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CLAY MINERAL DISTRIBUTION IN THE LOWER CRETACEOUS SEDIMENTS IN THE MERSA MATROUH WELL NO.1 WESTERN DESERT, EGYPT

By

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ABSTRACT

The clay mineral suit of the Lowere Cretancous sediments in Mersa Matruh well was studied by x-ray differaction analysis and scaning electron microscopy.

The studied samples were obtained from the 41 corses obtained from Mersa Matruh well driled by Amoco petroleum company.

Kaolininte is the dominant and most frequently encountered clay mineral. Illite is next in abundance. Mixed layer minerals and montmorillonte occur generally in small amounts.

The abundant occurance of kaolinite is attributed to the effects of weathering and leaching of previously existing alkali feldspar rocks and sediments. Illite may be partly a product of diagenetic alteration of kaolinite. The mixed layers probably resulted from the incoplete adsorption of h on these clay minerals. The lack of abrub changes in the clay mineralogy of these sediments suggests a homogenous source area and/or a good mixing of fine suspended material in the basin.

INTRODUCTION

Mersa Matruh well No. 1 drilled down to a depth of about 14900 ft. int he northwestern part of the Western Deert (Dig. 1) provides very useful maatrial for detrital, stratigraphical, sedimentological and mineralogical studies of the lower Cretaceous sediments.

The purpose of the present study is to find out if systematic changes, particularly in clay mineral composition exist. Such changes may then be interpreted in terms of source rocks,paleoclimatic rate of deposition, and postdepositional processes.

LITHOLOGY AND STRATIGRAPHY

The Lower Cretaceous roks in the Western Desert were the target of many investigators. Brooks (1966) gave an account of the geological history of the northern part of the Western Descrt. Beckman (1967) pointed out that at the Cretaceous-Jurassic boundary, there is a widespreed unconformity with evidence of emergence and local uplift, particularly in the northeastern part of the Western Desert. He also mentioned that the Lower Cretaceous transgression started from the north and northwest and seems to have covered a surface of considerable relief. The center of the Lower Cretanceous basin received over 10,000 feet of sediments (Merss Matruh well No. 1).

The Lithology of the penetrated section in Mersa Matruh well is graphically presented in Fig. 2.

Tectonically the northern part of the Western Desert belongs to Unstable Shelf Area of Egypt (Said, 1961) which lies between the foreland stable unit and the geosyncline. This shelf area is characterized by the existence of a thick marine sediments ranging from Paleozoic to recent and considerable tectonic disturbance where upto five episodes of diastrophism are indicated through its entire geologic history.

METHODOLOGY

X-ray diffraction analysis:

Samples used for X-ray analysis were washed, crushed and sieved through 63 um mesh sieve. The fine fraction was decarbonaized in 0.2 M hydrochloric acid and excess acid was removed by subsequent centerifugation. The < 2 um fraction was obtained by standard sedimentation process. Oriented aggregates were prepared on glass slides from a clay suspention. Three x-ray diffraction patterns were rcorded for each oriented specimen, viz in the untreated state, after glycolation, and after heating to 490 ^{o}C for 2 hours. The analysis were carried out with a phlips x-ray diffractometer type 1390, at a scaning speed of 1 20/min. A receiving slit of 1.25 mm was used to allow for a better determination of mixed layer minerals. Peak intensities were calculated by multiplaying peak high by width at half high. In order to calculate the semiquantitative mineral composition, peak intensesities of kaolinite (7 Å), illite (10 Å), and smectite were multiplied by factors of 2,4 and 1 respectively (Biscay 1965).

Scaning electron microscope:

About 20 samples were dried under vacum after frozen by immersion in liquid freon. After drying, the cubes were fractured to reveal internal surfaces, mounted on specimen support stubs, and sputter-coated with gold. The specimens were examined in detail with a SHIMADZU SEM, operated at 15 KV and at magnification 3000 times.

