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CLAY MINERAL DISTRIBUTION IN ABU - HAD SHALES, QENA, EGYPT.

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ABSTRACT

The clay mineral suit of Abu - Had shales was studied by X-ray diffraction analysis. About fourteen samples were selected for this study.

Smectites are the dominant and most frequently concentrated clay minerals in the studied section. Kaolinite is next in abundance. The mixed - layer clays increase markedly with depth, thus becoming the dominant clay minerals in the basal part of the section, mainly in the varigated shales.

The uniform distribution of kaolinite is attributed to the effect of weathering and leaching, aided by pronounced reliefs in the source areas. This also confirms the prevalence of humid tropical conditions throughout the period of deposition. Smectites and mixed - layer clays are mainly of diagenetic origin.

INTRODUCTION

Gebel Abu-Had is located at wadi Qena (Fig 1). The chosen section (Fig. 2) is built up of a number of shale units intercalated with sandstone and limestone .

The shale units from base to top are as follows:

1- The varigated shales (Campanian):

Overly conformably the Nubian sandstone, are formed of laminated greyish green to dark grey shales alternating with yellowish and brownish ferrignous fine-grained sand stone beds. They attain a thickness of about 75 ms.

2- The shales of phosphatic Formation (Maestrichtian):

Overly conformably the varigated shales, are formed of laminated grey to green shales alternating with finegrained ferruginous and phosphatic yellowish brown sandstone and yellowish brown phosphatic beds. They attain a thickness of about 672 ms.

3- The Dakhla Shales (Maestrichtian) :

Are formed of dark, grey calcareous shales alternating with yellowish white ferruginous and phosphatic marl beds. They attain a thickness of about 30 ms.

4- The Esna shales (Paleocene) :

Are composed of thinly laminated and papery grey to greenish shales with an interbed of chalky limestone. They attain a thickness of about 15 ms.

PATRICLE SIZE ANALYSIS

Particle Size Distribution :

Particle size analysis data of 14 clay samples collected from the different shale varieties of Abu-Had section are listed.

For a better understanding of the environment of deposition of the different rock type of shales, the values of C and Md were plotted on the CM diagram of Passega (1957). In figure (3), all the rock types are based upon irregularly dispersed points in a relatively limited area for both C and M. This area lies in segments (1) and (11) of the basic pattern of Passega. It is more or less similar to the pattern given by Passega which represents a mixture in variable proportion of rolled grains and suspension sediments.

distribution of Clay Mineral :

Some typical X-ray diffraction patterns are shown in figures (4). Smectites, kaloinite and mixed layer clays (illitesmectite) are the caly minerals identified from the X-ray diffractograms of the clay fraction of Abu-Had shale sequence.

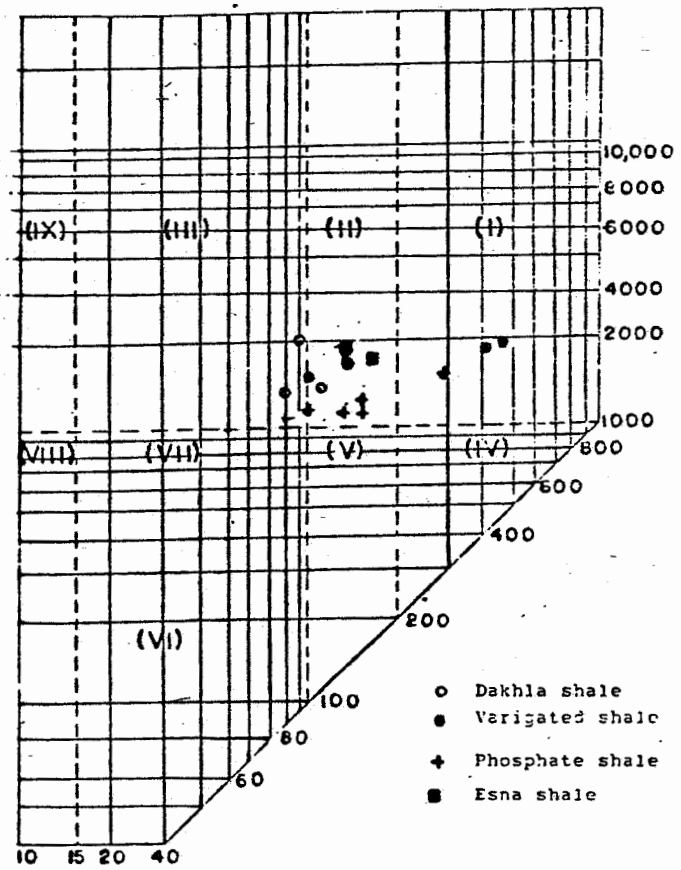

Fig. (3): C-M diagrams of Abu Had shales.

