pressions rather than a transport process unique to the trench environment.

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Isotopic Composition and Sources of Strontium in Sandstone Cements in High Plains Sequence of Wyoming and Nebraska

The $^{87}Sr/^{86}Sr$ ratios of sandstone cements reflect the isotopic composition of strontium released into the pore fluid by different rock and mineral constituents. However, little is known about the extent to which the isotopic compositions of strontium in cements reflect local or regional variations in sandstone compositions. The $^{87}Sr/^{86}Sr$ ratios of sandstone cements permit identification of the major sources of strontium in the pore fluid and indicate the dimensions of the aquifer system within which the pore fluid was isotopically homogenized. Since the abundances of radiogenic ^{87}Sr is continually increasing by decay of ^{87}Rb, isotopic compositions of strontium may also suggest the sequence and time of cement formation in sandstones that contain detrital mineral and rock grains having high Rb/Sr ratios.

After removing the calcite, montmorillonite, or zeolite cements, sandstones from the Arikaree and Ogallala Groups of the High Plains sequence (Oligocene to Pliocene) have $^{87}Sr/^{86}Sr$ ratios ranging from 0.7065 for plagioclase arenite to 0.7491 for arkosic arenite; rhyolitic vitric ash samples have intermediate ratios of 0.7093 and 0.7133. In contrast to the detrital fractions of the sandstones, the cements contain strontium that is isotopically homogeneous over distances of 70 km or more. Calcite and montmorillonite cements from the Arikaree Group (Oligocene-Miocene) have an $^{87}Sr/^{86}Sr$ ratio of 0.7103, whereas calcite and clinoptilolite from the Ogallala Group (Miocene-Pliocene) yield 0.7112. The ratio of the cements suggests that the pore waters were homogeneous on a regional basis and were not locally controlled. The slight difference in the isotopic composition of strontium in the cements of the Arikaree and Ogallala Groups may have resulted either from decay of ^{87}Rb during the time interval of about 20 m.y. between lithogenesis of the Arikaree and Ogallala Groups or from differences in their mineral compositions. A quantitative model for mixing of different isotopic varieties of strontium indicates that Precambrian plagioclase, Paleozoic marine carbonate rocks, and Tertiary volcanic ash were the dominant sources of strontium in the pore solution and that Precambrian K-feldspar was the principal contributor of radiogenic ^{87}Sr.

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Estuarine–Coastal Plain Coal Deposition in Southern West Virginia; Pennsylvanian Beckley Seam

Current studies of the Beckley (Pennsylvanian) seam in an area 60 by 30 km in southern West Virginia indicate that the Beckley was formed in a back-barrier depositional setting. Examination of about 1,800 core records as well as underground workings shows that the Beckley stratigraphic position is characterized by linear northeast-southwest-trending orthoquartzitic sandstone bodies about 1,500 m wide representing stranded barriers on a prograding coastal plain. Areas between the barrier sandstones are about 15 km wide and are occupied by coal and shale of estuarine and tidal-creek origin. The thick bodies of coal, which are relatively small (4.8 by 9.6 km or less), are located on the flanks of the barrier and thin toward the shaly central part of the interbarrier area. Adjacent to the barriers, the coal is split by small linear tongues of sandstone produced by erosion of the barrier. Where the coal adjoins estuarine and tidal-creek sediments, it interfingers and thins into shale and sandy shale. Within the interbarrier areas, the thickest coal is near the headward parts of the tidal creeks; closer to the major estuary the coal bodies are thinner and smaller in areal extent. Knowledge gained from exploration and mining of the Beckley seam should aid in searching for and developing coals in similar depositional settings.

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Geochemical Evaluation of Ensenada de la Vela Basin, Offshore Falcon State, Venezuela

Maturation mapping in the Tertiary La Vela basin, based on bottom-hole temperatures of 12 wells, indicates that only the Paleogene Guarabal Formation and the lowermost part of the Miocene Agua Clara Formation reached temperatures adequate for the generation of oil.

Plotting of temperature contours on cross sections of the basin and on isopach maps delimited the extent of the potential oil-forming units. Flows of oil in drill-stem tests came from wells on a basement horst adjacent to a deeply buried "pod" of Guarabal Formation, which was suggested as the local source rock.

Later geochemical analyses of samples from three wells confirmed this model by showing that the Miocene Agua Clara Formation was immature and contained insufficient amounts of organic matter to be an oil source. Furthermore, it was confirmed that the "pod" of Paleogene Guarabal Formation was mature, and contained up to 6% total organic carbon as well as predominantly oil-prone kerogen.

Accurate location of the oil-generating beds in the La Vela basin was thus made possible by geochemical mapping, and should help focus exploratory drilling on those traps most likely to contain oil accumulations.

