chemical quality of the ground water also has been determined.

Natural erosion of the coal deposits generally occurs in the form of mass wasting, sheet wash, and eolian deposition. This material is periodically reworked by ephemeral streams to produce thin valley-fill deposits. Infiltration of runoff into the underlying sediment creates a perched ground-water aquifer that is likely to go dry during periods of limited runoff. These ephemeral aquifers have hydrologic characteristics and water quality similar to the undisturbed coal sequences.

Through conventional reclamation processes, spoil material replaces the original coal sequence. The spoil material has been found to have hydrologic characteristics and water quality similar to the natural coal-bearing deposits and the valley-fill material.

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Geologic Controls of Uranium Mineralization in Tallahassee Creek Uranium District, Fremont County, Colorado

Two important orebodies have been defined by drilling in the Tallahassee Creek uranium district, Fremont County, Colorado. They are the Hansen orebody, which contains about 12 million kg of U_3O_8, and the Picnic Tree orebody, which contains about 1 million kg of U_3O_8. Host rock for the Hansen is the upper Eocene Echo Park Alluvium, and host rock for the Picnic Tree is the lower Oligocene Tallahassee Creek Conglomerate. Average ore grade for both deposits is about 0.08% U_3O_8.

The principal source rock for the uranium in the deposits is the lower Oligocene Wall Mountain Tuff, although a younger volcanic rock, the Oligocene Thirtynine Mile Andesite, and Precambrian granitic rocks probably also contributed some uranium. Leaching and transportation of the uranium occurred in alkaline oxidizing ground water that developed during alteration of the ash in a semiarid Oligocene or early Miocene environment. The uranium was transported to sites where it was deposited in a reducing environment controlled by carbonaceous material and biogenic products such as hydrogen sulfide.

Localization of the ore was controlled by ground-water-flow conditions and by the distribution of organic matter in the host rock. Ground-water flow, which was apparently to the southeast in Echo Park Alluvium that is confined in the Echo Park graben, was impeded by a fault that offsets the southern end of the graben. This fault and attendant displacement prevented efficient discharge into the ancestral Arkansas River drainage, and protected chemically reducing areas from destruction by the influx of excessive amounts of oxidizing ground water. Localization of orebodies in the Echo Park Alluvium may have occurred in areas where overlying rocks of low permeability were breached by erosion during deposition of the fluvial Tallahassee Creek Conglomerate (which overlies the Wall Mountain Tuff), allowing localized entry of uranium-bearing water. Paleohydrologic control in Tallahassee Creek Conglomerate may have been affected by the alteration of pervious ash beds to impervious clay beds.

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Palynological Evidence for Miocene Age of Abiquiu Tuff, North-Central New Mexico

The Abiquiu Tuff crops out at the north end of the Nacimiento uplift and in the western part of the Espanola basin in north-central New Mexico. No paleontologic or radiometric age dates have been published for this unit, but regional correlations based on lithology and stratigraphic position suggest a Miocene age. At the south end of the Nacimiento uplift are extensive outcrops of the Zia sand of early to middle Miocene age based on vertebrate fossils. Between the outcrops of these two units are scattered exposures tentatively identified as Abiquiu(?) formation.

To determine if the Abiquiu Tuff, Zia sand, and Abiquiu(?) formation are stratigraphically equivalent, sections of each were analyzed for pollen content. The Abiquiu Tuff near the village of Abiquiu, the Zia sand at its type locality near Zia Pueblo, and an outcrop in the Nacimiento uplift near Gilman were sampled at 30-ft (9.3 m) intervals. Most samples were barren, but sufficient pollen was recovered to indicate a Miocene age for all of the outcrops. Pollen from the Abiquiu Tuff and Zia sand are similar to pollen from the Miocene Split Rock Formation of Wyoming and Brown's Canyon Formation of Chaffee County, Colorado.

The Zia sand and Abiquiu Tuff are exposed along the west margin of the Rio Grande rift. Extensional faulting that cuts these formations cannot have occurred earlier than late Miocene. The Abiquiu(?) formation at Gilman rests against Precambrian rocks along the Sierrita fault, the major bounding fault between the south part of the Nacimiento uplift and the Rio Grande rift. The juxtaposition of Miocene and Precambrian rocks along this fault indicates that 530 to 685 m of movement associated with rifting and uplift occurred in post-middle Miocene time.

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Preliminary Pore Structure Analysis of Tight Sandstones Using Computer-Processed Photomicrographs

The complexity of pore networks in fine-grained low-permeability sandstones makes accurate modeling of fluid-flow properties difficult owing to the lack of quantitative information concerning the pore structure. Many such sandstones in the Uinta basin, Utah, are reservoirs for large amounts of natural gas. These sandstones, most of which are Tertiary and Cretaceous in age, commonly contain pores that vary greatly in size. Variation in pore size is partly due to the dissolution of mineral grains and pore-filling cement; however, many of the secondary pore spaces contain authigenic clay, principally illite and kaolinite, which has served to create micropore space.

We have developed a method to digitize and quantify pore networks of fine-grained rocks using the apparent pore space observed in photomicrographs of thin sections. By digitizing numerous photographs, statistical data were generated, thereby making it possible to address the problem of pore structure. Pore structure data include such parameters as the pore size and shape, anisotropy of the pore arrangement within the rock matrix, and pore connectivity.

Specimens obtained from CIG Exploration, Inc., Natural Buttes 21 cores (Sec. 15, T10S, R22E) were used to determine