

Pleistocene Connection and Holocene Separation of the Caspian and Black Seas: Data from the Modern Kura Delta, Azerbaijan*

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Abstract

The modern Kura River delta in the Caspian Sea overlies the important Pliocene fluvio-deltaic hydrocarbon reservoirs of the South Caspian Basin, and therefore constitutes a possible modern analogue. Shallow seismic profiles and grain size, pollen, geochemistry and ¹⁴C data from a 50 m offshore core show a subdivision into five sequences.

The deepest reflector at ~ 24 m depth marks the top of a late Pleistocene unit of reddish clays with ¹⁴C ages between 23,480 and 47,070 cal yr BP. Pollen data suggest a large influence of fresh water and pollen influx from the Volga River through coast-hugging marine currents. Overlying peaty sediments dated at 12,000 cal BP have been deposited, according to pollen data, under salt marsh conditions close to a sea level that must have been almost 65 m lower than the present one of -27 m below oceanic level, but within the range of published estimates for the Early Holocene Mangyshlak regression. In the overlying greyish marine muds with minor sand intercalations several cycles can be discerned on the basis of TOC contents. They span a large part of the Holocene, and pollen data suggest a rising sea level. They are truncated by a reflector horizon probably corresponding to the 6th century AD Derbent ~48 m lowstand during the Warm Mediaeval Period. This unit is overlain by greyish and green muds between 1.5 and 6 metres depth, with a definite peak in steppe pollen and a dip in the warm temperate pollen, indicating warm semi-arid conditions, probably between the mediaeval lowstands of the 6th and 12th century AD. The uppermost ~ 1.5 m shows a tendency to cooler climatic conditions according to the pollen profiles, and thus may correspond to a period of sea level rise heralding the start of the Little Ice Age highstand.

Geochemically, the Pleistocene reddish clays differ strongly (high Fe, low Ca) from the overlying Holocene sediments (low Fe, high Ca), and resemble in that respect similar Pleistocene reddish clays recovered from the deepest part from both the Caspian and the Black Seas, as well as to some extent the so-called chocolate clays cropping out in the North Caspian Plain. This might suggest that these clays were deposited when both seas were united by an overflow from the Caspian during the Last Glacial highstand (Khvalyn) or at least proceeding from drainage basins that underwent similar drastic changes in sediment output characteristics at the Pleistocene-Holocene transition.

Acknowledgement

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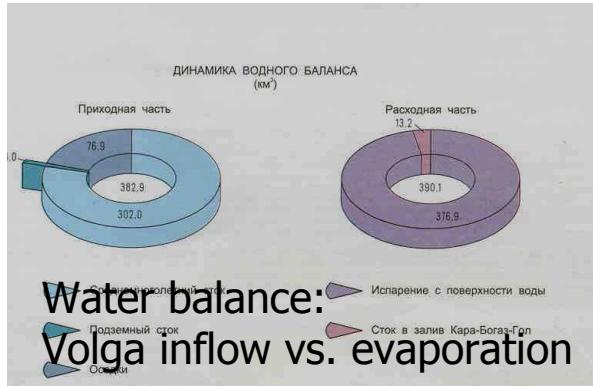
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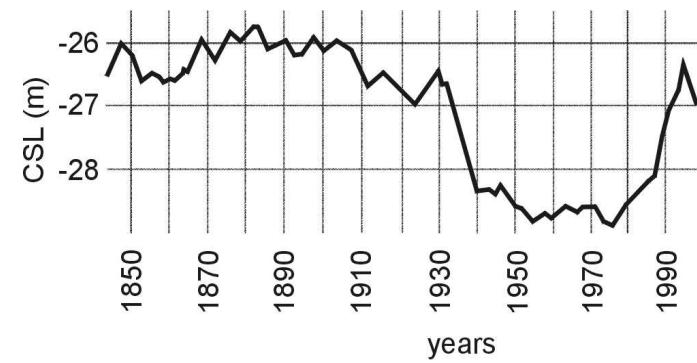
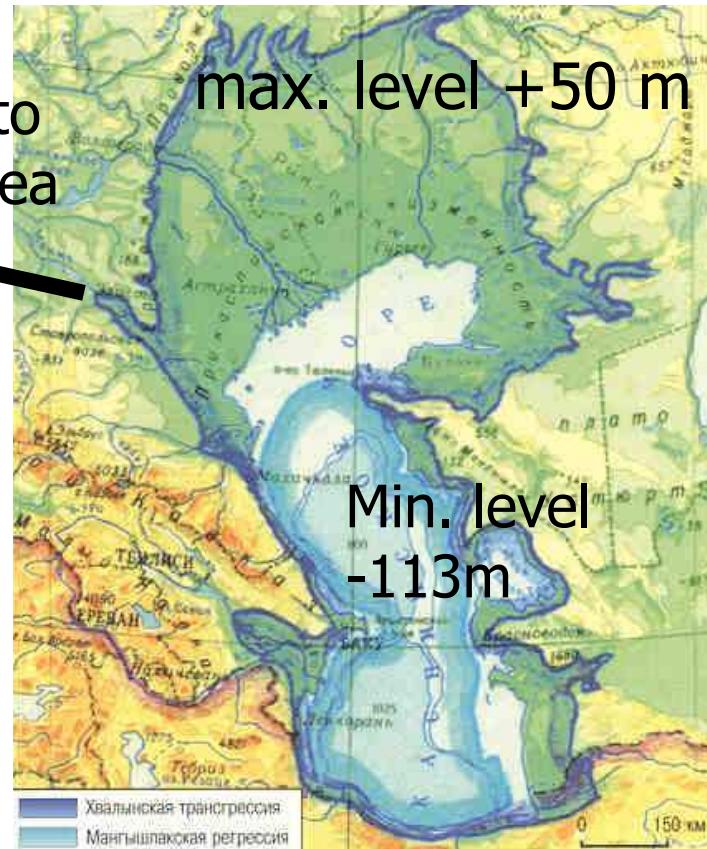
Pleistocene Connection and Holocene Separation of the Caspian and Black Seas. Data from the Modern Kura delta, Azerbaijan

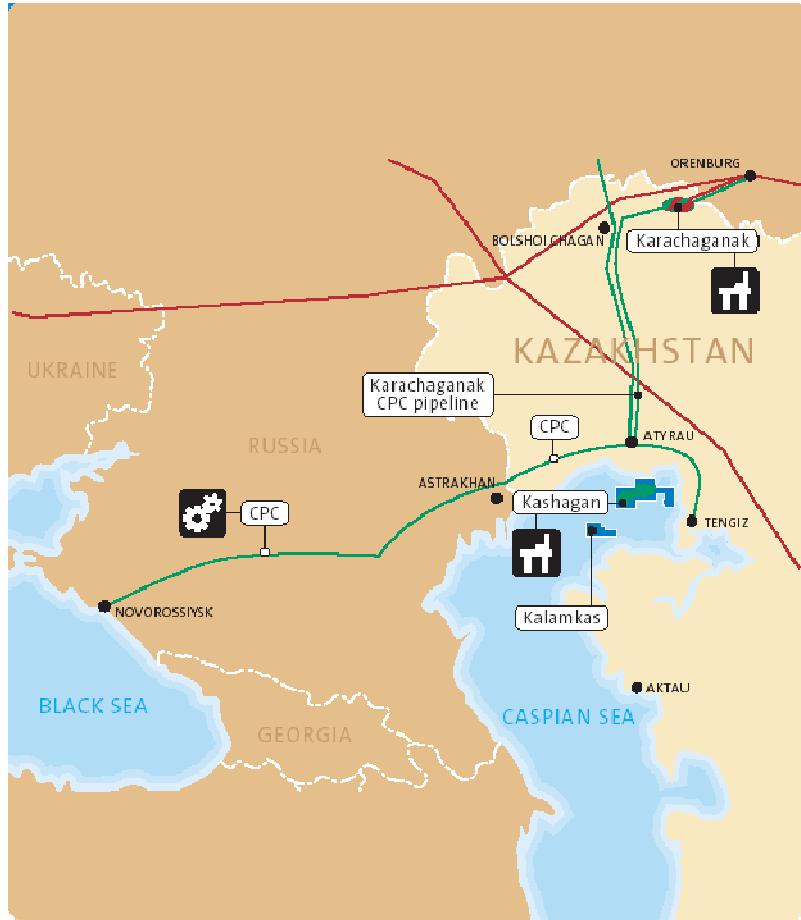
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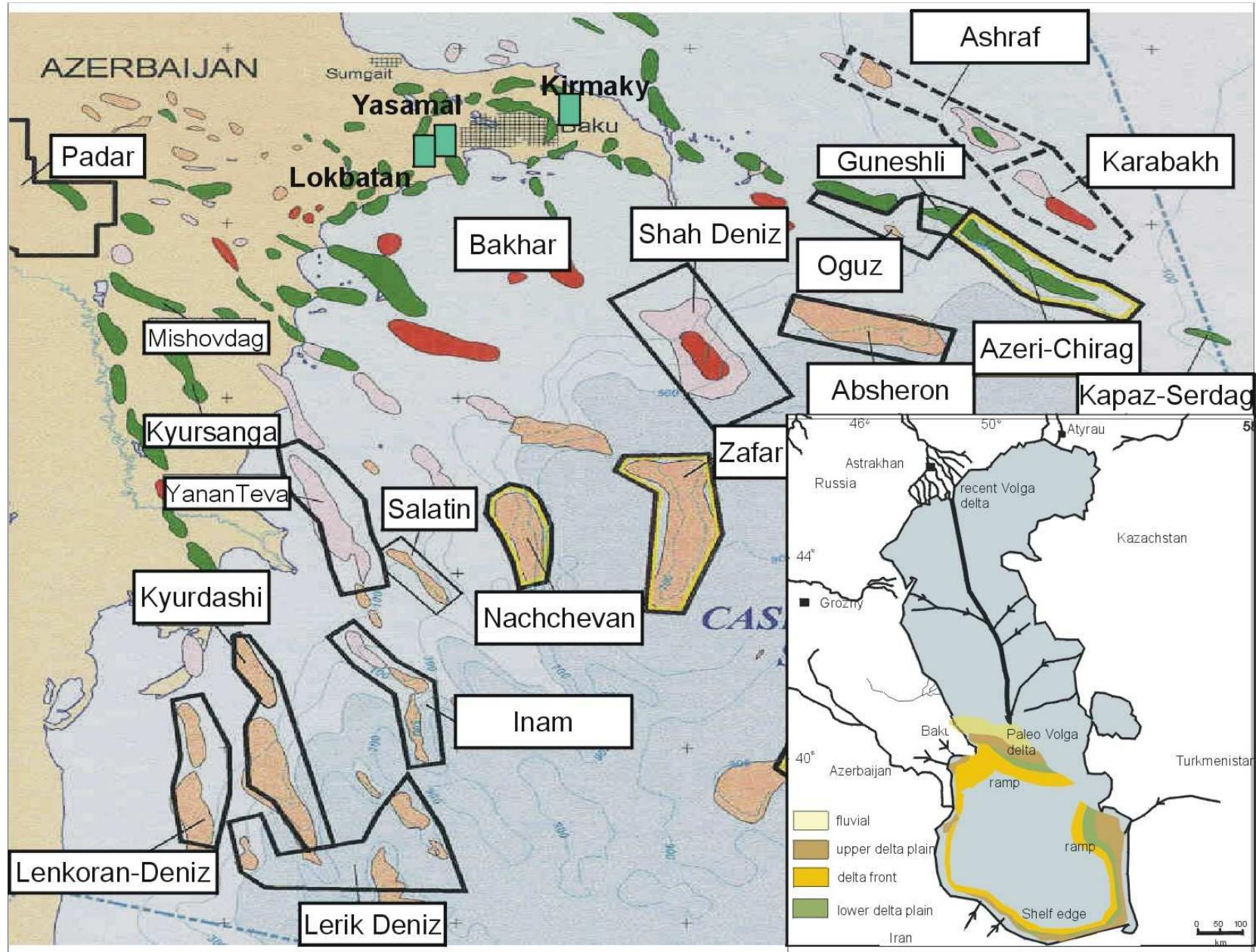


