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Effects of Mineralogy and Environmental Factors on Soil Structures.

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Abstract.
Elements and Effects of Mineralogy are due to particles and distribution of elements within fabric of clay particles distributions, Structure of different clay minerals and influence which also is Environmental factors such as Montimorillonite, kaolinite, Illite and which in summary does present some physics-chemical effective stress form of equations. However, the effect of this mineralogy on compressibility and strength of cohesive soil.

KEYWARD: *Particle, Elements Mineralogy.*

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I. INTRODUCTION

In general, soils are formed by weathering of rocks, but the physical properties of soil are dictated primarily by the minerals that constitutes soil practices and hence the rock. Terzaghi, K. (1943)

The introduction of this topic is for the demonstration of how the minerals by effect on clay material and other soil components benefit from this environment. However, this is more of structural built up of soil material components using macro-level for illustration of radiography in different stages of formations this chemical/mineralogy form together to produce the most sedimentary.

1 **Clay Fabric**
Refers to orientation and distribution of particles; distinguish between fabric at macro-level & micro-level.
1) Macro-Level (Illustrated via radiographs in class). Radiography measures charges in soil density and is ideally suited for detecting features such as:

- Vaived deposits = alternating layers of "silt" (summer deposition) and "clay" (winter deposition) in fresh water, glacial lake deposits.
- Distribution of silty /sandy layers/lens in sedimentary deposits.
- tern of fissuring.
- Presence of shells, stores, etc.

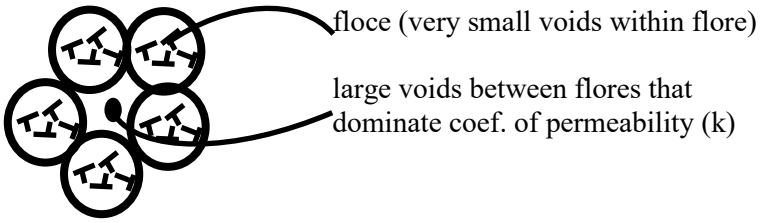
NOTE: also excellent for detecting evidence of sample disturbances MIT x-rays all tube samples puri to testing →best quality

→most representative

2) **Micro-Level**

1) a) Methods of measurement. 1) Scanning election microscope (SEM).
→"picture" (claim to = 10Å, but must dry).
2) X-ray diffraction →orientation of platy partulic
3) pore segi distribution from Hg intrusion (also must dry)

b) most sedimentary cohesive soils are composed of floccs = group of particles that stick together during sedimentation.



c) **Effects of Sediment Environment on Fabric of Flows (Illitic Clay)**
•Sedimentation in fresh water (R>A)→
"Dispersed" fabric - smell flows with semi-parallel pactulo

•**Sedimentation** in sea water (R<A) →
"Flocculated" fabric - large flows with edge to face orientation

d) **Effects of Application of Stusser**
• 1-D compression →preferred orientation of plates 1 to σ_{vc}^{1} direction
•Shearing→ breaking of contacts and preferred orientation of plates parallel to T_H

Data on kaolinite from x-ray diffraction (Martin & Ladd 1975)

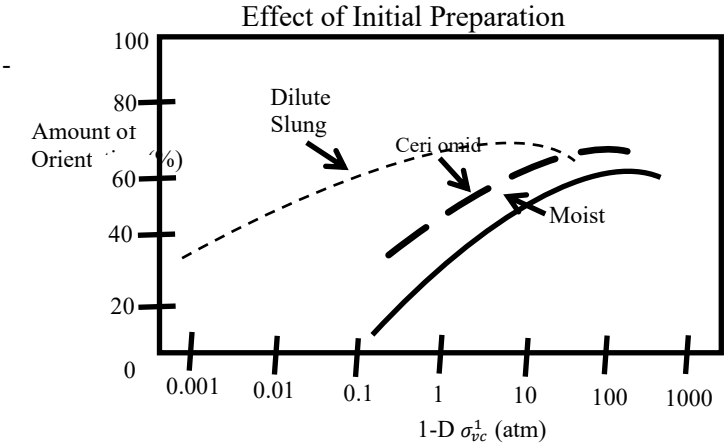
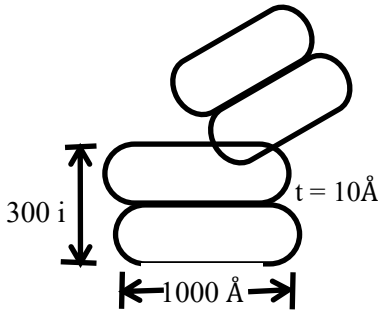


