northwest-central South Dakota is recorded in the offlap sequence beginning with the Elk Butte Member (offshore shelf) of the Pierre Shale followed by the Trail City (bar-influenced shelf), Timber Lake (offshore bar), and Iron Lightning (deltaic) Members of the Fox Hills Formation. Well-preserved molluscan assemblages from these facies permit comparison with assemblages from analogous recent environments.

Factors controlling the distribution of Late Cretaceous mollusk assemblages are related to (1) sediment organic content, (2) sedimentation rate, and (3) sediment-water interface stability. These limiting factors closely control feeding adaptations and are reflected, therefore, in the distribution of feeding groups.

*Bottoms dominated by deposit feeders.*—Deposit feeders are limited to bottoms containing an organic food source. Shelf areas receiving deltaic sediments (Iron Lightning) or deeper offshore areas receiving settling fines (Elk Butte) were dominated by this feeding group. Mud bottoms extensively reworked by deposit feeders have a high water content and are suspended easily by weak bottom currents. High interface turbidity and instability may explain the low diversity of filter feeders from this bottom type as high concentrations of suspended silt-clay cause clogging of filtering mechanisms.

*Bottoms dominated by filter feeders.*—The clean-washed upper part of the Timber Lake sand bar and the distributary sands of the Iron Lightning were dominated by mobile filter-feeding bivalves burrowing into the shifting unstable sand bottoms. Interface instability excluded attached epifaunal forms.

*Bottoms with mixed feeding groups.*—Peak filter-feeding diversity was attained on bottoms during periods of low Trail City sedimentation. Physical stability of these bottoms provided a firm surface of attachment for epifaunal mollusks and interface turbidity was relatively low providing optimal conditions for filter feeders. Root structures and high gastropod diversity indicate that some parts of the bottom were covered with plants during Trail City deposition. The presence of small amounts of organic matter in the sediment also permitted the population of a few infaunal deposit feeders.

The distribution of the Fox Hills bivalves by feeding groups reflects the conditions of food source, sedimentation rate, and bottom stability. These relations are supported by independent evidence of lithologic and stratigraphic analysis. The recognition of feeding groups can provide a strong tool in environmental reconstruction and analysis of ancient community structure.

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### Reefs and Reef Environments

Reefs are considered as largely unbedded or obscurely bedded, massive structures which are composed of solid, organically bound, *in situ* organisms, and which were at least potentially wave-resistant structures that rose topographically above the surrounding depositional surface. Reefs are somewhat unusual and quantitatively minor features in the geologic record, but they have received considerable attention because of their economic importance, biologic uniqueness, or distinctive facies relations.

Any model for recognition of reefs in the geologic record must allow for considerable variation in relief, size, shape, biologic composition, and facies relations. They are associated commonly with normal marine environments, but the associated complex may span from freshwater to hypersaline deposits or from euxinic to well-oxygenated conditions.

Relief and shape depend on several factors, principally the comparative rate of subsidence and growth, direction of prevailing currents, structural relation, and organic composition. Size and shape commonly are discernible, but demonstration of depositional relief is difficult in many places.

Textures of single outcrops, hand specimens, or thin sections, may be diagnostic of at least reef potential if the massive, bound relations of organisms are apparent, but commonly additional criteria are necessary. Recognition of biologic and lithologic facies relations are critical in investigation of reef and associated environments in the geologic record.

The term "reef" has been applied loosely to several structures by different workers. Locally, it has been used for merely a faunal association, even though the organisms are present as loose, discrete fragments and the rocks in which they occur are evenly bedded in moderately thin layers. The term also has been applied to carbonate lenses in noncarbonate sequences, even though these lenses are of bedded, unbound detritus, oölites, or crinoid columnals. It also has been applied to sheetlike deposits of *in situ* corals or algal crusts or other reef-associated organisms even though the deposit is widespread, thin, and with no demonstrable topographic expression. Massive tumbled blocks also have been considered to be reefs, particularly if the blocks are abundantly fossiliferous and occur in distinctly more thinly bedded rocks. The term "reef" also has been applied to large carbonate structures which may be truly of reef origin at their margins, but which are composed mainly of bedded, clastic debris.

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### Comparison of Continental Margins off Northwest Africa and Cape Hatteras[1]

Pre-drift reconstructions of the Atlantic place the continental margin off the middle Atlantic region of the United States against the continental margin off northwest Africa. An implication of this reconstruction is that the opposing continental margins would be mirror images if the two margins formerly had been joined and then had separated and had undergone parallel development. Relevant sections of the outer continental shelf, continental slope, continental rise, and abyssal plain off northwest Africa between Point Durnford, the Spanish Sahara, and Cape Timiris, Mauritania, and off Cape Hatteras, United States, were investigated with continuous seismic reflection (air gun), magnetic, and bathymetric profiles.

Geophysical data and regional geology from the two continental margins disclose some similarity in their stratigraphic framework. Mesozoic through Cenozoic coastal-plain strata dip seaward at low inclinations ($<5°$) under much of the continental shelf of both continents. Paleozoic-Precambrian crystalline rocks are exposed along the landward margin of the coastal plain and apparently incline seaward as base-

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