

COMBINED ALLO- AND LITHOSTRATIGRAPHY AS A TOOL FOR QUATERNARY GEOLOGICAL MAPPING IN GLACIATED TERRAINS

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Outline:

- 1) Background
- 2) Short look on classifications in use
- 3) Examples of the combined use of allo- and lithostratigraphy
- 4) Conclusions

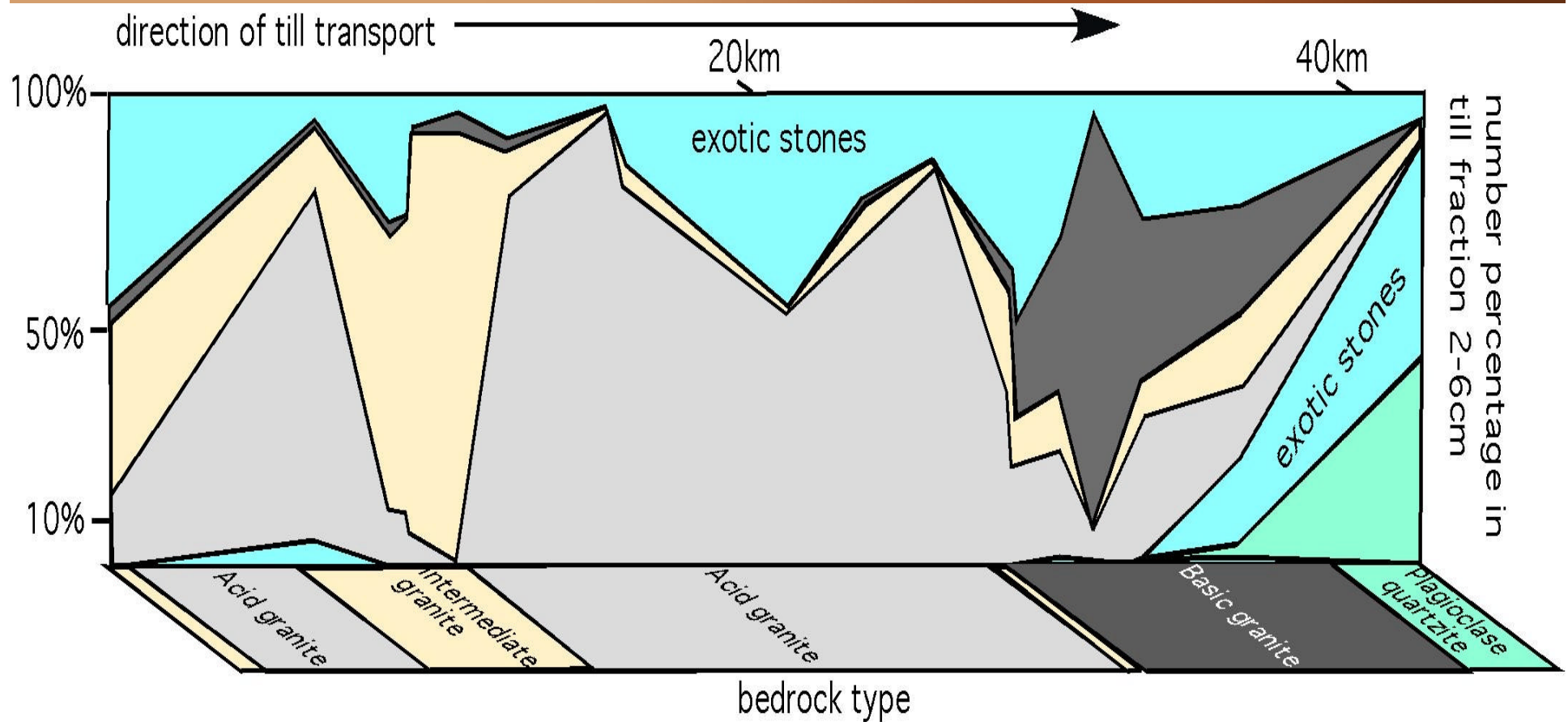
Quaternary stratigraphic mapping is needed to solve:

- scientific questions: - history of the geological processes
- applied needs of the societies: ...

Is Quaternary glacial stratigraphy
different from pre-Quaternary
stratigraphy?

YES ! but only in some aspects

Till bed lithology varies on Precambrian bedrock



2) Classifications in use

Different approaches :

- 1) Lithologic and lithogenetic
- 2) Morphogenetic and morpho(litho)stratigraphic
- 3) Lithostratigraphic
- 4) Depositional system
- 5) Allostratigraphic (= unconformity bounded units)

3D

2) Classifications in use

Conclusions :

- the morpholithostratigraphic, lithostratigraphic, depositional system and allostratigraphic approaches are in practice quite identical in the way they have been applied in Quaternary deposits
- all seem to end up to define unconformity bounded units
- so why not handle them as alloformations?

National Quaternary Stratigraphic Frameworks:

- rare in glaciated areas
- not well developed f.ex. in Finland
- clean table to start with...

