ENGINEERING-GEOLOGICAL PROPERTIES OF PlioCENE ARGILLACEOUS SEDIMENTS OF THE WADI EL-NATRUN AREA (EGYPT)

CARACTÉRISTIQUES GÉOTECHNIQUES DES SÉDIMENTS ARGILEUX DU PLIOÈNE DANS LA RÉGION DE WADI EL-NATRUM (EGYPTE)

M.A. RASHED*

Abstract

In the Wadi El Natrun area, Egypt, sediments of Upper Pliocene age, ranging from alluvial plain deposits passing through coastal plain sediments up into high-energy nearshore shallow-marine deposits, mark a transgression. Study of these sediments provides information about the origin, texture, distribution and composition of clay minerals, which in turn is used in the description of physicochemical and physicomechanical properties. The clay minerals present are smectite pure or with minor illitic layers (70-80%), illite (5-20%), and kaolinite (5-15%).

The controlling factors in the physicochemical and physicomechanical properties of the Upper Pliocene sediments are primary composition, environment of deposition, microstructure characters, and physical properties. These interacting factors have been of varying importance in time and space in the engineering-geological properties of the studied sediments.

Résumé

Dans la région de Wadi El-Natrun, en Egypte, les sédiments du Pléistocène supérieur, qui consistent en dépôts de plaine alluviale, passant à des dépôts de plaine côtière, puis à des dépôts marins peu profonds, indiquent une transgression. L'étude de ces sédiments fournit des renseignements sur l'origine, la texture, la répartition et la composition des minéraux argileux, permettant ensuite une description des propriétés physico-chimiques et mécaniques. Les minéraux argileux présents sont la smectite pure ou avec des lits réduits d'illite (70-80%), de l'illite (5-20%) et de la kaolinite (5-15%).

Les facteurs qui influencent les caractéristiques physico-chimiques et mécaniques des sédiments du Pléistocène supérieur de cette région sont leur composition de base, les conditions de dépôt, les caractéristiques microstructurales et les propriétés physiques. Les influences respectives de ces facteurs dans le temps et dans l'espace expliquent les caractéristiques géotechniques de ces sédiments.

Introduction

Neogenic deposits are widely distributed in the north of Egypt, represented mainly by sandy deposits, while to the northwest of Cairo at Wadi El-Natrun they are dominated by argillaceous sediments. The engineering-geological properties of these argillaceous sediments are still scarce. Since the progressive development and newly developed towns along the Cairo-Alexandria highway, there has been a resurgence of economic interest in these argillaceous sediments. The intent of the present study is to clarify the engineering-geological properties of the argillaceous sediments using three stratigraphic sections. Two sections are located at 104-116 Km Northwest of Cairo near El-Zaagig and El-Bida lakes, the third is located at Abou-Gazala village 2 Km to the South of Wadi El-Natrun town (Fig. 1).

Stratigraphy and Lithological Characteristics

There is considerable variation in the texture of the Upper Pliocene sediments studied which has a direct bearing on both the detrital and authogenic mineralogy and physical, physicomechanical characteristics of these sediments. Lithologically, the Upper Pliocene sediments of the Wadi El-Natrun area can be grouped into four lithofacies, comprising loam, sand, clay and marl layers.

The stratigraphic section of the area studied (Fig. 2) shows that the El-Bida and El-Zaagig sections are characterized by interstratified loam, clay and marl layers, while the Abu Gazala section is represented by an interstratification of sand, loam and clay layers. These sediments belong to the Upper Pliocene, Astian (Muluk Formation) with Ostrea cucullata Born(1-6) and are overlain by the Pleistocene limestone.

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The following is a brief description of the Upper Pliocene sediments at the three studied sections using the Sergeev classification of sands (1983) and the classification of Kachenky for the clayey and silty samples (1984) depending on the data of the mechanical analysis.

### Mineral Composition, Grain Size and Microstructure

The mineralogical composition of the separated clay fraction from the Upper Pliocene sediments is com-

<table>
<thead>
<tr>
<th>Top sample No</th>
<th>Bed No</th>
<th>Lithology</th>
<th>Description</th>
<th>Thickness (m)</th>
</tr>
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<tbody>
<tr>
<td>Top sample No</td>
<td>Bed No</td>
<td>Lithology</td>
<td>Description</td>
<td>Thickness (m)</td>
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<tr>
<td>1</td>
<td>1</td>
<td>Medium loam</td>
<td>Pale grey, laminated</td>
<td>0.6</td>
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<tr>
<td>2</td>
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<td>Pale grey, massive with plant remains</td>
<td>0.4</td>
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<tr>
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<td>Pale grey, weakly laminated</td>
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<tr>
<td>4</td>
<td>4</td>
<td>Heavy loam</td>
<td>Greensh grey, weakly laminated</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Light loam</td>
<td>Yellowish grey, sandy in the lower part with clay galls</td>
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</tr>
<tr>
<td>6</td>
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<td>Light clay</td>
<td>Pale grey variegated shale</td>
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</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Light clay</td>
<td>Greensh grey, laminated with v.c. and inclusions in the lower part</td>
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</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Marl</td>
<td>Pale grey, porous with <em>Angulus cf. teneris</em></td>
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</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Light clay</td>
<td>Greensh grey, laminated becomes sandy towards the base</td>
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</tr>
<tr>
<td>10</td>
<td>2</td>
<td>Marl</td>
<td>Light grey</td>
<td>0.3</td>
</tr>
<tr>
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<td>Greensh grey, laminated</td>
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</tr>
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<td>Marl</td>
<td>Yellow with gravel inclusion in the bottom</td>
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</tr>
<tr>
<td>14</td>
<td>6</td>
<td>Heavy loam</td>
<td>with ferrugineous tinge</td>
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</tr>
<tr>
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<td>7</td>
<td>Light loam</td>
<td>Dark grey, massive</td>
<td>0.2</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td>Light loam</td>
<td>Yellowish grey, Greensh grey, laminated</td>
<td>–</td>
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<tr>
<td>17</td>
<td>1</td>
<td>Medium clay</td>
<td>Greensh grey, laminated with admixture of coarse sand grains</td>
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<tr>
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<td>Coarse sand</td>
<td>yellow, loose</td>
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<tr>
<td>19</td>
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<td>Light clay</td>
<td>Pale grey with plant remains</td>
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</tr>
<tr>
<td>20</td>
<td>4</td>
<td>Coarse sand</td>
<td>Greensh yellow, loose</td>
<td>0.5</td>
</tr>
<tr>
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<td>Light loam</td>
<td>Laminated, friable</td>
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<td>Greensh yellow, weakly laminated</td>
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<tr>
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<td>Greensh grey, laminated</td>
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<tr>
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<td>Medium to fine sand</td>
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<tr>
<td>25</td>
<td>9</td>
<td>Light clay</td>
<td>Greensh grey, massive</td>
<td>0.4</td>
</tr>
<tr>
<td>26</td>
<td>10</td>
<td>Light loam</td>
<td>Greensh grey, massive, friable</td>
<td>0.8</td>
</tr>
<tr>
<td>27</td>
<td>11</td>
<td>Medium sand</td>
<td>Yellow, friable</td>
<td>–</td>
</tr>
</tbody>
</table>

Fig. 1 : Location map of the study area.