Some Engineering Implications of Chemical Weathering of Soil Formations At Nile Valley Boundaries

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SUMMARY Analysis of result, of silica sesquioxide ratio of clayey deposit in Egypt showed that there are significant variations in the values of this ratio depending upon whether the soil is in side or outside the Nile Valley. It is observed that the clayey deposits outside the Nile Valley (desert region) are poorly developped eventhough they are quit old compared to inside the Nile Valley. These changes could be attributed to genesis of soil deposits. The alluvial formations of the Nile Valley have been enriched by lateritic soil carried down by the Nile River from tropical zone of Abyssinia. Furthermore it was found that the morphological conditions affected the silica/sesquioxide ratio indicating differential weathering between east and west desert formations. Also the results indicated that chemical weathering modified geotechnical properties significantly.

1. INTRODUCTION:

The extent to which different types of soils have been chemically weathered may be expressed by the ratio of the silica remaining in the soil to the amount of iron oxide and aluminium oxide that has accumulated(margnien 1966). This is known as the silica/sesquioxide ratio (Margnien, 1966 correia, 1967; Gidigasu, 1971 and Tuncer and Lohnes, 1977).

Lateritic soils occurs extensively in tropical zones of the world as defined by (Hadu, 1975 and Massed et al., 1985). Although Egypt lies outside the tropical zone, observations of silica/sesquioxide ratio of clayey deposits occuring in the flood plain of the Nile Delta indicated lateritic origin of these deposits (El-Sohby et al., 1988). This was shownby the significant variation in the silica/sesquioxide ratio between the deposits of the Nile Delta and thoseof its boundaries. This may be due to the enrichment of the alluvial formations of the Nile by soil deposits carried by the Nile River from the tropical zone of Abyssinia. This agrees with Novias- Ferreiva, 1985 who stated that lateritic soils may be somtimes carried out by erosion process to low levels to form recent alluvium.

The objective of the present work is to confirm the previous findings. Therefore, sections across the Nile were taken at different locations in Egypt in Nile Valley and the boundaries. Their geotechnical, chemical and mineralogical properties were determined. Then the silica/sesquioxide ratio was taken as a basis for the identification and the evaluation of chemical weathering and chracterstics.

2. MATERIAL INVESTIGATED

Soil for study were taken from five sections across the Nile (See Fig 1). The First section (A) is in the Nile Delta. The second section (B) is in Cairo area. The third section (C) is in Fayoum in the south west of Cairo. The fourth location (D) is in Assuit at a distance of 500 Kilometers south of Cairo. The Fifth location(E) is in Asswan at a distance of 1000 kilometers south of Cairo.

From each location two groups of samples were taken. The first group represents The Nile deposits (A,B,C,D,E). The second group representes the desert boundaries. Eastern bounderies are represented by Ae, Be & Ee whereas western bowdaries are represented by Aw, Bw, Cw, Dw, Ew.

In the present work, the clay of the second group is termed desert clay. This is to differentate it from the alluvial Nile Clay and to emphasize the effect of arid climate conditions of the region.

3. EXPERIMENTAL WORK

The program of study of the present work included chemical analysis and Geotechnical laboratory testing of soil samples. Complete chemical analysis was carried out on all soil samples for the determination of chemical constituents. Geotechnical laboratory testing was done for the determination of grain size distribution, bulk unit weight, initial moisture content, Atterberg limits and specific gravity. Furthermore, X-ray differection analysis was performed on soil samples for the determination of predominant clay minerals.

All the results of chemical, engineering and mineralogical properties are summarized in Table (1). They represent soil deposits from The Nile Valley and from eastern and western desert boundaries.

