

STUDIES OF CLAY MINERALS (AND FINE-GRAINED NON-CLAYS)
OF PARTICULATES OF WATER COLUMN FROM THE MAFLAOCs BASELINE MONITORING SITES

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INTRODUCTION

Although Manheim, et al (1972) found montmorillonite and kaolinite in suspended matter in surface waters of the northern Gulf of Mexico, no systematic studies have been taken to determine if suspended mineralogy varies with seasons from the MAFIA OCS monitoring sites. This baseline information is essential to determine any adverse variation of suspended matter caused by drilling operations. In this paper are reported two significant changes of suspended minerals with seasons.

PROCEDURES

Field Sampling

In collaboration with the sampling program for a study of trace metals in water columns, suspended particulate in the remaining 2l & solution were separated through 0.45 μ millipore filters using an inline-47 closed filtration system. The detailed procedure for collecting samples is described by Betzer(1976). A total of 46 samples from 15 stations at three sampling periods - July, 1975; September-October, 1975; and January, 1976 - were collected and stored at 4°C until they were analyzed in the lab.

Laboratory Analysis

Filter papers which contained particulates were first rinsed thoroughly with deionized water to remove residual salts. The particulates were then resuspended and filtered through Selas Flotronic silver membranes (0.45 μ size and 25 mm diameter) for X-ray analysis. In order to obtain a complete analysis of both clay and non-clay minerals in particulates, the samples were first X-rayed without treatment, and then X-rayed following various treatments with ethylene glycol vapor for 12 hr, with drying at 25°C, and heating at 110°C, 300°C, and 550°C. The X-ray analysis was carried out on a Norelco diffractometer using CuK_α , nickel filtered radiation generated with 35 Kv and 20 ma. A 1° beam slit and 7.62 μm receiving slit were used throughout scanning (2° to 33° 2 θ) except for lower 2 θ peaks (3° to 9° 2 θ) where a 1/4° beam slit was used. The scanning speed was set at 1/2° 2 θ /rein with chart paper on 76 cm/hr. Relative percentages of clay and non-clay minerals were also estimated following the method described by Huang, et al. (1974).

RESULTS AND DISCUSSION

A total of 450 data points were obtained from the analysis of suspended matter in the water columns of the MAFLA monitoring sites, as shown in Tables 1-6. They are described as follows:

A. First (July) and Second (September-October) Sampling Period

Clay minerals are predominant, and exceed more than 46% of the total suspended minerals. In July samples, clay mineral content, of suspended particulate generally decreased seaward in all transects

(except #IV), whereas in September samples the clay content increased seaward. This suggests that suspended mineralogy in the sites is strongly dependent on the season.

Furthermore, the distribution of clay minerals in suspended matter is different from that in surface sediments. The most striking is the presence of talc in virtually all sampling stations, which was not found in surface sediments. Specifically, the distribution patterns are as follows:

(1) Talc decreased seaward in most transects except those on the West Florida Shelf where talc increased seaward.

(2) Kaolinite generally decreased seaward, and has higher concentrations in Transects #III and IV than on the West Florida Shelf.

(3) Chlorite did not show any significant trend although it slightly decreased seaward on the West Florida Shelf (Transect #II).

(4) Illite virtually shows no significant trends.

B. Third (January) Sampling Period

As shown in Tables 5 and 6, the overall distribution patterns of suspended minerals are significantly different from those from the July and September samples. The major differences are as follows:

(1) In January samples, the percent of clay minerals in suspended particulate increased seaward.

(2) Relative abundances of individual clay minerals in suspended matters are similar to those found in bottom sediments.

On the West Florida Shelf, kaolinite is a predominant clay in particulate, whereas on the Mississippi Shelf, smectite is the most abundant clay mineral in the suspended matter. Carbonate minerals (including aragonite, low-Mg calcite and high-Mg calcite, and dolomite) are also present in appreciable amounts, up to 70% of total suspended minerals in the Transect #1 of the West Florida Shelf. These data strongly suggest that some disturbance of bottom sediments may have occurred during the January sampling period, which, in turn, affects the overall distribution of suspended minerals.