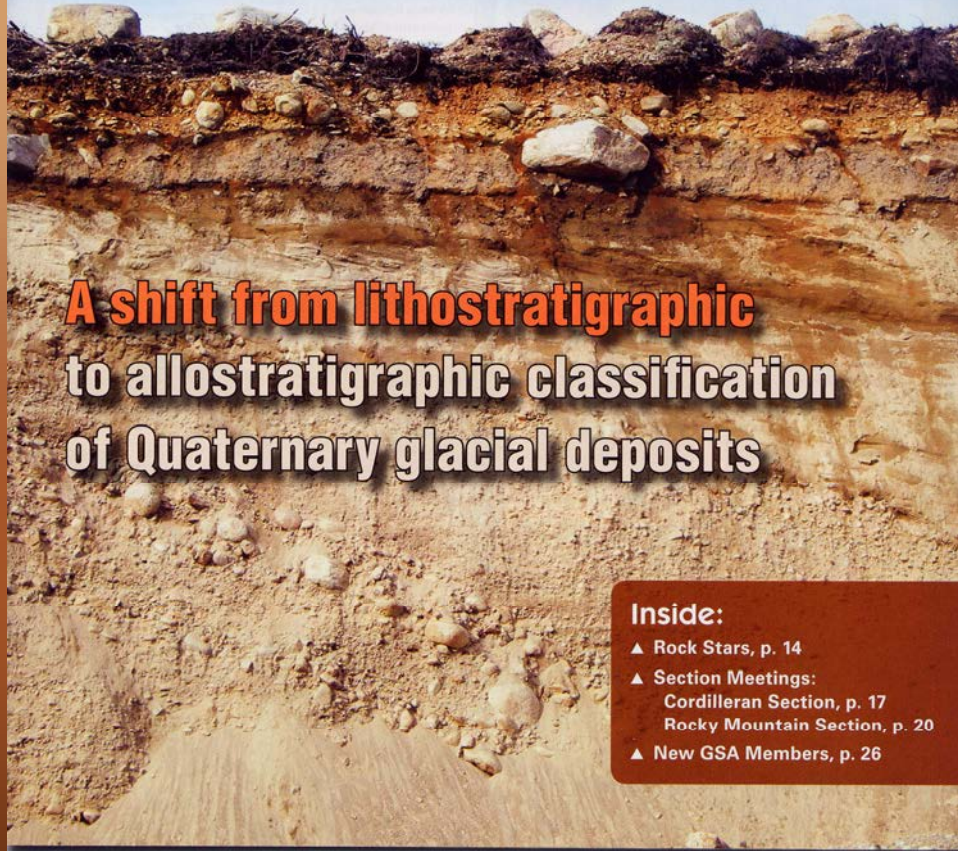
GSA–ExxonMobil Bighorn Basin Field Award, p. 33

GSATODAY

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FEBRUARY 2009



**A shift from lithostratigraphic
to allostratigraphic classification
of Quaternary glacial deposits**

Inside:

- ▲ Rock Stars, p. 14
- ▲ Section Meetings:
Cordilleran Section, p. 17
Rocky Mountain Section, p. 20
- ▲ New GSA Members, p. 26

- a proposal to define
unconformity bounded units

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Räsänen, M. E., Auri, J. M, Huitti, J.V, Klap, A. K, and Virtasalo, J. J. (2009) A shift from lithostratigraphic to allostratigraphic classification of Quaternary glacial deposits *GSA-Today*, vol.19. No.2, 4-11, do: 10.1130/GSATG20A.1

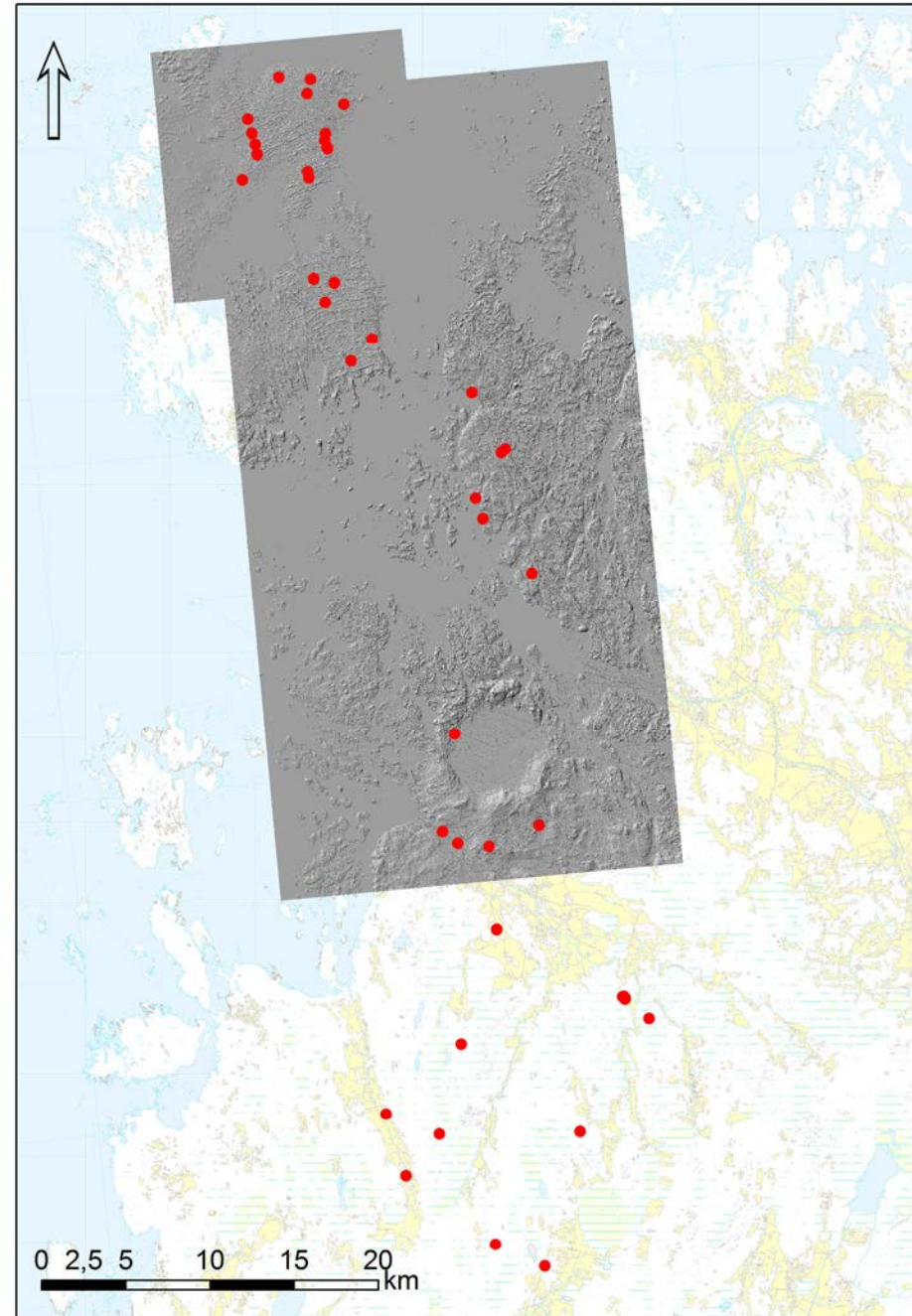
Combined use of allo- and lithostratigraphy (CUAL)

