alteration index (CAI) ranges from 1 at the type section to 1.5 to 2 in transitional and basinal areas. Because CAI values of 1 to 2 correspond to the thermal interval of oil generation, a vast area of Lower Triassic rocks has productive potential.

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Newly Discovered Inlier of Ordovician Phi Kappa Formation, South-Central Idaho

An inlier of Ordovician Phi Kappa Formation at Meridian Creek, Custer County, Idaho, provides new information on the distribution and character of this formation. The exposure, which trends 2.3 km along the drainage and ranges up to 0.5 km in width, is isolated from other Phi Kappa outcrops by Tertiary Challis Volcanics. Although the rocks here are similar in age and general lithology to the Phi Kappa exposed 7.1 km northwest in the East Pass Creek window and 5.2 km south on the North Fork of the Lost River, there are significant differences.

The Ordovician at Meridian Creek has a minimum thickness of 210 m. About 150 m is graptolite-bearing, Middle Ordovician (Caradocian) shale and calcareous siltstone, whereas the remainder consists of thick (30 m) units of dolomitic limestone and radiolarian-bearing chert. The carbonate unit, which consists of medium to thick beds of fine to medium-grained, dolomitic limestone with clasts of mudstone up to 1 cm long, is coarser grained and thicker than carbonates in Ordovician rocks in nearby areas. The limestones seem to be turbidites, but this interpretation is difficult to reconcile with potential carbonate sources.

The uppermost Phi Kappa at Meridian Creek is intensely deformed. Similar relations are present in adjacent areas where the Mississippian Copper Basin Formation is thrust over the Ordovician. Although Mississippian rocks are absent along Meridian Creek, it seems a Copper Basin thrust plate once extended across this area. Regional considerations also suggest that the Ordovician rocks at Meridian Creek are allochthonous.

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Exploration Guides for Uranium in Volcanic Environments

Exploration for volcanogenic uranium deposits in the United States is a relatively new endeavor, but it is not new in other countries in the world. The Soviet Union, Italy, Yugoslavia, Canada, Brazil, and Mexico have substantial reserves in volcanic host environments. Few volcanogenic uranium deposits have been discovered in the United States, but they may be indicators of larger, more favorable environments.

Volcanogenic systems that evolve from mantle-derived, hydrous, alkaline, magmas than can be enriched in Li, Be, Mo, and Hg, are most likely to develop favorable host environments. Rocks that develop in these host environments exhibit regional enrichment of uranium and thorium. The tectonic settings of these systems are extensional and are related to rift systems and transverse zones in the Basin and Range province of the western United States.

Uranium mineralization processes active in the volcanogenic system produce deposits in both high-temperature and low-temperature regimes. High-temperature deposits form from pneumatolytic, magmatic-hydrothermal, and meteoric-hydrothermal processes; the deposits may be fumaroles, breccia pipes, brecciated margins of intrusives, fractured and porous country rock, and porous zones along ash-flow contacts. Diagenetic and reduction-oxidation processes work in conjunction to form low-temperature deposits, commonly in sedimentary environments where oxidizing ground-water flow can introduce labile uranium into reducing environments.

Sierra Pena Blanca, Chihuahua, Mexico, is a preserved part of an alkaline volcanic complex that formed in a rift system active in late Eocene through early Oligocene time. Although detailed mapping is still underway, the number of uranium and thorium enriched alkaline and peralkaline ash-flows suggests several eruptive centers nearby. Enrichment of other metals in these ash-flow sheets suggests regional enrichment of lithophilic elements. Sierra Pena Blanca has pneumatolytic uranium deposits in fumarolic ash flows, magmatic and meteoric hydrothermal deposits in interbedded ash flows and invaded country rock, and low-temperature deposits forming in closed basins adjacent to the volcanic complex.

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Stratigraphy and Petroleum Trapping Mechanisms of Upper Jurassic Entrada Sandstone, Northwestern New Mexico

Extensive outcrops and 14 measured sections of the Upper Jurassic Entrada Sandstone and overlying Todilto Formation in the southern Chama basin Echo Amphitheater–Ghost Ranch area show long, parallel, eolian transverse dune buildups in the upper Entrada perpendicular to the dominant wind direction as shown by cross-bed foresets. Some bevelling of the buildups occurred prior to the evaporitic deposition of limestone and gypsum of the Todilto Formation and this deposition preserved the buildups, filling in the low interdune areas.

The subsurface Entrada-Todilto of the southeastern San Juan basin was mapped over an area including 20 townships. An isopach of the Todilto Formation shows that essentially the same trend of Entrada dune buildups is present here as in the outcrop area.

Support for the mechanism of trapping in Entrada oil fields as proposed earlier by Bryant is present both in the surface and subsurface where relief created by eolian buildup of sand is preserved by the infilling of the Todilto. However, structural dip counter to regional dip along the axis of dune buildups is needed to trap oil. This dip can be provided by syndepositional faults cutting across the buildup axis as in the outcrop area where there is sudden thickening of the Todilto and of the Entrada downthrown to the fault.

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Distribution and Stratigraphic Correlation of Burro Canyon(?) Formation, Chama and Northern San Juan Basins, New Mexico

The Lower Cretaceous conglomerate sandstone, sandstone, and mudstone interval stratigraphically between the Upper Cretaceous Dakota Sandstone and the Upper Jurassic Brushy Basin Member of the Morrison Formation in the Chama and northern San Juan basins, New Mexico and Colorado, is tentatively called the Burro Canyon(?) Formation. In this area the Burro Canyon(?) consists of a basal fluvial sequence deposited in braided-stream environments and an upper fluvial sequence deposited in braided to meandering-stream environments.