(4) In contrast to the first and second sampling periods, talc in the January samples was only found on the West Florida Shelf, and was virtually absent on the Mississippi Shelf. This is quite a contrast to those found in the July and September samples from the Mississippi Shelf in which talc was almost 30-40% of the total suspended materials. This comparison rules out a possibility of contamination of talc from the sampling ship. It is conceivable that talc may have originated in the beach sands, where talc was reported to be present in significant amounts.

In conclusion, results of suspended mineralogy in the MAFLA monitoring sites are significantly different from those found by Manheim, et al. (1972). Suspended minerals in the sites are strongly dependent on the seasons, and further studies are needed to verify these seasonal variations.

TABLE 1
 PERCENT (%) COMPOSITION OF CLAY AND NON-CLAY MINERALS IN
 SUSPENDED PARTICULATE MATTER FROM 10 M DEPTH ON THE
 WEST FLORIDA SHELF - THE MAFLA SITES
 (JULY 14, 1975 & July 21, 1975)

| Station # | Smectite | Chlorite | Illite | Kaolinite | Talc | Quartz | Feldspars | Aragonite | L.M. Calcite | Dolomite |
|-----------|----------|----------|--------|-----------|------|--------|-----------|-----------|-----------------|----------|
| 1101 | -- | 10 | 11 | 23 | 13 | 23 | 8 | -- | 6 | 6 |
| 1102 | T | 5 | 19 | 22 | 32 | 11 | 11 | -- | -- | -- |
| 1103 | -- | 6 | 9 | 18 | 18 | 14 | 20 | 8 | 6 | -- |
| 1204 | -- | 8 | 18 | 16 | 18 | 25 | 15 | -- | -- | -- |
| 1205 | -- | 10 | 9 | 13 | 33 | 14 | 21 | -- | -- | -- |
| 1206 | -- | 9 | 8 | 16 | 15 | 26 | 26 | -- | -- | -- |
| 1207 | -- | T | 18 | 28 | T | 1s | 36 | -- | -- | -- |
| 1308 | -- | 16 | 14 | 23 | 38 | -- | 9 | -- | -- | -- |
| 1309 | -- | 5 | 21 | 21 | 40 | 13 | T | -- | -- | -- |
| 1310 | T | -- | 8 | 20 | 38 | 11 | 23 | -- | -- | -- |
| 1311 | -- | 16 | 14 | 12 | 30 | 7 | 21 | -- | -- | -- |
| 1412 | 7 | 11 | 11 | 25 | 6 | 25 | 15 | T | -- | -- |
| 1413 | -- | T | 22 | 25 | -- | 41 | 12 | -- | T | -- |
| 1414 | -- | T | 12 | 15 | 26 | 19 | 18 | 10 | T | -- |
| 1415 | -- | 8 | 9 | 13 | 49 | 15 | 6 | -- | -- | -- |

L.M. Calcite- low magnesium calcite
 T- trace amount

TABLE 2

PERCENT (%) COMPOSITION OF CLAY AND NON-CLAY MINERALS IN

SUSPENDED PARTICULATE MATTER FROM 10 M DEPTH ON THE

WEST FLORIDA SHELF - THE MAFLA SITES

(SEPTEMBER 16, 1975 & OCTOBER 3, 1975)

