debouching in Corpus Christi Bay. It has been theorized that the Neuces River once flowed southeasterly crossing northwest Webb and central Duval Counties and then into Baffin Bay.

A subsurface stratigraphic study was initiated to determine the existence of stacked fluvial sequences within the confines of the proposed former course of the Neuces River. Four hundred and three electric logs were examined to determine the formation tops, bottoms, thickness, percent sand, net sand, and maximum sand of both the Oakville and Catahoula Formations.

The electric log data were reduced to acceptable form for use with the University of Rhode Island SYMAP program. The SYMAP program is capable of producing a map of any dimension using a conventional line printer. Data base, cross section location, percent sand, net sand, and maximum sand maps were produced by this method. An advanced University of Rhode Island program known as SYMVU was used in conjunction with a CalComp plotter to display the data as a colored, graphic, three-dimensional map.

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Submarine Diagenesis (Aragonite Dissolution, Cementation by Calcite, and Dolomitization) in Ordovician Galena Group, Upper Mississippi Valley

The Galena Group is a fossiliferous, dominantly carbonate unit about 85 m thick, which was deposited in a broad epeiric sea mostly below wave base.

Submarine dissolution of aragonite and cementation by calcite appear to have proceeded simultaneously in Galena sediments. Commonly, the enclosing sediment (mostly carbonate mud) lithified before shell aragonite dissolved, resulting in moldic voids. Most of these voids were later cemented with block calcite spar; some were filled by bioturbation.

Some burrow fills became lithified but the enclosing matrix remained soft. Where this occurred, sparry replacements of aragonitic bioclasts now exist only within these burrow fills; lithification preserved bioclast outlines. Where scouring later exhumed lithified burrow fills, they produced topographic highs on scoured surfaces or intraclasts with meniscus-fill fabric.

Hardgrounds very commonly occur in most exposures of the Galena; many are bored. Sparry calcite fills cracks in some hardgrounds, and is transected by borings or by the overlying bed. Spar-filled voids suggestive of former aragonitic clasts are preserved in the upper centimeters beneath hardgrounds in some strata which otherwise lack these fossils.

Fine to very fine crystalline dolomite fills burrows extending downward from many hardgrounds. Individual dolomite crystals are abraded at scoured surfaces and at margins of intraclasts. These features suggest that dolomitization occurred on the seafloor.

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Anoxic Environments and Oil Source Beds

The anoxic, aquatic environment is a mass of water so depleted in oxygen that virtually all aerobic biologic activity has ceased. Oxygen demand relates to surface biologic productivity, while oxygen supply largely depends on water circulation, which is governed by global climatic patterns and the Coriolis force.

Organic matter in sediments below anoxic water is commonly more abundant and more lipid-rich than under oxic water mainly because of the absence of benthic scavenging and bioturbation. Geochemical and sedimentologic evidence suggests that oil source beds are and have been deposited in four main anoxic settings.

1. Large anoxic lakes. Permanent stratification promotes development of anoxic bottom water, particularly in lakes not subject to seasonal overturn such as Lake Tanganyika. Warm, equable, paleoclimatic conditions favored lacustrine anoxic settings.

2. Anoxic silled basins. Only those landlocked silled basins with positive water balance tend to become anoxic. Typical are the Baltic and Black Seas. In arid region seas, such as the Red Sea and the Mediterranean Sea, evaporation exceeds river inflow, causing negative water balance and well-oxygenated bottom waters. Hence, silled basins do not necessarily imply the presence of oil source beds.

3. Anoxic layers caused by upwelling. These develop when the oxygen supply in deep water cannot match demand due to high surface biologic productivity. Examples are the Benguela current and Peru upwellings. No systematic correlation exists between upwelling and anoxic conditions because deep oxygen supply can commonly match strongest demand. Anoxic sediments resulting from upwelling are found preferentially at low paleolatitudes.

4. Open-ocean anoxic layers. These are found in the oxygen-minimum layers of the Pacific and northern Indian Oceans, far from deep, oxygenated, polar water sources. They are analogous to worldwide "oceanic anoxic events" during global climatic warm-ups and major transgressions, as in Late Jurassic and middle Cretaceous times.

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Use of Trace Fossils for Interpretation of Triassic Depositional Environments, Northeast Border of French Massif, Central France

A variety of trace fossils occur in Triassic sediments of the northeast border area of the French massif as follows:

1. Vertebrate tracks: numerous species (approx. 30) that point to the existence of: (a) numerous large herbivorous reptiles (*Isochirotherium*) accompanied by small ones (*Rhynchosauroïdes, Rotodactylus*); rare carnivorous reptiles of relatively small size (*Coelurosaurichnus, Sphingopus, Anchisauripus*); common omnivorous or necrophagous reptiles (*Brachychirotherium*); (b) very small insectivorous or herbivorous reptiles or amphibians (small *Rhynchosauroïdes, Prolophonichnium, Platipes, Furcapes*).

