



The swelling potential of clays from the Bahlui river plain, in relation to their mineralogy

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Abstract

The present paper highlights the specific swelling of several clay samples collected from different areas of the city of Iași (the Bahlui river plain, in particular), through dedicated geotechnical determinations and mineralogical analyses.

The results obtained within this research have emphasized the following aspects:

- the rocks analyzed exhibit swelling potentials ranging from reduced to high and even very high; the clays with very high swelling potentials were located in Miocene deposits and collected from depths of 19 meters and 34 meters, respectively.

- from a mineralogical point of view, the clay rocks studied display a similar qualitative aspect; however, quantitatively, there is a certain disparity between the samples. The sediments from depths of more than 10 meters contain 25-35% smectite (philosilicate mineral group with swelling properties), while the Miocene rocks, which are older, exhibit lower values, of 22-25%. Exceptionally, there are two soils that have a smectite content exceeding 30% (the same rocks harvested from depths of 19 m and 34 m, respectively).

The present research has finally proven the fact that swelling properties can be correlated with aspects regarding smectite content, in other words, samples with more consistent swellings have a high content of minerals from this mineralogical group. However, the existence of those clay rocks with high swelling potential in a deposit where rocks are predominantly considered less dangerous (geotechnical specialists regard them as the bedrock of the research area), may be a subject that needs to be carefully addressed in a future study.

Keywords: swelling potential, bedrock, shallow deposits, mineralogical analysis.

1. INTRODUCTION

An important area occupied by the clay soils underlying the Municipality of Iași is

rightly classified by geotechnical specialists as difficult soils. These pose significant problems in the construction of various types of engineering structures, their

behavior being extremely varied. The high swelling potential of these clay rocks, often manifested only sporadically in the field, requires particular attention in the construction of new buildings.

The swelling-shrinking capacity of a soil is defined as the property of that soil to change its volume significantly when its humidity varies. As a consequence of these volume changes of the rock, severe hurdles are generated at the level of various types of civil and industrial constructions, such as roads, buildings, halls, underground works etc. Moreover, manifestations of this kind can lead to the appearance of imbalances at the level of slopes, the most important being the formation of cracks through which water infiltrates, or by loading the massif when the rocks increase their volume through water absorption.

In the study region, the lowland area of Bahlui River (Iași Municipality), soils capable of large swellings and contractions have been a constant topic of debate in the field of geotechnical research. The most extensive study on the issue associated with these types of rocks was carried out by Boți, 1975. According to the data analyzed by the author, soils with large swellings and contractions occupy quite significant areas in the Municipality of Iași, mainly in the Bahlui River meadow, the research being carried out on clay soils sampled from this area. This work is supplemented by a list of studies that deal with various geotechnical aspects, but also with the specific swelling potential of clay rocks from the same perimeter (Ciornei and Răileanu, 2000; Aniculăeși et al., 2012).

The present study aims to correlate the geotechnical swelling characteristics of certain clays collected from the Bahlui river plain with their mineralogical characteristics. On the other hand, the study intends to identify common features in terms of expansion between the rocks that make up the bedrock in the region (of Miocene age) and the soils that constitute covering deposits (of recent, Quaternary age). The bedrock coincides with the deposits of Sarmatian age, while the shallow deposits are consistent with the recent sediments, of Quaternary age. The geotechnical characteristics are generally better for the first category of rocks, and less favorable in the upper part. However, as demonstrated in previous studies (Pascariu, 2016), the sporadic appearance of soils with unfavorable properties at the level of those dominantly suitable for constructions, generates a lack of predictability regarding the behavior of buildings over time.

The delineation of the bedrock from the overlying formation in the studied region, based on paleontological criteria, was carried out based on the identification of the faunal associations typical of the Cryptomactra Formation. From a geotechnical point of view, the differentiation of these deposits is difficult to achieve (Ionesi and Pascariu, 2011), although an analogy is currently made by specialists between the bedrock and the Miocene age, and the upper deposits and Quaternary age, respectively. In reality, the identification in the field is not correctly justified by some geotechnicians.