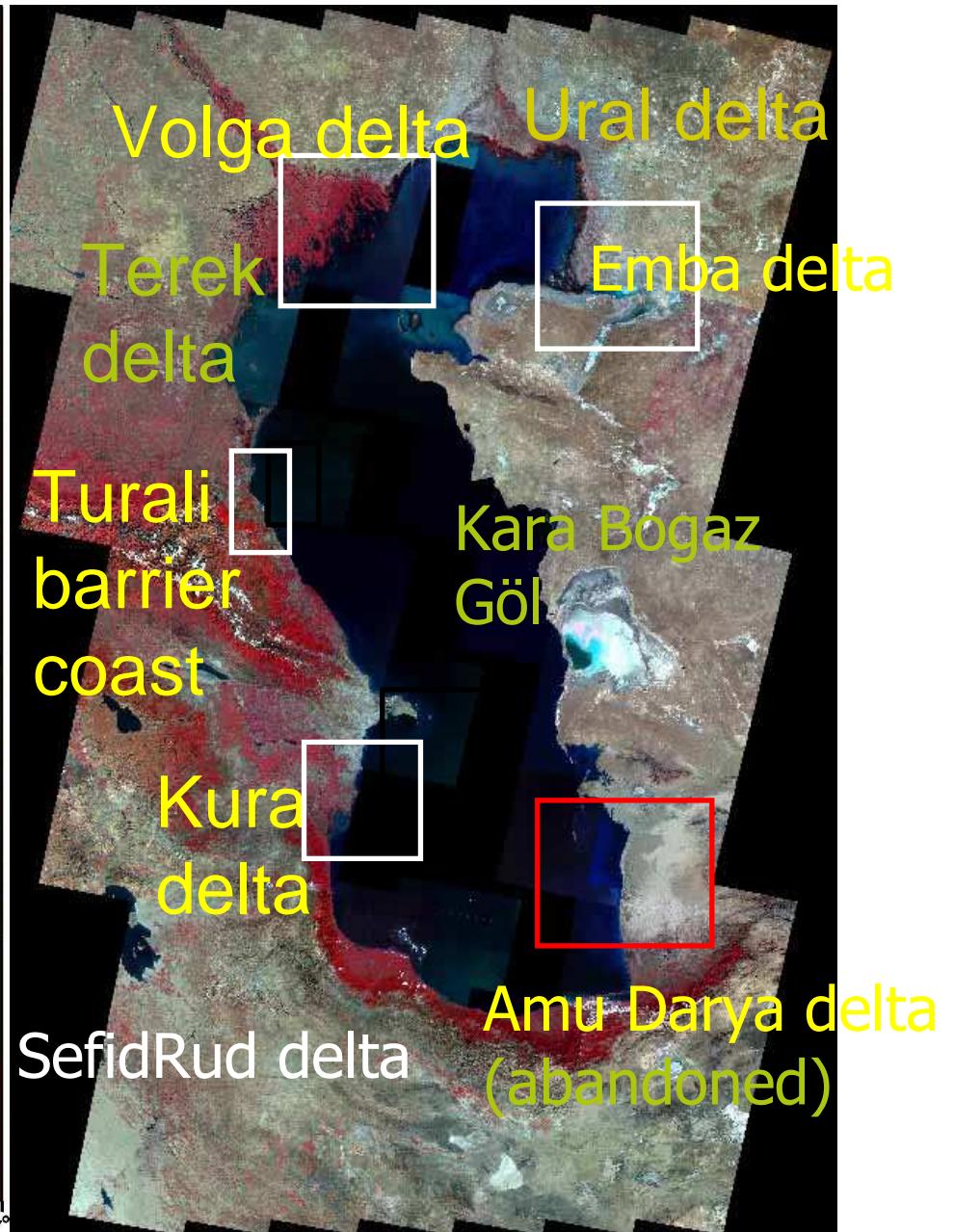
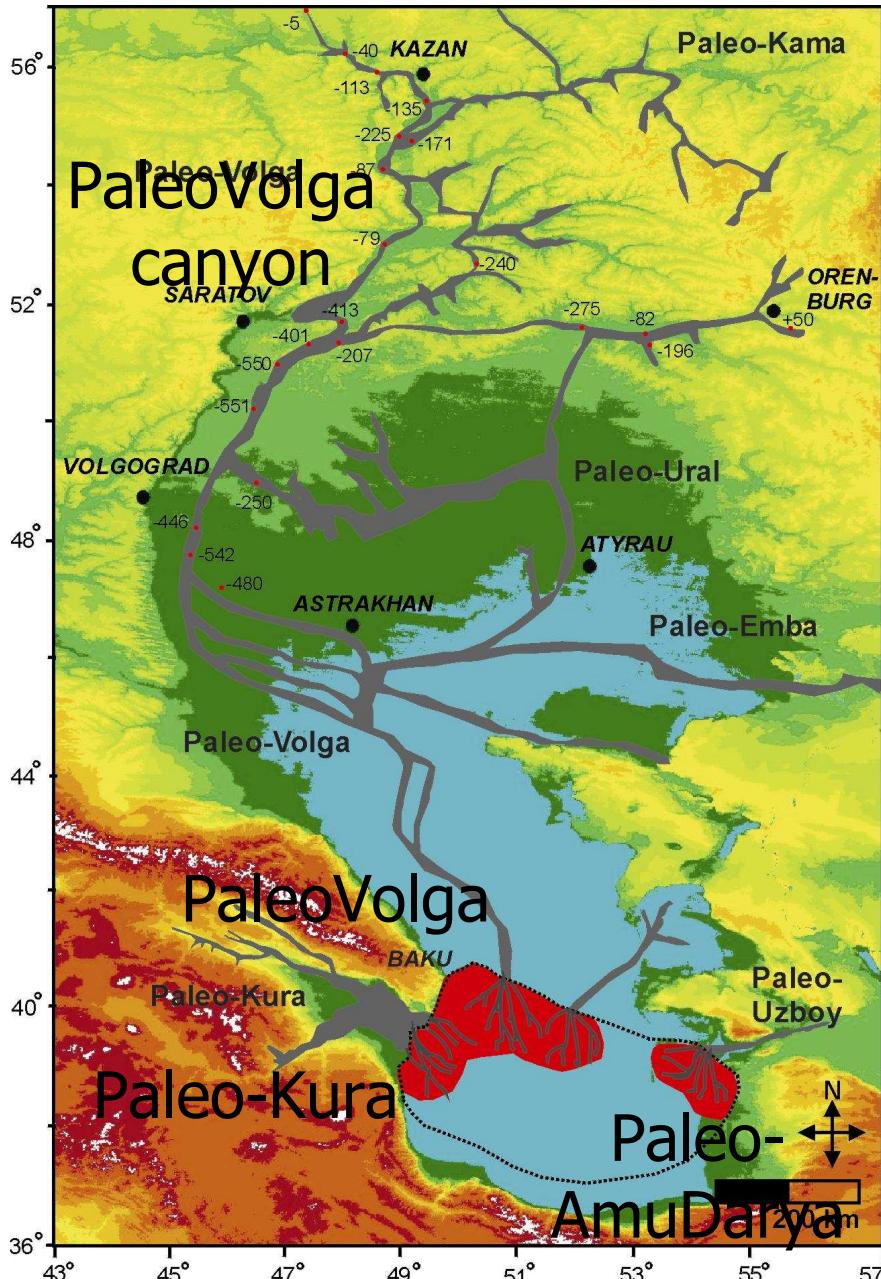
Overflow to
Black Sea

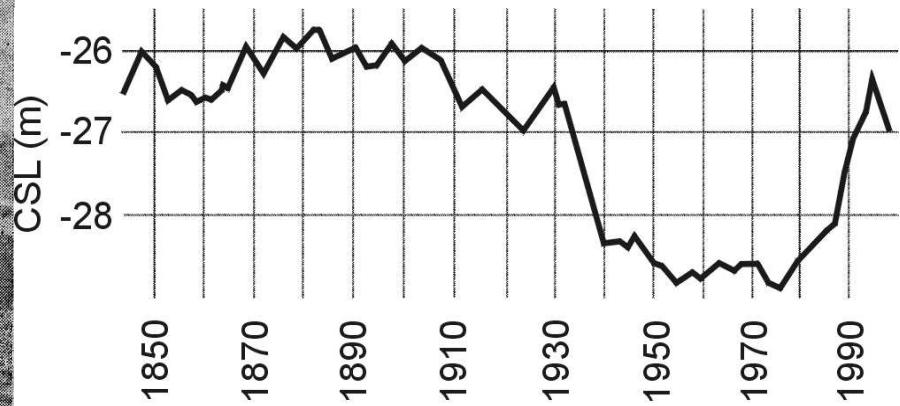
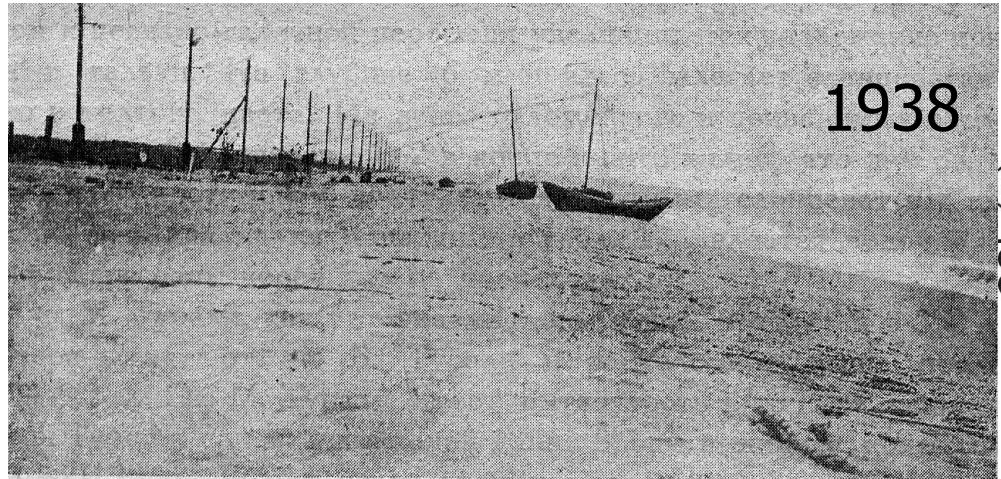




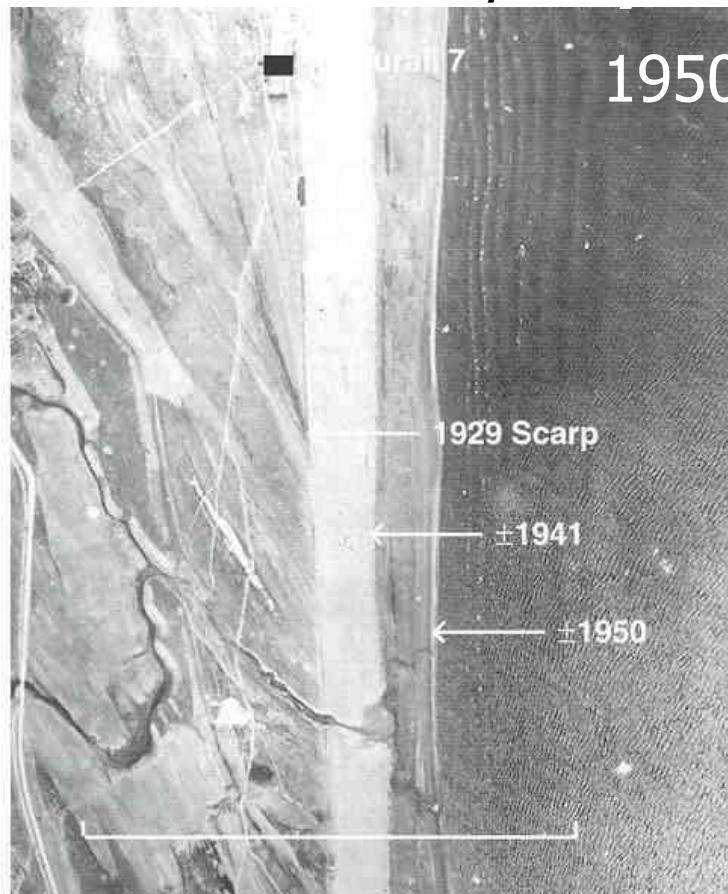
The giant Kashagan field, Kazakhstan: 3-8 m water depth:
What happens if sea level rises/falls?

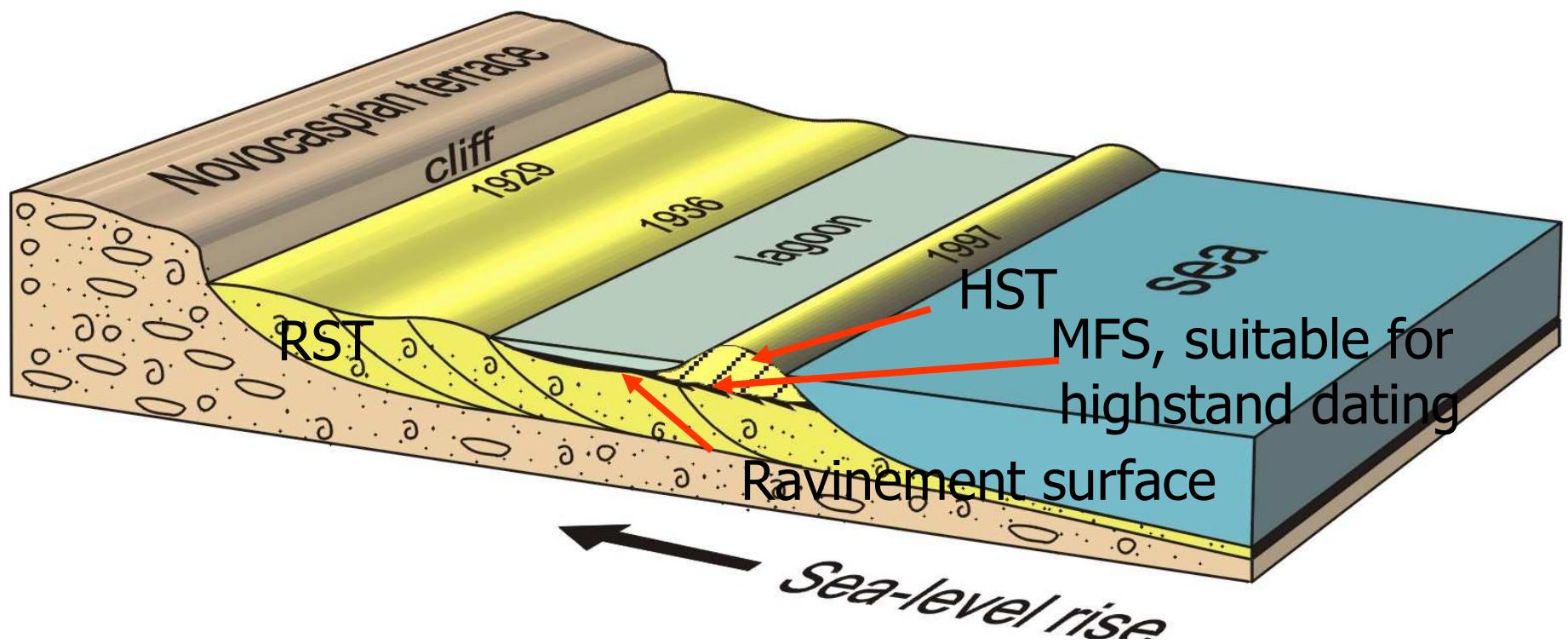
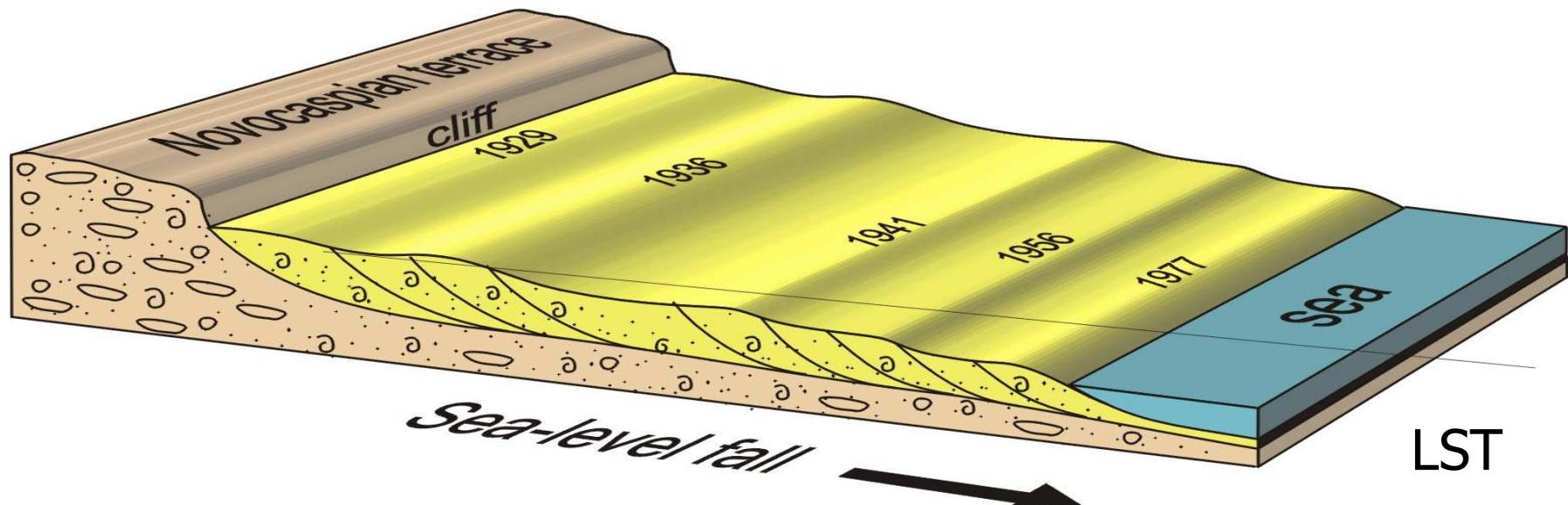


