3-D Stratigraphic Modeling from High-Resolution Seismic Reflection Data: An Example from North Carolina Continental Shelf

Over 2,000 km (1,240 mi) of high-resolution seismic reflection data were "rapidly" reduced to stratigraphic line drawings with a predetermined vertical exaggeration of 100:1 using a graphics digitizing tablet and desk-top computer. These data form the basis of a three-dimensional stratigraphic model for the upper southeastern North Carolina continental margin.

Correlations between the seismic data and drill, core, quarry, and outcrop data from the adjacent emerged coastal plain, supplemented by lithostratigraphic and biostratigraphic analyses of over 200 (9 m [30 ft]) vibracores collected along the seismic lines depicts an internally-consistent chronostratigraphic framework ranging in age from middle Eocene to late Pliocene. Seismic sequence analysis delineates five mid-late Paleogene depositional sequences, each bound by basin-wide unconformities. The distribution of these sequences is regionally controlled by the mid-Carolina Platform high of the Cape Fear Arch and locally influenced by Gulf Stream erosional events.

The Neogene section is an extremely complex, highly variable lithic package consisting of at least ten depositional sequences bound by regional unconformities and associated channels. Preliminary biostratigraphic analyses (both nannoflora and planktonic foraminifera) of vibracores penetrating these sequences suggest they represent high-frequency (4th- and possibly 5th-order) sea-level cyclicity. The seismic data indicate that these short pulse sea-level episodes were primarily low amplitude (< 50 m [164 ft]) events. The general distribution for each Neogene sequence, as well as the temporal and spatial relationships of lithofacies changes, seems to be a consequence of a constant interplay between high-frequency sea-level cyclicity and concomitant Gulf Stream dynamics.

The evolving depositional model for the upper southeastern North Carolina margin consists of a few low-frequency (3rd-order) high-amplitude, mid-late Paleogene sea-level events. During their maximum transgression, the western boundary current bypassed the Charleston Bump to the south and impinged on the North Carolina shelf 35 to 40 km (22 to 25 mi) southeast of Cape Fear. These Gulf Stream erosion events deeply scoured the shelf, extending the Blake Plateau to the north. Conversely, the Neogene was dominated by high-frequency, low-amplitude sea level cyclicity. Maximum transgression was relatively lower, forcing the Gulf Stream to be deflected by the Charleston Bump to the south. Consequently, the Neogene sequences comprise a major depositional episode in which the shelf prograded east to the present location of the Florida-Hatteras slope.

SPEER, STEPHEN W., and ALAN J. SCOTT, Univ. Texas, Austin, TX

Evolution of a Fluvial Clastic Wedge, Abo Formation (Wolfcampian), Sacramento Mountains, New Mexico

Outcrops of the Abo Formation (Wolfcampian) in the northern and central Sacramento Mountains of south-central New Mexico record the evolution of fluvial systems within a major clastic wedge. This wedge was derived from the Pedernal uplift and prograded westward into the Orogrande basin. Regionally, the Abo Formation thickens from 60 m (197 ft) in the central Sacramentos, to over 545 m (1,788 ft) in the northern portion of the range, a distance of approximately 29 km (18 mi). Superposed on the regional pattern are local thickness variations of up to 91 m (300 ft). These occur within distances as small as 0.4 km (0.25 mi), and represent local tectonic and paleotopographic controls on sedimentation.

Clast-supported cobble conglomerates, associated with laminated mudstones and discontinuous coarse arkosic sandstones, are present near the base of the Abo Formation. The conglomerate lenses range from 0.5 to 20 m (1.5 to 66 ft) thick, and from 15 m (49 ft) to several kilometers wide. They exhibit poor stratification, occasional clast imbrication, and near horizontal to concave-upward erosional bounding surfaces. Locally, nodular $CaCO_3$ occurs in beds or scattered throughout the associated mudstones.

The central portion of the sequence is characterized by abundant conglomeratic medium to very coarse-grained arkosic sandstone lenses interbedded with laminated mudstones. These lenses range from 0.25 to 10 m (0.8 to 33 ft) in thickness, and 10 to 110 m (33 to 361 ft) in width. Commonly, several lenses will coalesce, forming laterally extensive belts. Both erosional and depositional (lateral accretion) bounding surfaces are well developed within individual lenses. Low-angle, large-scale trough cross-bedding is the dominant stratification type within these units, however, small to large-scale tabular foresets occur, as do planar, ripple, and small-scale trough stratification. Occasionally, individual units fine upward in grain size and/or scale of structures. This sandstone-rich horizon varies laterally in thickness, and grades upward into a mudstone-rich horizon at the top of the Abo Formation.

The upper interval of the Abo sequence contains infrequent fine to coarse-grained arkose lenses enclosed in laterally extensive red mudstones. Paleosols and caliche horizons are present, but not common, in the mudstones.

The basal conglomeratic horizon of the clastic wedge represents braided stream deposition at the distal end of arid alluvial fans associated with the tectonically active Pedernal uplift. Caliche and paleosols developed in the overbank mud drapes and levees of these deposits. The conglomerates grade into arkosic sandstones, reflecting the intense weathering and erosion of the granitic core of the uplift. The multilateral sandstone lenses characteristic of the mid portion of the Abo Formation were deposited in low-sinuousity, coarse-grained (bed-load) meander belts; however, higher sinuousity, mixed-load channel and crevasse splay deposits also occur locally. Finally, as the Pedernal source area was buried by its own debris, thick, broad flood-plain deposition predominated. Sandstones associated with the red mudstones were deposited in shallow ephemeral channels and crevasse splays.

SPENCER, LANA M., Cities Service Co., Houston, TX

Effects of Lower Cambrian Archaeocyathid Patch Reefs on Distribution of Interreef Faunas

In general, reefs create a physical obstruction to existing circulation patterns as they develop and grow vertically; thus the growth of a reef can promote changes in the local physical-sedimentological conditions. As a reef grows, it develops a distinctive biological zonation that appears to be correlated with changes in the associated sedimentological regime of the reef. Thus some change should also be produced in the interreef organism-sediment associations. These changes should be more pronounced near the reef, where the perturbation in the circulation pattern is higher, and diminish gradually away from the reef. Such physical changes may be small and yet have a significant effect on the local biological habitat.

Archaeocyathid patch reefs of the lower Forteau Formation, southern Labrador, developed in the relatively quiet water environment of the Lower Cambrian epeiric sea. Even though the