

Welkom bij werksessie 3:

Verklaren en voorspellen van bodemdaling

LOSS symposium, 5 November 2021



LOSS

Living on Soft Soils

Subsidence & Society

Doel werksessie 3



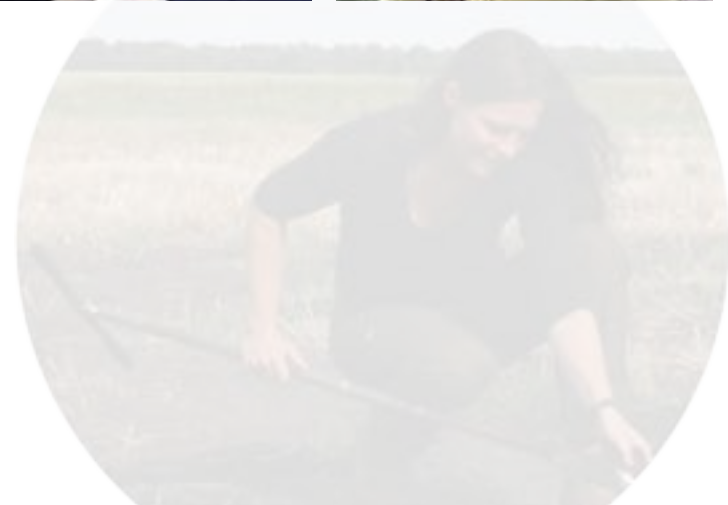
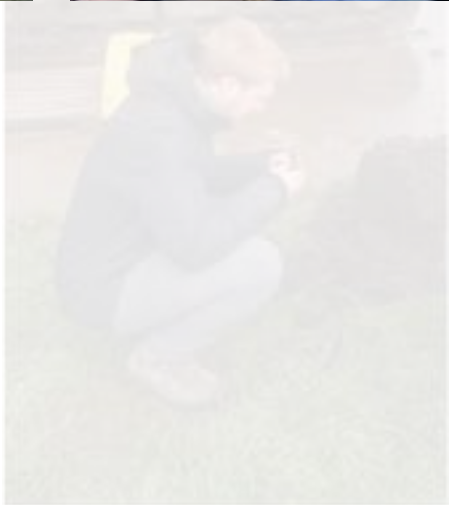
*Informereren over
mechanismen in
ondiepe
bodemdaling*




Communiceren

Tijdschema Werksessie 3

14:20-14:25	Introductie en kennismaking
14:25-14:40	Processen & Mechanismen
14:40- 15:05	Discussie
15:05-15:10	Korte pauze
15:10-15:30	Dubbel interview (tennis)
15:30-15:40	Consultatie & poster sessie
15:40-15:45	Conclusie en afronding





Inhoud presentatie

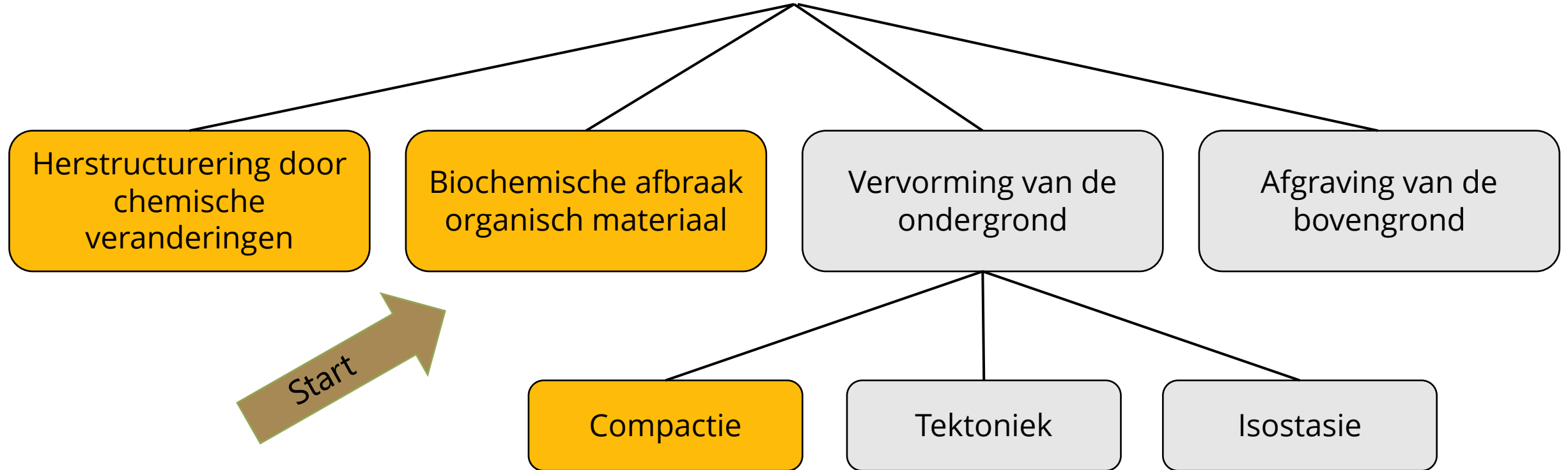
- Bodemdaling mechanismen
- Materialen en eigenschappen
- Integratie en voorspellen