2. GENERAL ASPECTS

2.1 Geographical setting

The study area overlaps the lowest landscape in Iași Municipality, the Bahlui river plain. The entire region is located in the southern extremity of the Moldavian Plain landscape unit (Băcăuanu et. al., 1980, Băcăuanu, 1968), precisely at the border with the Central Moldavian Plateau landscape unit, the delimitation being marked by the Iași Slope (Fig. 1).

The hydrographic network plays a major role in shaping the landscape in this area. Bahlui River, together with its tributaries – Nicolina, Vămășoia, Cîric, REDIU – have contributed over time to the deepening and widening of the valleys, shaping fluvial terraces with heights between 10 and 30 m, and determining an average energy of the valleys between 50-70 m. The terraces and meadows were formed against the background of alternating periods of erosion and sedimentation, in the context of slow neotectonic uplifts of the Moldavian

Platform (Barbu and Ungureanu, 1987). The area subject to the present study was, therefore, also formed under these circumstances.

2.2 Geological background

The stack of rocks upon which the city of Iași is built on is of Miocene age, being marked by the Cryptomacra Formation lithostratigraphic unit. The unit comprises an alternation of marly clays, clays and silty clays with sandy intercalations, in which fossil remains of *Cryptomacra pesanseri* are frequently found. In the superficial layers, Quaternary deposits of deluvial, colluvial and alluvial nature also develop, composed mainly of dusty clays and sands, which make up the slopes and terraces of Bahlui River (Grasu et al., 2002; Grasu et al., 2004). The thickness of these newer deposits varies greatly, from a few centimeters, where more aggressive external factors intervened, to approximately 20 m on the terraces less affected by disaggregation phenomena.

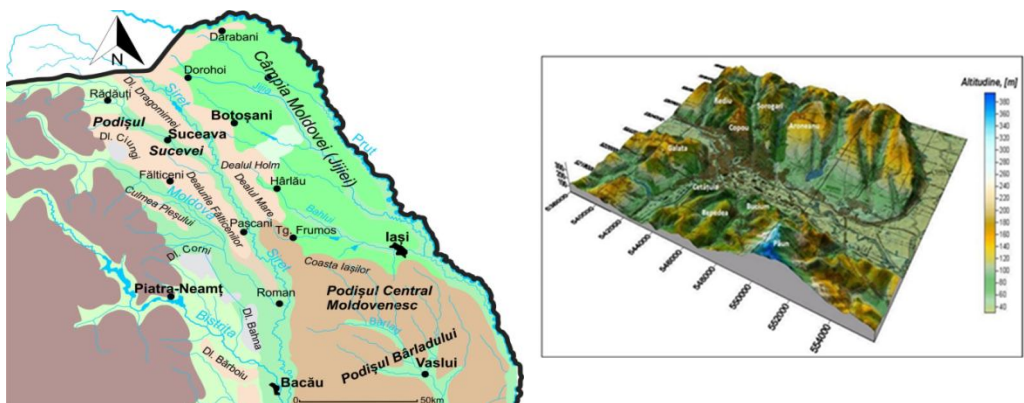


Fig. 1 Physical-geographical setting of the city of Iași.

This geological configuration explains the presence of numerous lithological and hydrogeological discontinuities in the area. At the same time, it influences the behavior of the land in the face of dynamic factors such as moisture (generated by the antagonistic climate), pore water pressure and anthropogenic loads. In the case of smectitic clay deposits from the Neogene levels, in particular, seasonal variations in temperature and precipitation can lead to important volume oscillations, with direct implications on the stability of the buildings. In this context, detailed knowledge of the local geology becomes essential in any geotechnical and urban planning approach in the Iași Municipality area.