- 1) all units are given preference and lithostratigraphic units are subordinate to allostratigraphy
- 2) lithostratigraphy is applied according to its stricter principles

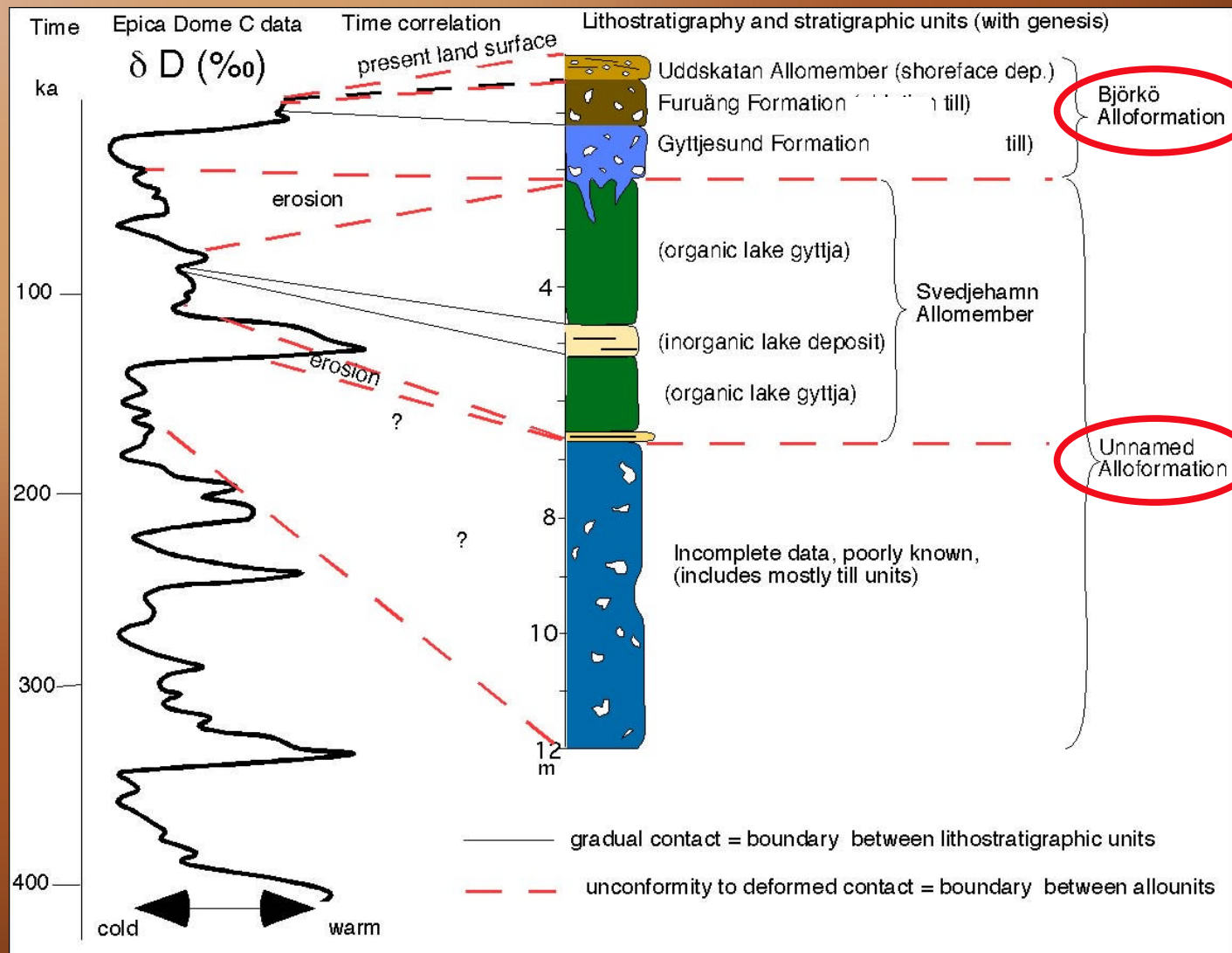
Ostrobothnian research area:



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Application of the CUAL-classification



Lower boundary of the Björkö Alloformation

sharp erosional unconformity



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Lower boundary of the Björkö Alloformation