Veen

Veen
& Klei

Klei

BODEMDALING



Biochemische afbraak organisch materiaal

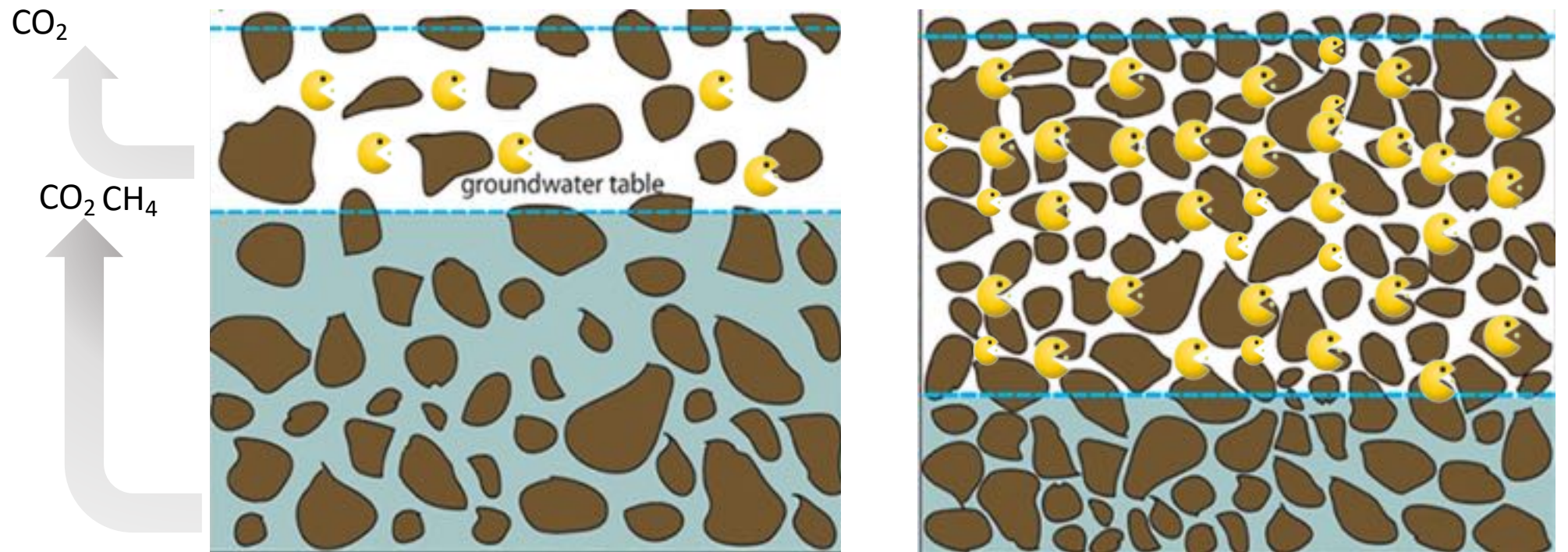
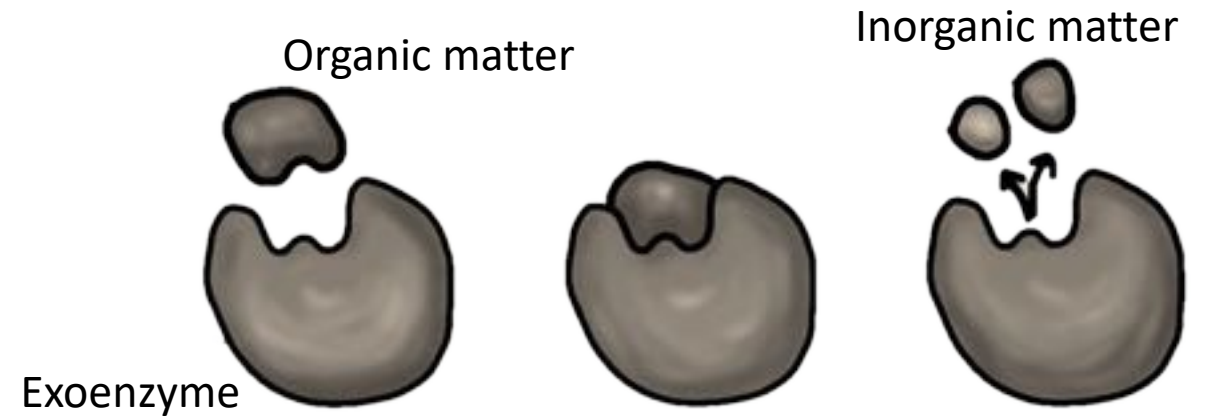


Figure 5. Microbial activity with higher and lower water table (revised from *Ahmad et al 2020*)²