DISTRIBUTION OF CLAY MINERALS

Some typical X-ray diffraction patterns are shown in figure 3. Kaolinite, illite, mixed layer smect-ill and small quantities of montmorillonite are the clay minerals identified from the X-ray diffractograms of the clay fraction of the Lower Cretaceous sediments. Kaolinite is the dominant (70-88 %) and most frequently occurring clay mineral. Illite is next in abundance (3-25 %). Irregular mixed layer clays

Table 1: Clay mineral content of some shale core samples of Mersa Matruh well No. 1.

Core No.	Formation/Member	Clay mineral %			
		kaolinite	illite	mont.	I - S
c 22 a	Mersa Matruh	85	5		
c 22 b		82	8		
c 24		88	4		
c 25		82	4		
c 29 a		84	3		3
c 30		75	3		4
c 31 a		88	4		
c 32		78	12		
c 35		83	5		
c 36		75	14		
c 38		70	20		
c 39		87	6		
c 40		83	11		
c 41		70	25		
c 13 a	Burg El Arab Fm.	57	5		23
c 13b	Kharita Mbr.	82	4		
c 13 b		85	5	3	6
c 13 c		82	4		5
c 14	Alamine Fm.	60	4	18	

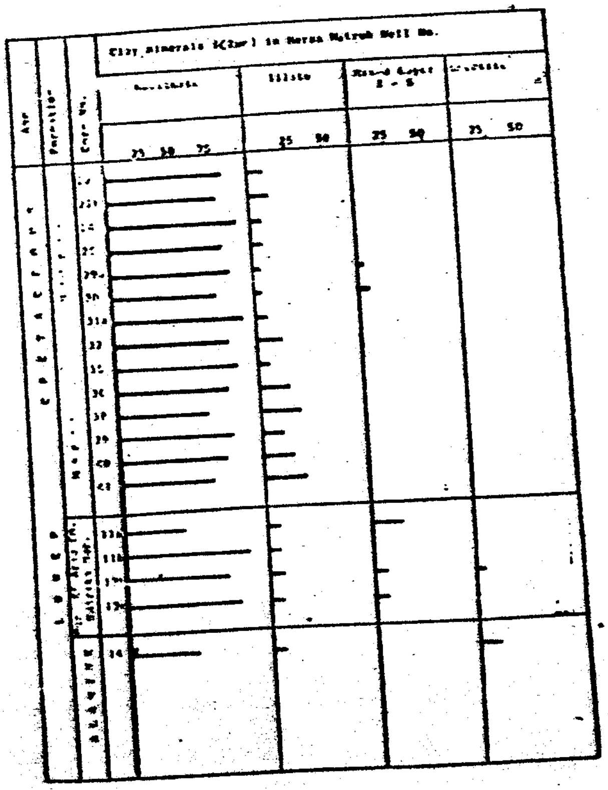


Fig.4: The composition of clay mineral fraction of Marsa Matruh well No. 1.

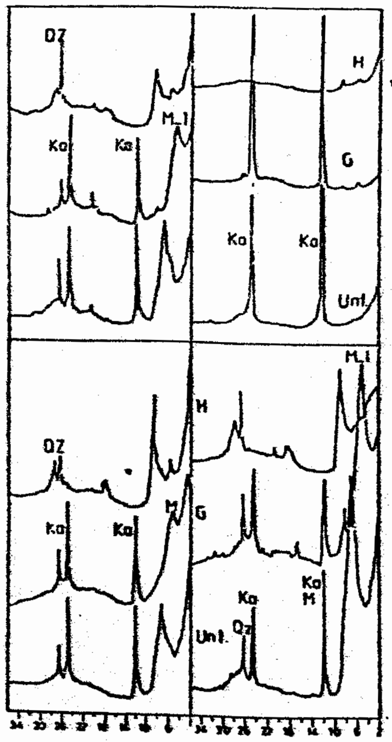
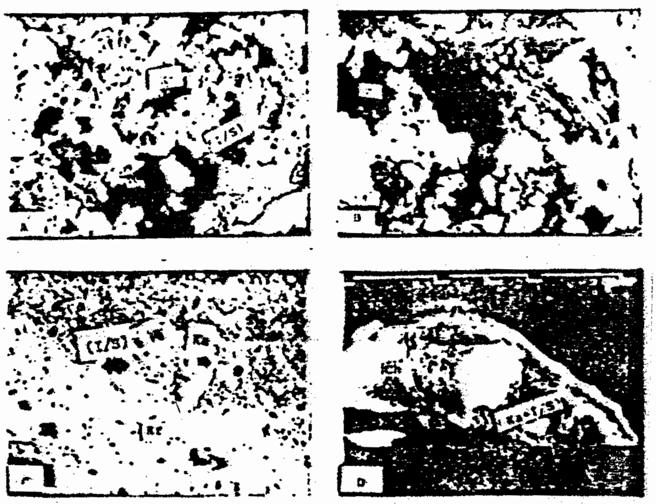