From a geotechnical point of view, the Cryptomactra Formation is considered the bedrock of the region, while the Quaternary deposits, usually non-homogeneous and predominantly macroporous, are associated with the overlying formations.

3. METHODS AND MATERIALS

For the present study, 7 clay samples (M1, H1, G1, D1, A1, A2 and A3) were collected from 5 different observation points in the Iași Municipality area (Fig. 2). Most of the rocks come from the Bahlui river plain area, with the exception of one sample (H1), which was collected from the connection area between the main bed and the lower terrace of Nicolina River, a tributary of the Bahlui River. The samples were extracted directly from geotechnical boreholes, being, thus, disturbed rock specimens. The five observation points are located as follows (Fig. 2):

- Arcadia Hospital, Mircea cel Bătrân neighborhood – one sample (M1), collected at a depth of 6 meters from an observation point next to the bridge above the Bahlui River, near the confluence with the Nicolina River;

- Hlineca street, CUG neighborhood – one sample (H1), collected from a depth of 19 meters;

- Galata neighborhood – one sample (G1), collected from a depth of 10 meters;

- Comat residential complex, Dacia neighborhood – one soil sample (D1), collected from a depth of 34 meters;

- Residential complex, Aviației neighborhood – 3 samples (A1, A2 and A3), collected from depths of 5-8 meters, 9-10 meters and 12-13 meters, respectively.

The rocks extracted from the boreholes are mostly of Miocene age (M1, H1, G1, D1, A3), therefore, they could be correlated with the bedrock level, from a geotechnical point of view.

On the other hand, all the soils were subjected to various types of geotechnical tests (granulometric analysis, characteristic humidity, free swelling) in order to meet the objectives of the present study. The seven samples were also studied from a mineralogical point of view so as to follow the trend of correlating the swelling-shrinkage potential with the typical mineralogy.

3.1 Geotechnical evaluation of the rocks

Upon preliminary examination of the samples, the following physical characteristics were observed: yellowish color (samples A1 and A2) or gray color (samples A3, M1, H1, G1 and D1), earthy

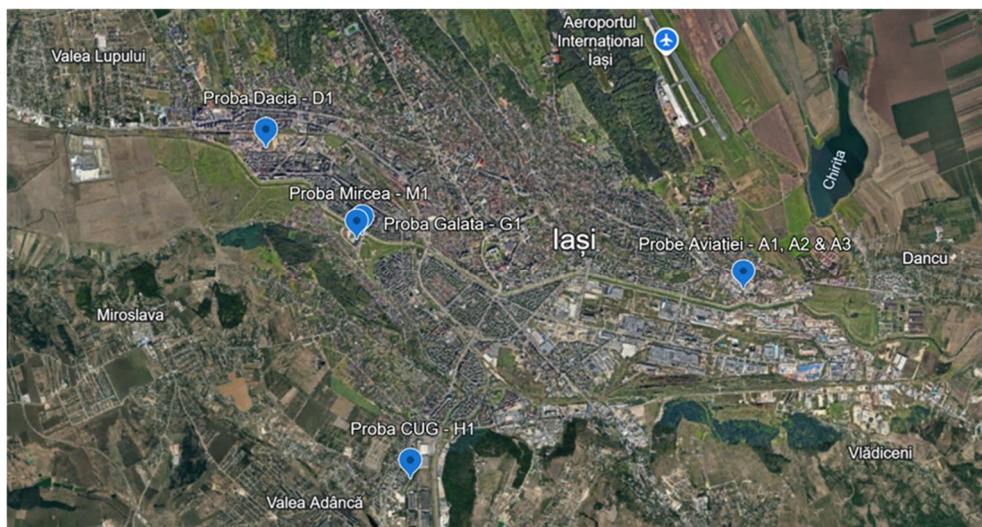


Fig. 2 The locations along the Bahlui river plain from which the clay samples were collected.

luster (A1, A2, A3, M1) or very oily luster (D1, H1, G1), solid-plastic or soft-plastic (STAS 2914/84, NP 126-2010) (M1, A1). The presence of fine intercalations of a silty-sandy nature was also noted.