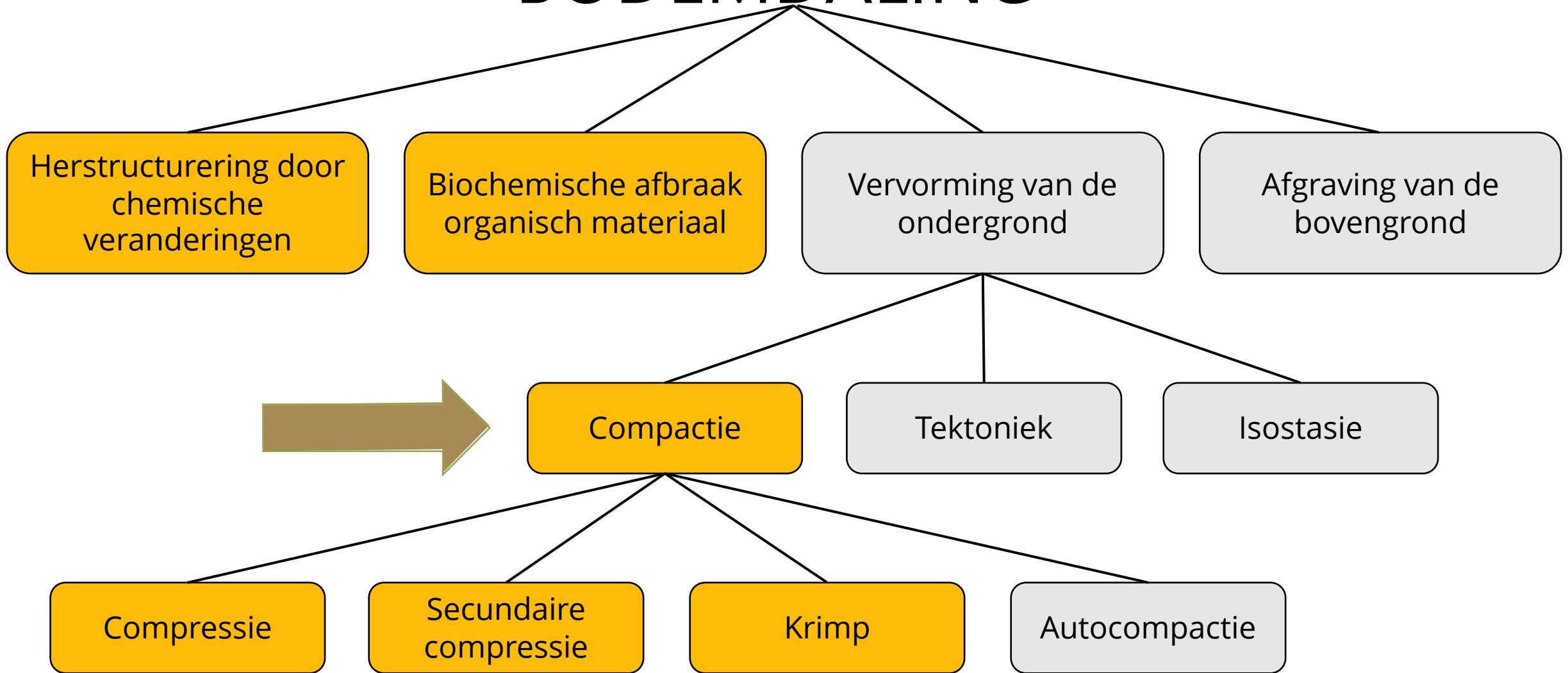


House of Cards

12500 playing cards



BODEMDALING



Compactie



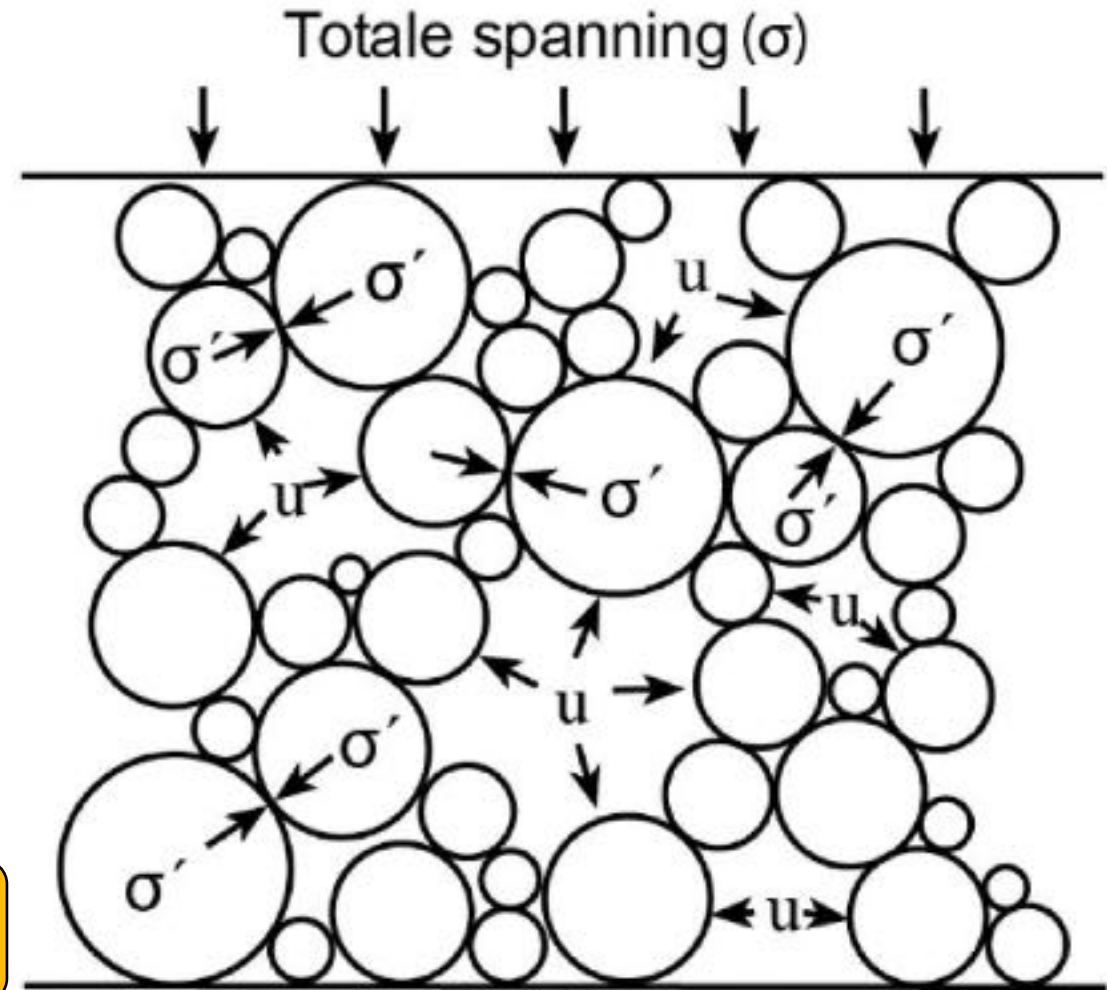
$$\sigma' = \sigma - \mu$$

Effectieve spanning =
totale spanning - waterspanning

Compressie

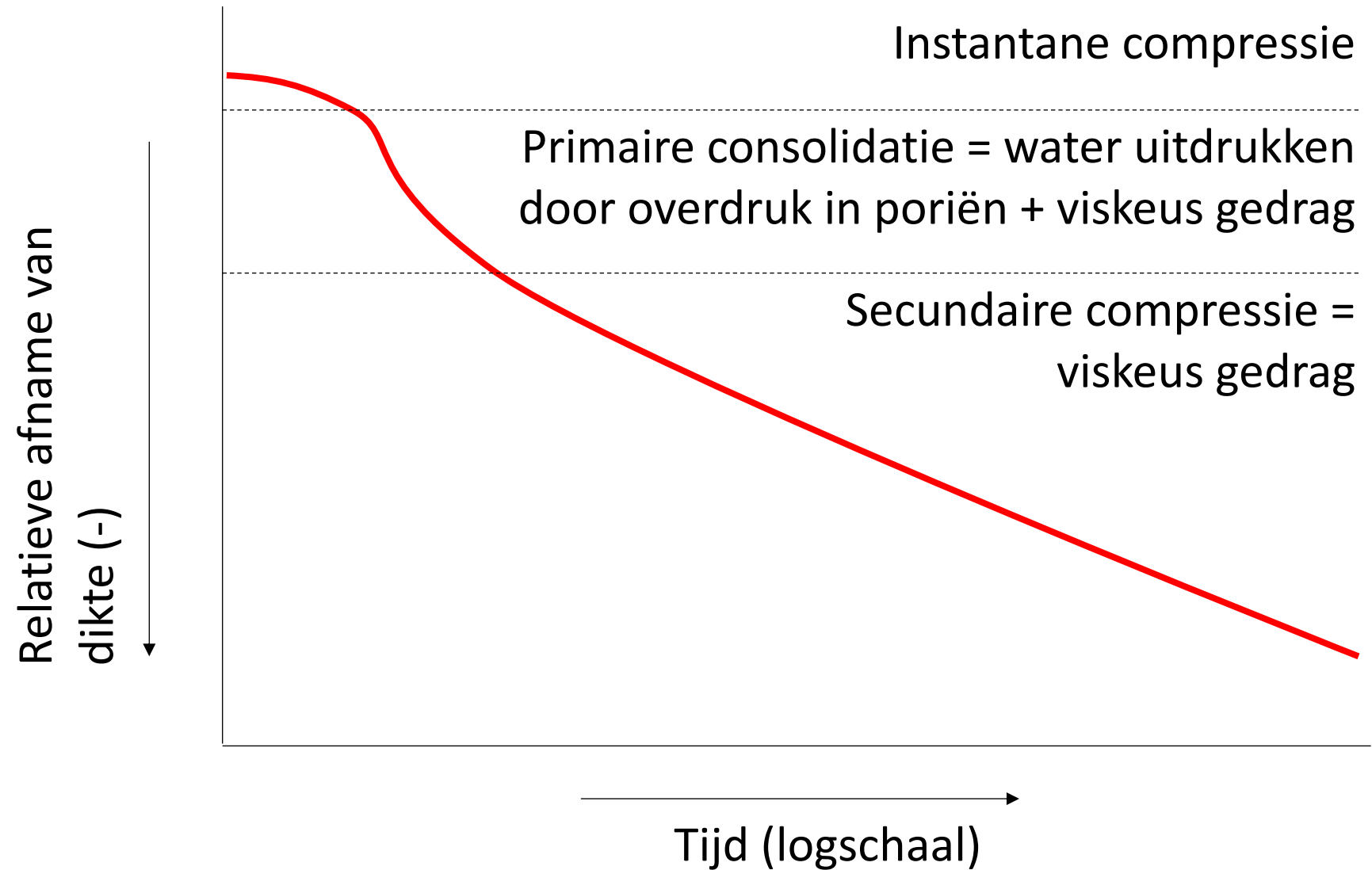
Secundaire
compressie

Krimp



Bron: Van Asselen, 2010

Compressie



Veen

Veen
& Klei

Klei



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Veen

BODEMDALING

Herstructurering door
chemische
veranderingen

Biochemische afbraak
organisch materiaal

Vervorming van de
ondergrond

Afgraving van de
bovengrond

Compactie

Tektoniek

Isostasie

Bodemdaling in Veen

- **Oxidatie organisch materiaal**
 - Aerobe afbraak
 - Anaerobe afbraak
- **Compactie**
 - Compressie
 - Secundaire compressie
 - Krimp-zwel