Fig.3: Selected X-ray diffraction of some core samples of cretaceous sediments from Mersa Matruh well No.1.



Scaning electron micrograph of Mersa Matruh well No.1 shale cores:
A- Random distribution of kaolinite (Ka) and (I/S) crystals through the calcic plagioclase mixture. B- Under compacted fabric; little evidence of prefferred mineral orientation or pressure dissolution and/or distortion of detrital grains. C- Grain edge and surface dissolution of K-feldspare (Kf) with illite smectite and kaolinite filling the cavities D- Authiginic clay fillings (Ka + I/S) in skeltal carbonate remains. Distortion of the skeltal remains Distribution of the skeltal remains due to compactio is noted. Chlorite (Ch) is postdated by a mixture of kaolinite (Ka) and (I/S).

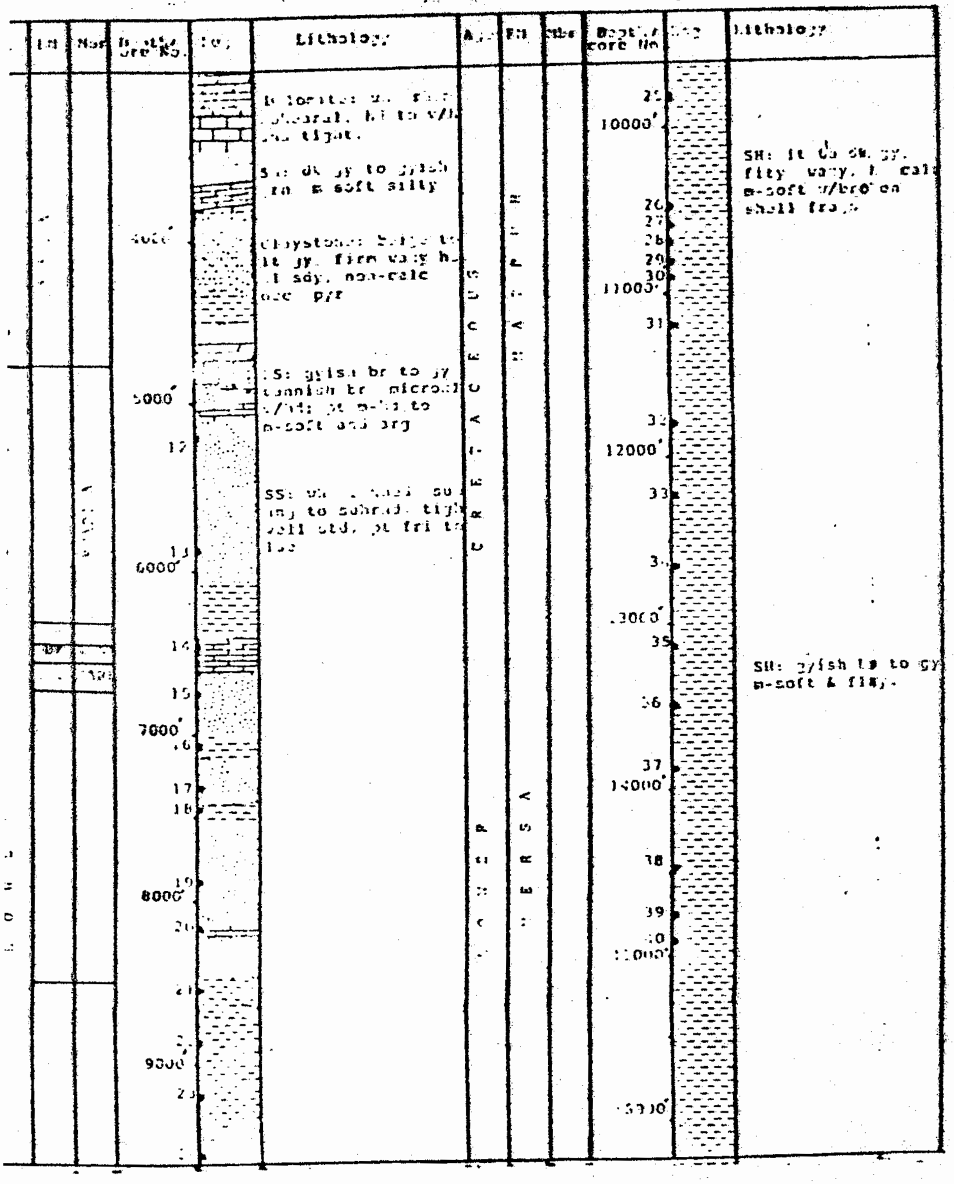


Fig. (2): Lithostratigraphical columnar section of the Lover Cretaceous rocks in the Mersa Matruh well No.1.

Mersa Matruh Well No.1

Coordination

N 31° 19' : E 27° 16' 07"