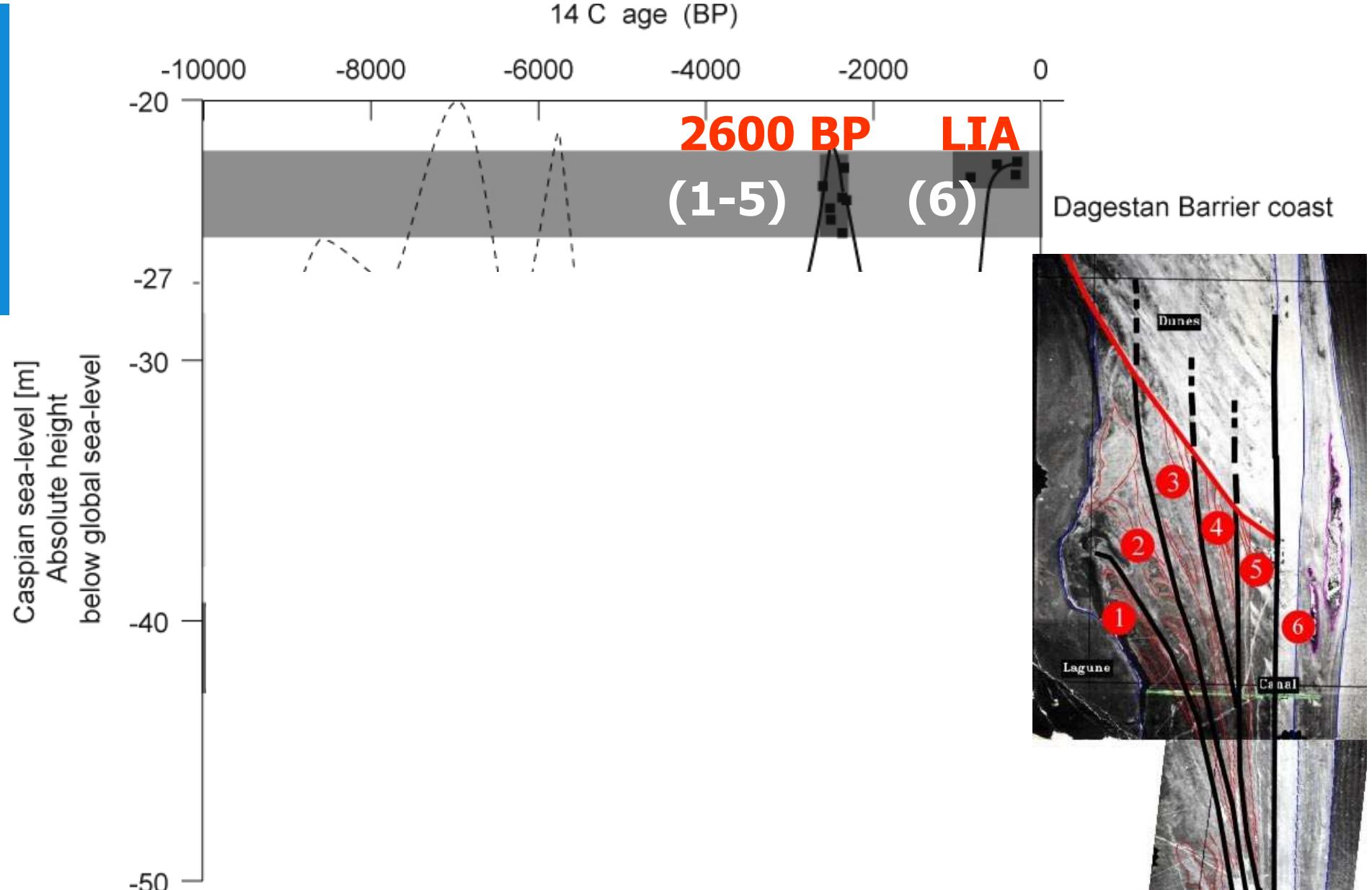




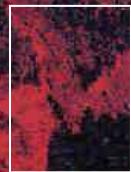
Full sea level cycle in 65 years, barrier coast, Turali, Dagestan



