

## ***SUMMARY AND CONCLUSIONS***

Five traverses were chosen to represent some scattering newly reclaimed sandy soils in Egypt. These traverses were studied, to get more information about these soils. Nineteen soil profiles were dug in these traverses and morphologically described. Chemical and mineralogical properties of soil samples, collected from these profiles were determined. The obtained results could be summarized as follows:-

Soil texture: sandy in soil profiles dug in traverse no. 1 (North Delta), sandy to loamy in soil profiles of traverse no. 2 (El-Nubaria), sandy loam in soil profiles of traverse no. 3 (Belbeis - El-Shbab project), gravely sand to loamy in soil profiles of traverse no. 4 (El-Saff-Kom Oshim) and gravely sand to clay in soil profiles of traverse no. 5 (Wadi El-Khrail-West Kom-Ombo).

CaCO<sub>3</sub> content: varied widely in the studied soils and ranged from 0.21 to 50.37%, and increased with depth. Soils of traverse no. 2 contained the higher CaCO<sub>3</sub>, while traverse no. 1 contained the lower one.

- Gypsum content: ranged between nil and 2.88% and reached its maximum in some profiles of traverses no. 2 and 4.

- Organic matter content: was low in all profiles but its higher value was found in the surface layers.
  - Soil salinity (EC): ranged between 0.53 and 87.42 mmhos/cm 25°C. The soils affected by shallow water table and middle Eocene formation contained the highest soluble salts. Soluble salts were accumulated in the surface soil layers. On the other hand, the high salinity in Gamassa soil was related with seepage from the sea. Soil salinity increased with increasing salinity of ground water and tended to increase with increasing the fine fraction (clay content).
  - Soluble cations and anions: sodium was the dominant cation, followed by calcium or magnesium according to the location of each traverse, while, potassium content was always the lowest.
  - Chloride was the predominant anion, except most soils of traverse no. 2, where sulfate was the predominant anion.
  - Soil reaction (pH): ranged between 7.5 and 9.2 according to CaCO<sub>3</sub> content and ESP values.
  - Cation exchange capacity: varied between 1.87 and 39.11 me/100g soil. It significantly and positively correlated with clay, silt, organic matter and total carbonate contents, while it negatively correlated with sand content.
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- Exchangeable cations: in general, exchangeable calcium was predominant followed by magnesium or sodium, while potassium was the least exchangeable one.
- Total amorphous materials contents: ranged between 0.48 and 7.32%. The soils of traverse no. 5 contained higher amorphous materials. Amorphous silica varied from 0.14 to 4.62% and its higher content was associated with the higher content of clay. Amorphous alumina varied between 0.04 and 1.67% and its higher content was related to clay content. Amorphous iron varied from 0.11 to 3.70%.  $\text{SiO}_2/\text{Al}_2\text{O}_3$  molar ratio indicated the presence of sesquioxidic allophane, halloysitic allophane and predominated siliceous allophane.
- Trace elements in soils:
  - 1- Total iron content ranged from 3000 to 26000 ppm and the soils of traverse no. 5 contained the higher total iron, total Fe was significantly and positively correlated with silt and clay contents and the opposite was true concerning sand content. Available iron was adequate to marginal in traverse no. 1 and most profiles of traverse no. 3, while traverse no. 2 exhibited a deficient level. Soils of traverses no. 4 and 5 have available iron between marginal and deficient levels. Available Fe was significantly and positively correlated with total iron but <sup>it</sup> significantly and negatively correlated with silt and total carbonate contents.
  - 2- Total manganese content varied from 60-526 ppm and soils of traverse no. 5 contained higher Mn. Manganese content was significantly and negatively correlated with  $\text{CaCO}_3$  content, while it insignificantly and

positively correlated with silt, clay and organic matter contents. On the other hand, Mn content was insignificant, and negatively correlated with sand fraction contents. Available Mn exhibited adequate levels in most profiles, except some profiles in traverses no. 2 and 3 which exhibited deficient level. Available Mn significantly and positively correlated with organic matter and total Mn contents, but it significantly and negatively correlated with  $\text{CaCO}_3$  content.

3. Total zinc content varied widely between 7 and 237 ppm and the soils of traverse no. 2 had a higher Zinc content. Zinc content was significantly and positively correlated with silt, clay and  $\text{CaCO}_3$  contents, while it significantly and negatively correlated with sand fraction content. Available zinc exhibited deficient (traverse no. 1) to marginal levels in all traverses. It was significantly and positively correlated with silt, clay,  $\text{CaCO}_3$  and total zinc contents, but it was significantly and negatively correlated with sand content.
  4. Total copper content differed from 5 to 68 ppm. It significantly and positively correlated with clay, while it insignificantly and negatively correlated with sand. Available copper exhibited adequate limits in traverses no. 1, 3 and 5, while traverses no. 2 and 4 contained available copper between adequate to deficient levels. It was significantly and positively correlated with silt, clay, organic matter,  $\text{CaCO}_3$  and total copper contents, but it significantly and negatively correlated with sand content.
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5- Boron content varied between 1.30 and 24.90 ppm and the highest B content was found in the soils of traverse no. 1. Total boron was significantly and positively correlated with sand and tourmaline contents, while it significantly and negatively correlated with silt, clay and  $\text{CaCO}_3$  contents. Available boron was not sufficient for normal plant growth. Available boron was significant and positively correlated with, sand, organic matter, total and tourmaline, but significant and negatively correlated with silt, clay and total carbonate.