4. RESULTS AND DISCUSSION

From the obtained results we observ the following:

a. Comparison of values of silica/ sesquioxide ratio of all samples in all

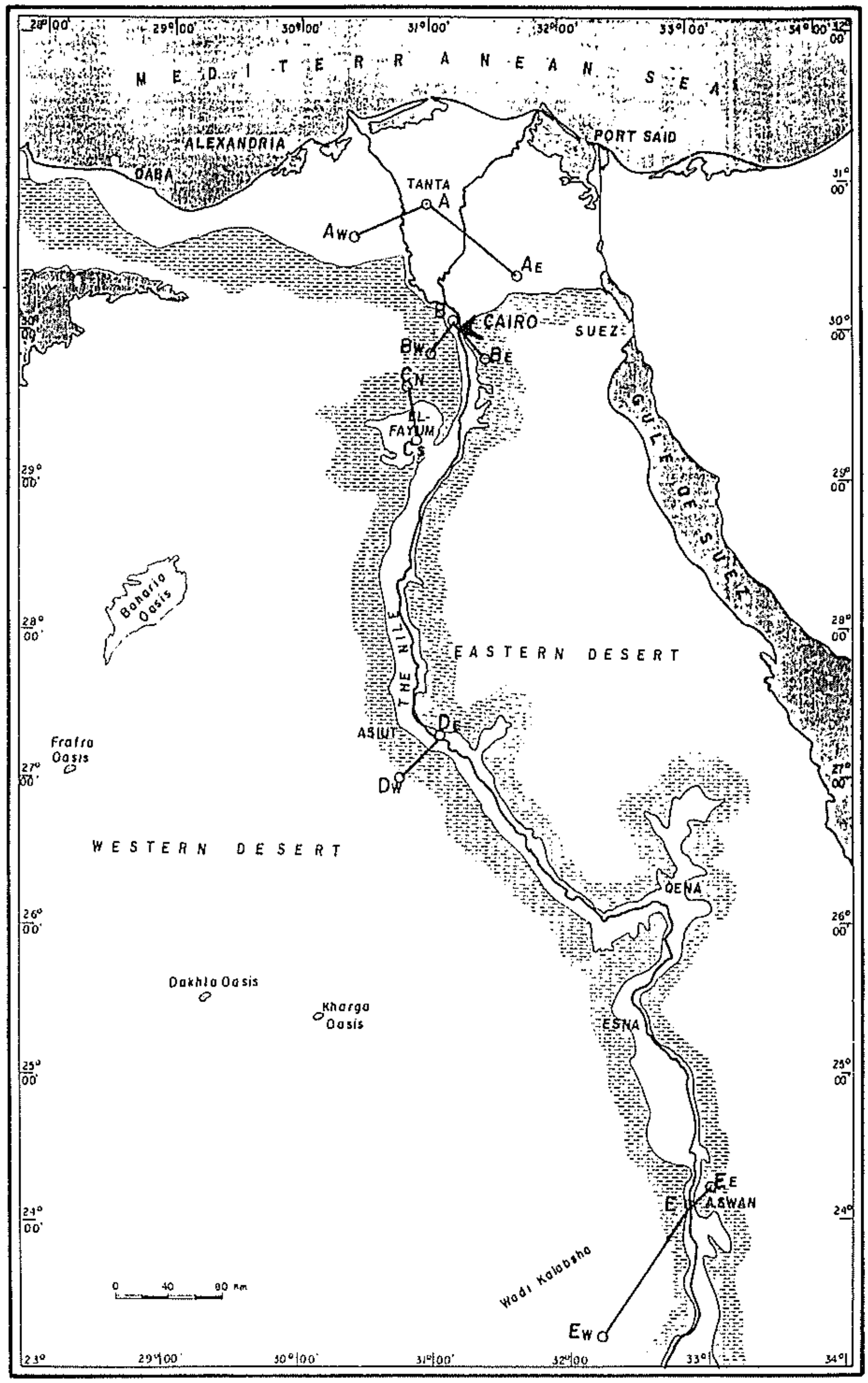

Figure 1 Location map

Table I

Geological, Mineralogical, Chemical and Geotechnical Properties of Investigated Soil