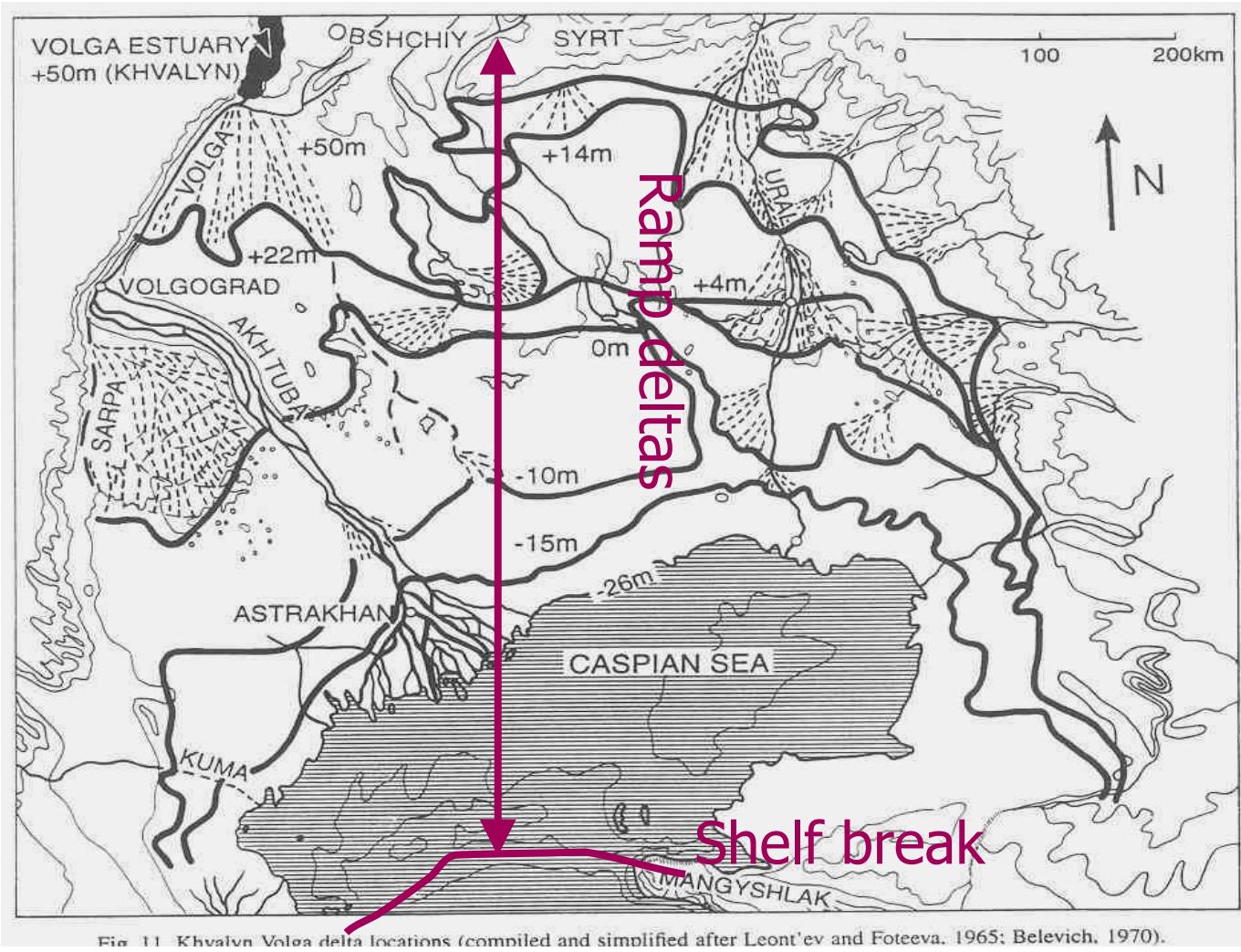




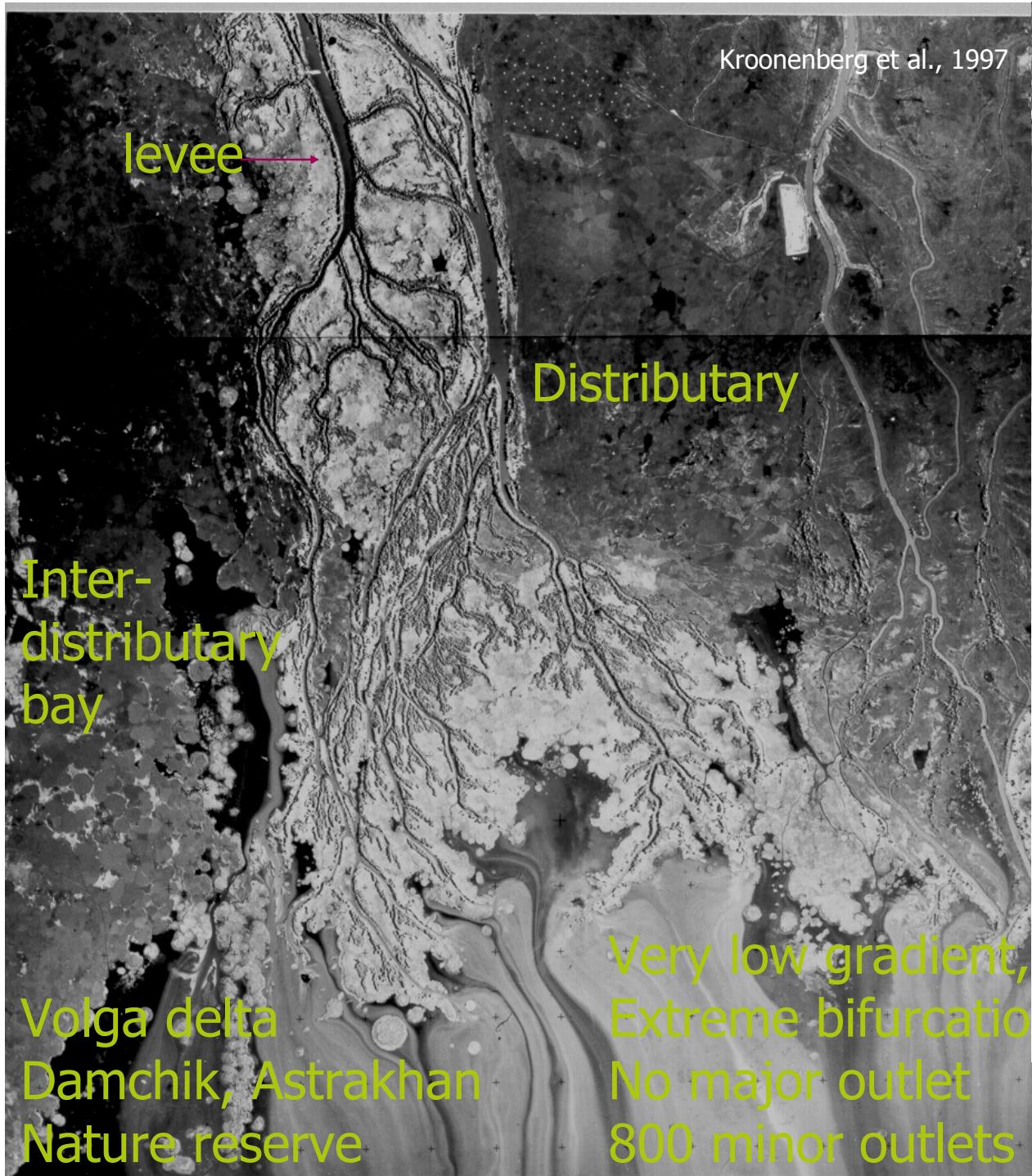
Volga delta
low gradient
800 outlets



Astrakhan Nature Reserve, Damchik

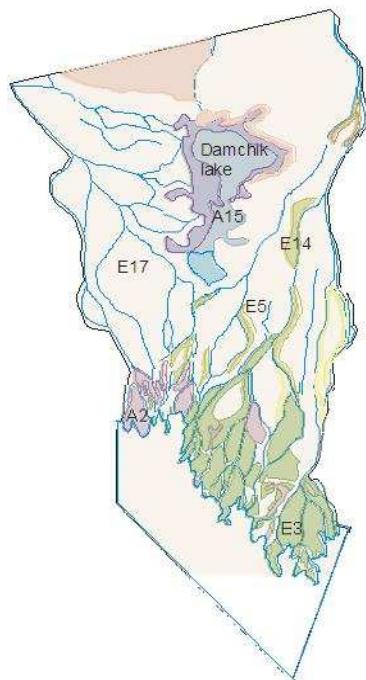


Volga delta: Ramp delta
shelf break at -34 m, 10 m water depth, 200 km offshore

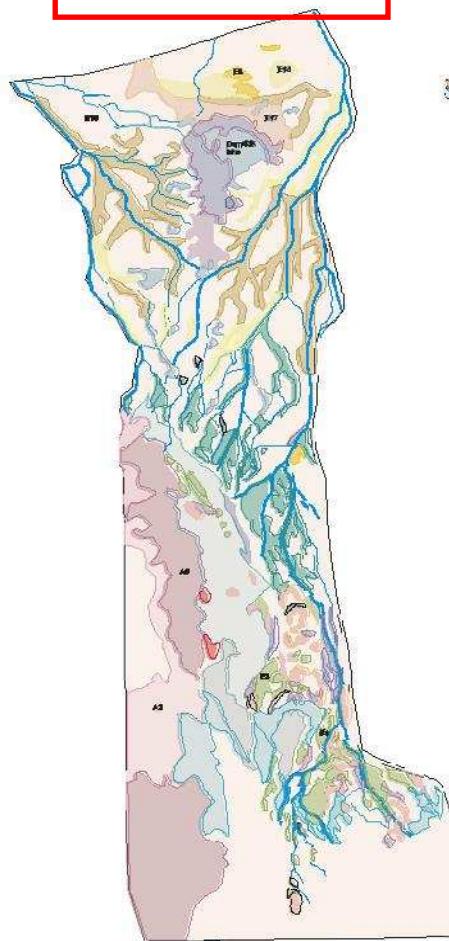


Very low gradient,
Extreme bifurcation
No major outlet
800 minor outlets

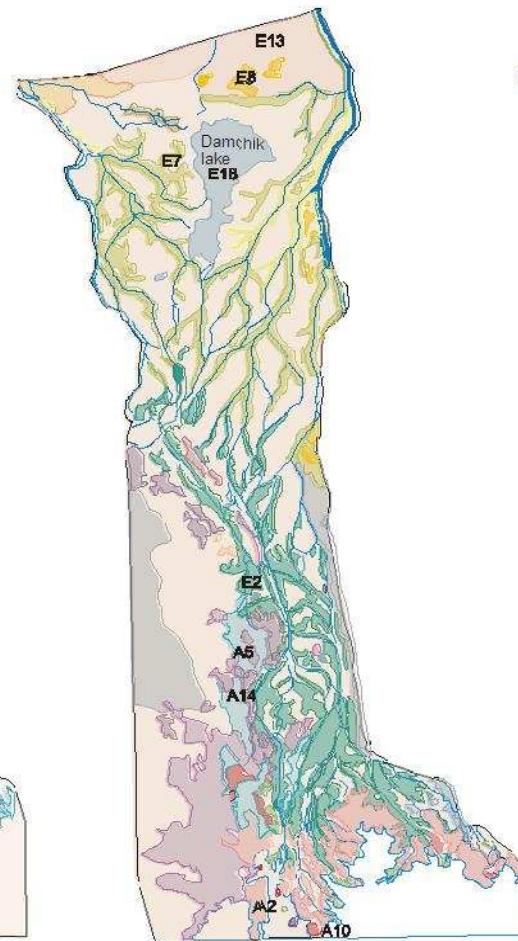
**just after
highstand**



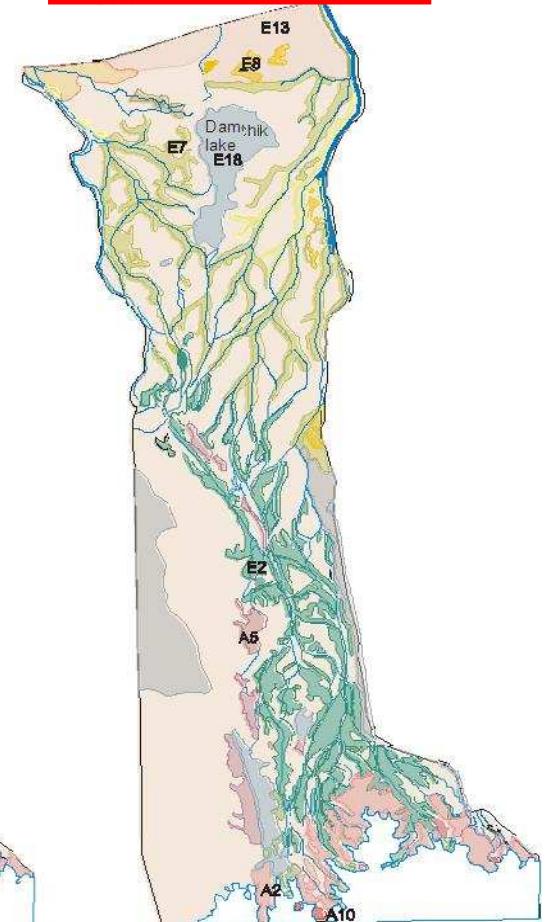
regression progradation



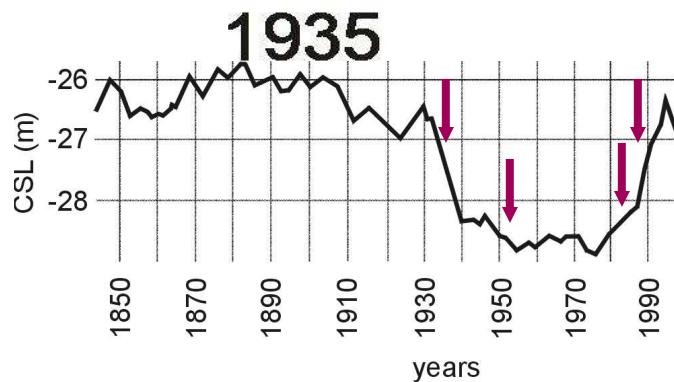
**just after
lowstand**



**transgression,
aggradation**



1935

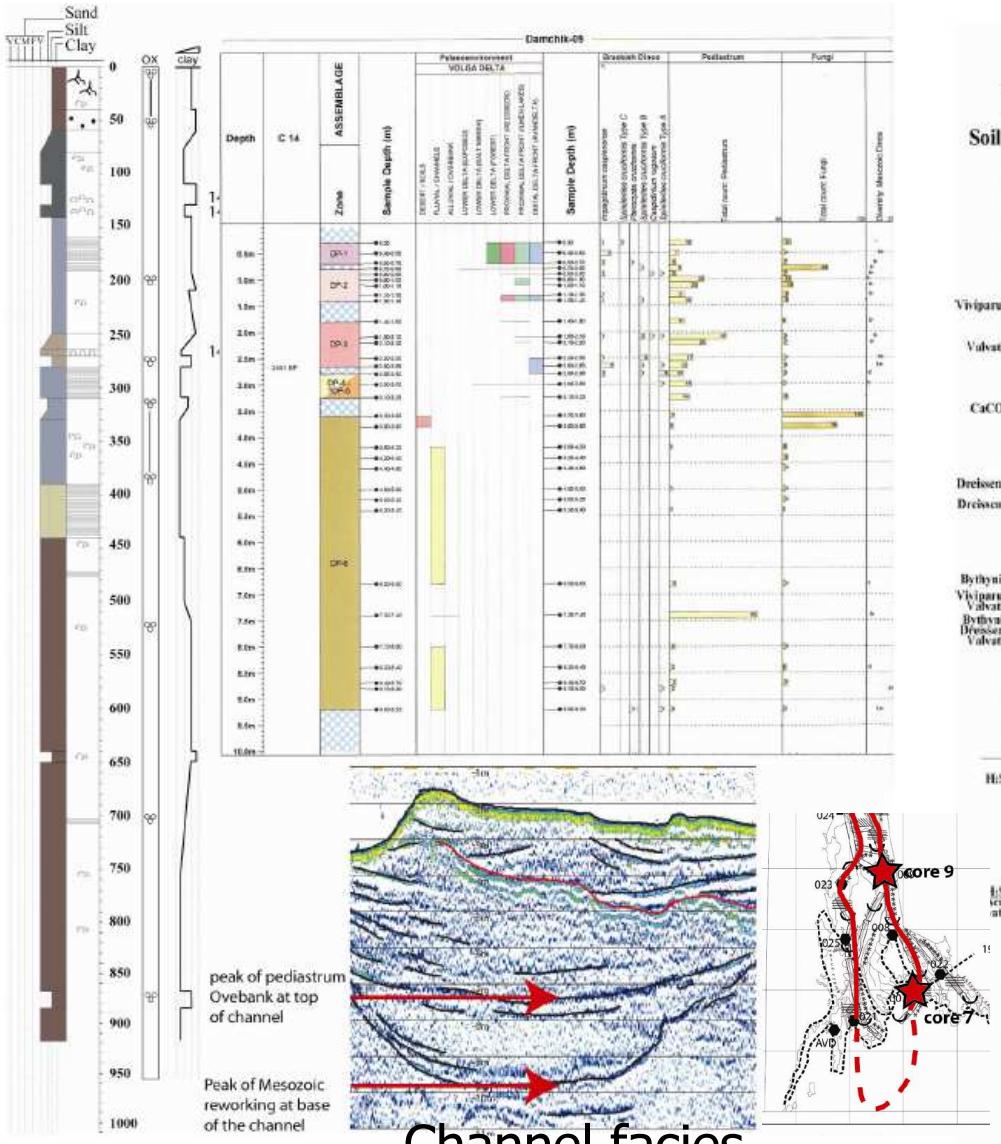


1951

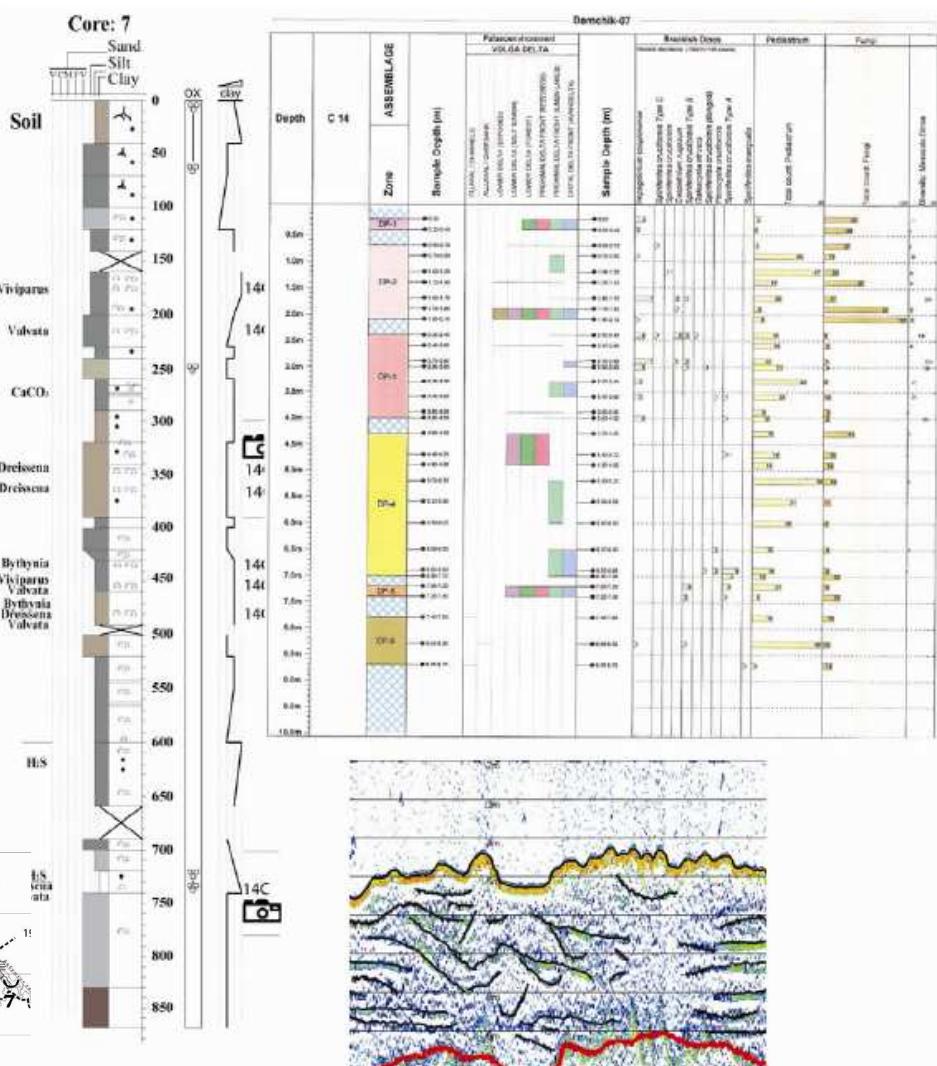
1981

1989

- Sea-level fall: rapid progradation (CU on avandelta)
- Sea-level rise: *aggradation* alone (FU on levees)
- No sands, no ravinement during transgression:
Waves do not reach coast