Vlist

Zegveld
Wood

Aldebaorn

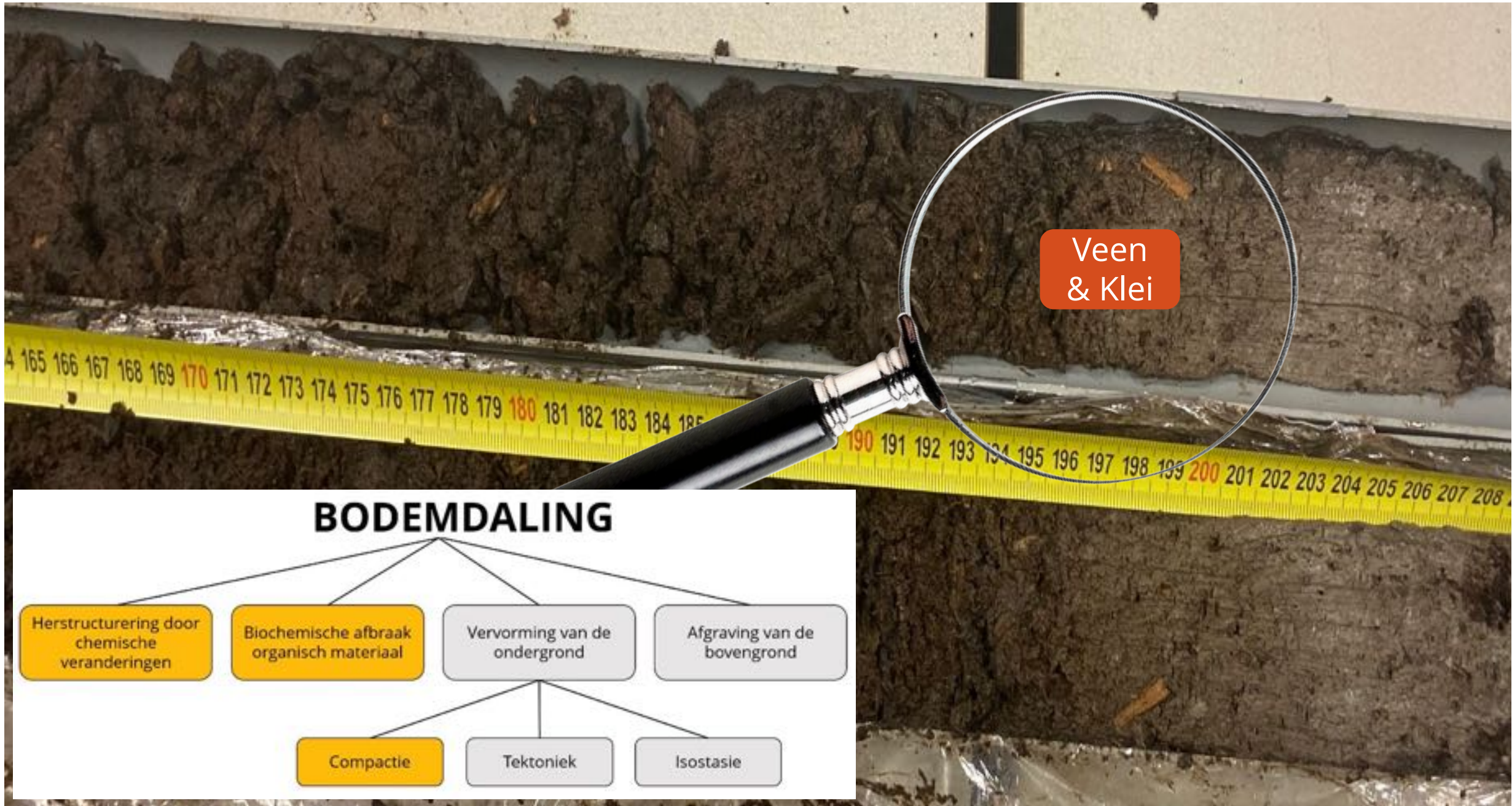
Onlanden
Reed

Rouveen
Sedge

Bunschoten
Sphagnum

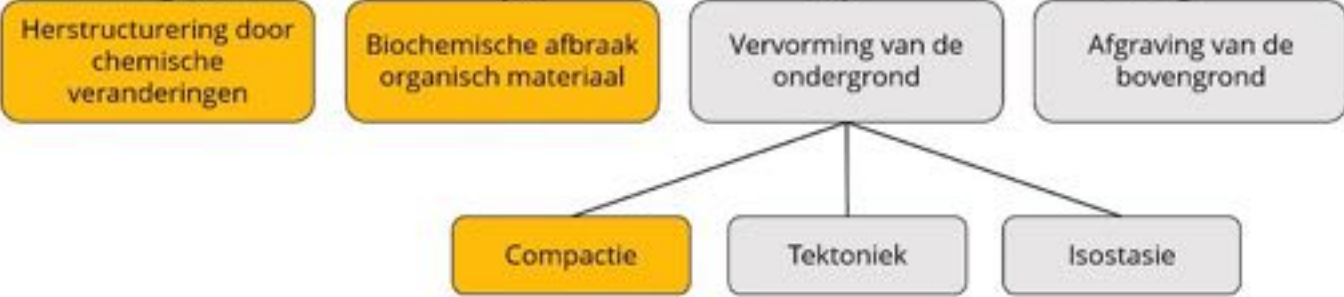






