ft, whereas the hexosamine-N increased from 130 μg/g to 380 μg/g at the same levels. This suggests that the α-amino acid and hexosamine compounds were well preserved even to 100-ft depth and that their distribution was related to the initial environments of deposition. It was also found that in the fresh-water environment the percent organic-C was nearly parallel with the percent of $<5\mu$ fine clay and that the C/N ratio was related closely to the percent of total cementing minerals (such as $FeCO_3$, $MnCO_3$, $CaCO_3$, Fe- and Mn-oxides) which accumulated with depth. In addition, organic-N was found in the nodules. This demonstrates one of the important roles of soluble organic matter in the translocation or diffusion and subsequent redeposition or recrystallization of various minerals during the diagenetic process.

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Progress Report on Two Unusual Alaskan Sediments—Recent Beach Carbonate From Three Entrance Bay, and Polished Grains From Easter Egg Hill

BEACH CARBONATE

Modern southeastern Alaska cold-water skeletal carbonates are composed chiefly of whole and fragmented mollusks, barnacles, echinoderms, and foraminifers mixed with basalt pebbles and sand from the island bedrock. Average $CaCO_3$ content is about 80 percent by weight and increases from 0 percent at -4ϕ (16.0 mm) to 88 percent at 4ϕ (0.0625 mm). Texturally this beach sediment is polymodal, with two dominant modes: a gravel mode about -4ϕ and a sand mode about 2ϕ (0.25 mm). Traces of carbonate mud are present. Fractionating this sediment into carbonate and silicate mineral phases shows that these gravel and sand modes are present in each mineral phase. This suggests that selective size sorting in the beach environment, rather than fragmentation into certain size classes, may be the chief process involved in the formation of modal size classes for this sediment.

POLISHED GRAINS

Highly polished particles occur in (?)Pleistocene pebbly sandy loess on a topographic ridge in interior Alaska. Most polished particles have near-perfect roundness and occur in all sizes between -5.1ϕ (34 mm) and 4ϕ (0.0625 mm). Polished grain surfaces essentially are smooth, with some pits and very few facets. Rounded and polished grains are mixed with totally angular and dull grains. Polished grains seem to have bimodal size distribution, being abundant about -3.6ϕ (12 mm) and 0.5ϕ (0.25 mm). Modes from size analysis of loess do not correspond to modes for abundance of polished grains. Attempts to duplicate polished grains by tumbling unpolished grains from the same locality with wet and dry loess failed. Most polished grains are quartz; some are chert. Origin of these polished grains is uncertain. The following origins have been rejected: polish by wind-blown silt or ice crystals, solifluction, *in situ* chemical polish, and inheritance.

It is believed that these polished grains are gizzard stones produced by Pleistocene bird(s). Gizzard stones collected from grouse and ptarmigan in late winter are highly polished. Unfortunately, modal classes of gizzard stones from birds now living in interior Alaska do not coincide with modes of polished grains from the loess; average size of grouse gizzard stones is -1.0ϕ (2.00 mm) and of ptarmigan stones is -1.3ϕ (2.5 mm).

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Sedimentologic and Reservoir Characteristics of Abandoned Delta Distributary

An abandoned delta distributary of the Bethel-Sample Formations, a very small part of the Michigan River system that supplied sand and mud to and across the Illinois basin during the Late Mississippian, has been delineated for 15 mi in west-central Indiana by outcrop mapping and shallow drilling.

This elongate sandstone body has sharp and relatively straight boundaries, averages 2 mi in width, and has a maximum thickness of 145 ft. Along its axis of maximum thickness the sandstone body fills a shallow channel cut in the underlying thick limestone sequence. Cross-bedding and ripple marks constitute its two principal facies and form as many as five fining-upward cycles. The ripple-bedded facies is very fine grained and much less permeable than the generally coarser grained cross-bedded facies. Cross-bedding dips uniformly southeast except in the very basal part of the sandstone body where the orientation is northwest—considered to be the product of up-channel tidal currents that introduced sparingly glauconitic marine sand into the shallow channel prior to deposition of the fluvially derived sand.

Decementation by groundwater percolating downward into the underlying carbonate has greatly increased the permeability of the sandstone body. The cross-bedded facies has an average permeability of 400 md except within 20–30 ft of the base where permeability values in excess of 2,000 md occur. Intra-sandstone-body channeling plus the distribution of the low permeability ripple-bedded facies modify permeability.

Comparable buried reservoirs should occur where an ancient distributary system is truncated by an unconformity with 100–200 ft or more of relief. Permeability will be enhanced greatly in such reservoirs if they are underlain by limestone and if the limestone-sandstone contact was above stream level during the development of the unconformity.

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Geology of Woodbine Formation in East Texas Oil Field and Related Areas

The East Texas oil field is in the eastern part of Texas. It was discovered by random drilling by Columbus M. ("Dad") Joiner, October 3, 1930, on completion of the No. 3 Daisy Bradford.

The producing formation is the Upper Cretaceous Woodbine Sandstone. The geology of the Woodbine Sandstone in the East Texas field and related areas is comparatively simple. Regionally the field is on the western flank of the Sabine uplift, which controlled the deposition of the Woodbine Sandstone and the accumulation of oil in the field. The accumulation of oil is due to updip pinchout of the sandstone. This pinchout forms the eastern edge of the field. The western limit of the field is defined by an oil-water contact at a subsea depth of approximately 3,320 ft.