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Carbonate Geology of Peña Blanca Uranium District, Chihuahua, Mexico

The Peña Blanca Range of central Chihuahua is the site of Mexico's largest uranium deposit. The exposure at Peña Blanca consists of Tertiary silicic pyroclastics overlying middle Cretaceous (Albian and Cenomanian) limestones. The uranium is present predominantly in the basal unit of the pyroclastics, at or near the contact with the limestones. The limestones make up a large rudistid reef, with extensive fore-reef and lagoon facies, situated at the edge of the Chihuahua trough. Younger basin limestones overlap the lower edges of the fore-reef slope. The reef is of Albian age and shares faunal and lithologic characteristics with both the El Abra Formation of Mexico and the Edwards Formation of Texas. Lagoon, back-reef, requienid rudistid mounds, near back-reef carbonate sand, caprinid and radiolitid rudistid-reef core, fore-reef carbonate sand, and fore-reef debris slope facies are all evident in outcrop. In the reef core, rudistids predominate over all other reef-forming organisms. The basin limestones include the rhythmic Cuesta del Cura Formation, upper Tamaulipas Formation, and Aurora Formation. Unlike the typical petroleum-exploration target, this reef has virtually no porosity. The abundance of carbonate mud and diagenetic calcite cement has occluded all available pore space.

Uranium mineralization is localized at and above the boundary between the pyroclastics and the limestone. The impermeable limestones may have formed both a barrier to mineralizing solutions and a reaction site for mineralization. Reaction of the uranium-bearing carbon dioxide solutions with the limestones could have resulted in uranium precipitation. In addition, hydrocarbons from the basin and reef-slope limestones may have provided a reducing environment that enhanced this precipitation. The Peña Blanca deposit demonstrates the presence of economically significant uranium resources in volcanic terranes.

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Geology of Gabes Basin, Tunisia

The Tertiary Gabes basin is located offshore of Tunisia and Libya and is bounded on the north by the Kerkenna high and Pantelleria rift zone, on the east by the offshore extension of the Sirte basin, on the south by the Djeffara fault zone, and on the west by the Tunisian north-south axis.

The most prospective sedimentary rocks in the Gulf of Gabes are those of the lower Eocene and Upper Cretaceous. The lower Eocene Metlaoui Formation (50 to 180 m thick) is the main producing interval in the Gabes basin and is productive in the Sidi Itayem field, Sidi Behara field, Ashtart field, Hasdrubal, Didon, A1-137, and B1-137. In these areas, the Metlaoui Formation is characterized by a nummulitic facies. In general, the Metlaoui Formation grades from a coquinoid facies in the southwest to a nummulitic facies near the center of the basin to a globigerinid facies in the northeast.

The Maestrichtian-Paleocene El Haria Formation underlying the Metlaoui consists of approximately 150 m of shale and is considered to be the major source rock in the Gabes basin.

Underlying the El Haria is the Mizda Formation (Campanian-Turonian), a shaly limestone approximately 400 m thick. Wet gas was found in the lower Mizda Formation in wells Miskar 1 and 2.

The Nefusa Group (450 m thick) is of Cenomanian age and underlies the Mizda. It is composed of marlstone, limestone, and dolomite. Reefal development within this group provides the reservoir for the Isis oil field, Elyssa-1 gas well, and Didon-1 oil well.

Although the Upper Cretaceous and lower Eocene are the major exploration objectives in the Gabes basin, data from onshore outcrop studies in Tunisia and Libya indicate excellent reservoir potential in Jurassic, Lower Cretaceous, and Oligocene rocks.

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Clay-Carbonate Diagenesis of Deltaic Sandstones—Basal Belly River Formation (Upper Cretaceous), Central Alberta, Canada

The Upper Cretaceous (Campanian) basal Belly River Formation from the subsurface of central Alberta averages 20 m in thickness and consists of a small, lobate, high, constructive delta prograding into a shallow basin. The major sandy facies are: distributary channel, distributary-mouth bar (formed during constructional phases), interdistributary beach (and other poorly defined facies formed by destructional processes), and fluvial channels of the delta plain.

The sediment is predominantly a mineralogically immature fine sand consisting of quartz, chert, feldspar, polycrystalline quartz, and volcanic lithic grains. Detrital mineralogy varies with lithofacies, reflecting a depositional process of controlled sorting, winnowing, and selective destruction of the sediment, which results in an increase in the quartz content of interdistributary beach facies and more abundant mica in mouth-bar facies.

These sandstones have had extensive diagenetic modification in the form of widespread calcite and/or clay cementation.

Calcite cementation is more extensive at the margins of the delta sand bodies and extends inward as discrete subhorizontal layers. Texturally these cements range from large poikilotopic crystals to spherulitic and isopach rims. Open packing of siliciclastic grains, lack of other diagenetic minerals, and the preservation of unstable detrital minerals within these tightly cemented zones suggest an early diagenetic origin.

"Authigenic" clays are abundant in these sandstones and include kaolinite, chlorite, illite, and minor amounts of montmorillonite and expandable interlayers. Kaolinite is present as pore-filling booklets. Other clays form as sequential coatings on grains and earlier cements. The distribution of clay minerals within these sand bodies appears to be at least in part facies related. Chlorite and kaolinite occur predominantly in fluvial facies, and illite/montmorillonite with less kaolinite occurs in destructional facies. This variation is in response to facies-controlled variation in detrital mineralogy, texture, and primary pore fluids.

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Smackover Formation of Gulf Coast Region

The Smackover Formation in the United States Gulf Coast region has been the target of continuing, and indeed renewed, exploratory interest of the oil industry. It is important that geologists understand the depositional and diagenetic realms that affected the Smackover, because of the influence they have on reservoir development. The Smackover was deposited during a major transgressive-regressive cycle. High-energy fossiliferous, pelletal, and oolitic grainstones deposited during the re-