ment that might be either shallow and protected from water agitation by a physical barrier, or deep and protected by water depth itself. The presence of calcarenite composed of whole shells exhibiting little fragmentation or abrasion might indicate only local organic proliferation or lack of dilution by fine sediment. In contrast, calcarenite composed of fragmented, abraded, well-sorted, skeletal grains indicates water turbulence and winnowing of fines, processes which are more probable in shallow water.

Environmental syntheses based on stratigraphic, petrographic, and paleontologic criteria can bring into focus certain aspects of ancient marine environments that are difficult to determine from the record. On a local scale, detailed facies mapping in undeformed rocks may allow detection of original topography that controlled facies changes. On a larger scale, systematic lithic variation along the outcrop of an entire stage of rocks may provide a regional picture of the lateral succession of ancient marine environments across an epicontinental basin. Perhaps one of the best modern laboratories to study analogs of ancient marine epicontinental deposition is the Sahul-Arafura shelf and Gulf of Carpentaria between orogenic New Guinea and cratonic Australia.

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### Continental Margins and Petroleum Geology

(No abstract submitted)

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### Continental Margins from Viewpoint of Petroleum Geologist (Keynote Address)

Major features of the earth's surface are its continents and its ocean basins—which in turn reflect fundamental differences between continental and oceanic crusts. The broad zone of separation, or junction, between the continental and oceanic domains has been called the *continental margin.* It particularly includes the seaward part of the continental shelf, the continental slope, and the landward part of the continental rise.

Many of the most exciting events in the history of our planet have been concerned with the interplay between continental and oceanic crust and between continents and oceans; and the continental margin represents the stage where, throughout earth history, this drama has been played.

Important elements of the continental margin are the outer shelf, the borderlands, the marginal plateaus, the slope, the base of the slope, the rise, and the marginal trenches. The origin of these features and the nature of their sediments and local structures are the essence of geology. Of particular interest to the petroleum geologist are also the sediment-rich semi-enclosed basins or seas associated world-wide with the continental margin, the barrier ridges and reefs so commonly developed near the rim of the continental slope, and the growing evidence for impressive vertical movements of basin floors.

Great advances in our understanding of the processes active at the continental margins have come from the subsea geological and geophysical studies of the last decades, and rapid additional progress may be expected from the stimulus of "the new global tectonics"; but current hypotheses are still largely in a developmental stage. Factual data are still woefully inadequate. Moreover, continuing studies are needed, not only of the present continental margins but also of the past continental margins.

For the petroleum geologist, it is significant that through the ages the continental margin has been the great mixing bowl in which has been brewed the bulk of the world's petroleum and from which the bulk of its petroleum production to date has been derived. The continental margin should be the fruitful meeting ground of the petroleum geologist, the geologist of the oceans, and the student of earth history.

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### Depositional Environment of an Upper Cretaceous Deltaic Sandstone in Southeastern United States

A detailed sedimentologic, mineralogic, and paleontologic study of an Upper Cretaceous sequence of clastic sediments in Alabama and Georgia has defined three regional deltaic facies for the Cusseta Sand.

*Fluviatile and upper delta.*—This facies is medium- to coarse-grained, poorly sorted sandstone and kaolinitic clay, with cut-and-fill structures, and unimodal trough-type cross-stratification.

*Delta front.*—The delta-front facies includes carbonaceous, micaceous siltstone and sandstone and mixed kaolinitic and montmorillonitic clay, abundant small mollusks and ostracods, estuarine and tidal channel deposits, bimodal cross-stratification, and *Ophiomorpha* borings associated with well-sorted, cross-bedded, "barrier-island" sandstone.

*Prodelta.*—The prodelta facies is fine- to coarse-grained, calcareous, glauconitic, fossiliferous sandstone and montmorillonitic clay. The mollusks *Ostrea* and *Anomia* are dominant, and there are abundant calcareous benthonic and planktonic Foraminifera.

Paleocurrent and light- and heavy-mineral data demonstrate southward transportation of immature sediments derived from a high-rank metamorphic and acid-igneous source in the southern Appalachians and Piedmont Plateau.

The Cusseta Sand has been interpreted previously as a basal unit in a transgressive sequence. The present study indicates that it represents the final coarsening upward or destructional phase of a positive regressive sequence. Previous difficulties in correlating thin discontinuous sandstone bodies in Alabama with the Cusseta Sand in Georgia are explained by their interpretation as barrier-island bars which developed during the destructional phase of the deltaic sequence.

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### Sedimentary Cycles in Green River Formation (Eocene): Modification of Walther's Law

Along Raven Ridge in northeastern Utah, the Parachute Creek Member of the Green River Formation contains contemporaneous sedimentary cycles that range in environment from fluvial through "deep" la-