area of about 250,000 sq km, is the only major shelf of the continental United States which is presently dominated by carbonate sedimentation. The veneer of sediments which comprises the present surface of the shelf is called the West Florida Sand Sheet. It is composed of greater than 75% carbonate and is the latest expression of a 5 km thick accumulation of carbonate rocks and evaporites of Mesozoic and Tertiary ages which has been cut off from major clastic provenance since Jurassic time.

The West Florida Sand Sheet differs from many great carbonate banks such as those of the Bahamas, the Persian Gulf, and the Great Barrier reef in that it extends as far north as 29°30′ and is composed mostly of residual carbonate, specifically of patches of molluscan shell hash, foraminiferal, algal, and even oolitic sands. Only a few patch reefs and one relatively large deep-water (>20 m) tropical reef, called the Florida Middle Ground, are present. Sediments resemble more closely those of the shelf of the southeastern Atlantic United States, with the clastic components removed, than those in other carbonate banks.

Inshore of the carbonate sands and separated from them by a transition zone of mixed composition lies a mature fine quartz sand, which also comprises the beaches of southwest Florida. The quartz sand appears to have been deposited at lower sea-level stands and then to have been moved up and down the peninsula in a seasonally changing longshore current system.

Side-scan and seismic surveys of the West Florida shelf show that far from being a featureless plain beneath the relatively low-energy gulf, the sand sheet has a full suite of bed forms from giant sand waves to small-scale ripples. These suggest that the seafloor is undergoing major redistribution and reworking of sediments, probably primarily as the result of passage of major storms.

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Shallow-Marine Trace Assemblages in a Cambrian Tidal Sand Body

Two distinctive assemblages of biogenic structures are present in the Mt. Simon Formation, basal Upper Cambrian quartzarenite in western Wisconsin. A *Skolithos* trace assemblage is dominated by specimens of *Skolithos* and *Arenicolites*, which commonly occur in medium to very coarse-grained, cross-bedded sandstones. *Skolithos* traces are typically 10 to 100 mm in length, 1 to 5 mm in width, and are oriented normal or slightly inclined to bedding. Specimens are present throughout the formation, even in basal conglomeratic beds, and thus point to a marine origin for the entire unit. *Skolithos* density increases upward to concentrations of 5 to 7 burrows/sq cm. A *Cruziana* trace assemblage is dominated by specimens of *Cruziana, Rusophycus*, and *Planolites*, which commonly occur in thin beds of very fine to medium-grained, horizontal to ripple cross-laminated sandstones. *Rusophycus* specimens are typically 10 to 100 mm in length and 6 to 60 mm in width, and are preserved in convex hyporelief on the bases of sandstone beds.

Distribution of the two trace assemblages and the associated physical sedimentary structures points to two different environmental regimes present within a shallow subtidal to intertidal setting: (1) a higher-energy tidal channel environment in which coarser-grained, cross-bedded sandstones containing a *Skolithos* assemblage were deposited; (2) a lower-energy tidal flat environment in which finer-grained, horizontal and ripple cross-laminated sandstones containing a *Cruziana* assemblage were deposited. The two subenvironments coexisted within a complex environmental mosaic, because the two trace assemblages are observed to intergrade both laterally and vertically, probably the result of lateral migration of each subenvironment. The pronounced upward increase in trace fossil density indicates a significant upward decrease in energy conditions and a reduced sedimentation rate, probably due to tidal flat progradation.

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Paleotopography's Influence on Porosity Distribution in Lansing-Kansas City "E" Zone, Hitchcock County, Nebraska

The Lansing-Kansas City "E" zone consists of carbonate packstones and grainstones deposited during the shallowest parts of the marine phase of a complex marine–nonmarine sedimentary cycle. The packstones and grainstones are best developed on ancient positive seafloor features (15 to 30 ft or 4.6 to 9.1 m of paleorelief) which were subjected to more wave agitation than surrounding low-lying areas where mud-supported textures prevail.

Postdepositional processes during subaerial exposure (nonmarine phase of the "E" zone sedimentary cycle) led to porosity development on paleotopographic highs and porosity destruction in lows. The mild topographic variations resulted in two distinct diagenetic environments. Percolating meteoric waters dissolved aragonitic skeletal grains and intergranular carbonate mud in the packstones and grainstones on paleotopographic highs. Surface runoff and groundwater collected in topographic lows. Here, large-scale dissolution accompanied by infiltration of nonmarine silt and clay totally destroyed all original reservoir potential.

An isopachous map of the nonmarine terrigenous rocks directly overlying the marine "E" zone carbonate rock is believed to reflect paleotopography. All significant oil production occurs where this interval is thin. Porosity in the "E" zone carbonate rock is nearly nonexistent where overlying nonmarine sedimentary rocks are thick. Therefore, thickness maps of these nonmarine rocks should facilitate future oil exploration and production efforts in this area.

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Trap Spring Oil Field, Nye County, Nevada

Trap Spring oil field, located on the west side of Railroad Valley, Nevada, is a combination structural and stratigraphic trap in the Tertiary Pritchard's Station ignimbrite. The reservoir is mainly in fractures caused by the cooling of the ignimbrite and local faulting. Structure is related to the valley bounding fault. Numerous unconformities and ignimbrite flows date the structural movement. Exact source of the oil is unknown, however both Tertiary-Cretaceous Sheep Pass Formation and Mississippian Chainman Shale are possible sources.