deformed contact with
clastic dykes

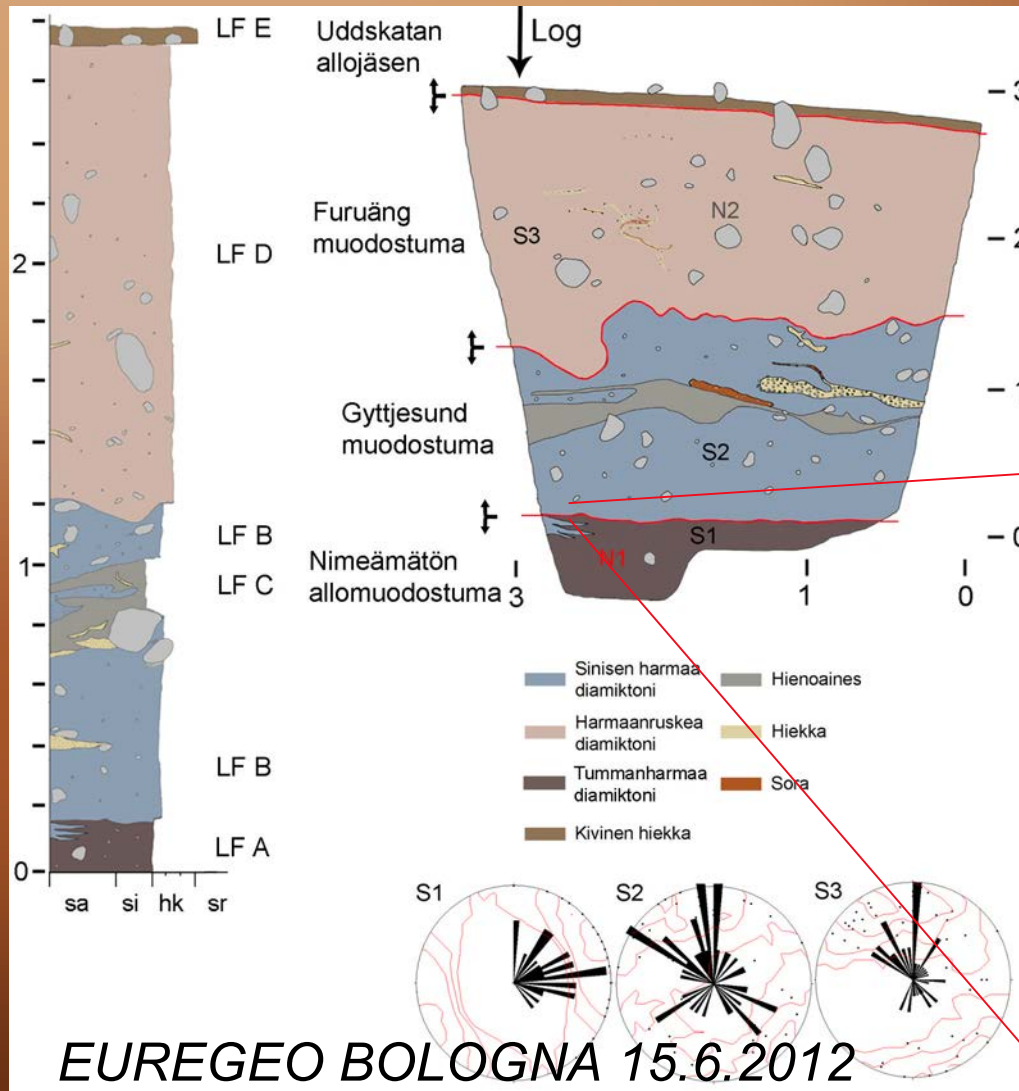


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(Huitti and Klap 2008)

Lower boundary of the Björkö Alloformation

relatively sharp deformed contact



(Huitti and Klap 2008)



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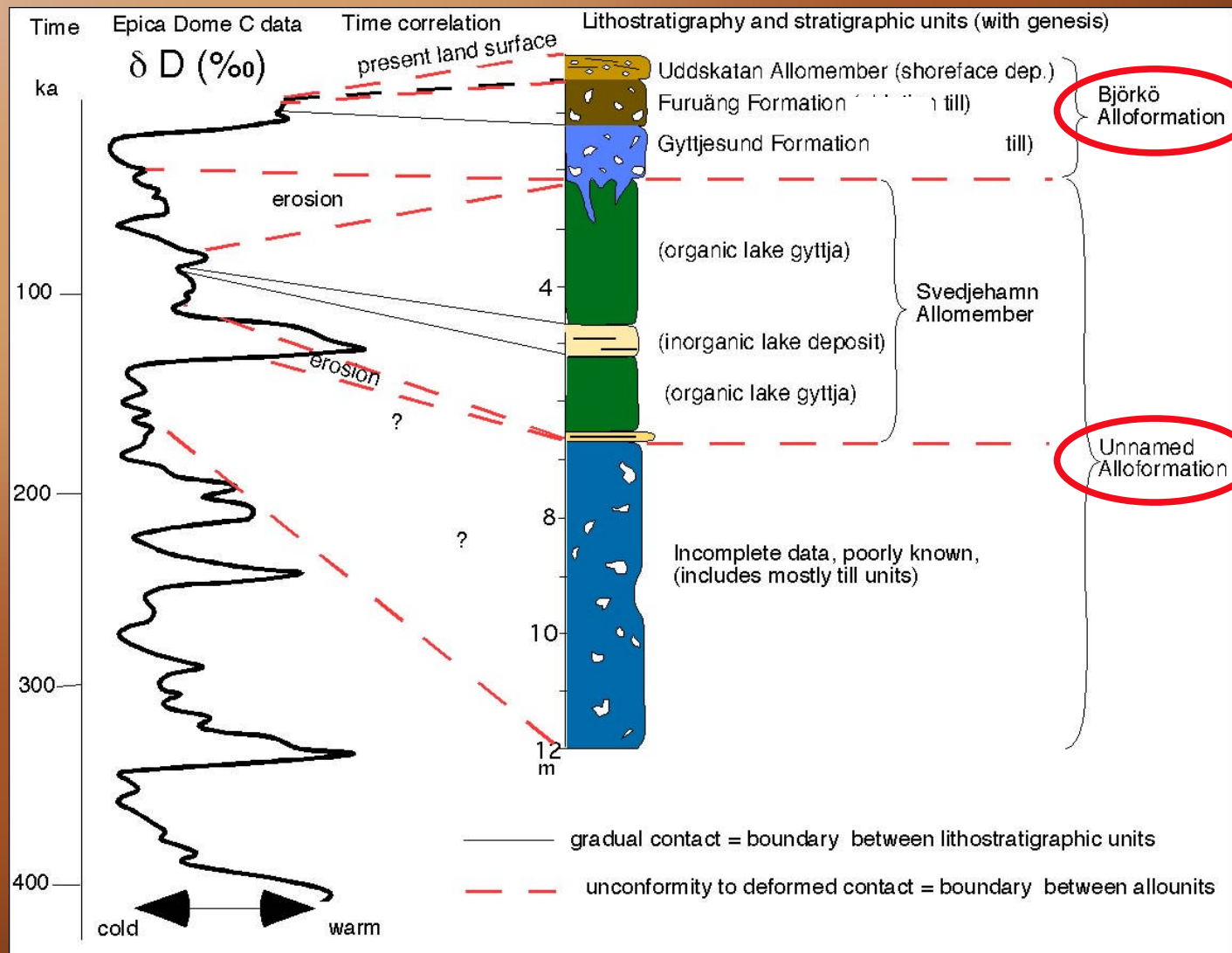
Lower boundary of an alloformation