| Station # | Smectite | Chlorite | Illite | Kaolinite | Talc | Quartz | Feldspars | Aragonite | L.M. Calcite | Dolomite |
|-----------|----------|----------|--------|-----------|------|--------|-----------|-----------|-----------------|----------|
| 1101 | -- | 7 | 12 | 30 | 29 | 11 | 11 | T | -- | -- |
| 1102 | -- | 5 | 8 | 19 | 49 | 5 | 14 | T | -- | -- |
| 1103 | -- | -- | 12 | 29 | 43 | -- | 16 | -- | -- | -- |
| 1204 | -- | 7 | T | 16 | 41 | 8 | 7 | -- | T | 21 |
| 1205 | -- | 6 | 6 | 50 | 1 | 18 | T | 5 | 14 | -- |
| 1205a | -- | 17 | 17 | 22 | T | 20 | 24 | T | -- | -- |
| 1206 | -- | T | 20 | 32 | 48 | -- | T | -- | -- | -- |
| 1207 | -- | 7 | 7 | 39 | 18 | 14 | 15 | -- | -- | -- |
| 1308 | -- | T | 9 | 17 | 25 | 11 | 38 | -- | -- | -- |
| 1309 | -- | T | 10 | 20 | 10 | 16 | 44 | -- | -- | -- |
| 1310 | -- | 15 | T | 29 | 14 | 11 | 31 | -- | -- | -- |
| 1311 | -- | -- | 26 | 38 | -- | -- | 36 | -- | -- | -- |
| 1412 | -- | 18 | 18 | 18 | 21 | 15 | 5 | -- | -- | 5 |
| 1413 | -- | -- | T | 29 | 38 | 14 | 19 | -- | -- | -- |
| 1414 | -- | -- | 25 | 33 | -- | 11 | 31 | -- | -- | -- |
| 1415 | 16 | 23 | -- | 22 | T | -- | 39 | -- | -- | -- |

1205a before hurricane

1205 after hurricane

L.M. Calcite - low magnesium calcite

T - trace amount

TABLE 3

THE CONTENT (%) OF CLAY MINERALS IN SUSPENDED
PARTICULATE MATTER FROM 10 M DEPTH ON THE
WEST FLORIDA SHELF
(JULY 14, 1975 & JULY 21, 1975)

| Station # | Smectite | Chlorite | Illite | Kaolinite | Talc |
|-----------|----------|----------|--------|-----------|------|
| 1101 | -- | 18 | 19 | 40 | 23 |
| 1102 | T | 7 | 25 | 27 | 41 |
| 1103 | -- | 1.2 | 18 | 34 | 36 |
| 1204 | -- | 15 | 29 | 27 | 29 |
| 1205 | -- | 15 | 15 | 20 | 50 |
| 1206 | -- | 19 | 17 | 33 | 31 |
| 1207 | -- | T | 38 | 62 | T |
| 1308 | -- | 17 | 16 | 26 | 41 |
| 1309 | -- | 6 | 23 | 24 | 47 |
| 1310 | T | 11 | 13 | 30 | 57 |
| 1311 | -- | 32 | 20 | 42 | 1.6 |
| 1412 | 11 | 18 | 18 | 43 | 10 |
| 1413 | -- | T | 46 | 54 | -- |
| 1414 | -- | T | 23 | 28 | 49 |
| 1415 | -- | 11 | 12 | 16 | 61 |

TABLE 4
 THE CONTENT (%) OF CLAY MINERALS IN SUSPENDED
 PARTICULATE MATTER FROM 10 M DEPTH ON THE
 WEST FLORIDA SHELF
 (SEPTEMBER 16, 1975 & OCTOBER 3, 1975)

| Station # | Smectite | Chlorite | Illite | Kaolinite | Talc |
|-----------|----------|----------|--------|-----------|------|
| 1101 | -- | 9 | 16 | 38 | 37 |
| 1102 | -- | 6 | 11 | 23 | 60 |
| 1103 | --- | -- | 14 | 35 | 51 |
| 1204 | -- | 11 | T | 26 | 63 |
| 1205 | -- | 9 | 10 | 79 | 2 |
| 1205a | -- | 31 | 31 | 38 | T |
| 1206 | -- | T | 20 | 32 | 48 |
| 1207 | -- | 10 | 10 | 56 | 24 |
| 1308 | -- | T | 18 | 34 | 48 |
| 1309 | -- | T | 25 | 50 | 25 |
| 1310 | -- | 26 | T | 49 | 25 |
| 1311 | -- | -- | 40 | 60 | -- |
| 1412 | -- | 24 | 24 | 24 | 28 |
| 1413 | -- | -- | T | 43 | 57 |
| 1414 | -- | -- | 43 | 57 | -- |
| 1415 | 26 | 38 | -- | 36 | T |