Oil has been generated in commercial quantities in Nevada. Unconventional traps, reservoirs, and source rocks should be regarded as normal. Exploration for conventional traps and accumulations of hydrocarbons in Nevada may be part of the reason for past failures.

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X-Ray Mineralogy of Upper Freeport Coal

Relative concentrations of the major mineral phases have been determined on 75 bench-channel samples of the Upper Freeport coal collected near Homer City, Pennsylvania. Spearman rank correlation coefficients (non-parametric) were determined on a data matrix which consisted of the X-ray diffraction data, the major oxide concentrations, heat content, total sulfur, and maceral concentrations. At the 95% confidence level, illite and kaolinite are correlated with Si, Al, Mg, and K as well as with vitrinite, vitrodetrinite, inertrodetrinite, fusinite, semifusinite, and macrinite. Quartz is correlated with Si, Al, Mg, and K and is strongly correlated with all of the inertinites except micrinite. Clay and quartz are not correlated with exinites; however, pyrite is correlated with micrinite and all the exinites as well as with C, S, Ca, Fe, and Na. Calcite is correlated with heat content, S, Ca, and Fe but not with any macerals. However, elemental Ca, as CaO, is correlated with spornite and micrinite. Statistical correlations imply genetic relations but not necessarily observed mineral-maceral-element associations.

The X-ray mineralogy data are consistent with our working hypothesis on the origin of the mineral matter in coal, which in part states that inherent plant mineral matter was the primary source of the quartz and clay components of the Upper Freeport coal ash. Pyrite and calcite are thought to be indirectly related to bacterial degradation because of their statistically distinct associations.

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Source-Rock Quality and Thermal Maturity, Palo Duro Basin, Texas

Measurements of source-rock quality in the Palo Duro and Dalhart basins suggest that fair to very good hydrocarbon source materials are present. Total organic carbon (TOC) was measured in samples taken from a range of depths and stratigraphic intervals, with sampling concentrated in Pennsylvanian and Wolfcampian shales from basin and prodelta facies. TOC content for all samples ranges between 0.008 and 6.866 wt %. Highest TOC content is in Upper Permian (Guadalupian) San Andres dolomite in the southern part of the basin. Pennsylvanian and Wolfcampian basinal shales are fair to very good source rocks on the basis of TOC values of up to 2.4%.

Optical properties of organic material in source rocks, especially kerogen and vitrinite reflectance, indicate maximum paleotemperatures. Pennsylvanian and Wolfcampian kerogen is yellow-orange to orange, which indicates slight thermal alteration. Temperatures were probably high enough to begin generation of hydrocarbons from lipid-rich organic material, which is most abundant in the deep-basin shale facies. Palo Duro basin samples have a broad range of vitrinite reflectance values (Ro), but populations with the lowest reflectance probably indicate the true paleotemperatures reached. Vitrinite with higher reflectance may have been reworked from older sediments. The average reflectance in representative Pennsylvanian vitrinite is 0.52%; in Wolfcampian samples the average reflectance is 0.48%. These values are consistent with the kerogen color and suggest that source rocks in the Palo Duro basin may have begun to generate hydrocarbons.

Potential hydrocarbon reservoirs are present in shelf-margin dolomite, fan-delta, and high-constructive delta sandstone. Juxtaposed reservoir facies and source beds delineate possible hydrocarbon fairways.

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Bivalve Trace Fossils in British Silesian

In the English Pennines, *Pelecypodichnus* Seilacher, a bivalve burrow, is common in silty to sandy sediments of Carboniferous age from near the top of the Kinderscoutian Stage of the Namurian deltaic succession to the lower part of the Westphalian A. At the base of this sequence burrows are short, typically inclined to the bedding, and were primarily resting places of the marine bivalve *Enevillia variabilis* Eagar MS (formerly cf. *Sanguinolites* Hind *non* M'Coy). In the lower part of the succeeding Marsdenian Stage the burrows become longer to form escape structures. These tend to be more nearly vertical to the bedding, straighter, and more numerous, their longer horizontal axes being broadly aligned to prevalent currents. *Carbonicola,* a nonmarine genus, first appears in the middle of the Marsdenian, evidently having evolved from *Enevillia.* Escape shafts associated with *Carbonicola* are indistinguishable from earlier ones and reach their maximum length near the top of the Namurian, where there was probably selection for elongate shells with low obesity. The latter, being more successful "risers" under heavy sedimentation on the prodelta, ultimately reached low-energy environments as the delta advanced southward. Thus the delta invaded the paleoenvironments of the bivalves, which moved upward or perished. Recent evidence has shown that rising of *Enevillia* was preceded by downward burrowing to a nearly vertical position, anterior end downward, and that this position was in turn sometimes preceded by a ploughing movement connected to escape shafts as seen in trails of cf. *Chevronichnus* Hakes (cf. movement of the living *Margaritifera*). In Westphalian B Stage *Pelecypodichnus* is sometimes associated with the nonmarine bivalve *Anthracosia.*