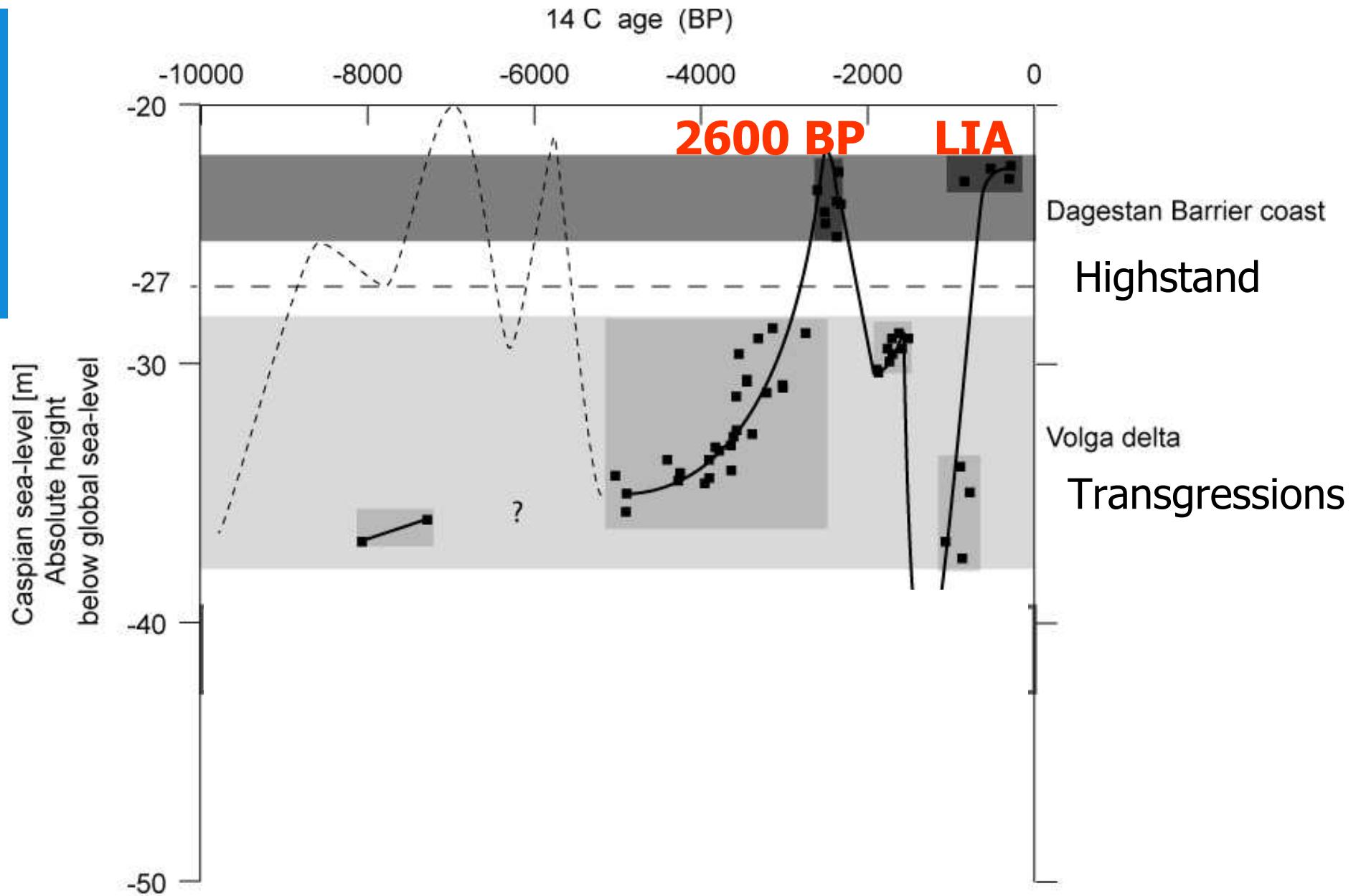


Channel facies

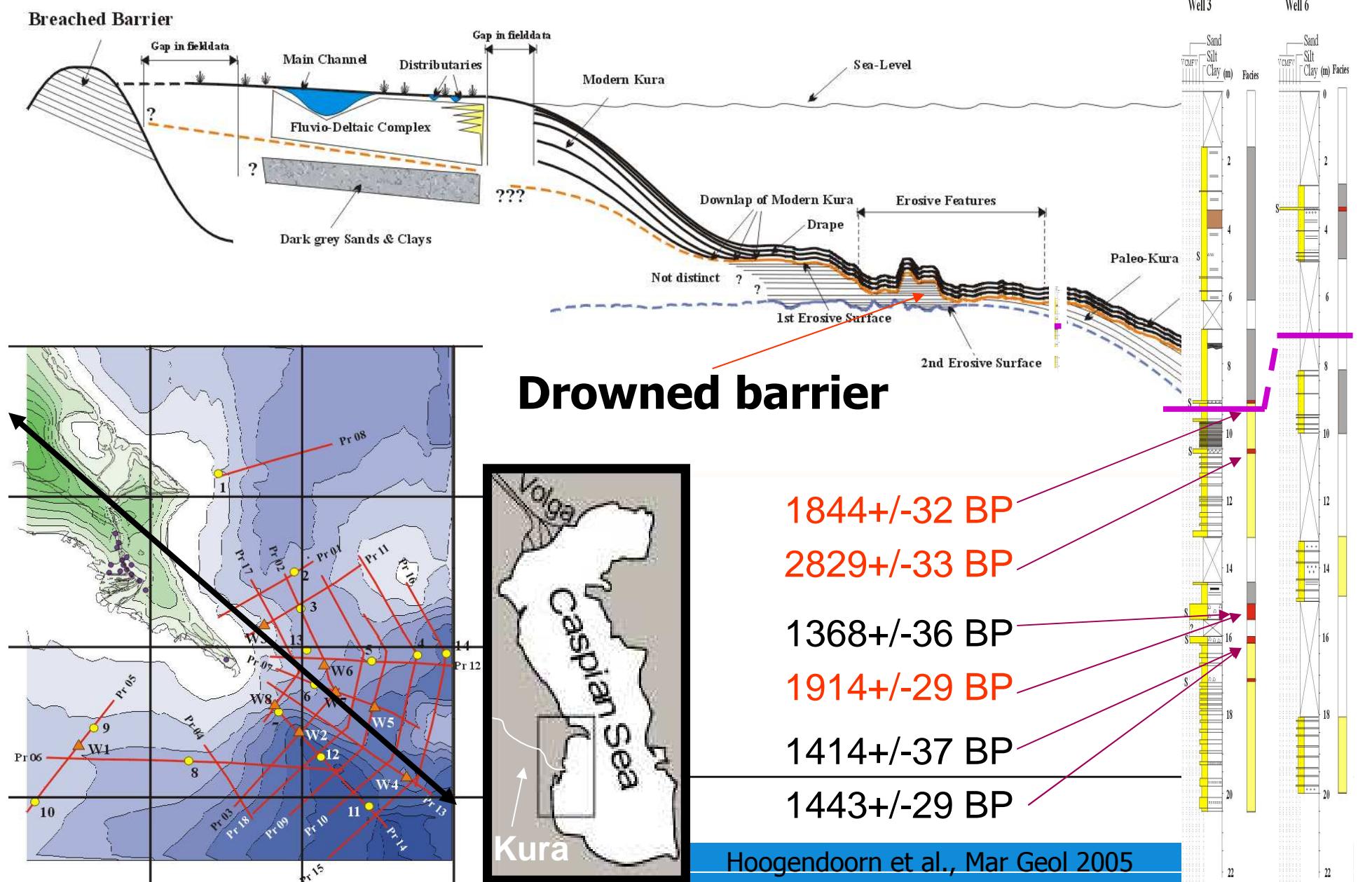


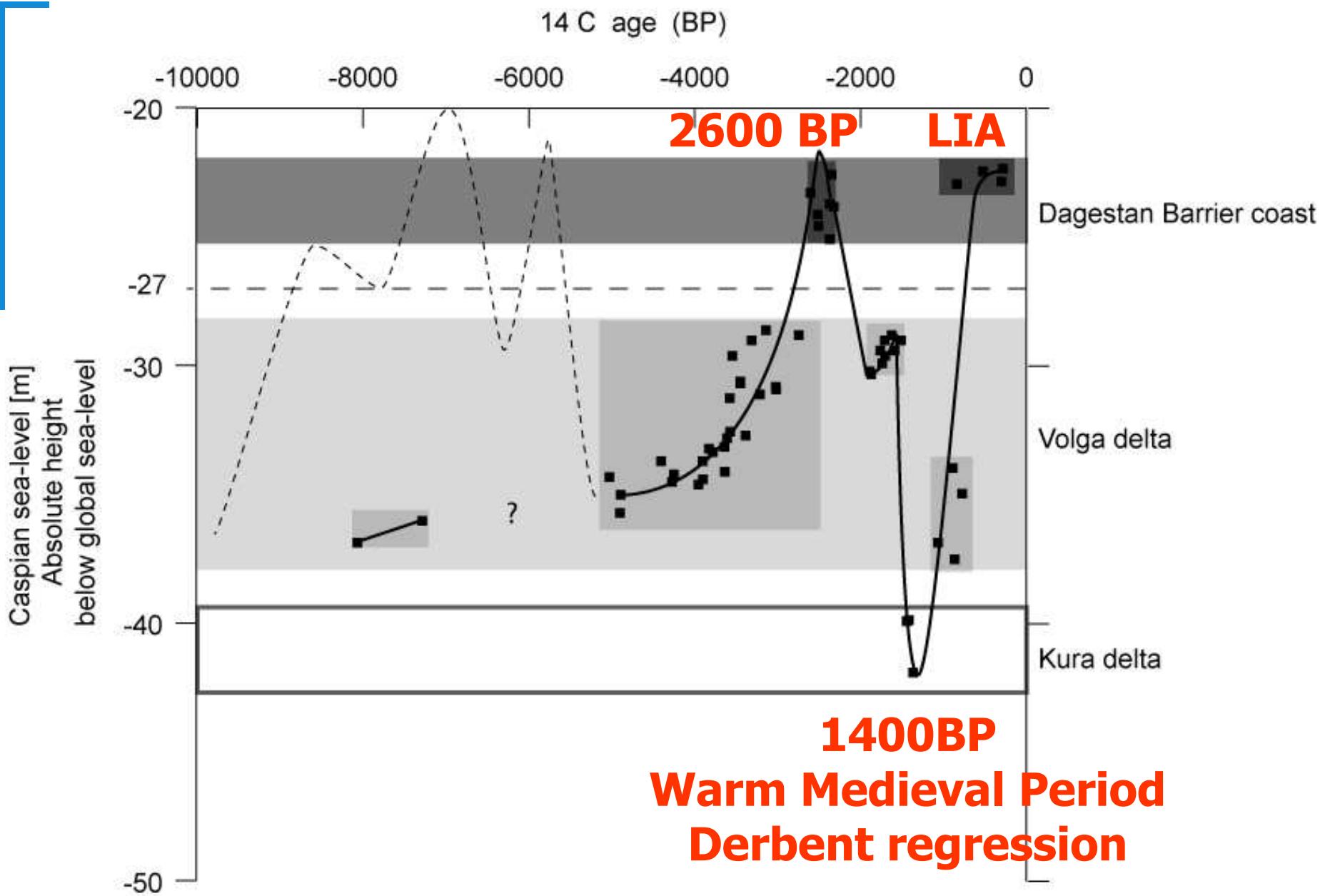
Heterogeneous facies

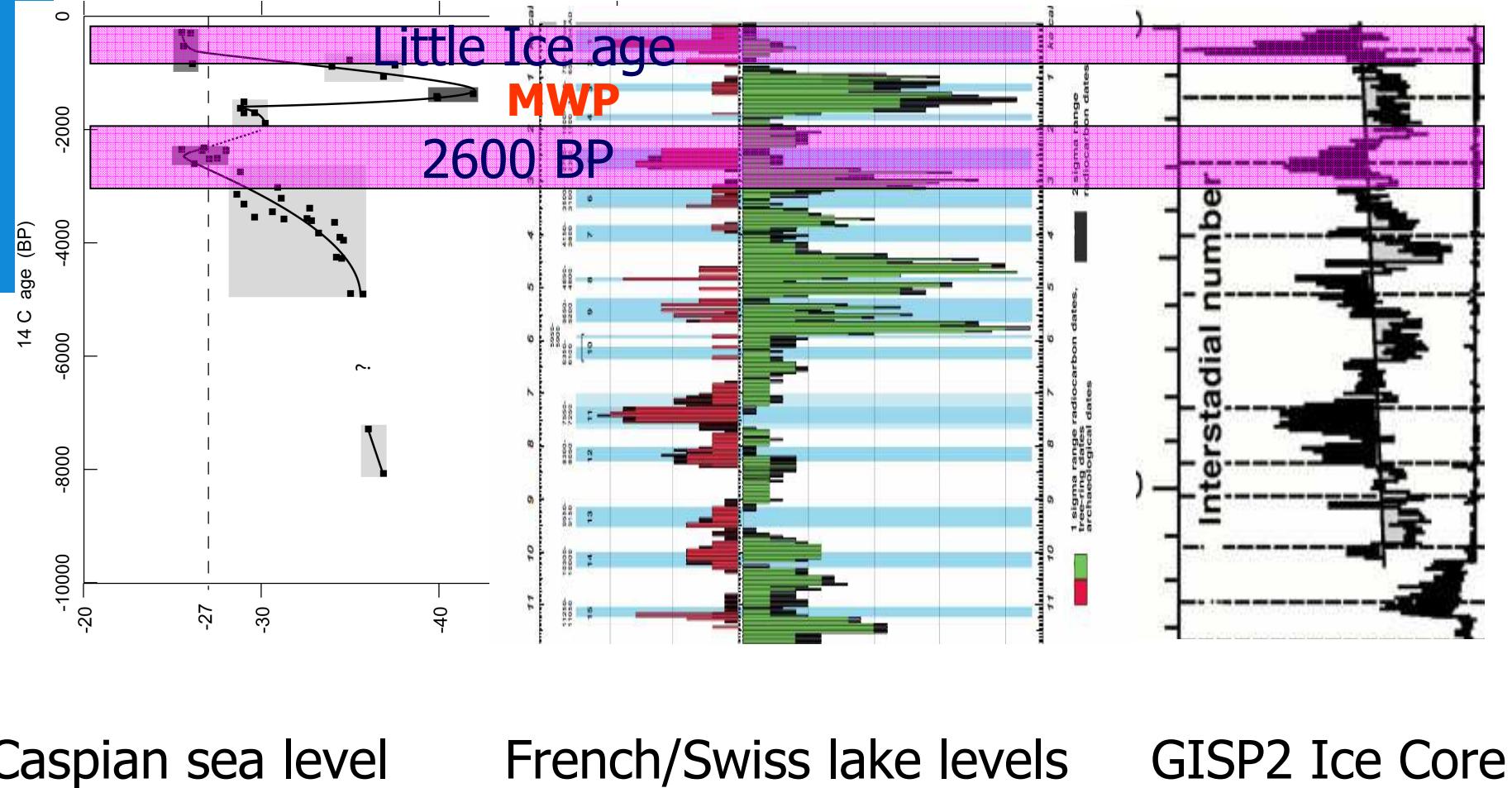
VHR Seismics Grain size, AMS ^{14}C datings, palynology (Richards)



Lowstand: Warm Mediaeval Period : -48 m, (offshore Kura delta, Azerbaijan)





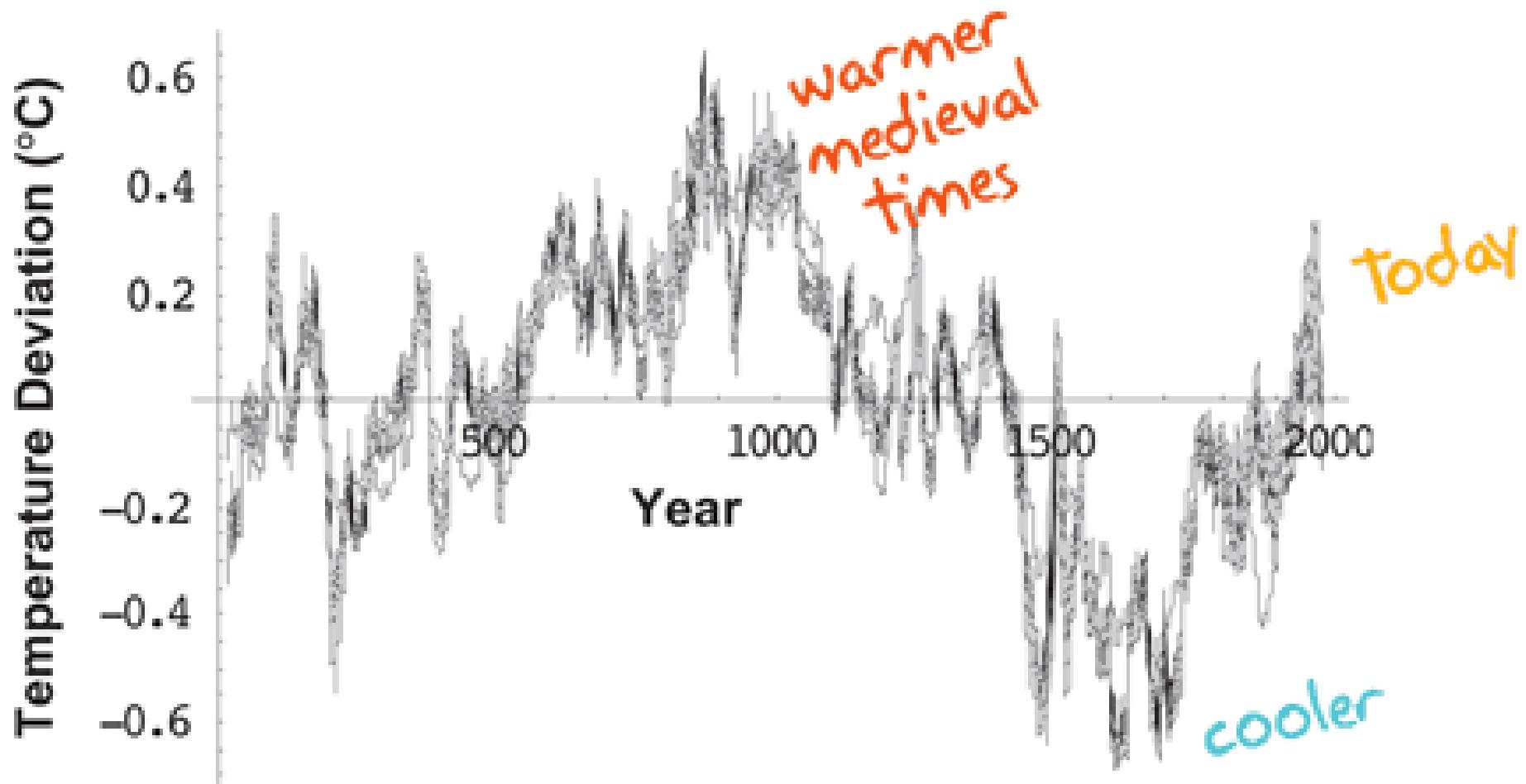


Caspian sea level

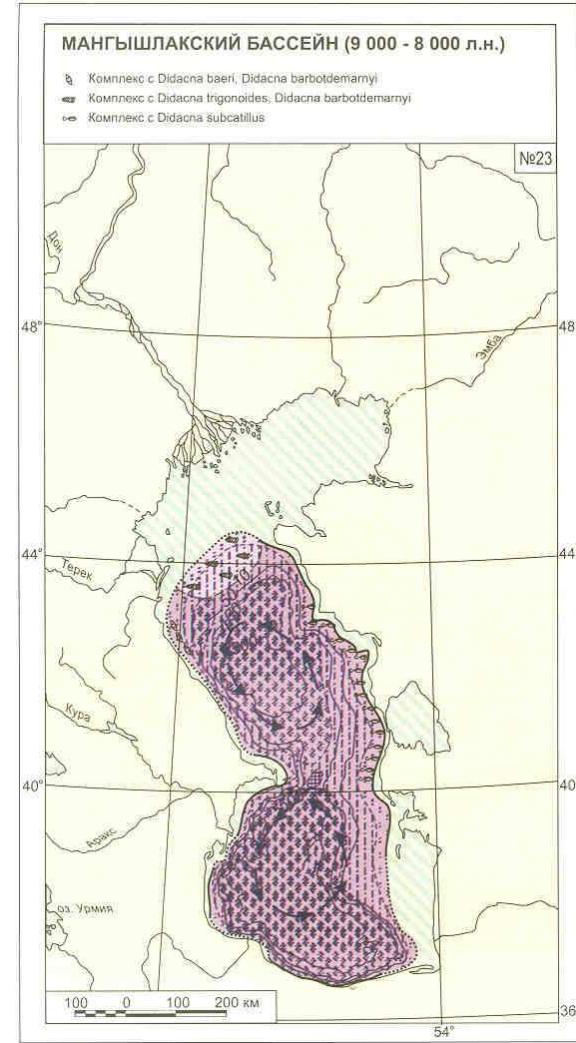