The Woodbine is the basal stratigraphic unit of the Upper Cretaceous. The seals above the Woodbine are the Eagle Ford Shale and the Austin Chalk. In most of the field, the Austin Chalk is in direct contact with the truncated and updip edge of the Woodbine. Beneath the reservoir sandstone is shale of the Lower Cretaceous Washita Group. Just east of the field, the Austin Chalk overlies the Washita directly.

The field has one of the largest proved oil reserves of any in the United States. This places it among the giant single oil pools of the world. The pool is 44.32 mi long (northeast-southwest) and 4.94 mi wide (east-west), and covers approximately 140,000 acres. The average net effective sandstone thickness is approximately 35 ft ranging from 0 to 102 ft. East Texas field has produced 3,860,000,000 bbl of oil to January 1, 1968, and has an estimated remaining recoverable reserve of approximately 2,000,000,000 bbl. The oil currently is selling for $3.15 per bbl in the field. The oil, gas, and liquid products produced from the field have an accumulated value of about $10,000,000,000.

In the East Texas basin there are 83 separate oil pools producing from the Woodbine, having an estimated ultimate recoverable reserve of 7,700,000,000 bbl. Seventy-six (76) percent of this reserve is in the East Texas pool.

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MINERALOGY AND DISTRIBUTION OF CLAY SEDIMENTS IN GREAT MIAMI RIVER BASIN (OHIO-INDIANA)

Sixty-one samples of suspended and sedimented clays were collected from master and tributary streams in the Great Miami River drainage basin in southwestern Ohio and southeastern Indiana. Major contributors of clay materials include Ordovician, Silurian, and Devonian shales and Pleistocene drift. These sediments were analyzed by X-ray diffraction for variations in composition and distribution pattern.

Dominant clay minerals include illite, chlorite, montmorillonite, mixed montmorillonite-illite, and mixed chlorite-vermiculite. The preponderance of illite is evident in Silurian and Devonian shales in the area and contrasts markedly with a significant proportion of chlorite in Ordovician shales. The suspended sediment in streams crossing from younger to older bedrock reflects these changes within a few miles. Variations in the degree of organization of chlorite in Ordovician shale and chlorite in highly leached till can be recognized as stream courses pass over bedrock and glacial material. Montmorillonitic components also appear to come from leached 10A clays in tills.

Significant sorting takes place between high- and low-water periods as a comparison of suspended clays and recently deposited bank clays shows. Degraded and mixed-layer clays tend to remain suspended longer whereas the larger, well-crystallized particles settle. Thus periods of sampling of suspended sediment are very critical for accurate identification of transported clays. Further, the heterogeneity of clay compositions at any particular location within the drainage basin points up the difficulty in defining completely the total mineralogy of a river system. Consideration of the data also illustrates the strong contrast between patterns of clay distribution in marine and fresh-water environments.

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MISSISSIPPIAN CARBONATE SEDIMENTATION ACROSS MIOGEOSYNCLINE-CRATON HINGE ZONE, EAST-CENTRAL IDAHO-SOUTHWESTERN MONTANA

The rocks of the Mississippian System in this region were formed by sedimentation on the edge of the craton, across a hinge zone, and on the eastern flank of the miogeosyncline. The Kinderhook and Osage Series are represented by the western-derived Milligen argillaceous sediments in the miogeosyncline and the Madison Group carbonates up to 2,000 ft thick on the craton. The Meramec and Chester Series consist of the 4,000-ft-thick White Knob Group carbonates in the miogeosyncline and a sequence less than 1,000 ft thick on the craton including: the uppermost Madison carbonates and evaporite cycles; a post-Madison erosion surface; and the Big Snowy Group shale and associated limestone. These major stratigraphic changes across the region are interpreted in terms of differential paleotectonism across the hinge zone or the "Wasatch Line."

Through petrographic study the carbonate strata have been subdivided into a succession of interrelated carbonate sandstone and mudstone deposits with distinctive grain assemblages, depositional fabrics, and bedding or cycle types. Record of a Kinderhook, Osage, and early Meramec regression on the craton is present in the Madison Group sequence which includes Lodgepole calcitic and argillaceous mudstone, Mission Canyon bioskeletal sandstone, algal limestone, evaporite cycles, and an unconformity. In the lower White Knob strata of Meramec age, regression in the miogeosyncline is recorded by the sequence which includes the Middle Canyon siliceous carbonate mudstone, and the Scott Peak crinoid-bryozoan sandstone, oölite, algal sediments, and carbonate mudstone with intertidal zone(?) open-space structures. The upper White Knob strata of Chester age are principally carbonate mudstone, which is divided into the South Creek and Surrett Canyon Formations and reflects a transgressive deepening of the Late Mississippian sea. Internal changes within the formations in the vicinity of the hinge zone suggest a shoaling or erosional event in this area, at least as early as middle Mississippian time.

New petrographic and stratigraphic evidence suggests that the carbonate sequences developed as a low slope "prograding shoal" complex, which advanced from the paleobathymetric highs into deeper areas of the craton and into the bathymetrically deep (starved) geosyncline. Biostratigraphic evidence limits the slope of the prograding surfaces to very low angles; the large stratigraphic units are approximately isochronous as indicated by preliminary study of the corals, conodonts, and endothyrids. It is inferred that the cratonic area was a bathymetric high, and that its shallows localized the first carbonate sedimentation in the region. The paleotectonic and paleogeographic importance of the hinge zone during the Mississippian Period is evidenced by major differences in sedimen-