ABSTRACT

Investigation of 18 core samples from Holes 388A, 391A, and 391C, Leg 44 of the Deep Sea Drilling Project, shows low-to-moderate amounts of organic carbon in Miocene and Upper Cretaceous sediments of the outer continental rise of the eastern United States and of the Blake-Bahama Basin. The organic matter is partly amorphous and algal in nature, and the extractable bitumens range up to 987 ppm in the 10 Tertiary samples and up to 476 ppm in the Cretaceous samples. Only a small fraction (from 0 to 18 per cent) of the bitumen is hydrocarbon which indicates the sediments have undergone virtually no thermal maturation (catagenesis); this is also indicated by the low kerogen alteration indices (17 of the 18 are 1+ or less).

The hydrocarbon fractions of the bitumens are unusual. The saturates are virtually all paraffins and one- and two-ring naphthenes, and the aromatics have relatively large quantities of indenes, and chrysenes and phenanthrenes with different ones in different samples.

Details of mass spectrometric determinations, both molecular and carbon isotopic, show that the five significant extracts are not products of two of the lubricants used aboard the Glomar Challenger. The gas chromatograms of the saturate hydrocarbon fractions also support this interpretation.

Five canned mud samples were very low in hydrocarbon gas (all less than 275 ppm); but this is probably the product of poor sampling techniques or leaking seals, and does not reflect the actual gas content of the samples.

RESULTS AND INTERPRETATION

Hole 388A

All four of these Miocene claystones had more than the minimum organic carbon (0.4%) generally thought...
the small hydrocarbon fraction of the total bitumen thought to be one of the more "oily" types. However, predominantly the amorphous type, also generally potential, and in three of the four, the organic matter is necessary for sediment to have petroleum source potential, and in three of the four, the organic matter is predominantly the amorphous type, also generally thought to be one of the more "oily" types. However, the small hydrocarbon fraction of the total bitumen and the low alteration index indicate that the sediment has undergone virtually no thermal maturation, i.e., catagenesis, which, in more deeply buried or older rocks, produces hydrocarbons from the kerogen, NSO's, and asphaltenes. The carbon isotope data suggest the organic matter is marine in origin, but the analytical mass spectrometer shows the aromatic hydrocarbons are unusual. The prominence of one compound type (indenes in Core 7, Section 3 and tetrahydrophenanthrene in Core 7, Section 4) often is found in very immature sediments.

Site 391

The organic carbon contents of the six Miocene samples, in Hole 391A at this site, are more erratic than in the sediments of the same age from Hole 388A, perhaps because the rocks are more calcareous. Five of the six exceed the requirements generally thought necessary for sediments to be potential petroleum source rocks (0.2% for carbonates and 0.4% for clastics). The mudstone (Core 13, Section 0) in particular is rich. However, as in the sediments in Hole 388A, these Miocene sediments also have very low hydrocarbon contents and low alteration indices. They too are very immature. This is further supported by the mass spectra of the aromatic hydrocarbon fractions of two of these cores; in one indenes predominate, in the other, naphthalenes.

Eight Cretaceous samples from Hole 391C vary widely both in organic carbon contents and lithology. The first four, all claystones, have enough organic carbon to classify them as potential petroleum source rocks, and the predominance of amorphous types suggests an oily nature, but the very low $\text{C}_{15+}$ hydrocarbon content and the low alteration indices indicate virtually no catagenic action.
Figure 1a-d. Gas chromatograms of the saturate hydrocarbon fractions.
Figure 1e-g. Gas chromatograms of the saturate hydrocarbon fractions.
The next two, shaly limestones, also are embryonic sources, but the bottom two, a limestone and a claystone, fall below minimum organic carbon levels for sources.

**CONTAMINATION**

The mass spectra of the hydrocarbons are unusual, particularly those of the aromatic fractions. They have relatively large quantities of indenes, chrysenes, and phenanthrenes, with different ones predominant in different samples. The same fractions of wire-line grease and pipe dope do not match any of the extracts overall or in detail. These show generally more benzenes. Moreover, the carbon isotope ratios are different, particularly in the difference between the saturate and aromatic fractions of one sample. The ratios of the two fractions for the shipboard lubricants are virtually identical (within 0.2 °/oo). They are different for the extracts (from 1.0 to 5.9 °/oo difference). The gas chromatograms of the saturate fractions also show the “extracts” are not from the two most likely contaminants. The cable grease is much higher in molecular weight; the pipe dope is in about the same molecular weight range, but is different. It has relatively less of the hydrocarbons in the C24 to C33 ranges and the ratios of pristane (a) and phytane (b) to normal C17 and C18 paraffins are much lower in the extracts than in the lubricant.

**CONCLUSIONS**

Holes at Sites 388 and 391 off the eastern continental margin of the United States only penetrated sediments above the catagenic zone of hydrocarbon generation. The type and amount of organic matter show that the sediments are richer in organic matter than average abyssal sediments, but it is virtually unaltered.

**REFERENCE**