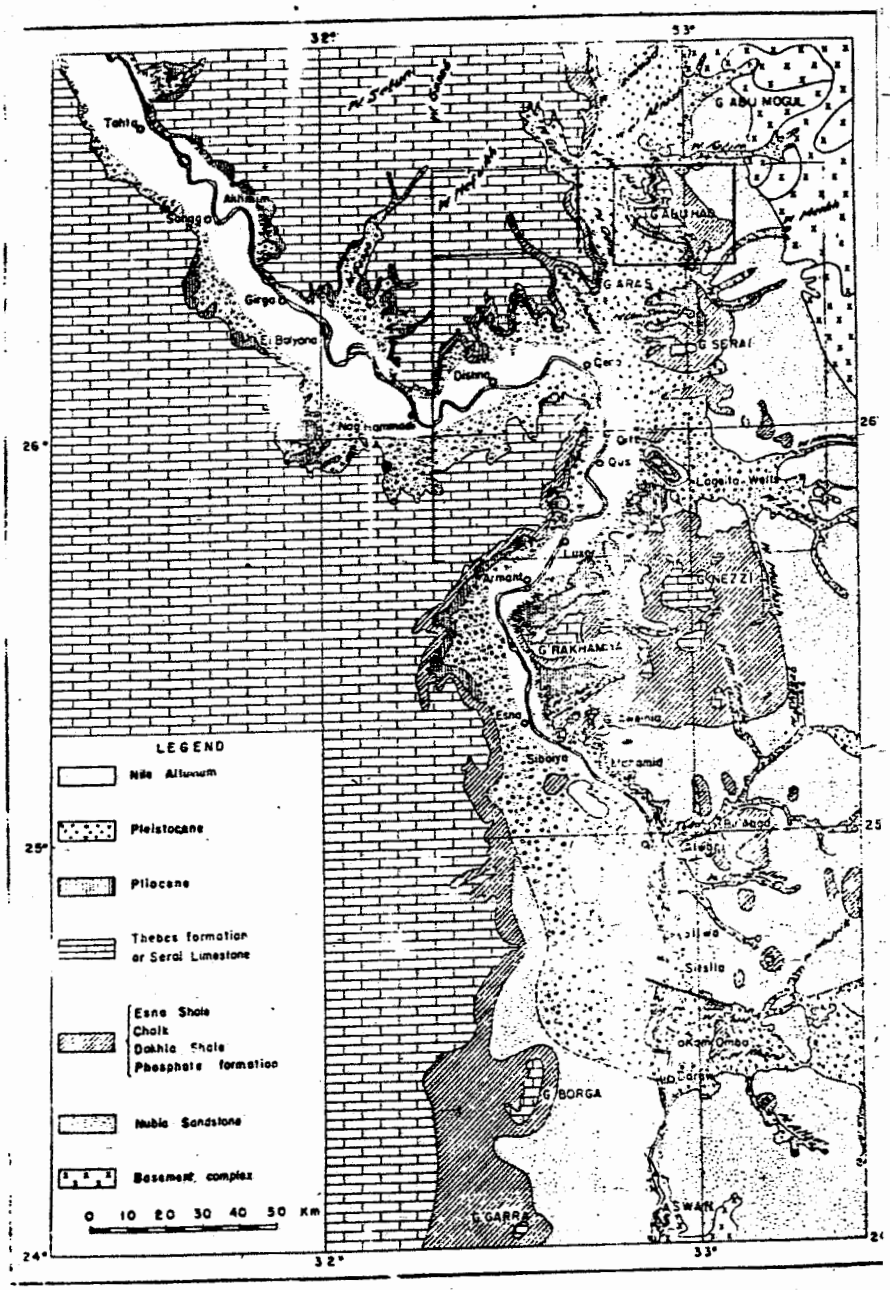

Fig.1: Location map (After Said, 1961).