Fig. 3.1 ∴Initial fabric has a large effect on the rate of particle reorientation during 1-D compression

3.2 Structure of Different Clay Minerals and Influence of Environmental Factors

3.2.1 Montmorillonite

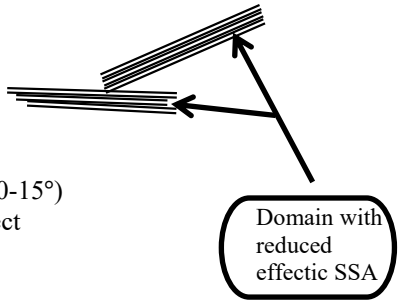
1) na in pure water



• Overlapping DL inhibits contacts and lead to parallel plate orientation

•After 1-D compression to 50 atm, σ^1_{vc}= R-A = P_r (à la Fig ii. 2 in 1)

• Hence very low steam strength (∅'<5°) due to very low $\bar{\bar{\sigma}}$. ac/σ^1ratio



2) **Effect of pore fluid chemistry**

• Ca^{+2} exchangeable cations→ {Medaced R − A * domains

σ^1= $\bar{\bar{\sigma}}$. ac + (R-A); inereased $\bar{\bar{\sigma}}$. ac + high in $\emptyset^1$ (≈10-15°)

• Increasing Naoh salt concentration has a similar effect

3) Amectites in general

• major mineral in expansive clays

• Screlling potential &$\emptyset^1$ greatly affected by factors that influence the DL repulsion (R), and interlayer swelling

if- cation valence
salt concentration
dialectic constant

* Domain = particle composed of several parallel layers (t = 10Å) separated by 2d ≤ 9Å; this occurs because Ca^{+2} acts as a weak glue that prevents further expansion between layers.

3.2.2 Kaolinite

1) Particles in pore H_2O (pH ≤7)

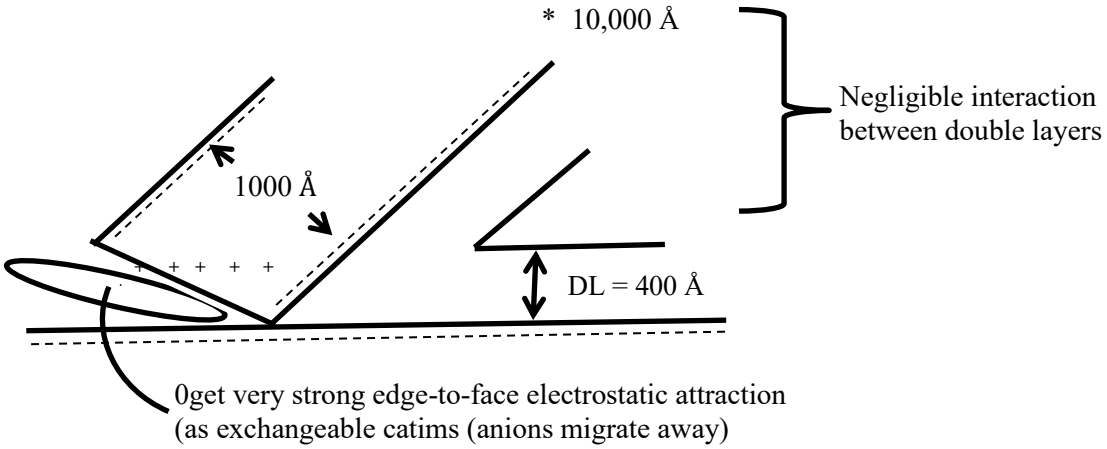


Fig. 3.2

2) All of σ^1 carried by contacts. σ'= ($\bar{\bar{\sigma}}_r$ - $\bar{\bar{\sigma}}_a$) a_c

3) Pore fluid chemistry that alters $\bar{\bar{\sigma}}_a$ electrostatic attraction very important