Rhythmic bedding of deformed sand and diamict



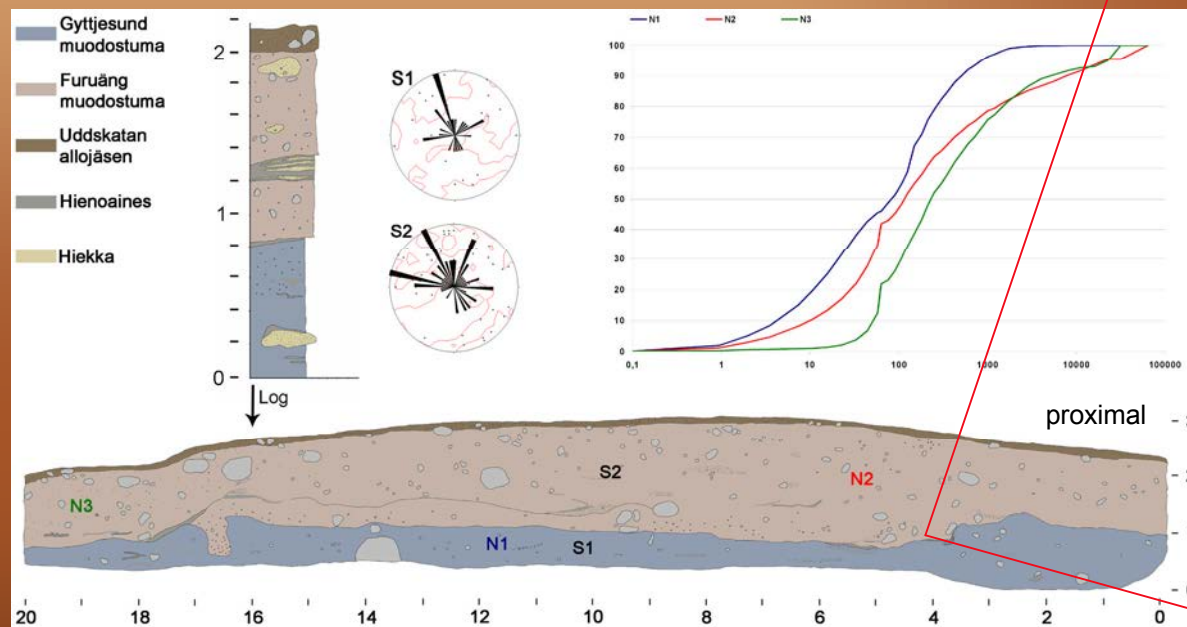
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Application of the CUAL-classification



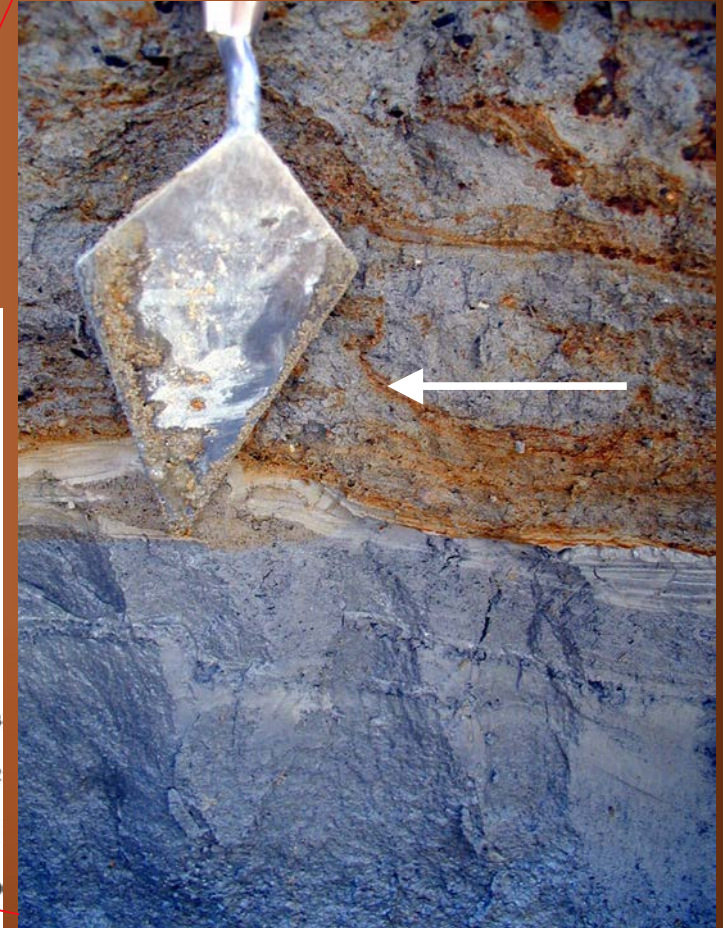
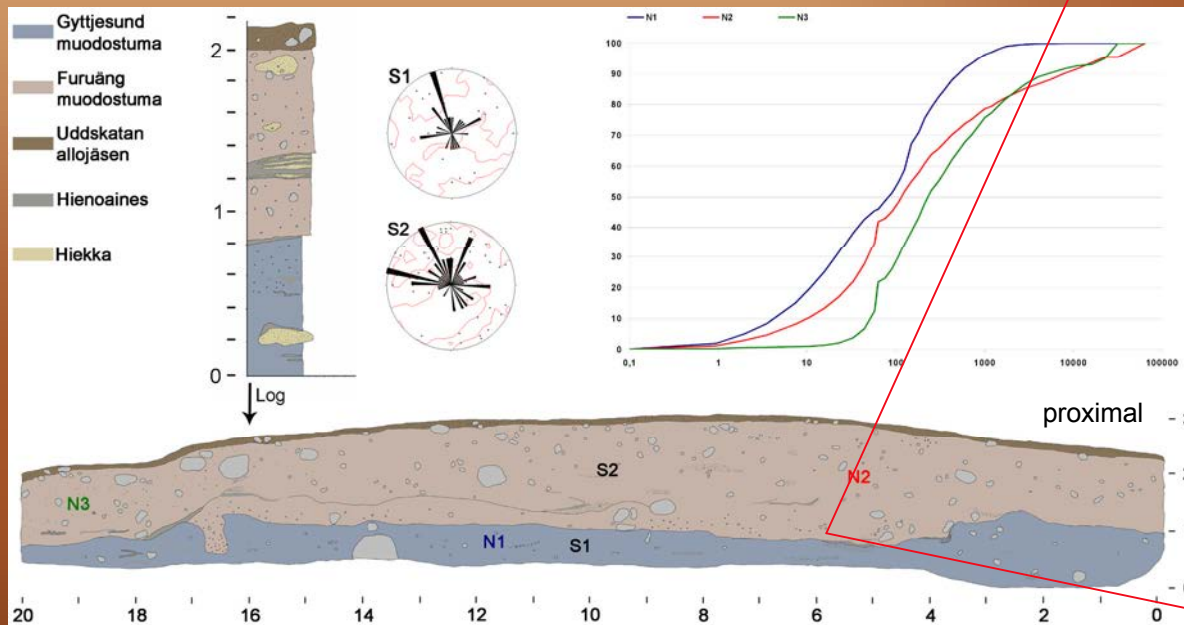
Lower contact of the Furuäng Fm