The following lithological types emerged from the granulometric analysis: clay (samples H1, D1, A3, G1) and silty clay (samples A1, A2, M1). It is important to note that the dispersion of the materials was difficult in the case of the clay samples.

The most important geotechnical test conducted during the present research was represented by the swelling potential test. The classification of rocks with swelling potential is frequently performed starting from the analysis of basic parameters, such as granulometry or the plasticity of the rocks and their correlation with certain reference values, indicated by the standards in use (Tab. 1). In order to have

a clearer picture of the expansion phenomenon, the collected rocks were also subjected to the free swelling identification test, UL (STAS 1913/12-88, NP 126-2010, ASTM D 4546-03). The method consists of determining the volume of sediment obtained by depositing a quantity of soil, with an initial volume of 10 cm^3 , dried and previously mortared, in water. Approximately 100 g of the material to be tested was scraped off, dried in an oven at 105°C , then milled so that the entire quantity passed through a 0.5 mm sieve. The milled quantity was returned to the oven for drying.

Each determination was performed in parallel on three samples, in graded cylinders with a volume of 100 cm^3 . The latter were filled with distilled water up to approximately 50 cm^3 , after which 12 g of soil (equivalent volume of 10 cm^3), prepared as previously described, were

introduced into each. The cylinders were thoroughly shaken. After the soil sedimentation (approximately 4 h), the suspension in the cylinders was mixed again, the inside of the cylinders was washed with distilled water up to 100 cm³ using a sprayer, and allowed to re-sediment for another 24 h. At the end of this operation, the final volume of the sediment was read. If the deposition of the granulometric fractions was incomplete, the test was repeated, adding 1 cm³ of calcium chloride solution before the last stage.

The free swelling for the sample in each cylinder was calculated using the following relationship:

$$U_L = 10 \times (V_f - V_i) \quad (1)$$

$$U_L = 10 \times (V_f - 10) \quad (2)$$

where U_L represents the free swelling of the clay samples, V_f is the final volume of the material in the cylinder, and V_i has the value of 10 cm³, the equivalent in volume of the 12 g of soil introduced into the container at the beginning of the test. In order to accurately identify this geotechnical parameter, the average of the three values obtained for the three tests

performed on each sample was calculated. The final volume reading was made with a precision of 0.5 cm³.

Clays with free swelling of less than 70% will be associated with a non-expansive character, while rocks with swelling exceeding 100% will be correlated with categories of soils that produce considerable swelling, particularly under light loads (Tab. 1).

3.2 Mineralogical survey of the clay samples

For the mineralogical characterization of the soil samples, X-ray diffraction (XRD) analyses were performed, using specialized equipment and software. The XRD study was performed both on the clay samples in their initial state (dried and milled), and on the clay fraction obtained subsequently by separation. This approach allowed a complete evaluation of the mineralogical composition, identifying both the dominant minerals in the entire soil matrix and the minerals specific to the fine fraction, which play an essential role in the geotechnical behavior of the material (especially in swelling-shrinking phenomena).

Tab. 1 Reference values of swelling characteristic for soft rocks and characterization of the behavior of expansive and highly shrinkable soils (NP 126-2010)

Clay fraction, $A_{2\mu}$, %	I_p	U_L (%)	Characterization of the behavior of HES
> 30	> 35	> 140	Very active
20 – 30	25 – 35	100 – 140	Active
15 – 20	12 – 25	70 – 100	Medium activity
< 15	< 12	< 70	Reduced activity

The samples were collected directly from the field, from boreholes, then dried in an oven for 24 hours to eliminate moisture retained in the pores. After drying, the samples were finely milled, and the fraction below 0.2 mm, considered optimal from an analytical point of view, was used for XRD analysis.