Location and Section	Type Classification		Geological, Mineralogical & Chemical Propertion			Geotechnical Properties				
			Age	Predminants Clay Mls	R	ω	γ_d KN/m3	S_r %	W_L	I_p
Nile Delta (A)	Nile Clay	A	Holecence	M-I-K	1.52	34.	15.7	100	67.	32
	Eastern Boundary Clay	Ae	Pliestocene	M-K-I	1.90	5.	19.5	35	72	35
	Western Boundary Clay	Aw	Pliestocene	K-M-I	1.49	8.	18.5	47	67	30
Cairo (B)	Nile Clay	B	Holecence	M-I-K	1.54	32.	15.	100	60	29
	Eastern Boundary Clay	Be	Eocene	M-K-I	2.40	4.5	19.	28	82	35
	Western Boundary Clay	Bw	Eocene	K-M-I	1.60	9.5	18.	51	70	30
Fayoum (C)	Nile Clay	C	Recent	M-I-K	1.50	33.	16.	100	65	31
	Western Boundary Clay	Cw	Eocene	M-K-I	1.70	8.0	19.5	37	92	45
Assiut (D)	Nile Clay	D	Recent	M-I-K	1.50	3.1	15.5	100	52	22
	Western Boundary Clay	Dw	Eocene	M-K-I	1.75	9.0	20.	69	75	32
Aswan (E)	Nile Clay	E	Pliestocene	M-I-K	1.50	29.5	14.8	97	62	30
	Eastern Boundary Clay	Ee	Cretaceous	M-K-I	2.20	3.5	21.	33	92	40
	Western Boundary Clay	Ew	Cretaceous	K-M-I	1.30	10.0	19.	62.5	72	37

* . The depth of the sample ranges between: 2-3m

M= . Montmorillonite

K= Kaolinite

I= Illite

R= Silica/sesquioxide ratio= $\frac{SiO_2}{Fe_2O_3 + Al_2O_3}$

studied sections indicate that this ratio is generally higher in case of desert clay compared to Nile Clay. The differences of the silica/sesquioxide ratio of these two groups of soils can be attributed to the origin of deposit. It may confirm that the Nile clay is most probably transported from the tropical zone in Abyssinia. Whereas the desert clay of the boundaries is old geological formations of Egypt.

b. The values of silica/sesquioxide ratio of the western desert clay are lower than those of the eastern desert clay as well as the predominance of kaolinite mineral in the western desert clay compared to the eastern desert clay. This can be due to the difference in morphological conditions between the western desert and the eastern desert.

c. At the site of Wadi kalabsha in western deset of Asswan, the value of the silica/sesquioxide ratio of soil on the western bowndaries is 1.30 (a value very close to the Nile clay). This low value can be explained in the light of geological history which attributed to sedimentary environment. Attia, 1955 indicated that the deposition of the soil in the western boundary at Asswan had taken place in lagoon and delta conditions. The predominance of kaolinite mineral in the clayey deposit of the Aswan western boundary confirm this point.

d. Physical and geotechnical properties of tested soils indicated:
1) a relatively high liquid limit, high plasticity, high dry unit weight of the desert clay compared to Nile clay.
2) a relatively high water content, high degree of saturation of the Nile clay compared to the desert clay.

5. CONCLUSIONS

1.The present study consisted of various sections representing the Nile Valley and its bounderies to confirm the effect of chemical weathering on different soil charactaristics.

2. Egyptian clayey soils were classified into two groups the first, denoted Nile clay represent Nile delta and its valley and the second denoted desert clay represent the boundaries.

3.Comparison between the silica/sesquioxide ratio of the two groups indicated that this ratio is generally higher in case of desert clays compared to the Nile clays except the western desert in Aswan location at Wadi Kalabsha which was on ancient delta during the createceous gealogical age.

4. For soil formation in Egypt, the silica/sesquioxide ratio can be an indicator of soil genesis and enviromental setting. It can differntiate between soil transported by the Nile from abayssinia and other formations.

5. The silica/sesquioxid ratio are relatively low in the western clayey desert compared to the eastern clayey desert. Also the kaolinite clay mineral is the predominant clay mineral in western clayey desert compared to eastern clayey desert.

6. Chemical weathering modified physical and geotechnical properties significantly.

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