2. Invertebrate trace fossils: *Isopodichnus, Planolites, Cochlichnus.*

3. Plant imprints: *Voltzia* sp.

4. Associated primary sedimentary structures: ripple

marks, mud cracks, salt-pseudomorphs, and groove marks accompanied by vertebrate footprints on the same slab.

The set of trace fossils and associated sedimentary structures indicates an origin at the fringes of aquatic areas and at the borders of vegetation zones. These large areas were used by the ruling reptiles as pathways between the water and the vegetation where they found resting, breeding, and feeding places. The smaller vertebrates were living in habitats near the vegetation or at the borders of small channels. The invertebrate traces point out the proximity of water and the fluctuation of water level. The primary sedimentary structures suggest variable water levels and the salt-pseudomorphs suggest marine water. The assemblage of traces suggests very large sandy areas between the sea or lagoons and zones of dense vegetation which favored proliferation of the mobile Archosaurs.

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How Geologic Objectives Should Determine Seismic Field Design

The geologist needs to take an active part in seismic field design so that the results of the seismic survey will answer his questions as clearly as possible. Geologic objectives should provide the basis for field design. A systematic procedure is outlined where the field parameters are defined by (1) the depth of objectives, (2) the expected dip, (3) the required resolution, and (4) signal-to-noise considerations.

Optimizing seismic data quality requires proper design of field acquisition parameters as well as proper execution of the field work. Field parameters are usually chosen as "those that were used last time," even though these may not have been optimum or may have been constrained by hardware considerations that no longer apply. Furthermore, the geologic objectives may have changed.

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Uranium in Tertiary Sediments in Alaska

The early search for uranium in the continental Tertiary sediments in Alaska raised the question of whether the necessary processes to produce epigenetic uranium deposits ever occurred under the paleoenvironmental conditions that existed this far north. Recent discoveries, however, have demonstrated that epigenetic uranium enrichment occurred in these Tertiary sediments.

At present, the most intensely explored and best known uranium occurrences in Tertiary sediments are found in the Healy Creek basin. The richest occurrence found in this area is in discontinuous beds of sideritic nodules near the base of the Oligocene and Miocene Healy Creek Formation where it overlies the Mississippian(?) Totatlanika Schist. The Healy Creek Formation consists of a clay-rich, gray to light-reddish-brown conglomeratic sandstone containing carbonized plant debris. The nodules are 2-5 cm in diameter. They have a reddish-brown, outer goethitic rind, a yellowish-brown, inner sideritic core, and scattered gray areas containing uraninite and manganite. A composite sample of the sideritic nodules contained 717 ppm uranium and 2,000 ppm manganese. A low-grade roll-front deposit has also been reported from this area. The roll front is in the Miocene Suntrana Formation, which consists of coal-bearing pebbly quartz sandstone.

Slight uranium enrichment (12 ppm) had been reported from a thin carbonaceous sideritic bed in a conglomeratic part of the Tertiary Kenai Formation near Camp Creek in the Susitna Lowlands. Additional collections yielded a sample containing 72 ppm.

A uranium occurrence has been reported from the Tertiary Kootznahoo Formation on Kuiu Island in southeastern Alaska. The Kootznahoo consists of arkosic dolomitic sandstone containing carbonized wood fragments. As much as 0.23% gamma eU (0.13% beta eU) was found in the carbonized wood fragments. Some of the samples also contained apatite and siderite.

Siderite and carbonized plant material are common to all the known uranium deposits in Tertiary sediment in Alaska. The siderite suggests alkaline conditions and the carbonaceous material indicates reducing conditions. Tertiary ash beds and other volcanic sediments were the apparent sources of uranium for the Healy Creek and the Kuiu Island deposits. Cretaceous and Tertiary granite and quartz monzonite were the apparent sources of uranium in the Susitna Lowlands occurrence.

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Paleogene Depositional Systems, Western Transverse Ranges, Southern California

Paleogene strata of the western Transverse Ranges include varied clastic facies that prograded southwestward from arkosic sediment sources in granitic and metamorphic terranes of the Salinian and Mojave blocks. Deposition occurred within a complex fore-arc basin whose bathymetry was modified by pronounced uplift of a structural high along the trench slope break, and by internal deformation associated with oblique subduction during shallow plate descent beneath the Laramide cordillera. Integrated depositional systems produced intertonguing deep-marine, shallow-marine, marginal-marine, and nonmarine deposits. Exposed transitions between basinal turbidite successions, deltaic strandline complexes, and alluvial-plain sequences are common at several horizons. Mappable formations and local members are distinguished chiefly by their shaly, sandy and conglomeratic, or mixed lithologic character. Each such stratigraphic unit typically includes several facies associations. Shale-rich facies were deposited on terrestrial flood plains, prodelta and basin-flank slopes, overbank surfaces of subsea fans, and distal basin plains. Sand-rich intervals include thickening-upward cycles of sheet-flow depositional lobes on subsea fans, thinning-upward cycles of turbidite channels on subsea fans, coarsening-upward cycles of prograding shelf breaks, fining-upward cycles of migratory shelf and shoal-water bars, coarsening-upward cycles of distributary-mouth bars, and fining-upward cycles of flu-