To separate the clay fraction, 5 grams of milled sample were placed in a 3-liter Berzelius beaker, to which distilled water was added. The suspension was homogenized for 2 hours using a magnetic mixer (MS11H), at 1000 rpm, at room temperature. After homogenization, the samples were left for 24 hours for sedimentation. The fine fraction was extracted from the upper layer (~8 cm) of the column, which was dried in an oven at 60°C for 24 hours.

Diffractometry was performed with a PANalytical Aeris (copper anode tube, 15 mA, 40 kV) and PIXcel3D hybrid detector. In some cases, an X'Pert Pro X-ray with cobalt tube and X'Celerator detector was also used to extend the analysis range ($2\theta = 5^\circ\text{--}85^\circ$). The scanning parameters included a time constant of 50 seconds/step and a resolution of $0.01^\circ 2\theta$. For the clay fraction, measurements were performed in the $2\text{--}15^\circ 2\theta$ range, with a step of $0.02^\circ 2\theta$ and 300 seconds per step.

The results were processed in the HighScore program, integrated with the ICSD, COD and ICDD PDF4+ databases. The background estimation was performed through the automatic iterative method (Sonneveld & Visser), with granularity and curvature adjustments, using smoothed data for increased accuracy. The diffraction peaks were identified using the

second-order derivative method, which is effective in detecting weak reflections (shoulders) superimposed onto the dominant peaks.

Phase identification was achieved by automatic matching of diffractograms with reference models, with scores calculated based on line intensity, coherence and percentage of match. In some cases, the Rietveld method was applied, which allows for full profile refinement and quantitative phase analysis, including the detection of amorphous content or microcrystalline strains.

4. RESULTS AND DISCUSSIONS

4.1 Analysis of the swelling potential

The examination of the swelling potential, carried out by applying the methods specific to geotechnical laboratories, highlighted the fact that, of the 7 clay samples analyzed, 2 samples (H1, D1) are very active, therefore they have very high swelling potential, one sample (A3) is active, samples M1, G1, A1 indicate lower values, being of medium activity, and the last clay (A2) is slightly active. The two very active soils have free swelling values over 140%, drawing particular attention to the clay collected from a depth of 34 m (D1), in the Dacia neighborhood area.

This has a very high swelling percentage, of 222.5%. Sample A3, collected from a depth of 12 m in the Aviației Street area, displays values of 131.66%, but the other samples collected from the upper portion of the same borehole (A1, A2), have reduced activity, with between 53 and 88% of the swelling potential.

Tab. 2 Swelling potential values of the clay samples collected from the Bahlui river plain

Sample	Age	Depth (m)	A (cm ³)	B (cm ³)	C (cm ³)	Results (%)
M1	Miocene	6	18,5	18	19	85
G1	Miocene	10	20	20	19,5	98,33
A1	Quaternary	5-8	18	19,5	19	88,33
A2	Quaternary	9-10	15	16	15	53,33
A3	Miocene	12-13	24	22,5	23	131,66
H1	Miocene	19	25	24,5	24	145
D1	Miocene	34	32,5	32	32	222,5

The clay sample collected from the Galata area (G1) displayed an expansion phenomenon limited to 98%, and can be characterized as having medium activity, although, from a value point of view, it is close to the character of a rock with high active potential.

The results of the free swelling analyses are generally proportional to the depth of the samples, with very few exceptions, as can be seen in table 2. The D1 and H1 rocks (Dacia and Hlincea) are examples of clays that should be considered for the construction of foundations (for example, foundations with bored piles can reach these depths of over 15 – 20 m). The reason why the D1 and H1 samples generate real reasons for concern is that both clays are integrated into the category of bedrock, deposits with favorable characteristics from an engineering point of view, and are considered good foundation soils. The very high plasticity and this swelling characteristic, has, however, earned them the title of problem rocks. In a dry state, this type of land behaves well, but in relation to water, the situation changes

radically, these rocks leading to the breakage of certain construction/foundation elements, the pushing of these bodies to the surface and, implicitly, the occurrence of major degradation at the level of structures etc. Knowledge of the entire rock package located under the foundations of high-rise buildings, under various geotechnical points of view, should by no means be neglected when developing the design of buildings of this type.