Veen
& Klei

BODEMDALING



Veen+klei

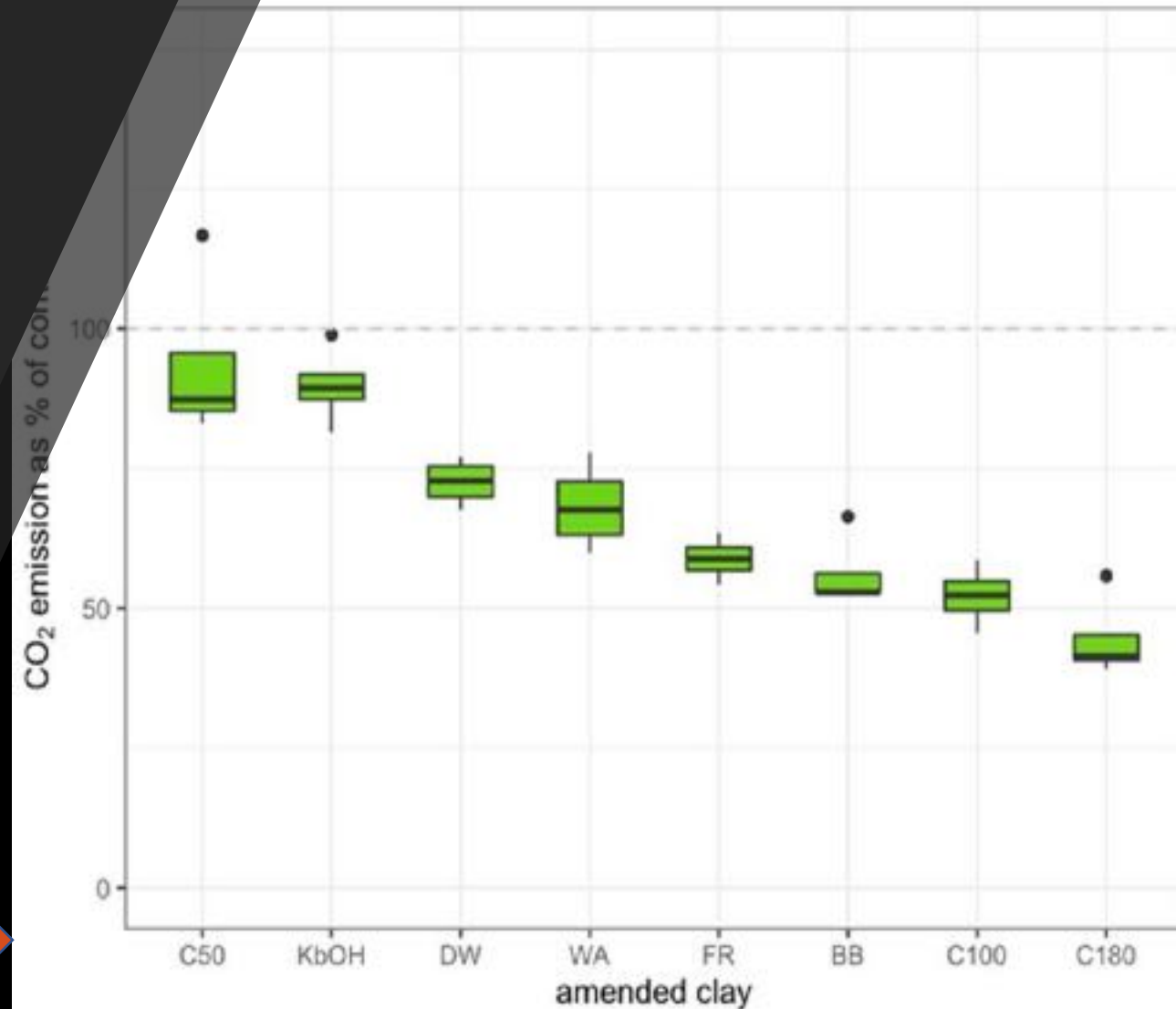


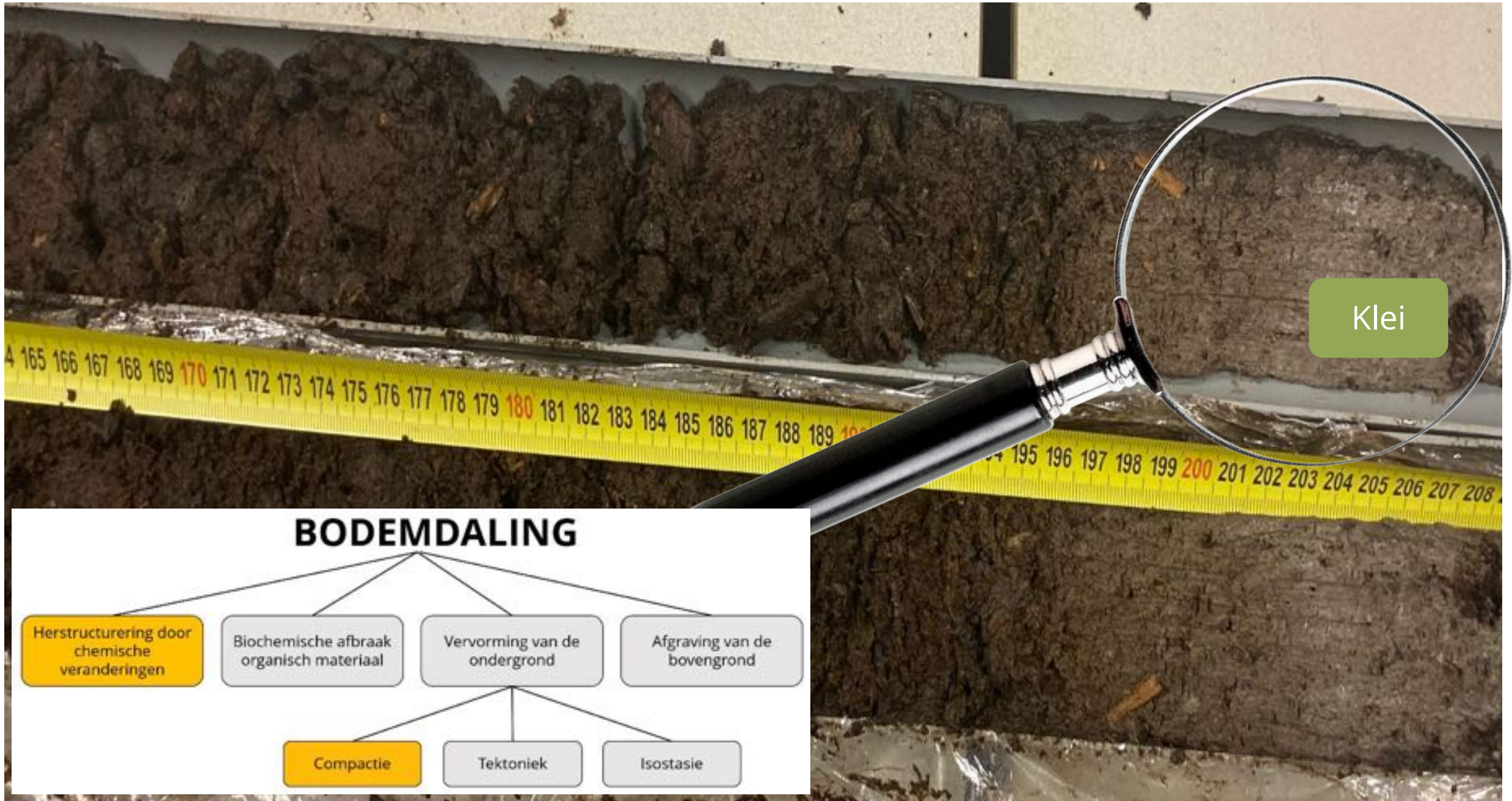
van Agtmaal & Keuskamp, unpubl.