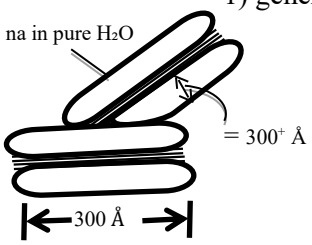
• iner. pH less + edge charge smaller $\bar{\bar{\sigma}}_a$ (less cohesion)

• Large anim's (TSPP) can neutralize + charge →zero attraction
• Increasing salt conc. reduces electric field → smaller $\bar{\bar{\sigma}}_a$

4) Engineering proportion
• $\emptyset^1$א 25-30° • F.D. compression (Olsen 1961) pH=7+ e = 1.35 at σ_{vc}^1 = latm
add TSPP →e =0.8 at σ_{vc}^1 = latm

3.2.3 Illite

1) general



• Intermediate between Mont. & Kasl.
$\sigma' = (\bar{\bar{\sigma}}_r - \bar{\bar{\sigma}}_a) \cdot a_c + (R\text{-}A)$
Both components are important

• Fructim angle, -2μm, Ip = 50%, (Olson, 1974)
Na $\emptyset^1$= 16°→ 20° w/ moi. salt concentration
Ca $\emptyset^1$ ∝25° indep. of salt conc.

Fig. 3.3

2) Deposition of Na illitic clay in fresh vs. sea water and effect of leaching
.
• Sedimentation behavior in test tubes

F = fresh water (R>A)
S = sea water (R<A)
(35 g/l =V.I.M & Co = 0,6)

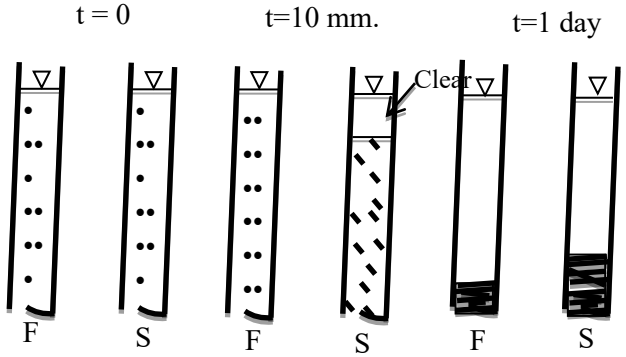
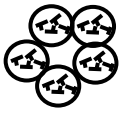


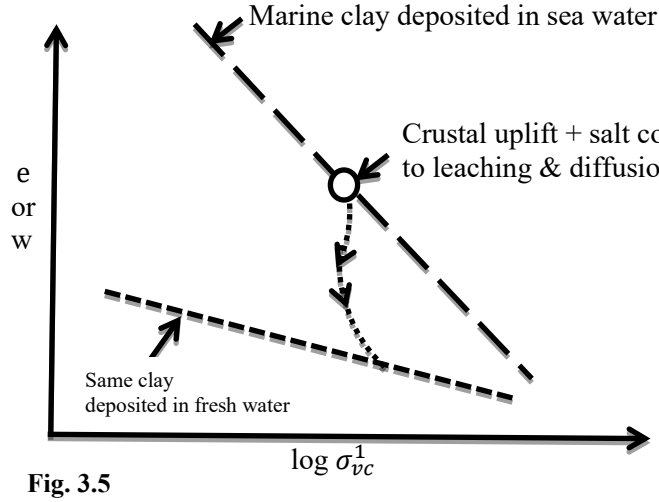
Fig. 3.4

Fresh →"Dispersed"

Sea → "Flocculated"



Large Flore dia → faster sedimentation



Initial: Sea Water	After → Zero Salt
• WN = 40%	=40%
• WL = 40%	= 30%
•WP = 20%	=20%
•IP = 20%	= 10%
•IL = 1.0	=2.0 → extremely low S_u = (R)

Fig. 3.5

Metastable Shuchine

$\sigma' = (\bar{\bar{\sigma}}_r - \bar{\bar{\sigma}}_a) \cdot a_c + (R\text{-}A)$

1 = 1 + 0 Pore fluid = sea water

1 = <1 + >0 Pore fluid = fresh water

• 1 - 0 compression → large increase in compressibility
• Unchained sheer breaking of contacts - very low remolded s_u
→ flow slides (Eastern Canada, Norway: photos on 3rd Fl. Bldg 1)

3.3 Summary

1) Physico-chemical effective stems equation

$\sigma' = (\bar{\bar{\sigma}}_r - \bar{\bar{\sigma}}_a) \cdot a_c + (R\text{-}A)$