gradational depositional contact
(disturbed by secondary oxidation)

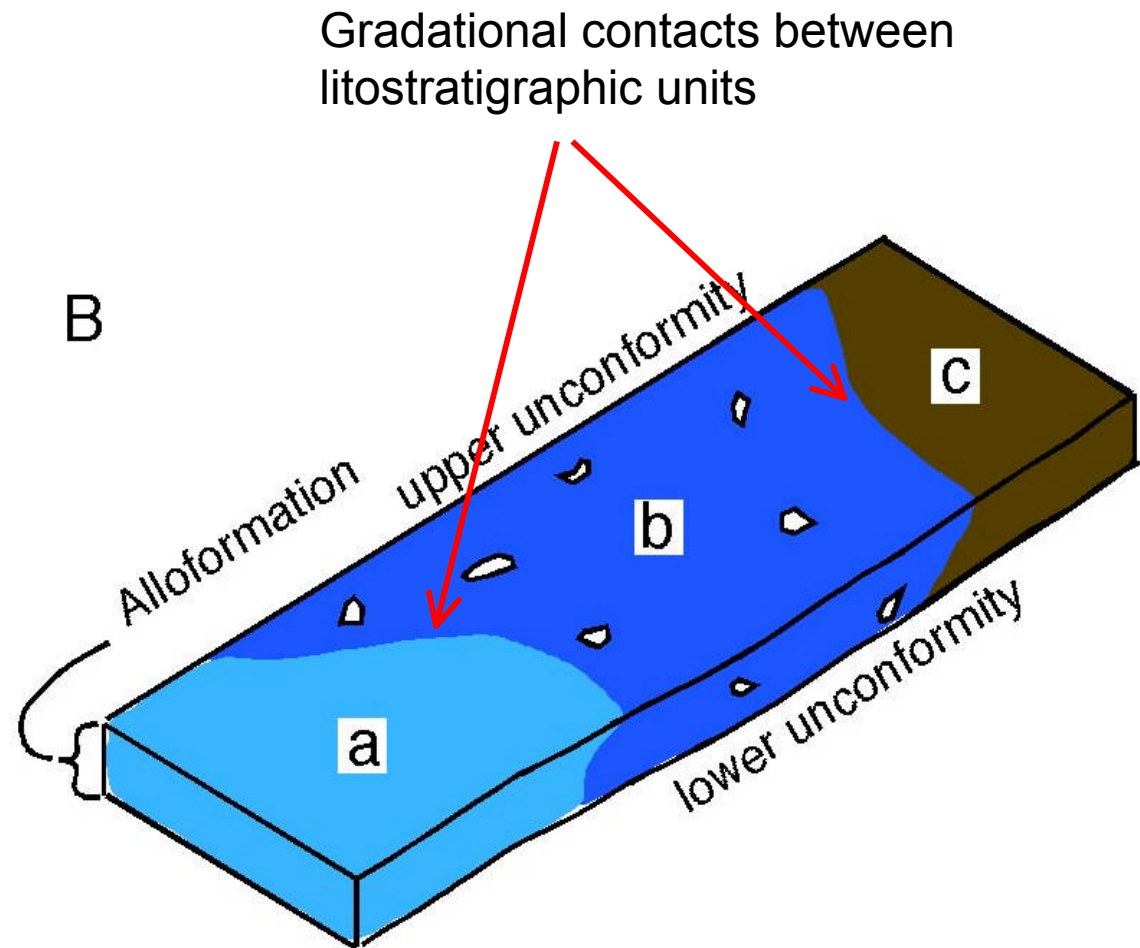


Lower contact of the Furuäng Fm

gradational depositional contact
(disturbed by secondary oxidation)



- Regionally lithologies grade laterally
- Several lithostratigraphic units in one alloformation



(Modified from Räsänen et al 2009)

Regionally, the basal contact of Björkö Alloformation can be differentiated from the depositional contacts between the different lithostratigraphic units.