The obtained results showed also that, available Fe and Mn were higher in the soils of shallow water table due to the reduction process. On the other hand soils of traverse no.1 had higher boron content affected by sea water.

The statistical measures; weight mean, trend and specific range of total micro nutrients showed that the content of each element varied according to sampling depth, location of each traverse and parent material. Generally, the computed trends of total micronutrients tended to be symmetrical distribution through the studied profiles. The values of specific range indicated also that the parent materials are heterogeneous.

-Grain size parameters.

The values of grain size parameters showed that, the mean size was fine sand in traverse no.1, medium sand to medium silt in traverse no.2, medium sand to very fine sand in traverse no. 3, medium sand to fine silt in traverse no. 4 and medium sand to very fine silt in traverse no. 5.

Sorting values indicated that the sediments falling between moderately well sorted and poorly sorted in traverse no. 1, from poorly sorted to very poorly sorted in traverses no. 2,4 and 5 and from moderately sorted to very poorly sorted in traverse no. 3. So, water was the main factor of transportation and deposition in the studied traverses except profiles no. 1 and 2 in traverse no. 1 and profile no. 12 in traverse no. 3, where water and wind were the factors of transportation and deposition.

- The studied soils had a non-normal distribution of skewed values, which indicated to more than one model and the positive and very positive skewed were dominated.

The kurtosis values showed that soils of traverses no. 1, 3 and 4 were dominated by leptokurtic to extremely leptokurtic, which indicated to a very high energy of deposition environment and very low modification of grain size, while soils of traverse no. 5 exhibited the domination KG values between mesokurtic to very platykurtic, which indicated to a very low energy of deposition environment and very high modification of grain size. On the other hand, soils of traverse no. 2 lied between these two groups.

- Mineralogy of the sand fraction:-
- Distribution of heavy minerals showed that opaques, amphiboles and pyroxenes were the dominated minerals. The soils of traverse no. 1 was distinguished by higher contents of tourmaline, apatite, sphene and glauconite, while rutile tends to be absent. The soils of traverse no. 2 contained higher amounts of opaques and zircon. In traverse no. 3, distinguished by pyroxenes, while epidote in traverse no. 4 and amphiboles

in traverse no. 5. Generally, it was found that the soils affected by ground water contained the lower amounts of opaque minerals.

- Distribution of light minerals showed that quartz was the dominated minerals, while feldspars took the opposite trend. The soils of traverse no. 1 had higher content of abnormal quartz followed by traverse no. 5.
- The distribution of heavy minerals (specially, ultrastable minerals i.e., zircon, rutile and tourmaline) and ratios of zircon/rutile, zircon/tourmaline and zircon/rutile + tourmaline, indicated that traverse no. 1 exhibited some homogeneity, while, other traverses were heterogeneous. Weathering ratios and distribution of heavy and light minerals indicated that the soils under investigation are recent and young.
- Source rocks of the studied soils were distinguished as follows:- Soils of traverse no. 1 varied between metamorphic rocks and acidic igneous ones, while metamorphic rocks was the main constituent in soils of traverse no. 2. On the other hand, basic igneous rocks were dominated in the soils of traverse no. 3. Soils of traverses no. 4 and 5 contained higher amounts of acid igneous rocks. Generally, it can be said that, the source of rocks in the studied soils are multi-origin.

- Mineralogy of the clay fraction:-

Distinctive minerals of the clay fraction were interstratified minerals, montmorillonite, chlorite, vermiculite, saponite, palygorskite, hydrous mica and kaolinite; while accessory ones were quartz, calcite, plagioclase, orthoclase and apatite. The source of clay in these layers was mainly due to alluvial materials transported by Nile water during some era in the past. On the other hand, carbonate content encouraged palygorskite formations.

- Land evaluation:

Soils of traverses no. 1,3,5 and 4 (except profile no. 16) were of relative limitation "very severe" and the same limitation was found in profiles no. 6 and 7 of traverse no. 2. While, soils of profiles no. 5 and 9 of traverse no. 2 were of relative limitation as "severe". On the other hand, the soils of profiles no. 8 and 10 of traverse no. 2 and profile no. 16 of traverse no. 4 were of relative limitation as "moderate".