lain by the oolitic grainstones of the Mississippian St. Louis Formation. Three distinct Chappel facies can be identified: the bank core, flank, and interbank facies. The bank core is composed of crinoid-fenestrate bryozoan mudstones and wackestones; the flank consists of crinoid-bryozoan grainstones and packstones; and the interbank consists of argillaceous sponge spicule mudstones with minor crinoid and bryozoan debris. Chert is a major constituent of the interbank facies but decreases in amount toward the bank core.

Bank growth began in a low-energy environment with the mechanical accumulation of lime mud which was baffled and trapped by crinoids and fenestrate bryozoan. Once the bank core reached wave-base, the crinoid-bryozoan mudstones and wackestones were reworked and redeposited as the crinoid-bryozoan grainstones and packstones of the flank facies. The extensive development of the flank facies, compared with bank core development, indicates that the top of the bank remained at or near wave-base for an extended period of time.

Porosity development in the Chappel banks is secondary and results from dolomitization of the micritic bank core, fracturing and leaching. Although the crinoid-bryozoan grainstones of the flank facies were originally porous, primary intergranular porosity is now absent because of epitaxial cementation.

The Chappel banks can be located in the subsurface by using isopach maps which help identify interval thickening within the Chappel. In addition, thinning, shown by the isopach intervals on horizons immediately overlying the Chappel Formation, can also be used to delineate the presence of these bank deposits.

In subsurface exploration, the bank facies can be differentiated from the interbank facies by petrographic analysis and by noting the more "massive" and also lower gamma ray log response. The lower gamma ray log response is caused by a lack of argillaceous material in the bank facies.

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Late Eocene to Early Oligocene Calcareous Nannoplankton Biostratigraphy and Biogeography

The extinction of *Discoaster barbadiensis* and *D. saipanesis*, the last representatives of the highly successful low- and mid-latitude group of Paleogene rosette-shaped discoasters, close to the Eocene-Oligocene boundary, has been unfortunately seen by some as evidence of a major extinction "event" in the calcareous nannoplankton. These extinctions (and a few others that occur at about the same time) should be more properly viewed against the larger background of calcareous plankton biostratigraphy and paleobiogeography.

A compilation of DSDP Paleogene calcareous nannoplankton data from low, middle, and high latitudes shows maximum diversity values (ca 120 species) during the middle Eocene (NP14-15) and minimum diversity values (ca 37 species) in the early Oligocene (NP22). The approximately 70% reduction in diversity occurs over an interval of approximately 7 m.y. in a stepwise fashion with the most abrupt reduction (~50%) occurring between the late middle Eocene (NP16) and the early late Eocene (NP18). A further reduction of about 20% occurs across the Eocene-Oligocene boundary (NP18 to NP22), and the values for the remainder of the Oligocene (NP23-25) stabilized at about 50+ species.

A quantitative investigation has been made of late Eocene-early Oligocene calcareous nannoplankton assemblages at 4 DSDP sites in the North (Site 292, 16°N) and South (Site 277, 52°S) Pacific, Indian (Site 219, 9°N) and South Atlantic (Site 363, 20°S) Oceans. An equatorward migration of high latitude floral assemblages occurred during the late Eocene and early Oligocene. This migration was initiated in the late middle Eocene (NP16-17) and the replacement of a tropical flora (dominated by discoasters and *Reticulofenestra reticulata*) by mid-high latitude assemblages (dominated by reticulofenestrids, *R. bisecta, R. hesslandi, R. umbilica, R. hampdenensis*) was not completed until the early Oligocene (NP22; see Figure 1). The extinction of the rosette-shaped discoasters and *R. reticulata* is related to the late Eocene-early Oligocene isotopic cooling event but does not reflect its maximum. These species became extinct when sea surface temperatures reached a threshold value below which they could not survive.

Sites	Age	*Reticulofenestra reticulata*	*Reticulofenestra bisecta; R. hesslandii; R. umbilica* s. l. (%)	*Reticulofenestra* gr. *R. hampdenensis* (%)
219	early Oligocene NP21-22		≈ 25°/°	0°/°
(≈9°N)	late Eocene NP18-NP19	up to 30°/° LAD at the E/O boundary	5°/°	0°/°
292	early Oligocene NP21-22		≈ 25°/°	≈ 5°/°
(≈16°N)	late Eocene NP18-NP19-20	~ 15°/° LAD well below the E/O boundary	12°/°	0°/°
363	early Oligocene NP21-22		very poor recovery	
(≈20°S)	late Eocene NP18-NP19-20	LAD in the late middle Eocene	≈ 25°/°	≈ 10°/°
277	early Oligocene NP21-22		≈ 12°/°	≈ 45°/°
(≈52°S)	late Eocene NP18-NP19-20		≈ 30°/°	≈ 30°/°

Migrations of species of *Reticulofenestra* from high latitudes toward low latitudes during late Eocene/early Oligocene interval. *R. reticulata* is a warm-water taxa, whereas *R. bisecta*, *R. hesslandii*, *R. umbilica*, and *R. hampdenensis* are cold-water taxa. As percentages show, the proportions of these latter forms increase at lower latitudes through late Eocene/early Oligocene, as intensity of the isotopic cooling increases.

Isotopic records on benthic and planktonic foraminifera from the same sites (Keigwin, work in progress) show a strong parallelism between climatic changes (sharp cooling in the late middle Eocene, at the Eocene-Oligocene boundary, maximum cooling within the earliest Oligocene) and calcareous nannoplankton migrations. The extinctions of the *Reticulofenestra umbilica* group and equilibrium within the floral migration patterns in the calcareous nannoplankton coincide with the maximum isotopic cooling event in the earliest Oligocene. Our data indicate that extinctions among the calcareous nannoplankton occurred in sequential, step-like manner over a several million year interval. They may best be explained as reflecting the gradual but clearly defined trend towards decreasing temperature values during the late Eocene to early Oligocene.

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Use of Synthetic Sonic Logs Derived from Seismic Data in Interpretation of Stratigraphic Variation in Cretaceous Carbonates of North Field Area, Qatar

This study uses geologic and synthetic sonic sections to evaluate the hydrocarbon potential of the Lower and middle Cretaceous Thamama Group carbonates of the Mishrif, Nahr Umr, Shuaiba, and Kharaib Formations in the North field, Qatar. The North field area, a regional high throughout Lower and middle Cretaceous time, is documented by depositional thinning and by