4.2 XRD analysis

According to XRD analyses, the seven clays investigated displayed different characteristics for Quaternary and Sarmatian rocks. Thus, in the case of sample M1, from the Mircea area (6 – 7 m depth), the XRD spectrum shows a mineralogy strongly influenced by the presence of the illite–smectite complex, whose proportion reaches 49.5%, which denotes a high degree of clayiness and an increased predisposition to swelling–contraction processes. Quartz, although significantly present (27.0%), appears in reduced quantity compared to the share of clay minerals

(Tab. 3). Calcite (8.0%) and dolomite (3.0%) suggest a modest carbonate component, possibly derived from sedimentary processes or from the alteration of carbonate cement. Feldspars such as albite (4.0%) and orthoclase (4.0%) appear in similar proportions, reflecting a detrital source originating from acidic rocks. Clinocllore (2.5%) indicates an association with hydrothermal alteration zones, while kaolinite (2.0%) reinforces the secondary character of the soil, possibly affected by weathering and pedogenetic processes. The high proportion of illite-smectite suggests moderate diagenetic conditions, characteristic of closed or low-energy sedimentary environments (Fiore et al., 2013).

Sample A3, collected from the Aviației area (12–13 m), reflects a balance between the siliceous component (quartz – 38.0 %) and the clay component (illite + illite-smectite – 39.0 %), which indicates a clay-sandy soil with medium cohesion. The illite-smectite complex is well represented, with an intermediate degree of interstratification, which suggests a partially

diagenized and potentially reactive evolution. Carbonate minerals, such as calcite (7.0 %) and dolomite (3.0 %), which may come from source rocks or from the initial sedimentary cement, also appear in the composition. Albite (7.5 %) is present in significant proportions, along with orthoclase (2.0 %), both indicating a detrital source with magmatic input. Clinocllore (2.5 %) is an indicator of hydrothermal alteration or low-temperature metamorphism, while kaolinite (1.0%) emphasizes a weak influence of pedogenetic alteration. The distribution of minerals indicates a soil with variable geotechnical potential, sensitive to changes in humidity, due to the high proportion of active clay minerals. The results obtained from XRD analyses performed on samples A1 and A2, clays collected from the same geotechnical borehole, indicate a complex mineralogical composition, dominated by silicates and phyllosilicates, with the presence of carbonates in secondary quantities. Diffraction performed on the two samples in their initial state revealed the presence of

Tab. 3 The mineralogical content of the soils from Bahlui river plain

Sample	Age	Illite/Smectite (%)	Illite (%)	Calcite (%)	Dolomite (%)	Quartz (%)	Other minerals (%)
M1	Miocene	49.5	13.9	8	3	27	12.5
G1	Miocene	38	-	4.5	3.5	30	24
A1	Quaternary	9.6	-	6.4	9.5	30	44.5
A2	Quaternary	11.6	8.3	10.9	5.4	35.3	28.5
A3	Miocene	39	13.2	7	3	38	13
H1	Miocene	36	13	8	5	15.5	35.5
D1	Miocene	36.5	13.4	9	6.5	36.5	11.5

