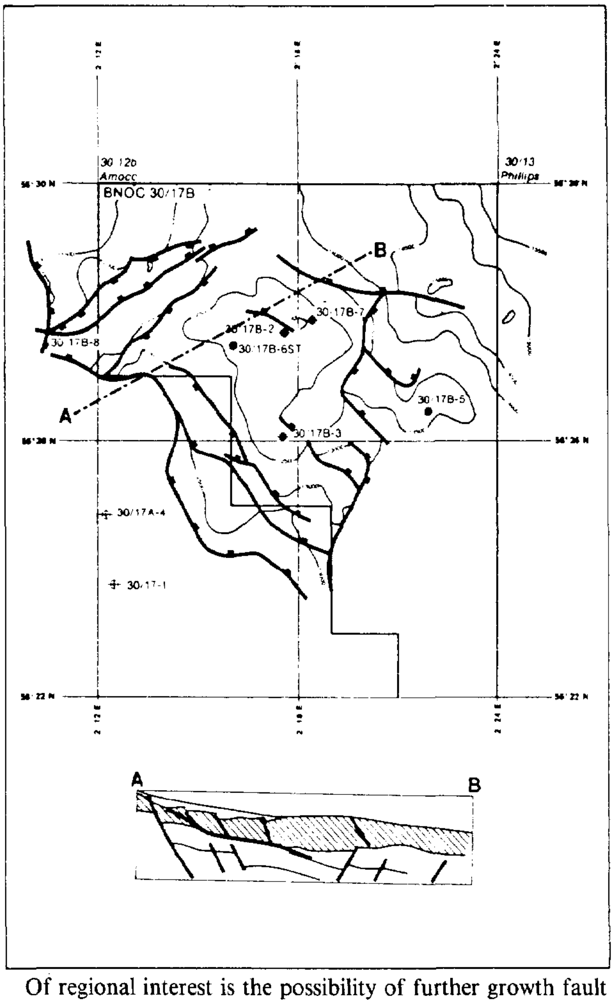
Palinspastic sections were constructed to honor the seismic and well data, and were tested iteratively using new techniques for balancing structural sections in extensional regimes. Cross-sectional area and bed length balance clearly demonstrate the presence of both shallow and deep fault detachments and eliminate models involving tectonic inversion or halokinesis. The deep basement faults form the main regional terrace system and sole-out in the crust at about 15 km (9 mi). A second shallower set of faults defines a listric slide and detachment at the top Permian. The listric shape of the detachment accounts for the lower boundary of the Triassic-Jurassic high. Seismic remapping has substantiated this model and demonstrates the decoupling of the basement and shallow listric fault sets. In plan, the shallower faults are arcuate with pull-apart lows on the downthrown side that show synsedimentary growth of the Upper Jurassic clays. Compaction buckling and uplift of the Jurassic section toward the toe of the slide form positive structural features that are oil-productive. The faults along the margins of the structures have a significant strike slip component where they parallel the structural dip.

The development of this growth fault model for the Clyde field has assisted in understanding the seismic mapping and in establishing a predictive model for the field geology. In particular, the recognition of Jurassic growth and strike slip components on the faults has significance in terms of variations in reservoir quality and possible reservoir discontinuities resulting from fault seals.



Of regional interest is the possibility of further growth fault plays within the North Sea basin. This contrasts with the classical development of growth faults on a continental margin. The distinctive geometry of large growth faults can generate structural highs that are offset from the basement and overlying base Cretaceous structure. This model, along with the lensoid cross section above a simpler basement and distinctive seismic expression of shallow dipping faults, is being used to identify other potential plays that may be analogous to the Clyde field.

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Close Encounters of Reefal Carbonates and Siliciclastics

Siliciclastic depositional environments are not normally favorable for the growth of reef-building organisms because of high turbidity, reduced salinity, or unfavorable substrate. Yet there are numerous examples, both living and fossil, of close associations, even intermixing, of the two kinds of deposits.

In the Red Sea (Gulf of Aqaba), Holocene coral reefs develop on the seaward margins of inactive alluvial fans of gravel. In the nearshore zones of Brazil (Abrolhos Bank), Mexico (Vera Cruz), and the northern Great Barrier Reef, there are reefs surrounded by siliciclastic sands and silty clays; locally some of this noncarbonate fraction occurs as internal sediment within the reefal frame. In the lagoonal areas of both the Belize (Central America) and Great Barrier Reef tracts, the positions and the geometries of some reefs were probably determined by the local relief (channel banks, bars, deltaic lobes) of the underlying siliciclastic foundations.

Throughout the Phanerozoic, there is a wide spectrum of interaction between reefal carbonates and siliciclastics. Reddish or greenish argillaceous internal sediments are common in some Triassic and Devonian reefs of western Europe. In the Phanerozoic of North America, there are numerous examples of reefs encased in shales or siltstones. In the Triassic of Europe and the Yukon (Canada), reefal carbonates are surrounded by and locally interfinger with volcaniclastics. In the Pennsylvanian, Permian, and Jurassic of North American and in the Permian of Japan, reefal carbonates are juxtaposed with deltaic and associated siliciclastics.

At least two factors relating to exploration emerge from this review of the connections between reefal carbonates and siliciclastics. One is the effect of local relief on the underlying siliciclastics in determining the locations and forms of reefs. The other concerns the combined source and seal provided by fine-grained, peri-reefal siliciclastics.

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Upper Eocene North American Microtektite Layer: Associated Radiolarian Extinctions, Climatic Change, and Iridium Anomaly

Tektites are glass objects believed by many authors to have been formed by meteorite (or cometary) impact. The areas on the earth's surface where tektites are found are called strewn fields. Thus, tektites found in Texas and Georgia belong to the North American strewn field. Microtektites (< 1-mm diameter tektites) have been found in upper Eocene sediments from one piston core and in cores from nine Deep Sea Drilling Project sites in the Caribbean Sea, Gulf of Mexico, equatorial Pacific, and eastern Indian Ocean. Based on their fission-track age (34.6 ± 4.2 m.y.), geologic age, geographic location, and chemistry, these microtektites are thought to be part of the North American strewn field. The North American tektites have fission-track, K-Ar, and ^{40}Ar-^{39}Ar ages of ~ 34 m.y. The North American microtektite layer