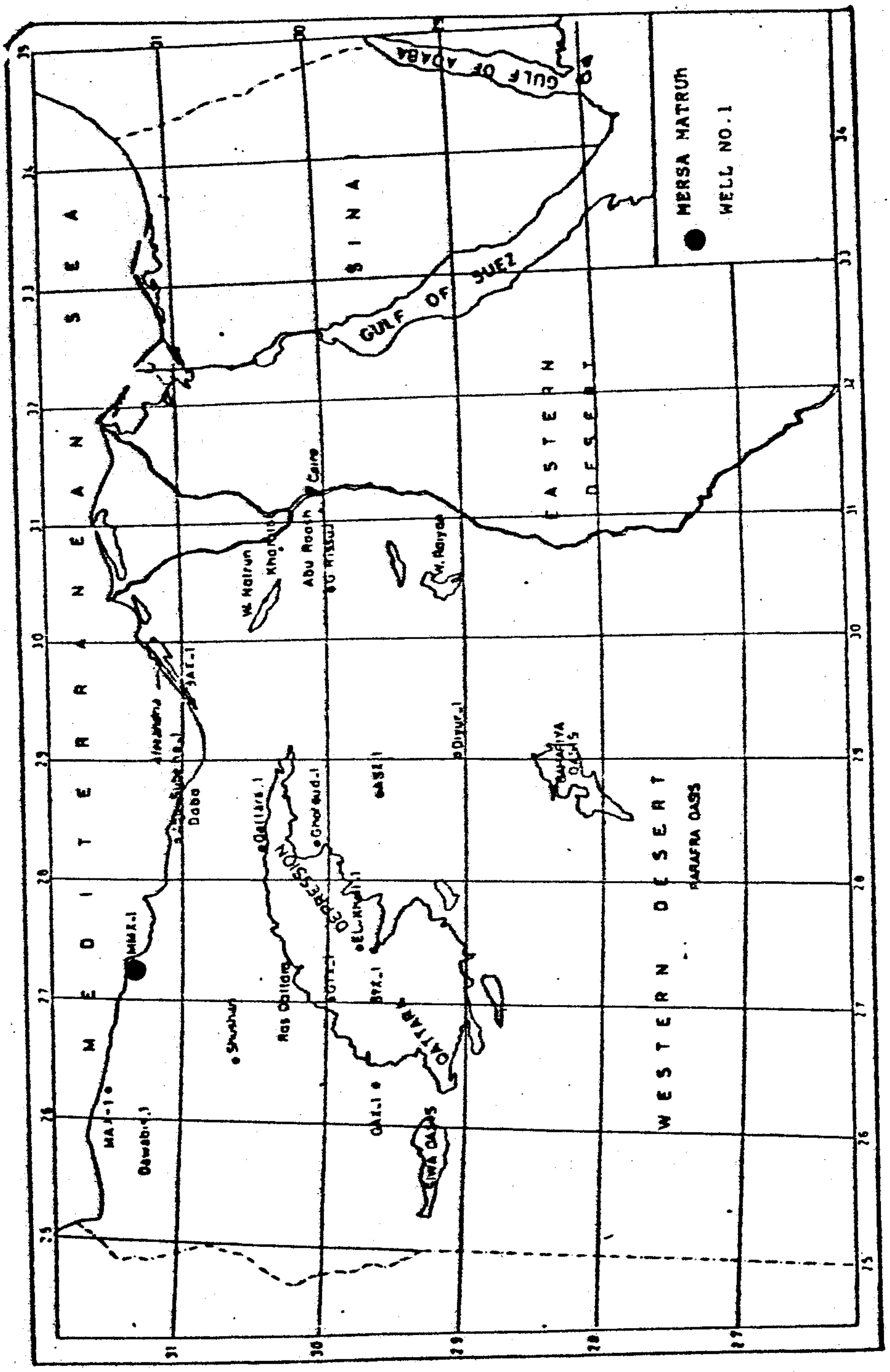


Fig.(1): Location map

are next in abundance and were diffrentiated only in a few number of samples and ranging from 3 % to 23 %. The mixed layer clays identified are mainly illite-smectite. Smectite was identified in a few number of samples. (see table 1).

The clay mineral suite of Lower Cretaceous sequence does not exhibit any distinct veritical variations. Though indiviedual clay mineral abundances may vary slightly, the assemblage remains virtually identical. Associated non-clay minerals are quartz, calcite, dolomite, feldspars and siderite.

The composition of the clay fraction for the whole well is shown in figure 4.

Electron microscopy:

Scaning electron microscopic examination of a number of samples (Fig. 5) shows a significant proportion of square to rectangular cross-sections. Euhedral kaolinite crystals were rarley observed. This indicates that kaolinite is most probably of detrital origin.

ORIGIN OF CLAYS

The clay mineral distribution in the Lower Cretaceous section in Mersa Matruh well No. 1 shows that kaolinite is the dominant clay mineral. It is known that kaolinite can be produced from Al-silicate rocks under suitable environmental conditions.

Mineralogical studies reveal that kaolinite is not restricted to a particular lithofacies. It is found in both sandy and clay-rich horizons (table 1 & figure 2). Its abundant occurrance through the sequence reflects the intensity of weathering and leaching conditions adided by pronounced relief in the soruce areas. Furtheremore a warm and humid climatic condition which generally favours the formation of kaolinite must have prevailed during the Lower Cretaceous time.

Illite could have been either detrital in origin or a product of diagenetic alteration or both. This may indicate that part of the sediment may have been derived from a near-by source different from the main rock of kaolinite. It is suspected that these are the older sediment elevated as a result of tectonism. The presence of calcite, siderite, hematite dolomite and pyrite together with the observed textural immaturity of some of the sediments confirm the existance of this nearby sediment source. This may favour the conclusion that most of the kaolinite may have been derived from these nearby sediments rather than a granitic source. These sediments were dumped in Mersa Matruh basin where they attain a thickness of about 6000 feet.

In some horizons illite increases at the expense of kaolinite. This may indicate that illite may be partly a product of K^+ kaolinite easily transformed to illite (Weaver and Pollard, 1973).

The mixed layers probably reuslted from the incomplete adsorption of K^+ on these clay minerals.

This study has shown that there are two of sediments in Mersa Matruh basin:

a. the weathered sediments from nearby highlands.

b. the residual weathered products from the basement complex.

The lack of abrupt changes in clay mineralogy especially the kaolinite-illite relation in these sediments suggests a homogenous source area and/or good mixing of fine suspended material in the basin.

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