ON THE POSSIBLE INFLUENCE OF SMALL IMPACT ON GEOENGINEERING PROPERTIES OF SUBSOIL

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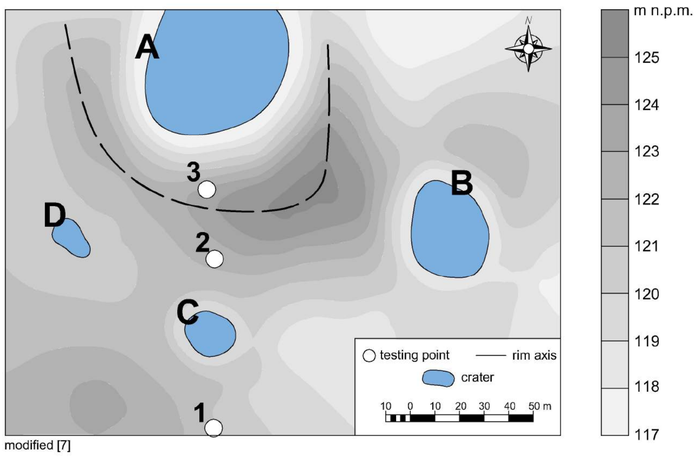
INTRODUCTION

The investigation was carried out in Morasko Meteorite protected area in northern Poznań. The Morasko meteorite impact has been assessed to be relatively young and took place in unconsolidated sediments [1], [5]. Bottom of the impact crater is built of Quaternary peat, gyttja, till and Neogene clay [6].
The main aim of the study was to verify the hypothesis of the genesis of the craters in the analyzed area using geotechnical methods to investigate the changes in geoengineering properties of non lithified deposits.



modified [7]

Three testing points were founded at the site, first on the top of the major crater rim and the last a 110 m away. An additional CPTU has been carried out in the Warta river valley, for get the reference values of geoengineering properties of similar sediments not subjected to the impact.

METHODS

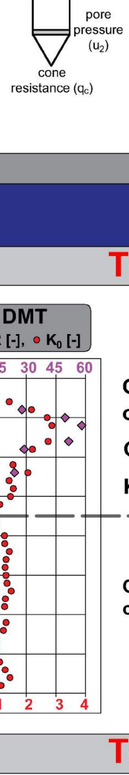
Sediments of the rim formed during the impact by ejection from the inside of the creater should have different values of the strength and deformation parameters like initial shear modulus (G_0), overconsolidation ratio (OCR) and coefficient of earth pressure at rest (K_0) than surrounding deposits. The values of these parameters were obtained from geotechnical in-situ tests [2],[3]:

Cone penetration test (CPTU)

Geotechnical in-situ test based on vertical penetration of tip gauge in to subsoil.
During the investigation the cone resistance and sleeve friction are measured.
These parameters are used to estimate e.g. OCR values [4].

$OCR = a \cdot \ln Q_t - b$

$a,b = f(I_P)$

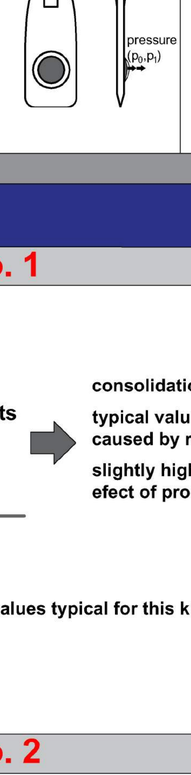


Marchetti dilatometer test (DMT)

Geotechnical in-situ test based on vertical penetration of blade with a membrane in to subsoil.
During the investigation the vertical pressure which is needed to pull the membrane by gas is measured.
These pressure values are used to estimate e.g. OCR and K_0 values.

$OCR = 0{,}5(K_D)^{1,56}$

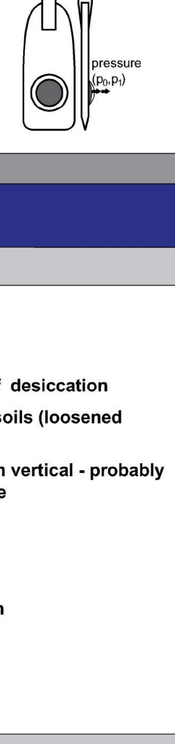
$K_0 = (\frac{KD}{1,5})^{0,47} - 0{,}6$



Seismic dilatometer test (SDMT)

The principle of operation is the same as in DMT but the device is additionaly equipped with geophones which allow obtaining the velocity of seismic waves.
Therefore G_0 can be determined.

$G_0 = \rho V_s^2$



RESULTS

Geotechnical parameters can be very helpful to describe the geological processes.

OCR indicate overconsolidation effect and thus areas where deposits were subjected to higher load in the past.