The Burro Canyon(?) is unconformably overlain by the Dakota Sandstone and may disconformably overlie the Brushy Basin Member of the Morrison Formation. The Burro Canyon(?) thins southward from the Chama and northern San Juan basins because of truncation of the formation under the

pre-Dakota erosion surface.

The relation of the Burro Canyon(?) to the underlying Morrison Formation is less clear and has been the subject of controversy; the Burro Canyon(?) has at times been equated with the Jackpile-type sandstone at the top of the Brushy Basin Member in the San Ysidro area and along the east side of the San Juan basin. However, several lines of evidence, including facies relations, differing styles of sedimentation and sedimentary structures, and differences in composition of sandstone and mudstone of the upper part of the Brushy Basin Member and of the Burro Canyon(?) Formation in the San Juan and Chama basins, indicate that the Burro Canyon(?) Formation occurs stratigraphically above similar-appearing sandstones at the top of the Brushy Basin along the east side of the San Juan basin.

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Stratigraphy and Paleobotany of Lower Kirtland (Upper Cretaceous) Leaf Locality near Bisti, San Juan Basin, New Mexico

During a detailed stratigraphic study in the area of Hunter Wash, near Bisti, a new leaf locality was discovered in a sequence of mudstones, carbonaceous shales, siltstones, and sandstones. In the Bisti area, the boundary between the Fruitland and Kirtland formations is taken at the top of the highest carbonaceous shale above the highest Fruitland coal and below the prominent brown sandstone. The leaf locality lies within a 59-ft (18 m) measured section, about 14 ft (4.5 m) above the highest carbonaceous shale, within a gray-green shaly siltstone protected by an overlying sideritic concretion. Poorly preserved bivalves and gastropods are present in the deposit, but leaves predominate.

Leaf collections contain the remains of ferns, conifers, and angiosperms; angiosperms dominate the assemblage. The most common angiospermous genera include *Cercidiphyllum, Cissus, Ficus, Laurophyllum, Myrtophyllum, Platanus, Salix,* and *Rhamnus.* Preliminary analysis of the collection has revealed that most of the angiospermous leaves are of medium size with entire, or nearly entire margins and drip points. These features indicate that during early Kirtland time, the climate of the area was warm-temperature to subtropical.

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Migration Study Using Horizontal Core from Beneath Solid Radioactive Waste-Disposal Pit at Los Alamos, New Mexico

Solid radioactive wastes are disposed of by burial in pits excavated in rhyolite tuff at the Los Alamos Scientific Laboratory. Contaminants known to be in the waste include fission products, uranium, and transuranic elements. Horizontal holes were cored during air as a cuttings carrier beneath a pit which was in use from 1963 to 1966. During drilling operations the air and cuttings from the holes were monitored for radioactive contamination as was the ambient air. No contamination was detected. Samples of the core were analyzed for gross alpha, gross beta, total uranium, ^{90}Sr, ^{137}Cs, ^{238}Pu, $^{239,240}Pu$, and ^{241}Am. None of the man-made elements were present in the samples at levels above the minimum detection limits. Gross alpha, gross beta, and uranium activity was detected in the samples. Statistical comparisons were made to identify any significant variations from natural background concentrations. The comparisons demonstrated that none of the radioactivity detected in the samples can be attributed to migration from the disposal pit.

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Vertebrate Paleontology of Lower Tertiary Baca Formation of Western New Mexico

A paleontologic survey of the western outcrops of the terrestrial Baca Formation has yielded the first Oligocene fossils from New Mexico. Three sites of Chadronian (early Oligocene) age are known, and their fauna included the small oreodont *Leptomeryx,* the cameloid *?Eotylopus,* the carnivore *Hyaenodon,* the entelodont *Brachyhyops,* and a large-horned titanothere *Menodus.* All these genera are also found in the Porvenir local fauna, Chadronian of Trans-Pecos Texas.

Vertebrate finds indicate far less contemporaneity of the formation's isolated outcrops than previous workers had accepted. The formation had been considered Eocene, partly on the strength of the discovery of a specimen of *Protoreodon pumilis,* a late Eocene–early Oligocene oreodont, in alluvial-fan deposits north of Datil. The Chadronian sites lie in fluvial deposits north of Quemado, approximately 60 km west. Most Baca vertebrates have been recovered from channel deposits or from float. No site with a concentration of small fossils suitable for screening has yet been discovered. Future goals for Baca Formation paleontologic work include location of fossils in the still unfossiliferous outcrop areas and location of screening sites.

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Provenance and Depositional Environments of Eocene-Oligocene Baca Formation, Catron County, New Mexico

The Baca Formation, which crops out discontinuously in east-west-trending exposures from Socorro, New Mexico, to the New Mexico–Arizona border, is composed of fluvial, alluvial-fan, and lacustrine deposits. It was deposited in a basin which formed during the Laramide orogeny in New Mexico and Arizona. Uplifts bordering the basin include the Defiance, Zuni, Lucero, and Sierra-Sandia, and the Mogollon highland. In the late Eocene, volcanism began in the Datil-Mogollon volcanic field in southwestern New Mexico and adjacent Arizona, south of the study area. Sediments were derived from adjacent uplifts and from the volcanic rocks. The Mogollon highland and the Zuni uplift supplied metamorphic, sedimentary, and plutonic detritus to the Baca Formation.

There is a westward increase in volcanic detritus in the Baca Formation, and faunal evidence shows an early Oligocene, Chadronian, age for western Baca outcrops north of Quemado, younger than outcrops further east which are Eocene in age. With the beginning of Eocene volcanism, volcanic detritus was supplied to the Oligocene Baca sediments which were deposited in a coarse-grained meander belt. Other depositional environments identified include fine-grained meander belt, alluvial fan, and distal, braided alluvial plain. Flow direction was dominantly eastward.