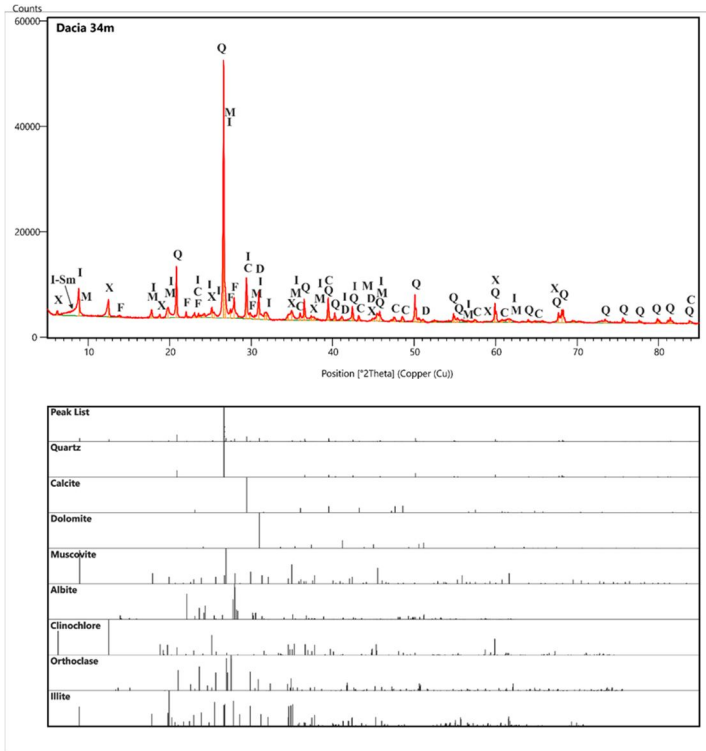


Fig. 3 XRD patterns resulted from the analysis of the D1 sample (Dacia).

the following mineral phases: quartz (30.0%), chlorite (14.2%), muscovite (24.6%), calcite (6.4%), dolomite (5.9%), ankerite (2.9%), microcline (6.4%) and ordered albite (0.6%) (Tab. 3). Within this interpretation, muscovite and chlorite were considered representative for the entire category of clay minerals, in order to simplify the process of analysis and quantification of the phases.

The XRD analysis of sample D1, collected from the Dacia area (depth of 34 m), showcases a mineralogical composition dominated by quartz (36.5%) and the clay fraction represented by illite and the interlayered illite-smectite complex, which

cumulatively reach 36.0% (Tab. 3). This type of soil has siliceous-clay characteristics and a moderate reactivity potential, indicated by the consistent presence of clay minerals with a mixed structure (Fiore et al., 2013). The presence of calcite (9.0%) and dolomite (6.5%) is also noted, suggesting a carbonate contribution possibly associated with sedimentary cement or with the alteration of limestone rocks. Albites (7.5%) and orthoclase (1.0%), along with feldspars of magmatic or metamorphic origin, support the hypothesis of a complex detrital input. Clinocllore (2.0%) is a ferromagnesian mineral of the chlorite series, indicating a possible influence of

metamorphic or ultrabasic rocks. The composition also includes kaolinite (1.5%), a clay mineral formed under pedogenetic or hydrothermal alteration conditions (Fig. 3).

4.3 Correlation between the geotechnical parameters and the mineralogical analysis

The geotechnical behavior of fine soils is largely determined by the mineralogical composition, particularly by the nature and proportion of clay minerals. In the present study, the influence of the mineralogical content identified by X-ray diffraction (XRD) was analyzed in relation to the swelling potential of clays from the area of Iași Municipality, located in the Bahlui river plain. These soils, deposited in various sedimentary contexts, were subjected to diagenesis processes specific to marine and lacustrine accumulation environments, which led to the formation of complex associations of clay minerals. The geotechnical evaluation of the swelling potential was carried out through experimental determinations in the laboratory, expressed in percentages of volumetric expansion, values that directly reflect the capacity of the minerals in the composition of the samples to absorb water and modify their volume.