1205a before hurricane
 1205 after hurricane

TABLE 5
 PERCENT (%) COMPOSITION OF CLAY AND NON-CLAY MINERALS IN
 SUSPENDED PARTICULATE MATTER FROM 10 M DEPTH ON THE
 WEST FLORIDA SHELF - THE MAFLA SITES
 (JANUARY, 1976)

| a. # | Smectite | Chlorite | Illite | Kaolinite | Talc | Quartz | Feldspars | Aragonite | L.M. Calcite | H.M. Calcite | Dolomite |
|------|----------|----------|--------|-----------|------|--------|-----------|-----------|-----------------|-----------------|----------|
| 101 | -- | 3 | 1 | 5 | 2 | 6 | -- | 12 | 47 | 17 | 7 |
| 102 | -- | 3 | 2 | 12 | 5 | 5 | -- | 7 | 57 | 9 | -- |
| 103 | -- | 15 | 13 | 12 | 38 | 15 | 7 | 7 | -- | -- | -- |
| 204 | -- | 14 | 6 | 37 | 12 | 23 | 8 | -- | -- | -- | -- |
| 205 | -- | 8 | 9 | 13 | 11 | 32 | 18 | -- | -- | -- | 9 |
| 206 | -- | 19 | 4 | 57 | 10 | 20 | -- | -- | -- | -- | -- |
| 207 | 3 | 4 | 3 | 23 | 2 | 12 | 6 | 4 | 36 | 7 | -- |
| 308 | T | 10 | 9 | 52 | 8 | 17 | 4 | -- | T | T | T |
| 309 | -- | 6 | 11 | 13 | 11 | 28 | 17 | -- | -- | -- | 14 |
| 310 | -- | T | 6 | 36 | 9 | 20 | 15 | -- | -- | -- | 14 |
| 311 | * | * | * | * | * | * | * | * | 9 | * | * |
| 412 | 45 | 1 | 6 | 18 | 10 | 28 | 2 | -- | -- | -- | -- |
| 413 | 45 | 1 | 8 | 12 | 0 | 32 | 2 | -- | -- | -- | -- |
| 414 | 66 | T | 6 | 8 | T | 18 | 2 | -- | -- | -- | -- |
| 415 | 57 | T | 7 | 10 | 4 | 21 | T | -- | -- | -- | -- |

L.M. Calcite - Low magnesium calcite

H.M. Calcite - High magnesium calcite

T - Trace Amount

* - Not enough sample

TABLE 6
 THE CONTENT (%) OF CLAY MINERALS IN SUSPENDED
 PARTICULATE MATTER FROM 10 M DEPTH ON THE
 WEST FLORIDA SHELF
 (JANUARY> 1976)

| Station # | Smectite | Chlorite | Illite | Kaolinite | Talc |
|-----------|----------|----------|--------|-----------|------|
| 1101 | -- | 31 | 9 | 44 | 16 |
| 1102 | -- | 15 | 10 | 51 | 24 |
| 1103 | -- | 19 | 17 | 15 | 49 |
| 1204 | -- | 20 | 8 | 54 | 18 |
| 1205 | -- | 18 | 23 | 31 | 28 |
| 1206 | .. | 24 | 5 | 71 | 0 |
| 1207 | 9 | 12 | 9 | 65 | 5 |
| 1308 | T | 13 | 11 | 66 | 10 |
| 1309 | -- | 16 | 27 | 30 | 27 |
| 1310 | -- | T | 11 | 70 | 19 |
| 1311 | * | * | * | * | * |
| 1412 | 63 | 2 | 9 | 26 | 0 |
| 1413 | 68 | 2 | 12 | 18 | 0 |
| 1414 | 83 | T | 7 | 10 | T |
| 1415 | 74 | T | 9 | 13 | 5 |

* . Not enough sample

T = Trace Amount

References

- Betzer, P. (1976). Rept. to BIM on the MAFIA project.
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- Manheim, F. T., Hathaway, J. C. and Uchupi, E. (1972). Suspended matter in surface waters of the Northern Gulf of Mexico. Limnology & Oceanography, 17, p. 17-27.