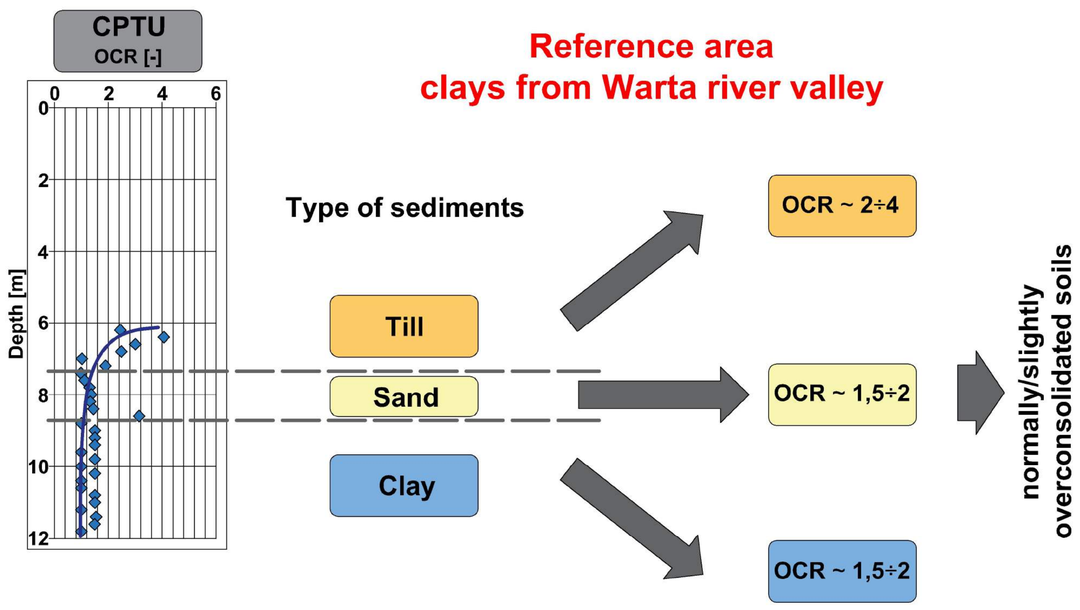
$$OCR = \frac{\text{preconsolidation stress}}{\text{present overburden stress}}$$

K_0 is a function of stress history and can be useful in interpretation of soils genesis.

$$K_0 = \frac{\text{horizontal effective stress}}{\text{vertical effective stress}}$$

G_0 describes elastics properties and is correlated with the initial deformation of solis.

$$G_0 = \frac{\text{shear stress}}{\text{shear strain}}$$



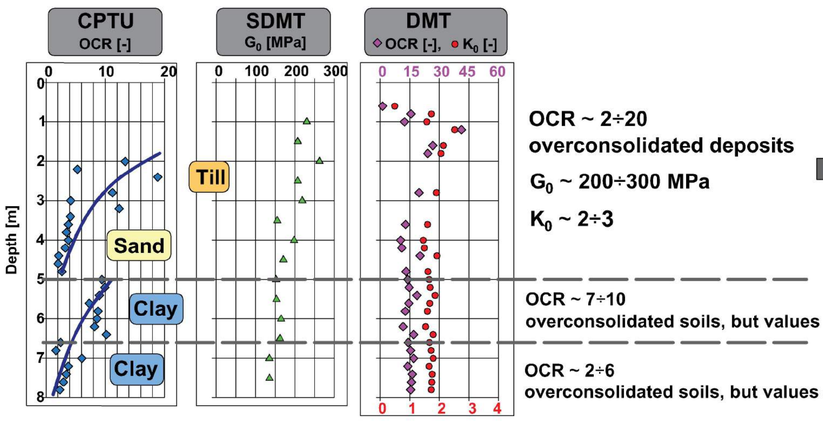
Testing point no. 1

OCR ~ 5÷15
overconsolidated deposits
G_0 ~ 100÷150 MPa
K_0 ~ 1÷2

- consolidation caused by changes of desiccation
- typical values of G_0 - slightly loose soils (loosened caused by roots)
- slightly higher horizontal stress than vertical - probably efect of process forming the moraine

OCR ~ 7÷10
overconsolidated soils, but values typical for this kind of deposits and depth