In the lithological and paleogeographic context of the Iași area, most of the clay rocks analyzed belong mainly to Miocene formations, characterized by an alternation of fine sediments (clays, silts) and carbonate fragments, initially deposited in marine conditions of a marginal platform, later in semi-enclosed basins with limnic influences. During the gradual retreat of the Sarmatian Sea, the sedimentation

environments changed more and more, forming alternations of continental and lacustrine sediments in the lowlands, which influenced both the granulometry and the mineralogical composition of these soils (Grasu et al., 2002). This formation context explains why some samples are dominated by illite and chlorite – minerals stable in marine or semi-marine environments, while others contain smectite and illite–smectite interstratifications, typical of calmer and less energetically-active environments, such as lacustrine or marginal marsh environments.

Based on the interpretation of the XRD results for the seven samples analyzed, significant differences were found in terms of clay mineralogical composition. Thus, samples H1 and D1 display high contents of smectite and illite–smectite complexes, together exceeding 30 – 35% of the total clay minerals. These are recognized for their high hydration and expansion capacity, determined by the 2:1 type crystalline structure, with interlayers capable of incorporating water molecules. This structure allows a large variation in the interlamellar distance, thus explaining the high values of the swelling potential experimentally determined for these samples – 145% for H1 and 222.5% for D1. By comparison, in samples with a predominance of illite, chlorite and muscovite (e.g., A2 and A1), the values are significantly lower, between 53% and 85%, which reflects a much lower absorption and expansion capacity. Illite, having a stable lamellar structure and poorly-hydratable interlayers, behaves almost inertly in terms of swelling, giving

soils increased stability in contact with water.

The differences in behavior between the samples are thus explainable both through the mineralogical nature and the sedimentological history of the area. For example, sample G1, with a swelling potential of approximately 98%, contains relatively-balanced proportions of smectite, I-Sm and illite, suggesting a mixture of sediments of marine origin and continental fluvial inputs. In the transitional areas between the marine and limnic regimes, clay minerals originating from the chemical alteration of feldspars and pyroxenes in the source rocks could have accumulated, and the degree of transformation into smectite was accentuated under conditions of water stagnation and reduction, characteristic of lacustrine or marshy environments, such as those found in certain sub-sectors of the Bahlui Meadow. These conditions are favorable for the formation of clays with high swelling potential, and the mineral composition confirms this.

In conclusion, the correlative analysis between clay mineralogy and geotechnical behavior of the soils in the studied area indicates a direct relationship between the smectite content and illite-smectite inter-stratifications, on one hand, and the values of the swelling potential, on the other. The Sarmatian deposits, although belonging to a common stratigraphic unit, exhibit significant mineralogical variability, depending on the depositional environment and paleoenvironmental conditions. This diversity explains the non-uniform distribution of swelling behavior in the field

and emphasizes the need to correlate mineralogical and geotechnical data in order to fully characterize clay soils with high expansive potential.

5. CONCLUSIONS

From an applied perspective, the results obtained highlight the importance of the correlation between the mineralogy and geotechnical behavior of foundation soils. In the case of Neogene clay formations in the Iași region, marked by the presence of smectites and mixed minerals with high swelling capacity, a careful approach is required in choosing the type and depth of foundations. Adapting soil stabilization methods, such as binder improvement, chemical treatments, controlled drainage or the use of separation layers, can significantly reduce the risks associated with differential deformations at the level of the foundation footing of any type of building or the degradation of the elevated structure.

The bedrock in the researched region has been increasingly exploited over the past decade for the construction of various types of large-scale works, the foundations also being developed differently compared to previous periods. Thus, from this perspective, more extensive knowledge of all the geotechnical properties specific to the entire rock package of interest for the respective project is required.

At the same time, the present paper highlights the need to continue research on these types of clays, especially in the context of accelerated urbanization and climate change that accentuates seasonal

alternation phenomena, more precisely those related to periods of excess humidity in contrast to dry weather. The extension of studies to other areas of the Moldavian Platform and the use of modern technologies for monitoring phenomena related to the behavior of foundation soils may represent useful directions for improving the performance and safety of future engineering works.

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