Contacts generate shear resistance

magnitude affects amount of σ' →
Contacts & ability to remake contacts during shear, also affects initial fabric

2) See p19
3) Changes in pore fluid chemistry affect DL repulsion (R),..
$\bar{\bar{\sigma}}_a$ electrostatic attraction, and effective SSA

•Very important influence on soil structure (esp. fabric) during sedimentation, e.g, fresh vs sea water illitic deposits
na vs Ca on effective SSA of montmorillonite

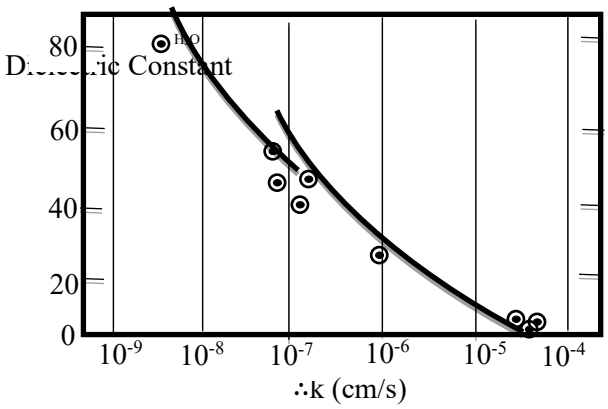
•Change in pore fluid after deposition also can be very important
- reduced salt come more expensive smectite
- increased pH reduces cohesion of kaolinite
- leaching of marine illitic clay → quick clay

•Significant difference in $\bar{\bar{\sigma}}.ac/\sigma'$ ratio of M vs K vs I and hence
- values of $\emptyset^1$
- effects of change in pore fluid chemistry

• If Δ pore fluid chemistry Δ Attending limits (esp. w_2), then probably change in engr. properties

• Extreme example of change in engr. properties (Fernandez & Quigley 1985, CGS)

but data plotted by CCL



Brown Sarnia Clay (I, C & S)
W_1 = 38, Ip> 20.5
CEC = 35 meg/100g, SSA-120m²/g

Samples molded with
•pore fluid at e≈ 0.8

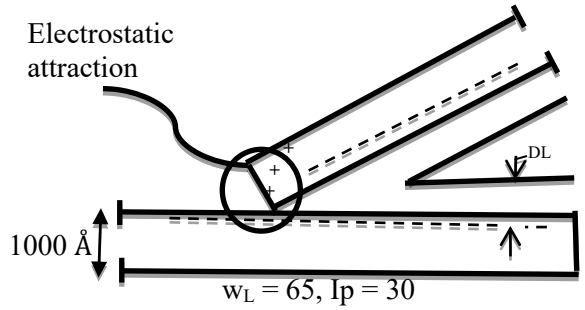
Results conclude very well w/ Debye length of DL

Fig. 3.6

3.3 Continued

2) Effect of mineralogy on Compressibility and strength of,Cohesive soils: look at two extremes

a) Kaolinite (low SSA) in water with pH ≤7



- $\sigma' = (\bar{\bar{\sigma}}_r - \bar{\bar{\sigma}}_a) \cdot a_c$
- Low Compressibility
- High function angle ($\emptyset^1$= 25-30")
- Evaluate effect of pore fluid on $\bar{\bar{\sigma}}_e$

6) Na Montmorilonite (V. high SSA) in water.

W_L=1500
Ip = 1450

- $\sigma' = (\bar{\bar{\sigma}}_r - \bar{\bar{\sigma}}_a) \cdot a_c$ + (R-A)
- Very high compressibility
- very low friction angle ($\emptyset^1 \approx 5°$)
- Evaluate effects of pore fluid on R and effective SSA

II. CONCLUSION

In conclusion, there are steps to this topic of soil structure and effects of mineralogy and environmental factors such as:

1) Clay fabric
2) Clay mineral and influence, and their difference.
3) Then in summary, physics-chemical effective stress equation as shown Kerisel J. 1984, and the American society for testing and material (2014).

In conclusion, An aggregate samples for laboratory where collected for testing and a determination were made from the three samples denoted as A,B, and C. however, it was determined of the percentages of gravel, sand and fines using unified effect of mineralogy on compressibility and strength of cohesions soil comes to look alike.

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