Testing point no. 2



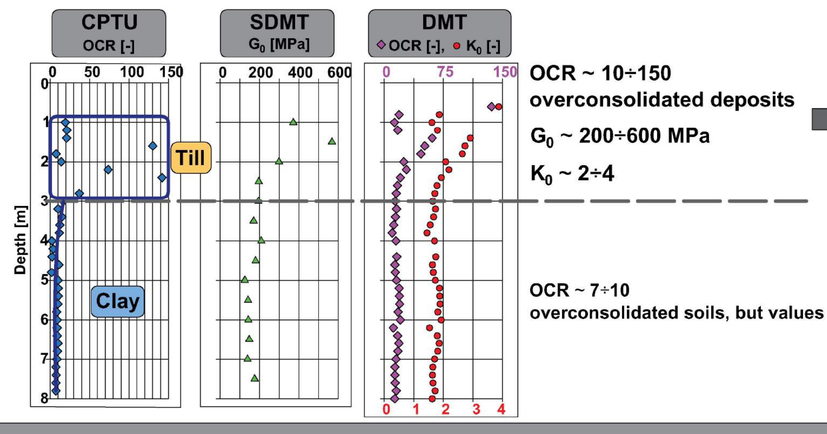
OCR ~ 2÷20
overconsolidated deposits
G_0 ~ 200÷300 MPa
K_0 ~ 2÷3

- consolidation caused by changes of desiccation
- higher values of G_0 - probably the impact effect
- higher horizontal stress than vertical - probably efect of process forming the moraine

OCR ~ 7÷10
overconsolidated soils, but values of OCR are typical for this kind of deposits and depth

OCR ~ 2÷6
overconsolidated soils, but values of OCR are lower - similar to clays from the reference area

Testing point no. 3



OCR ~ 10÷150
overconsolidated deposits
G_0 ~ 200÷600 MPa
K_0 ~ 2÷4

- disturbed zone - very diverse values of OCR (very high values) - lack of correlation with depth
- very high values of G_0
- significantly higher horizontal stress than vertical
- probably zone of the highest IMPACT INFLUENCE

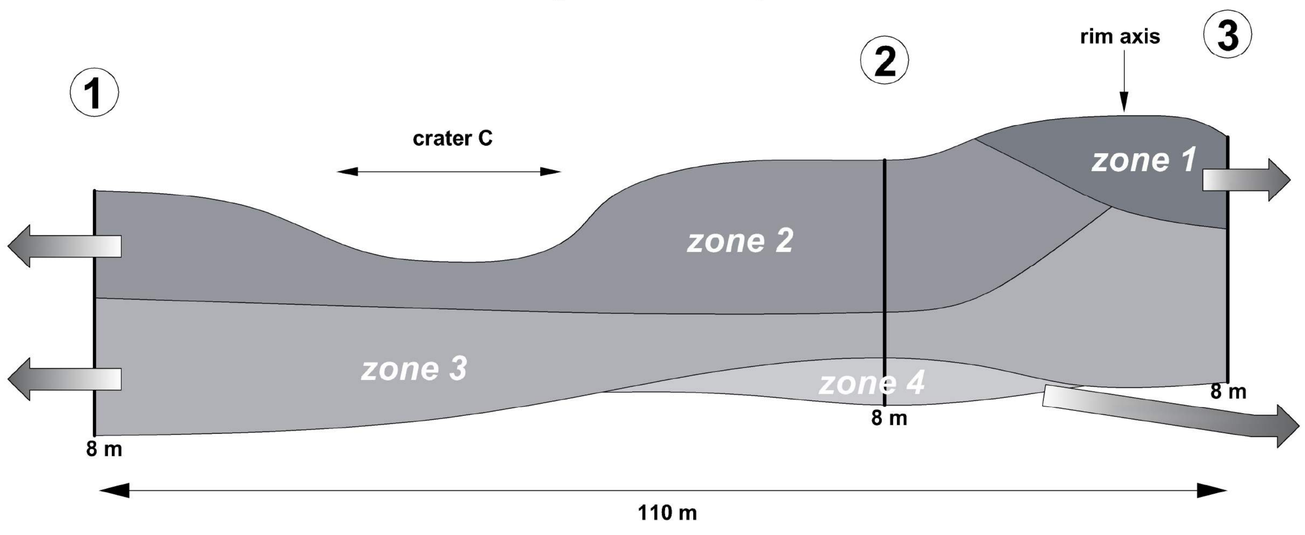
OCR ~ 7÷10
overconsolidated soils, but values typical for this kind of deposits and depth

CONCLUSION

Results from three geotechnical tests enabled determining zones of deposits on the basis of values of OCR, K_0 and G_0.

Zone 2:
Higher values of geotechnical parameters suggest that this zone was also influenced by impact but in smaller scale.

Zone 3:
In this zone values of geotechnical parameters are common for this kind of soil. The impact did not affect the geotechnical properties.



Zone 1:
It is a disturbed zone characterized by high values of OCR and K_0. These soils formed some kind of cap. It is highly probable that sediments of the rim were thrown out of the inside of the crater during the impact.

Zone 4:
Values of parameters are slightly lower than in zone 3 but are still typical for these kind of soils. It could be a relaxation zone created during process which formed the moraine.

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