Characteristics of the contacts:

- **lower boundaries of alloformations:**

- erosional unconformity
- brittle deformation
- deformation breccias
- downward oriented clastic dykes
- soils
- typical ichnofacies
- cryoturbation
- ice wedges

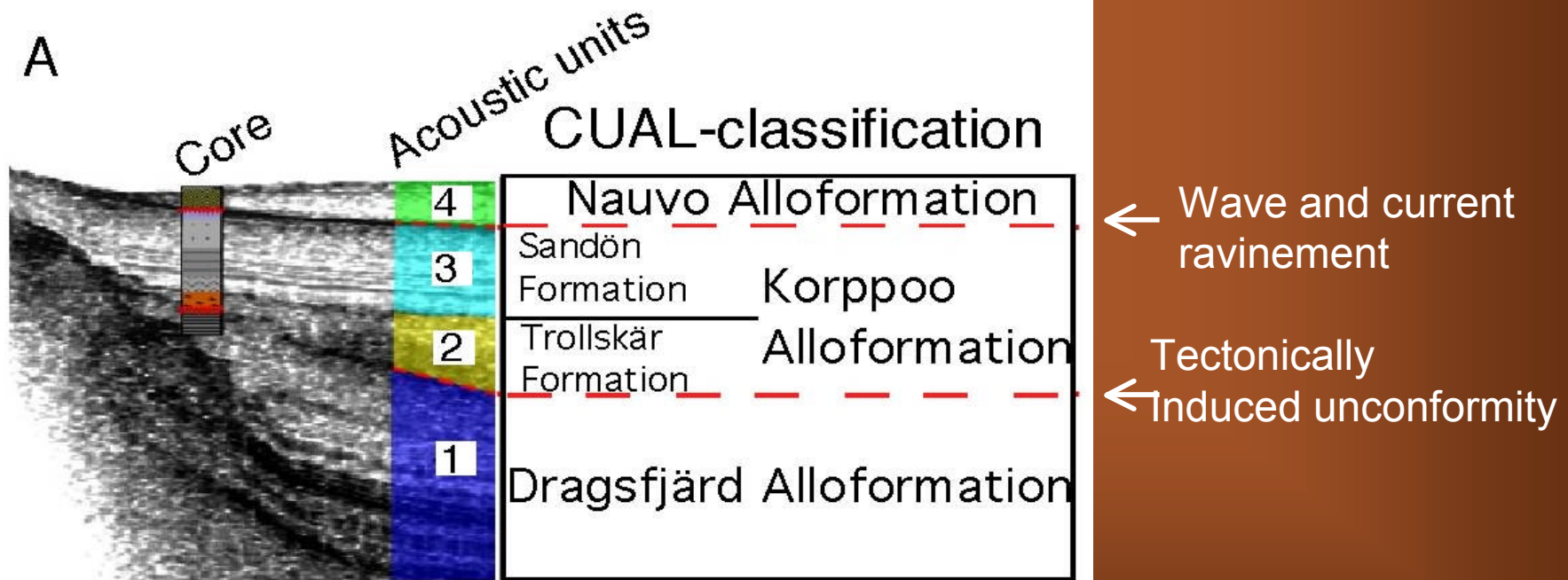
- **contacts between lithostratigraphical units**