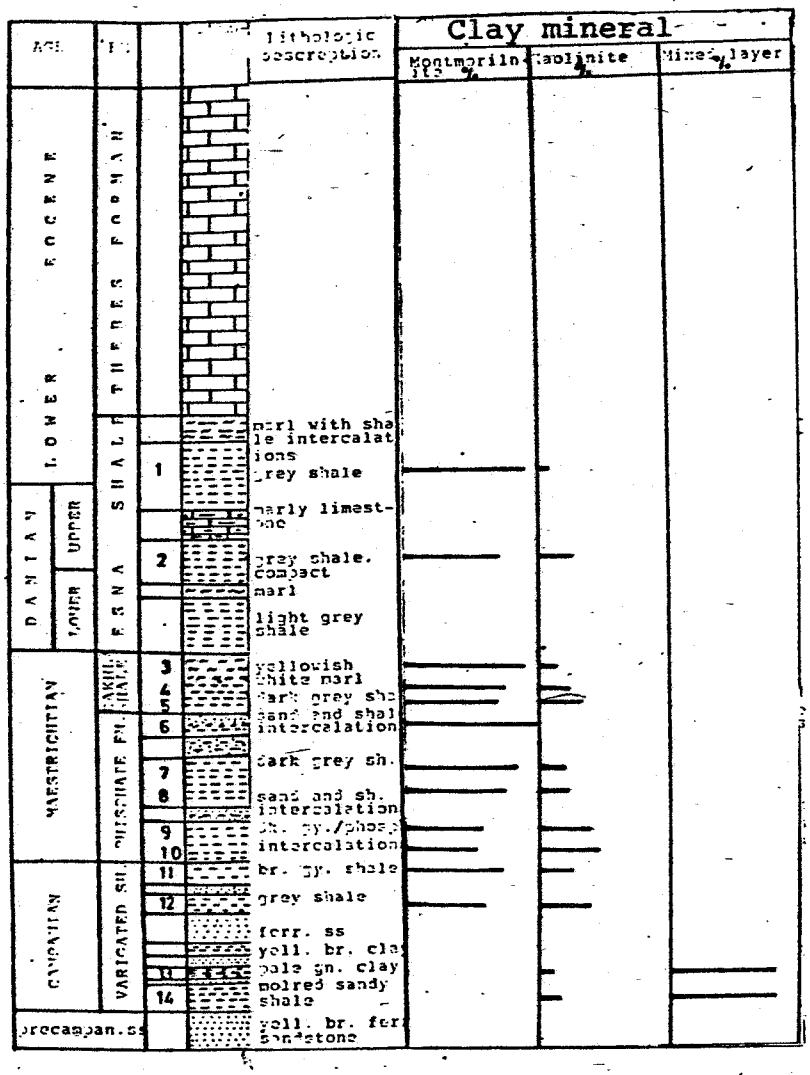

Fig.2: Lithostratigraphy and mineralogy of Abu Had shales.

Smectites are the dominant (55-100%) in the Esna, Dakhla, Shales of Phosphatic Fromation and the brown variegated shales. Kaolinite comes next in abundance (0-45%) in the above mentioned formaiton. The mixed-layer clays are the dominant clay minerals (83-88%) in the basal part of the section (the green varigated shales). However it must be pointed out that while kaolinite show more or less a uniform distribution throughout the section and smectites disappeare at the basal part. It must also be pointed out that the content of smectites increases at the expense of kaolinite (Table3) and (Figure 2).

Associated non-clay minerals are quartz, calcite, and feldspars.

Heavy minerals studies of the sediments reveal the presence of the minerals, zircon, rutile, tourmaline, garnet, epidote, staurolite, apatite, anatase, pyroxenes, amphipoles and iron oxides.

ORIGIN OF CLAY MINERALS

The clay mineral distribution in Gebel Abu-Had shale sequence shows that with the exception of the basal part of the section (green variegated shales), smectites are the dominant clay minerals. The increase of smectites at the

Table 3:- Relative clay mineral contents in Abu Had shales

Sample No.	Smectite %	Kaolinite %	Mixed-Layer %
1	99.70	0.30	---
2	71.50	28.50	---
3	92.50	7.50	---
4	91.45	8.55	---
5	69.00	30.92	---
6	100.00	---	---
7	90.00	9.80	---
8	74.20	25.80	---
9	61.44	38.56	---
10	55.00	45.00	---
11	76.33	23.67	---
12	58.45	41.55	---
13	---	11.33	88.67
14	---	17.00	83.00