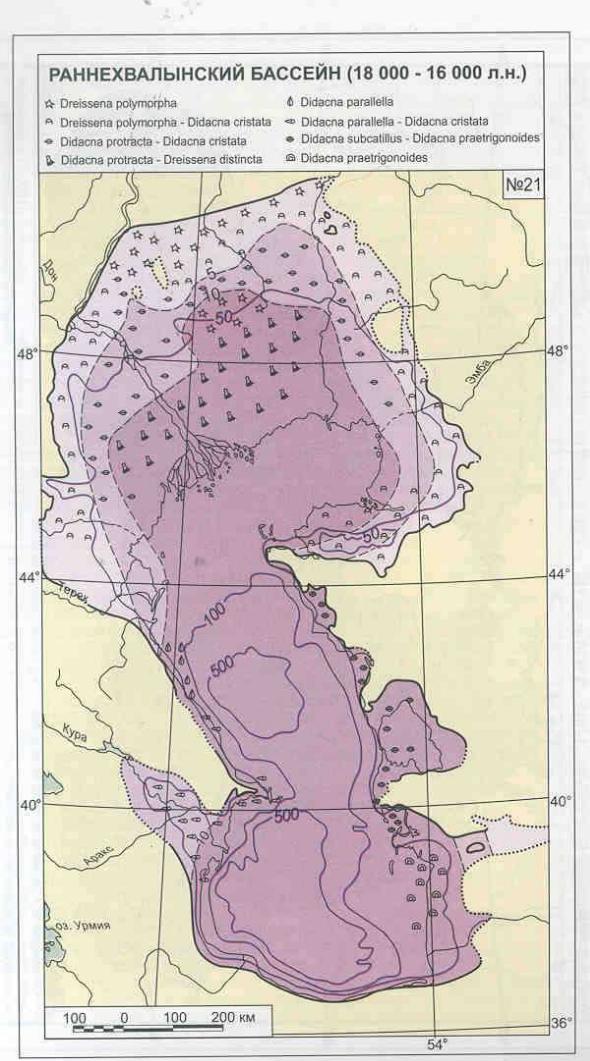
French/Swiss lake levels

GISP2 Ice Core

The real shape of the last 2000 years



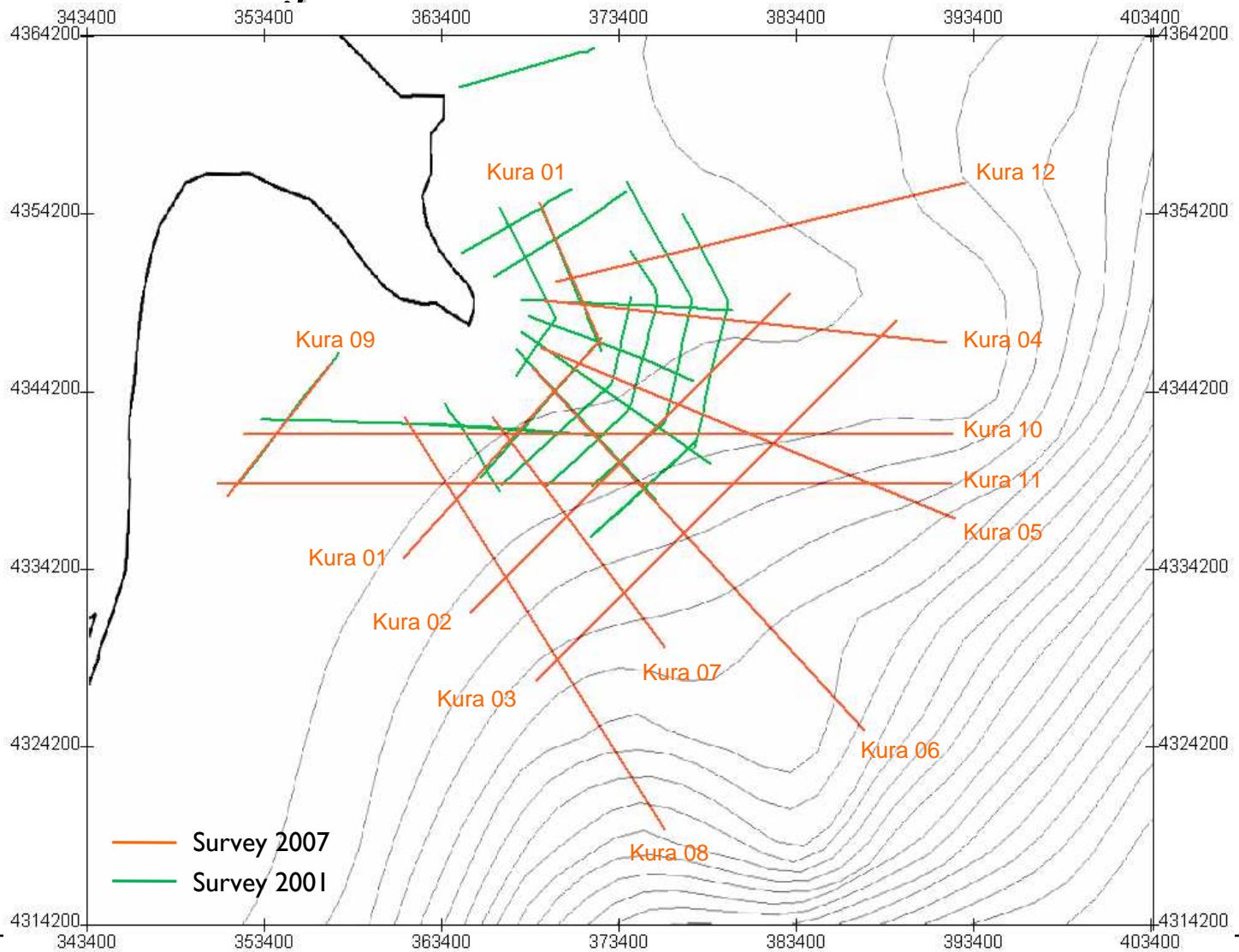
Craig Loehle used 18 other proxies and produced the graph above which clearly shows how the world was warmer 1000 years ago and cooler 300 years ago. We started warming long before coal-powered electricity was invented. There's no correlation with CO₂ levels.