- gradational
- rhythmically gradational
- ductile deformation

Application of the CUAL-classification

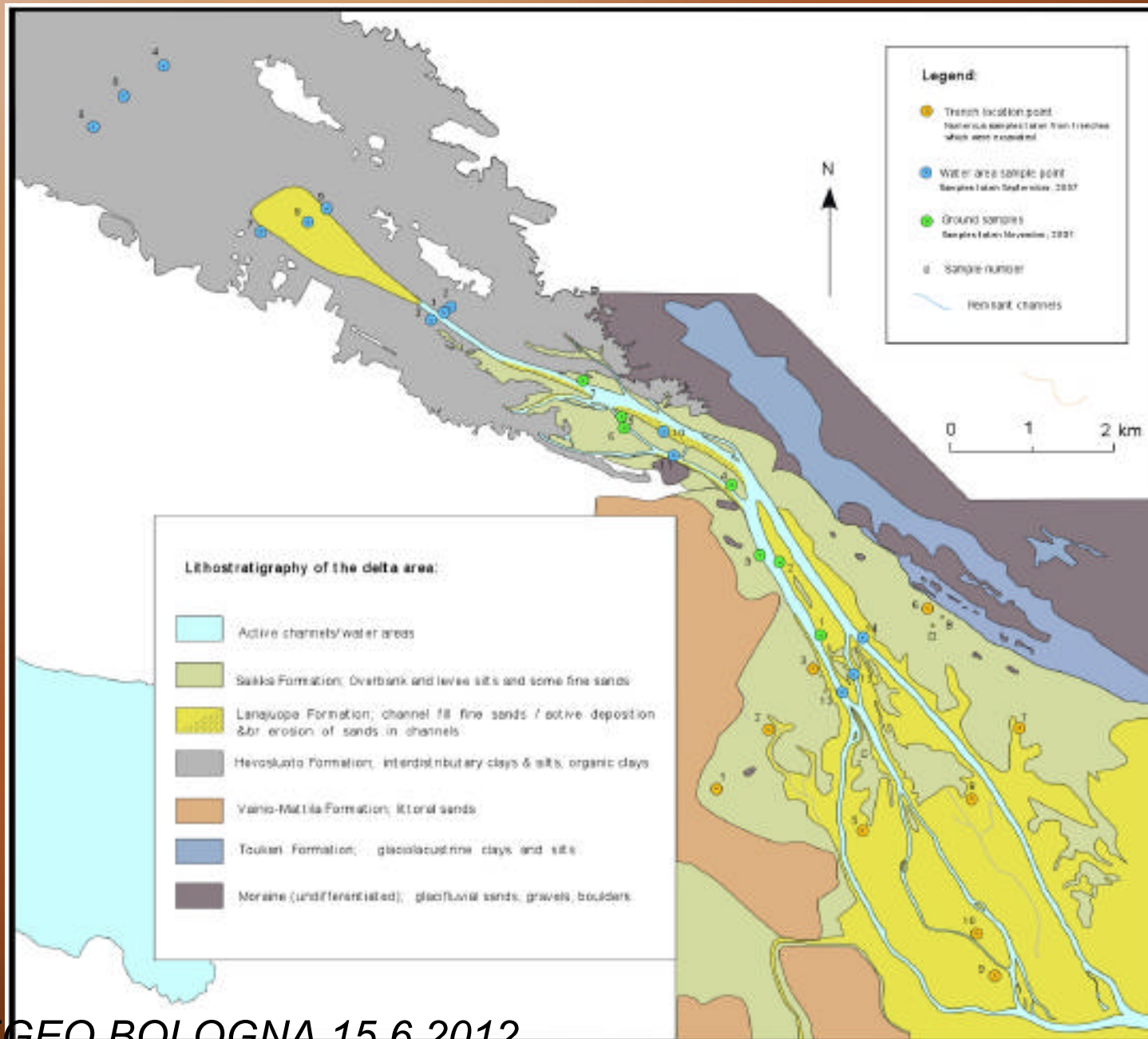
Offshore Baltic Sea sediments

Virtasalo et al. 2005



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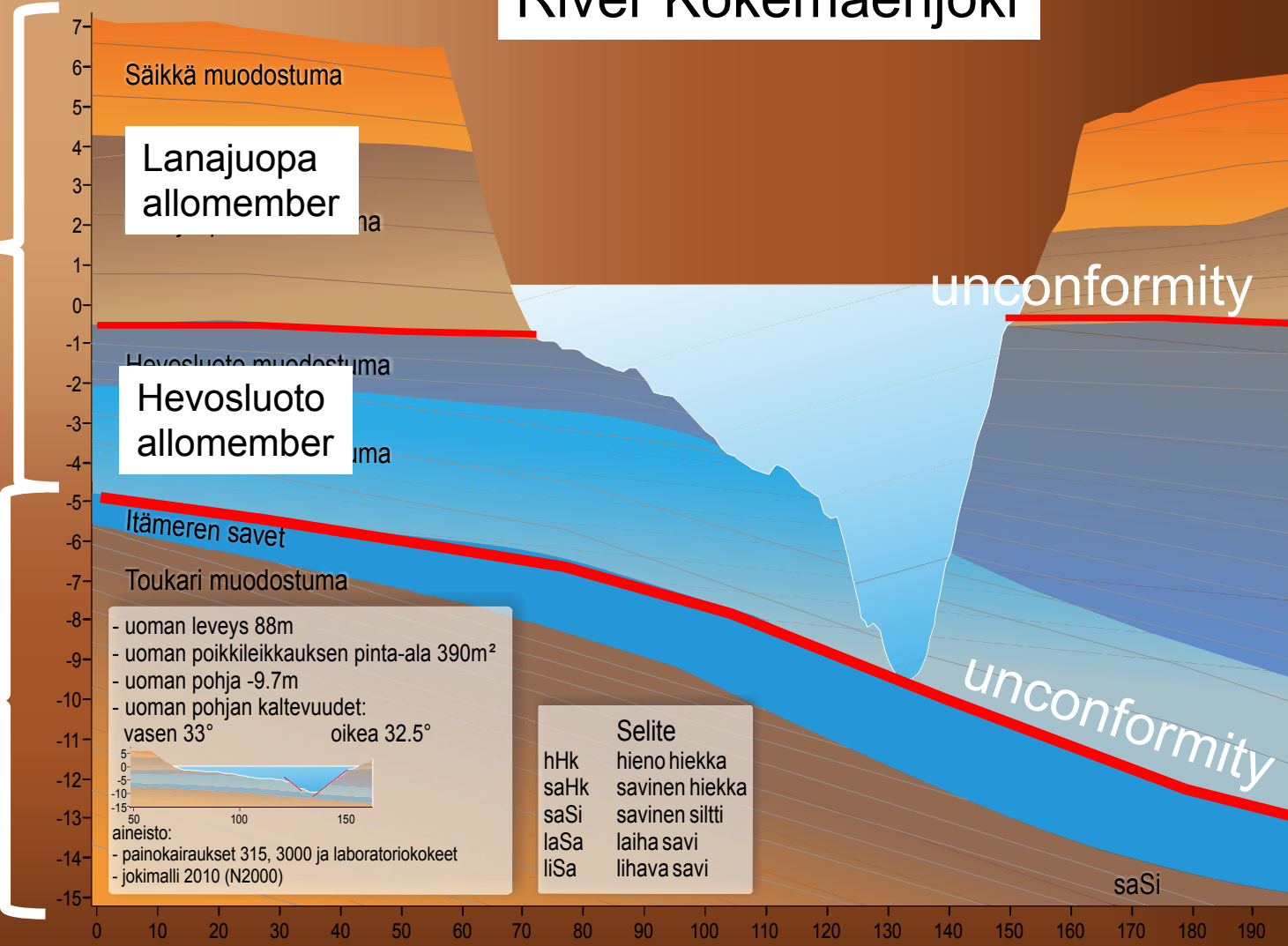
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(Cripps et al. 2012)

River Kokemäenjoki

Kokemäenjoki
Alloformation

Toukari
Alloformation



- uoman leveys 88m
 - uoman poikkileikkauksen pinta-ala 390m²
 - uoman pohja -9.7m
 - uoman pohjan kaltevuudet:
 vasen 33° oikea 32.5°

aineisto:
 - painokairaukset 315, 3000 ja laboratoriotokkeet
 - jokimalli 2010 (N2000)

Selite	
hHk	hieno hiekka
saHk	savinen hiekka
saSi	savinen siltti
laSa	laiha savi
liSa	lihava savi

How to differentiate unconformities ?

- basal unconformities of alloformations are often related to certain lithofacies associations (retrogradational or progradational successions)
- whereas intra(allo)formational unconformities are more often related to the intraformational lithofacies associations

Conclusions on the use of CUAL:

- 1) unconformities and their features are given the importance they have in the final sequence stratigraphic interpretation
- 2) use of unconformities give hierarchy for the stratigraphic classification
- 3) The CUAL framework gives a more realistic base for detailed (chronostratigraphic or) diachronic work than lithostratigraphic frameworks

Conclusions:

- 5) allostratigraphic units are enough large to be mappable
- 6) Excavations with detailed sedimentology, surficial drilling, wireline geophysics, ground penetrating radar, shallow seismics, acoustic soundings and other geophysical methods are needed

Thank you!