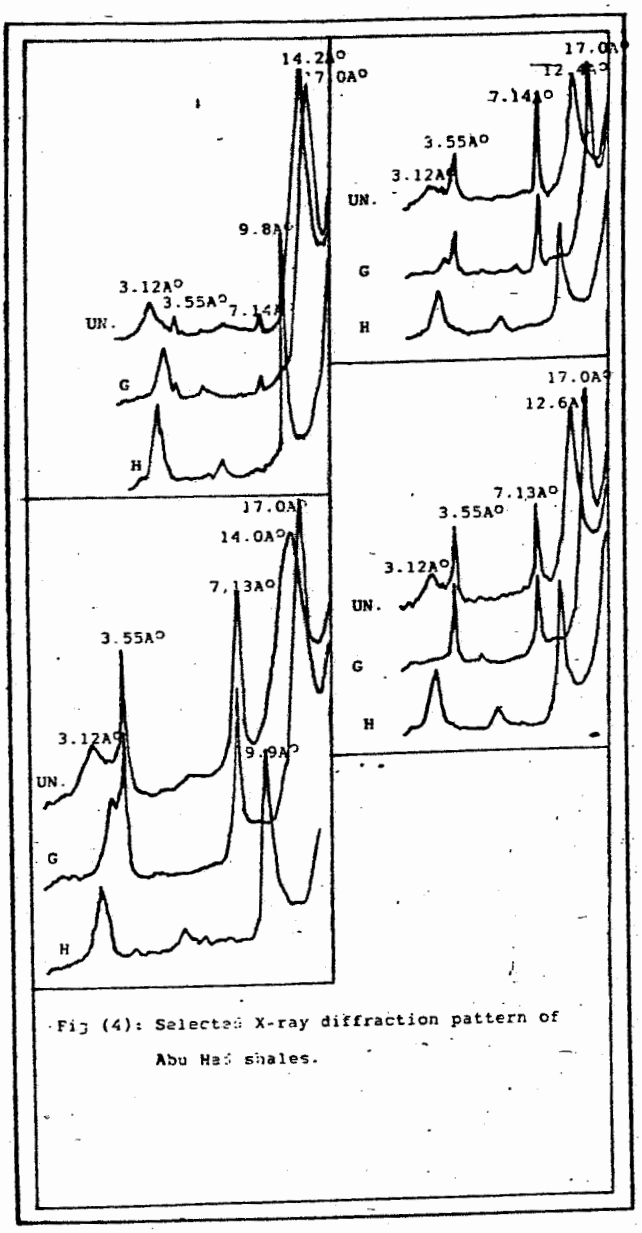

Fig (4): Selected X-ray diffraction pattern of Abu Had shales.

The purpose of this paper is to present data on the clay mineral suite and their distribution in Abu-Had Shale sequence with a veiw to their origin.

METHODOLOGY

X-Ray Diffraction :

Clay minerals were identified in oriented aggregates from the <-2u fraction on glass slides. A Shimadzu X-ray diffractometer (type XD-3) was used. The diffrction patterns were run with Ni-filtered Cu-radiation (λ=1.54A^{o}) at 30 kv and 30 mA potential and scanning speed of 2^{o} 2θ per minute. Three diffraction patterns were obtained for each sample as follows :

i- Untreated, i.e. air dry samples without any treatment.

ii- Glycolated, i.e. the sample saturated with ethelene glycol.

iii-Heated, i.e. the sample heated to 550^{o} C for two hours.

Particle Size analysis :

Particel size analysis was carried out using the standard wet sieve and pipette method adopted by Kilmer and Alexander (1949).

expence of kaolinite in the studied samples reveal their distribution from the originally formed kaolinit by diagenetic alteration. However its abundant occurrance, throughout the sequence reflects the intensity of diagenesis.

Kaolinite which comes next in abundance to smectites is most probably produced under suitable acid leaching conditions of alkali earth elements.

Heavy mineral studies indicate that Al-Silicte rocks (igneous and metamorphic rocks) constitute the major source rocks. These rocks occur to the South and East of Gebel Abu-Had.

Kaolinite is not restricted to a particular Formation. Its occurrance throughout the section reflects the intensity of weathering and leaching conditions aided by pronounced relief in the source areas. furthermore, a warm and humid climatic condition which generally favours the formation of kaolinite must have prevailed during the Upper Cretaceous-Paleocne Times.

The abundant occurrance of mixed-layer clays (illitesmectite) and the absence of smectites at the basal part of the section tend to favour derivation from

kaolinite and smectite by diagenetic transformation. It is known that in the presence K^+, smectite and/or kaolinite can easily be transformed to illite (Weaver and Pollard, 1973). Apart from the basal continental nubain sandstone, the overlying sediments in Abu-Had sequence are essentially marine. These sediments have the K^+ concentration required to produce the diagenetic transformation proposed by Garrels and Christ (1965). The mixed layers probably resulted from the incomplete adsorption of K^+ on these clay minerals.

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