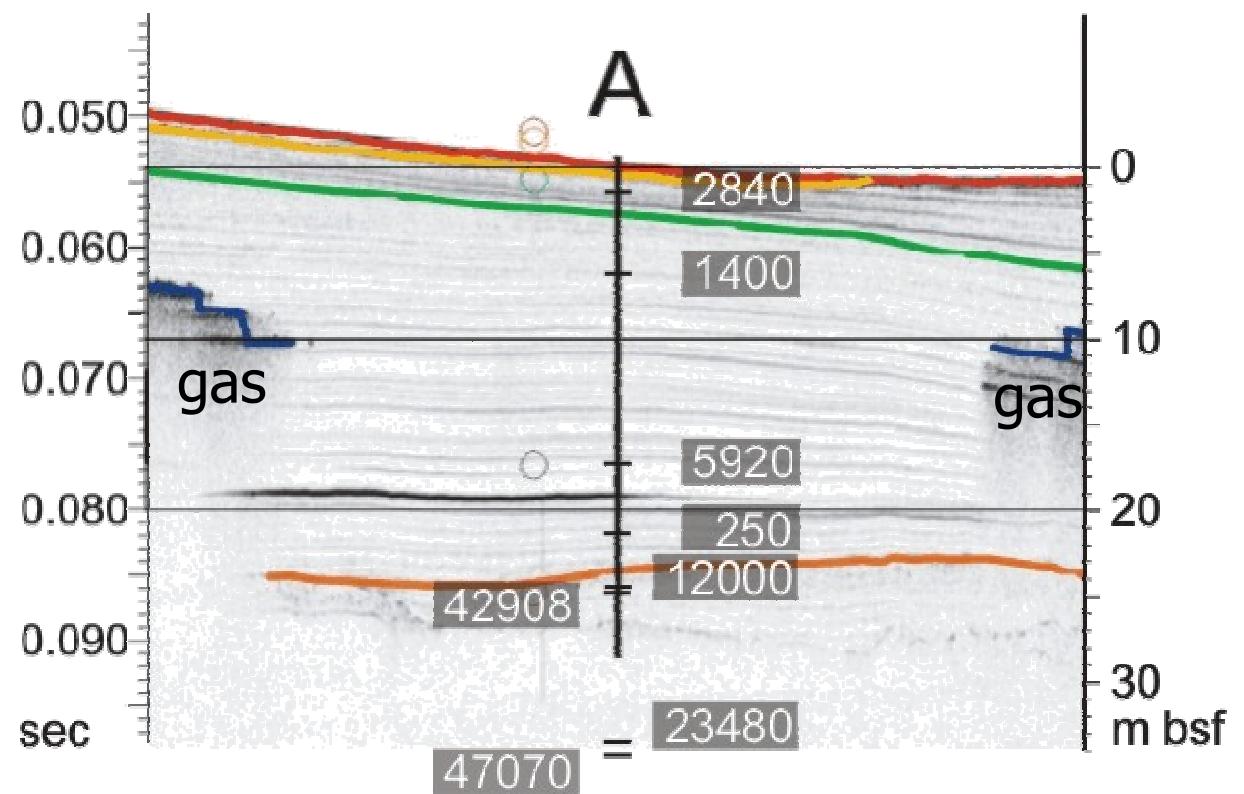
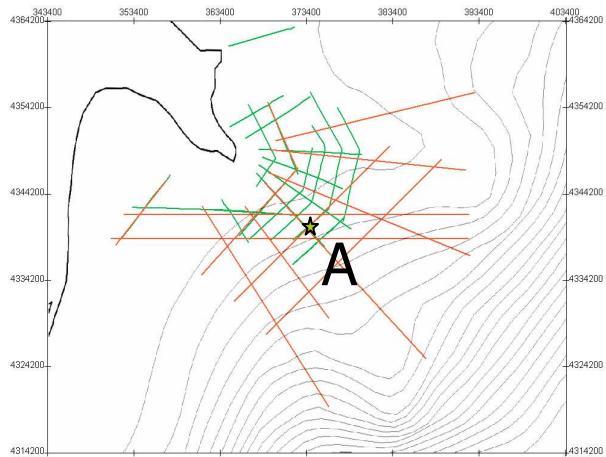
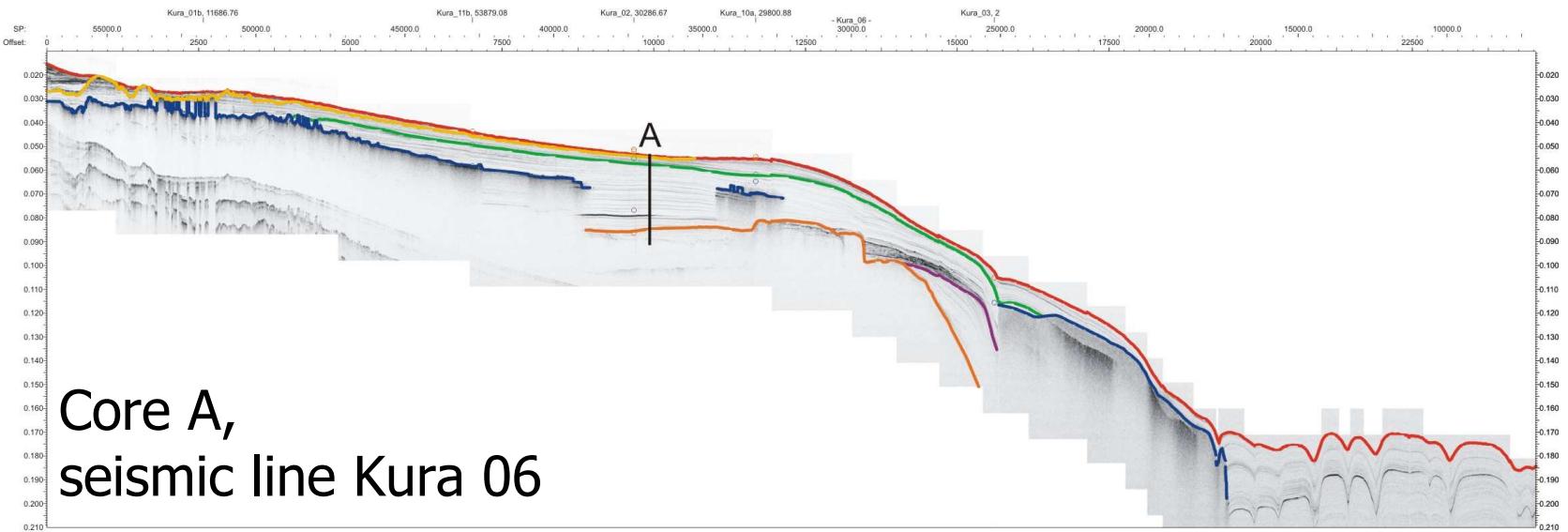


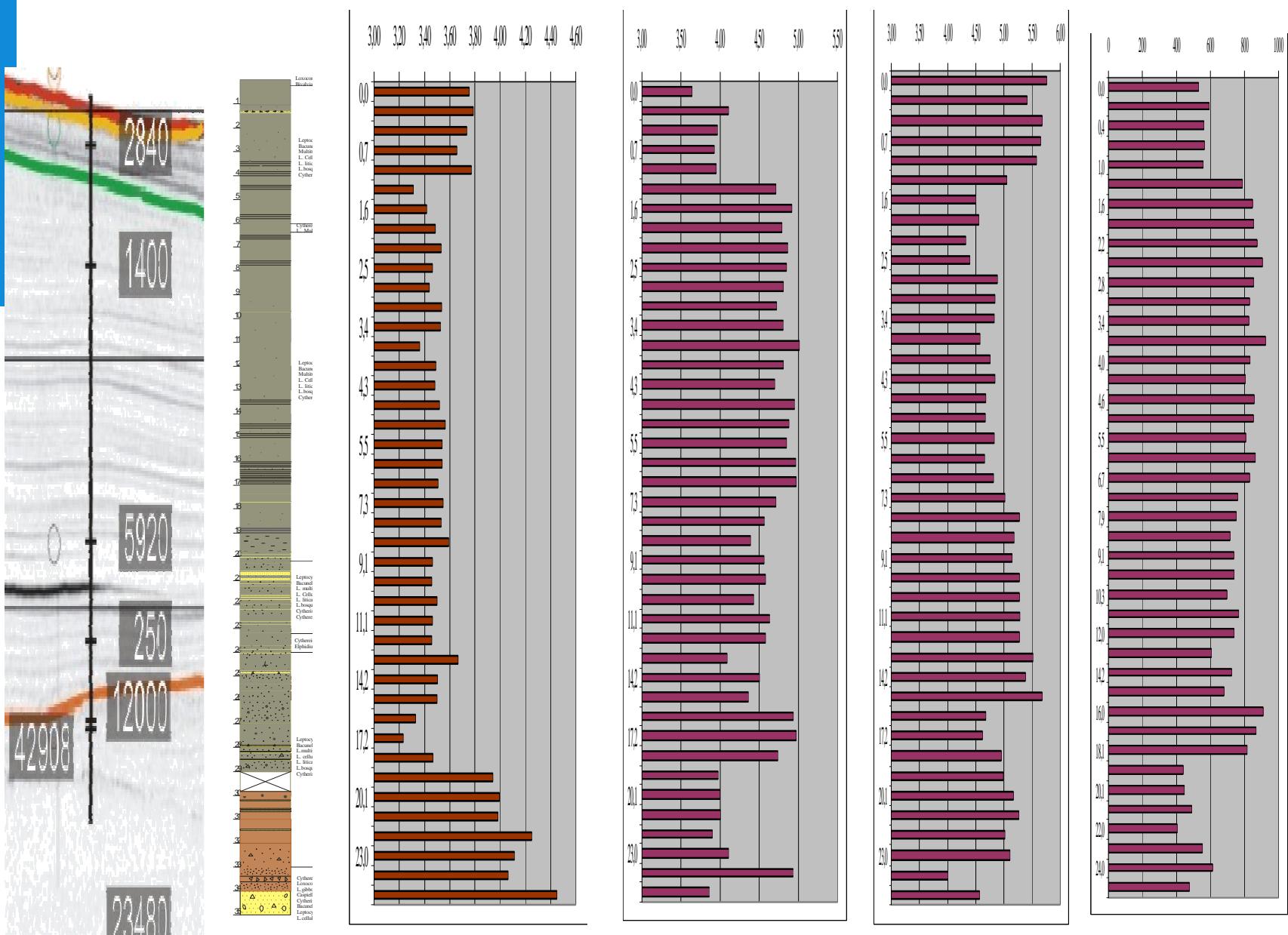
Early Khvalyn HST (17-13 ka BP?)
Overflow to Black Sea

Mangyshlak LST (9kaBP)