- Oxidatie organisch materiaal
- Organominerale complexvorming
- aggregaatvorming
- Verminderde zuurstofdiffusie
- Binding enzymen
- Chemische veranderingen
- Compactie
- Krimp-zwel dynamiek

Klei additie aan veen kan CO₂ emissies reduceren

Respiratory effects of mixing clay in Zegveld Peat (t8)





BODEMDALING

Herstructurering door chemische veranderingen

Biochemische afbraak organisch materiaal

Vervorming van de ondergrond

Afgraving van de bovengrond

Compactie

Tektoniek

Isostasie

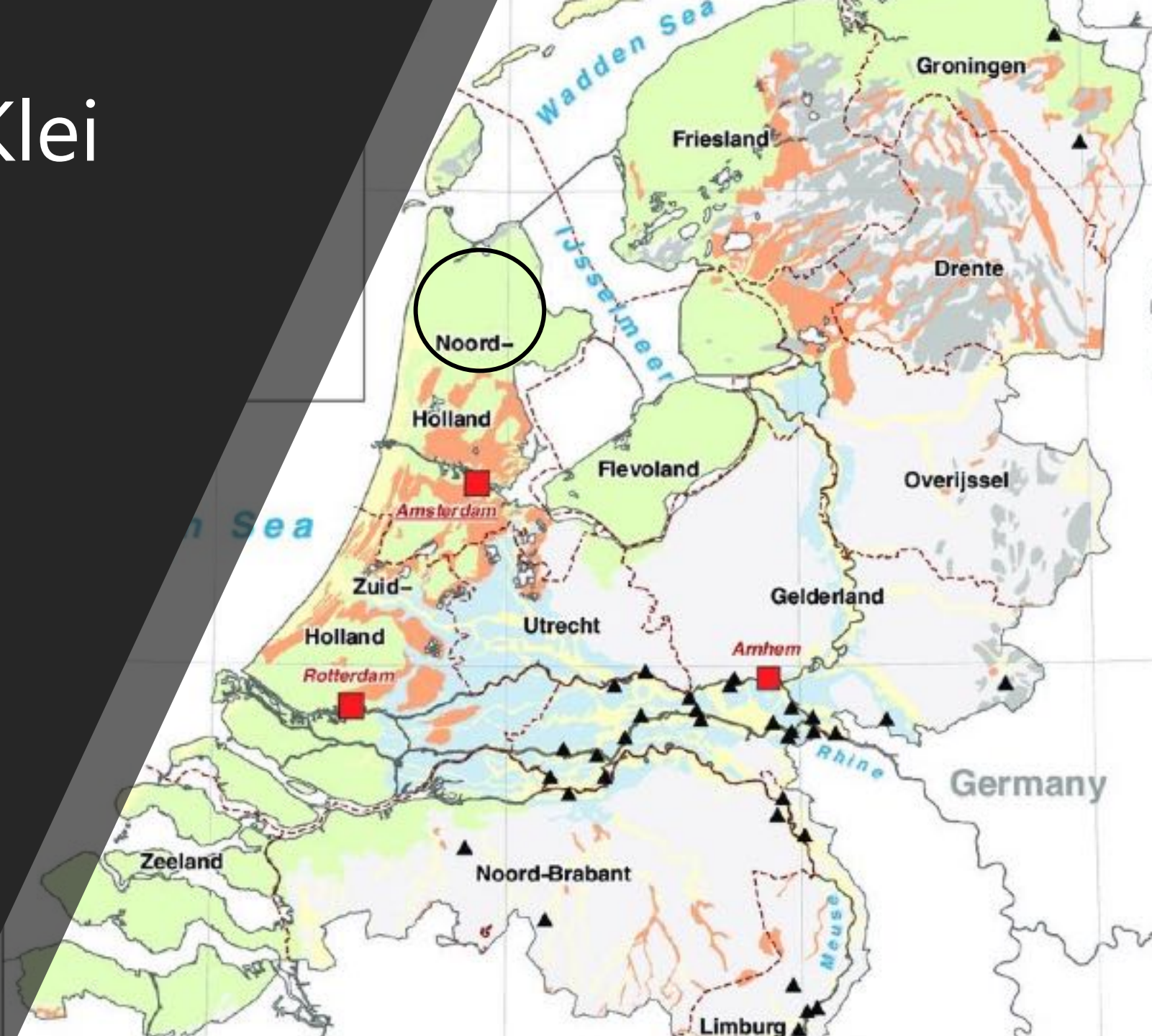
Bodemdaling in Klei

Compactie

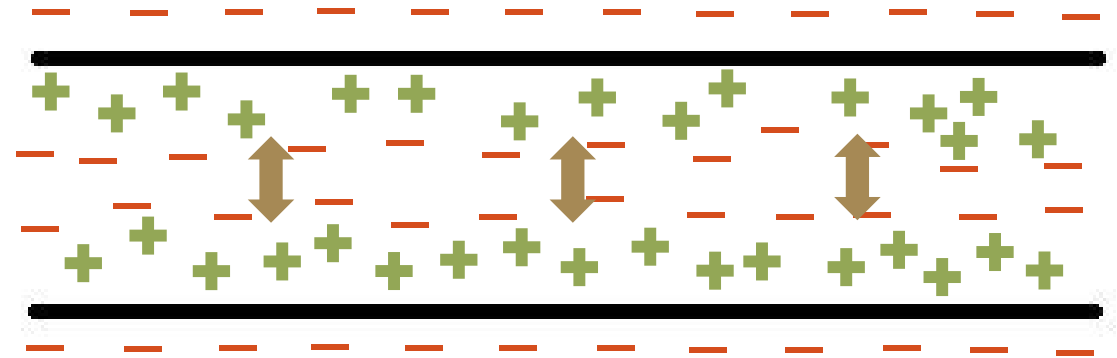
- Compressie
- Secundaire compressie
- Krimp-zwel

Chemische veranderingen

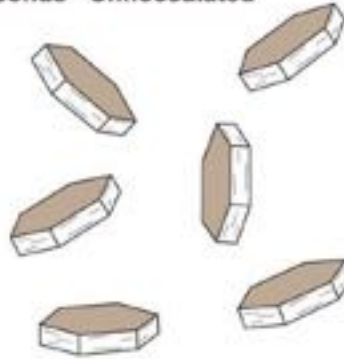
- Ionengehalte poriewater



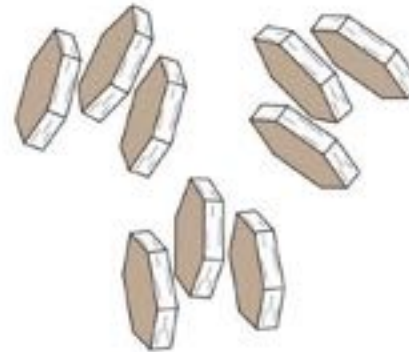
Herstructurering door chemische veranderingen



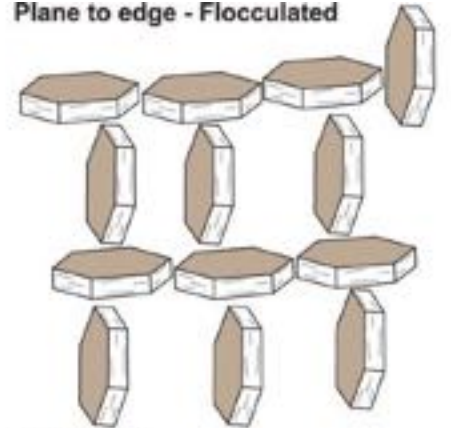
No bonds - Unflocculated



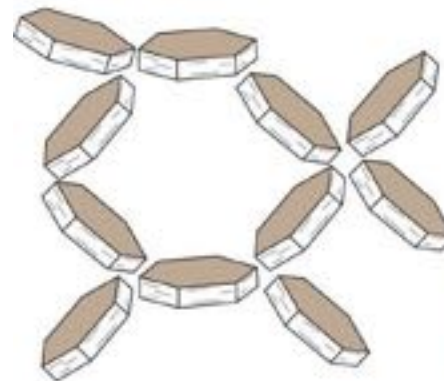
Plane to plane - Unflocculated



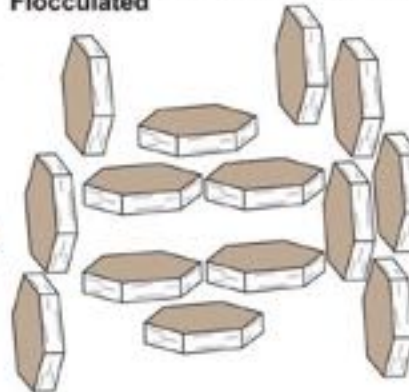
Plane to edge - Flocculated



Edge to edge - Flocculated

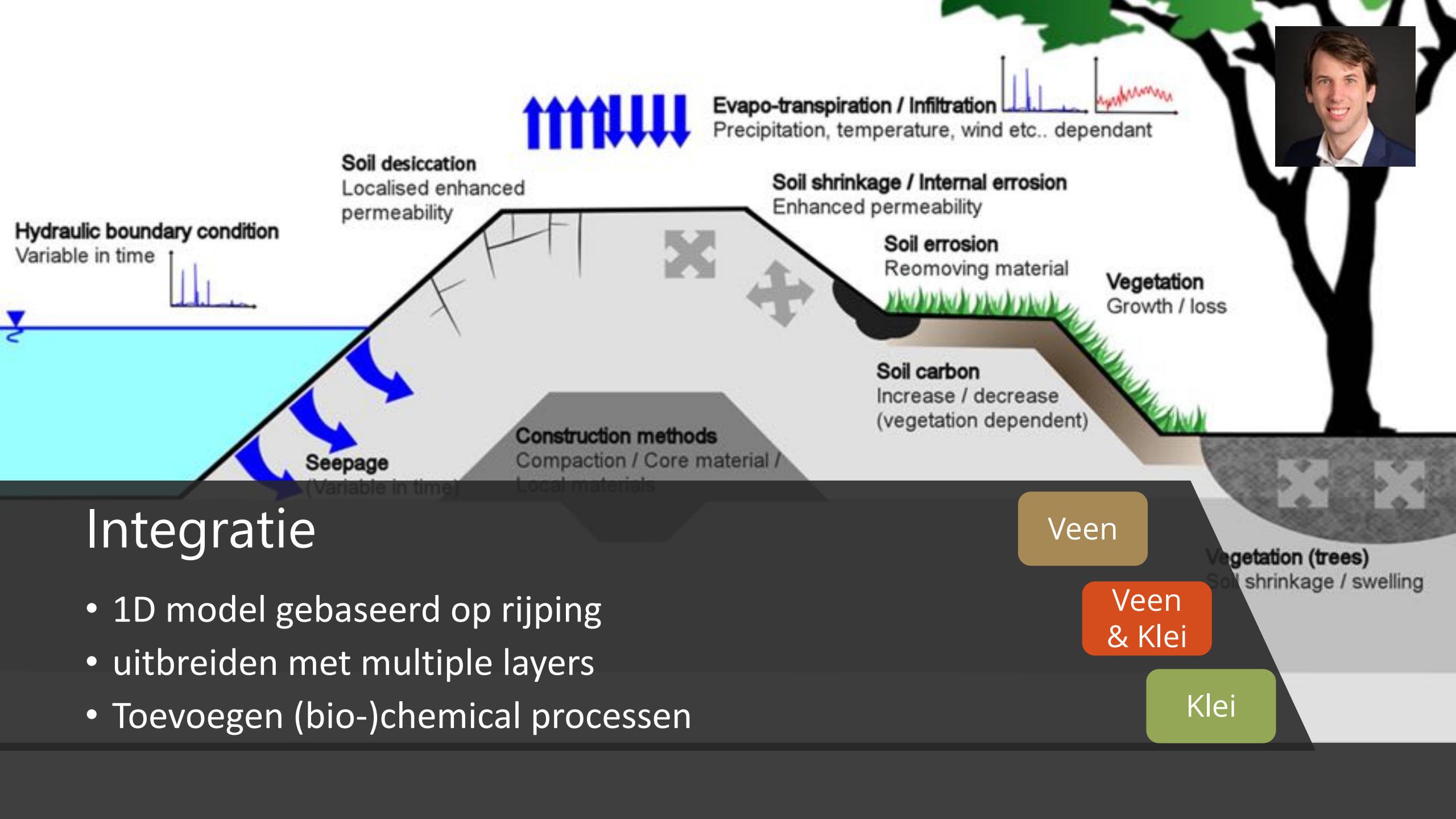
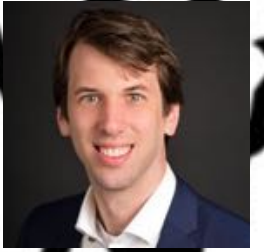


Plane to plane and plane to edge - Flocculated



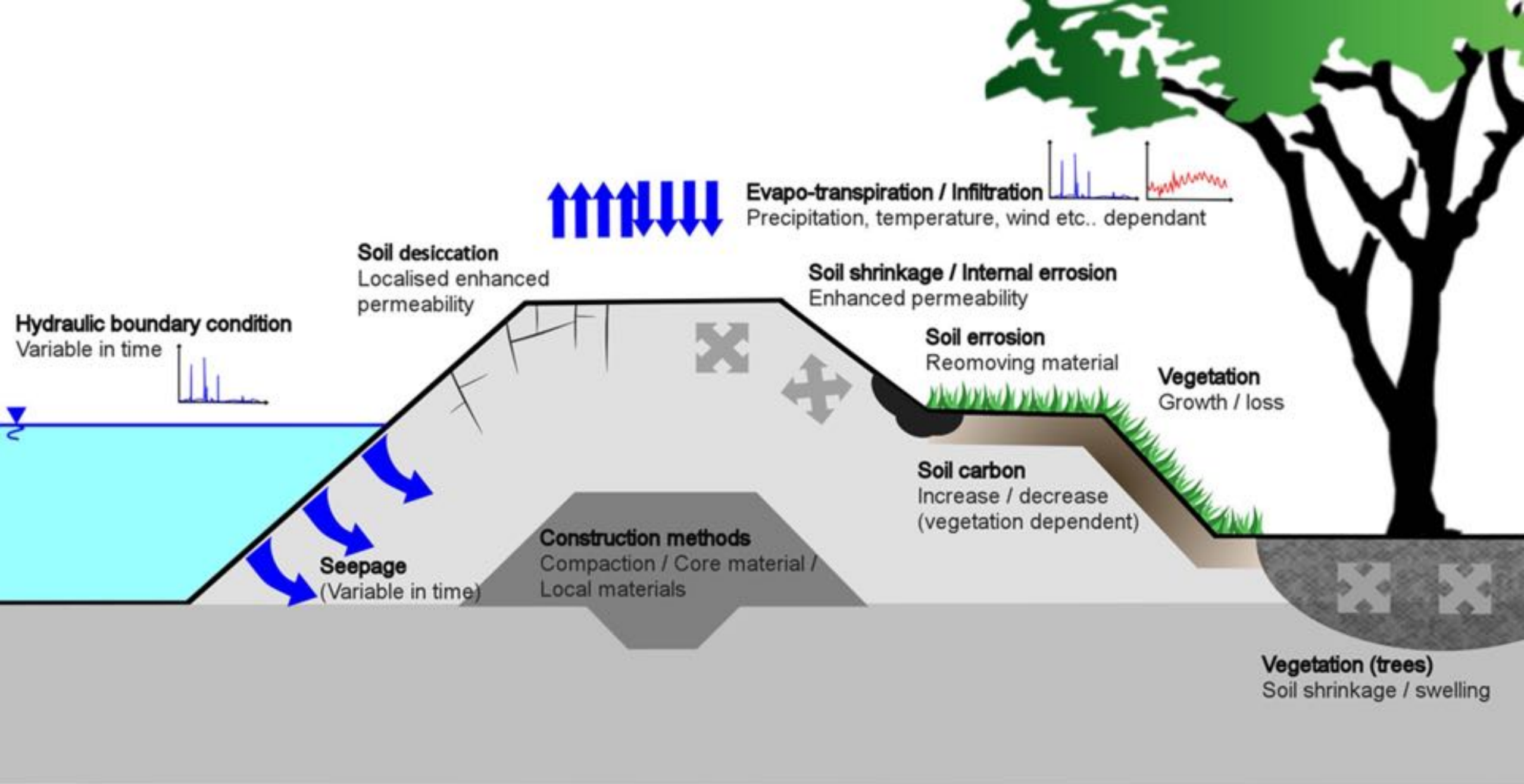
Dispersed





Integratie

- 1D model gebaseerd op rijping
- uitbreiden met multiple layers
- Toevoegen (bio-)chemical processen



Referenties

- van Asselen, S., Kooi, H., van den Akker, J.J.H. (2020). Deltafact bodemdaling 2020 STOWA
- Ahmad, S., Liu, H., Günther, A., Couwenberg, J., & Lennartz, B. (2020). Long-term rewetting of degraded peatlands restores hydrological buffer function. *Science of the Total Environment*, 749, 141571.
- van Asselen, S. (2010). *Peat compaction in deltas. Implications for Holocene delta evolution*. Netherlands Geographical Studies 395.
- van der Meulen, M. J., van der Spek, A. J., de Lange, G., Gruijters, S. H., van Gessel, S. F., Nguyen, B. L. & van der Krogt, R. A. (2007). Regional Sediment Deficits in the Dutch Lowlands: Implications for Long-Term Land-Use Options (8 pp). *Journal of Soils and Sediments*, 7(1), 9-16.
- Giles, D.P., (2020) Geological Society, London, Engineering Geology Special Publications, 29, 205-221, 9 June 2020, <https://doi.org/10.1144/EGSP29.7>
- Vardon, P. J. (2015). "Climatic influence on geotechnical infrastructure: a review." Environmental Geotechnics 2(3): 166-174.

Process	Chemical reaction	ΔG° (kJ m C ⁻¹) ^b
Aerobic respiration	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	-471
Organotropic denitrification	$5C_6H_{12}O_6 + 24NO_3^- \rightarrow 12N_2 + 24HCO_3^- + 6CO_2 + 18H_2O$	-444
Organotrophic manganese reduction	$C_6H_{12}O_6 + 18CO_2 + 6H_2O + 12\delta-MnO_2 \rightarrow 12Mn^{2+} + 24HCO_3^-$	-397
Organotrophic iron reduction	$C_6H_{12}O_6 + 42CO_2 + 24Fe(OH)_3 \rightarrow 24Fe^{2+} + 48HCO_3^- + 18H_2O$	-131
Sulfate reduction	$2C_6H_{12}O_6 + 6SO_4^{2-} \rightarrow 6H_2S + 12HCO_3^-$	-76
Methanogenesis	$2C_6H_{12}O_6 \rightarrow 6CH_4 + 6CO_2$	-49