New seismic survey offshore Kura delta, Azerbaijan







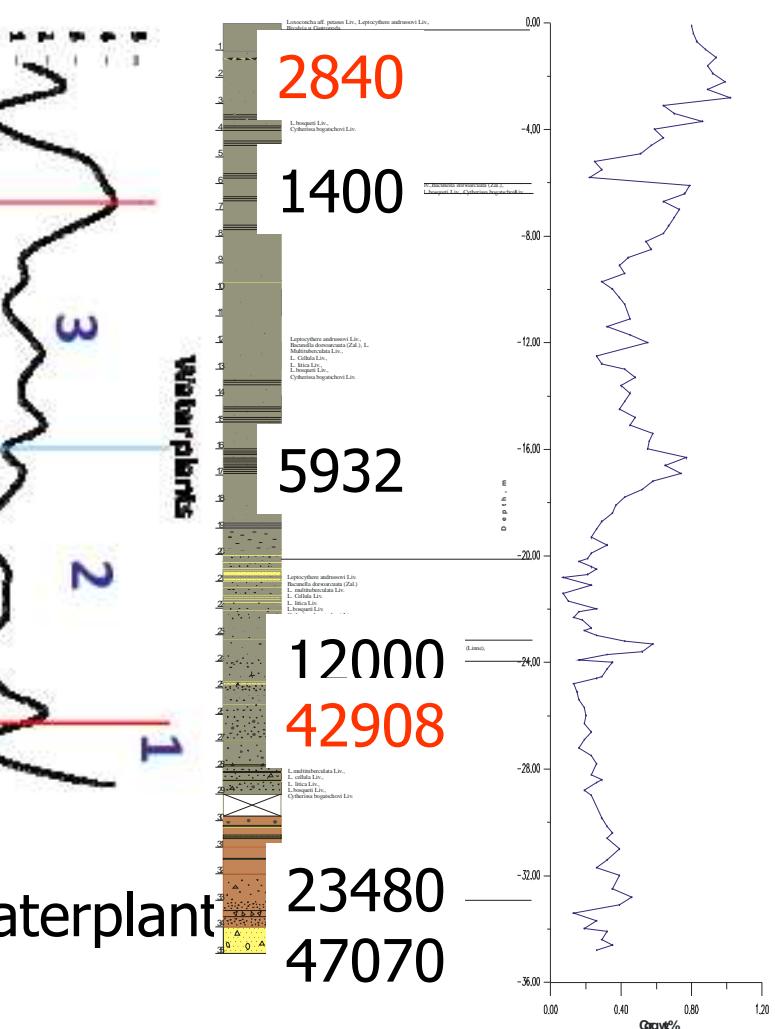
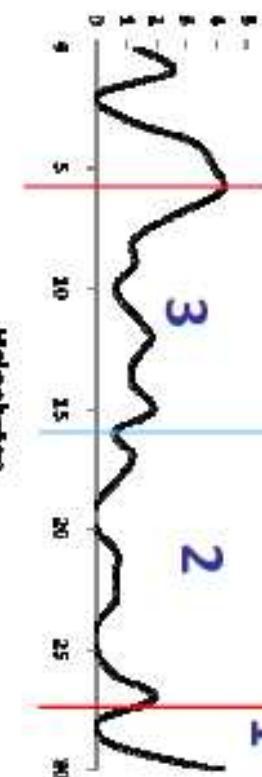
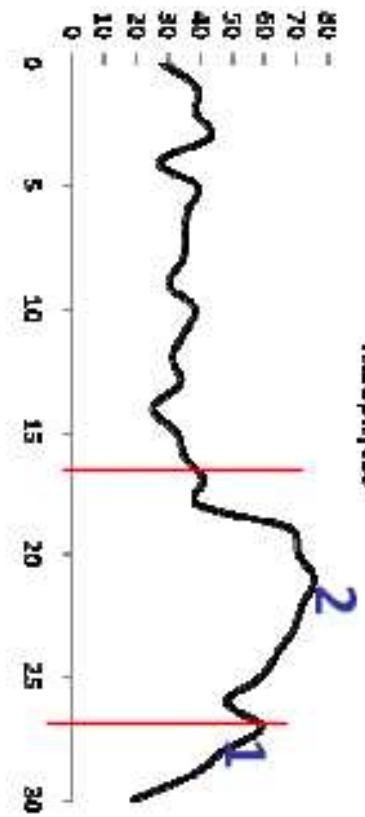
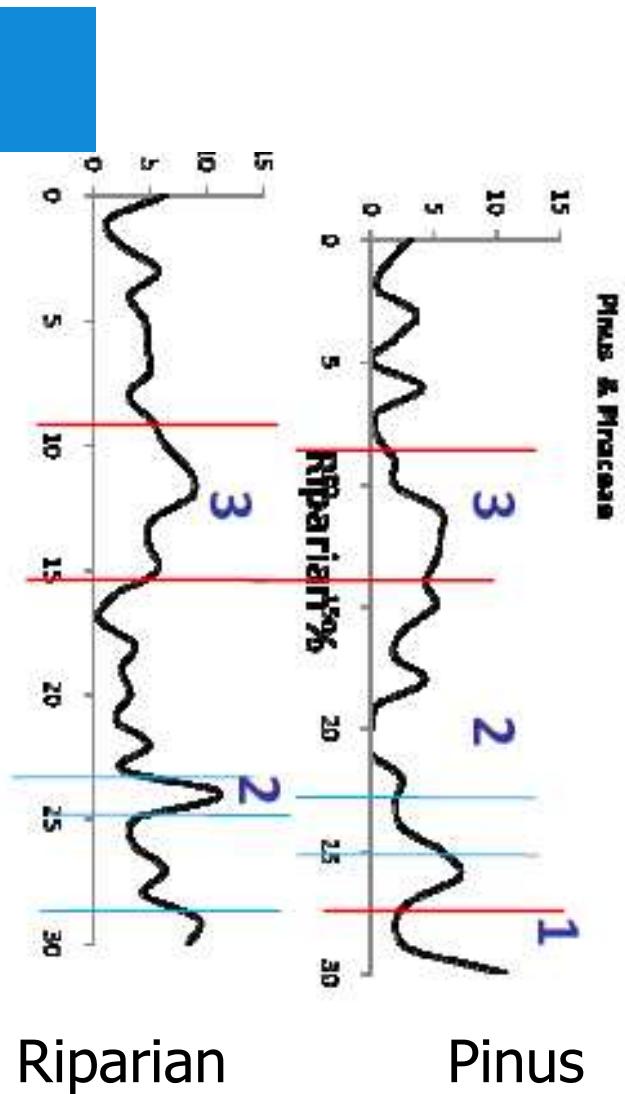
470

SiO₂/Al₂O₃

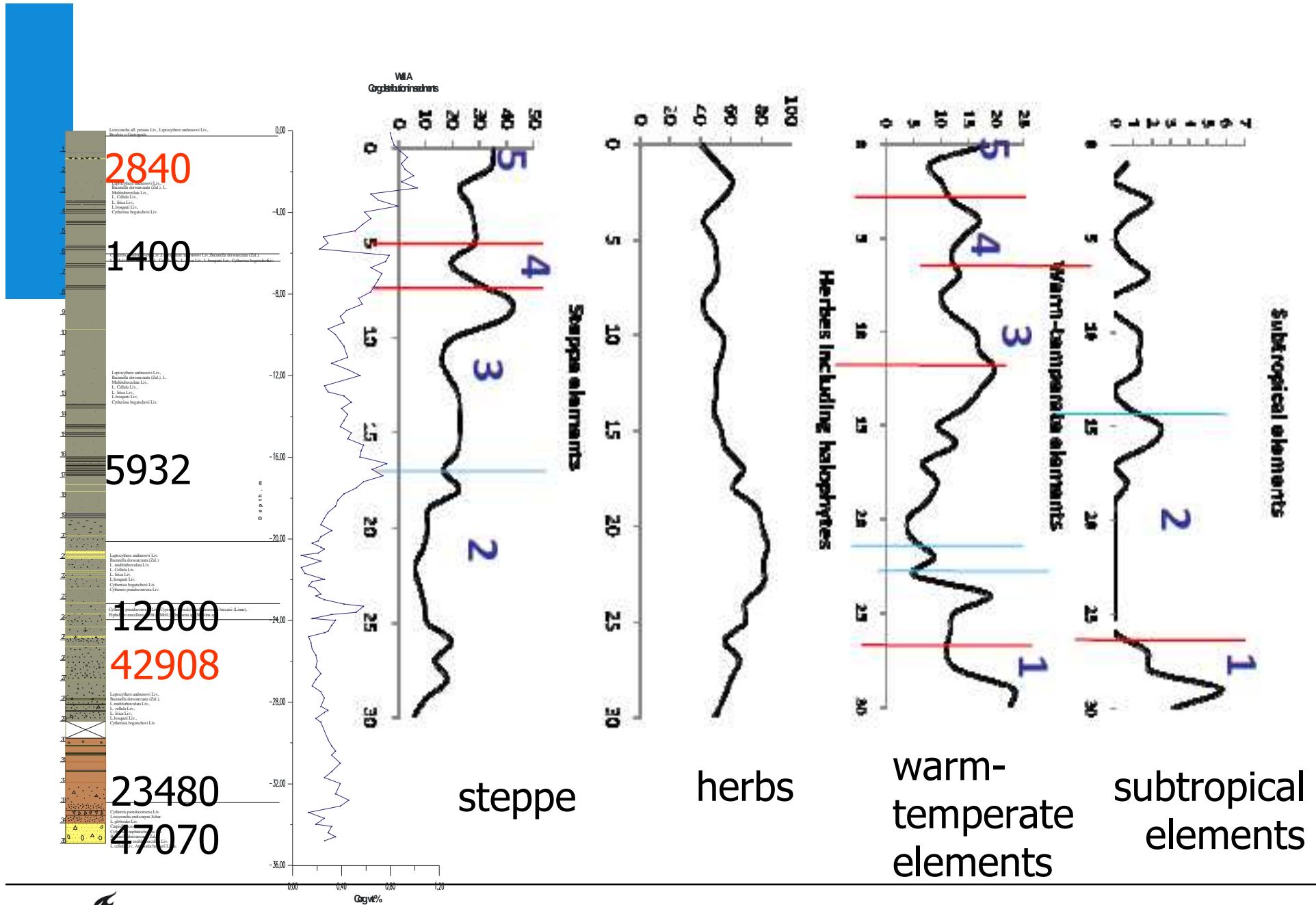
CaO/MgO

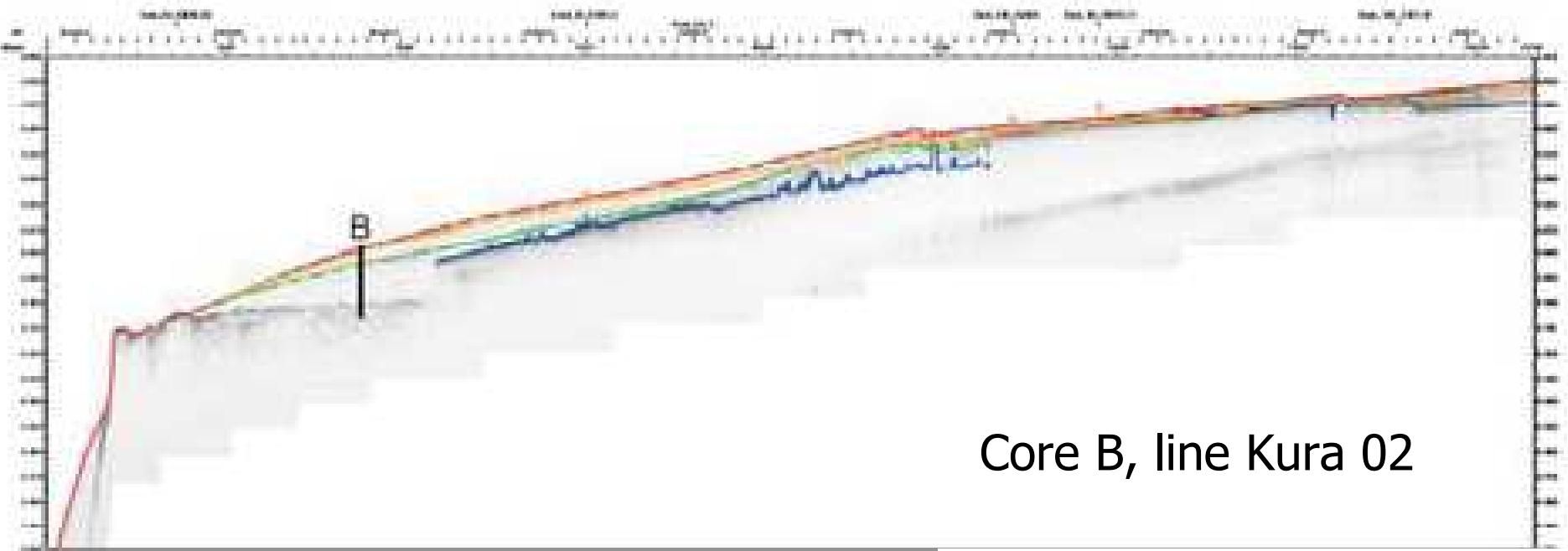
Fe₂O₃

SrO 22

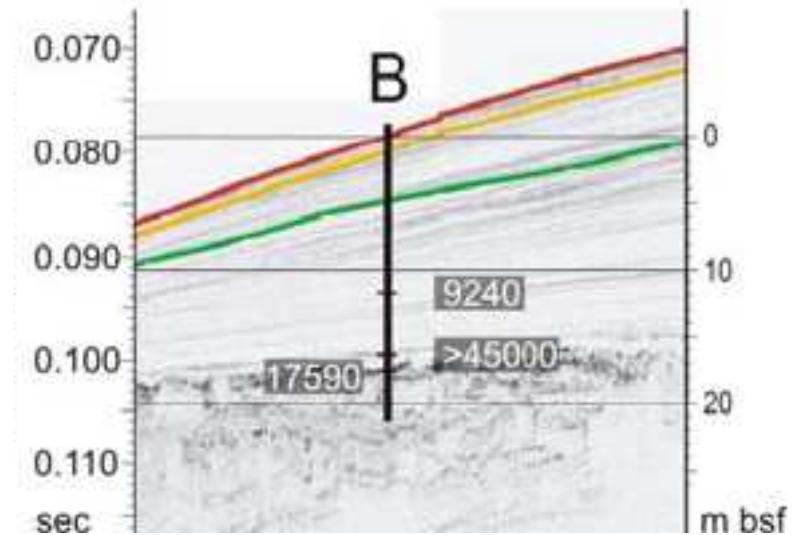
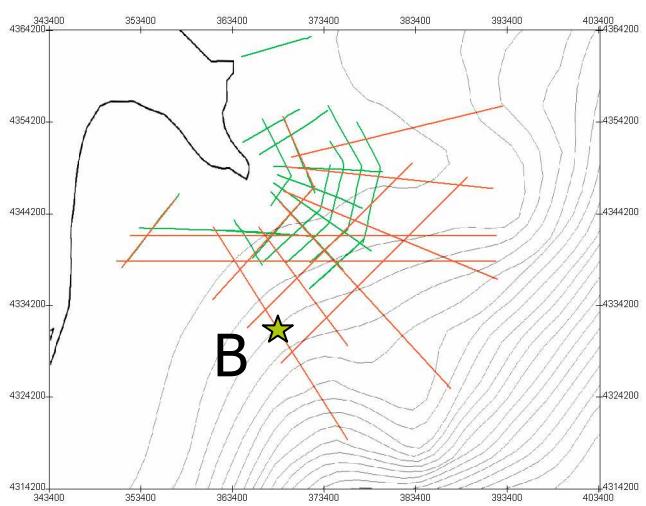


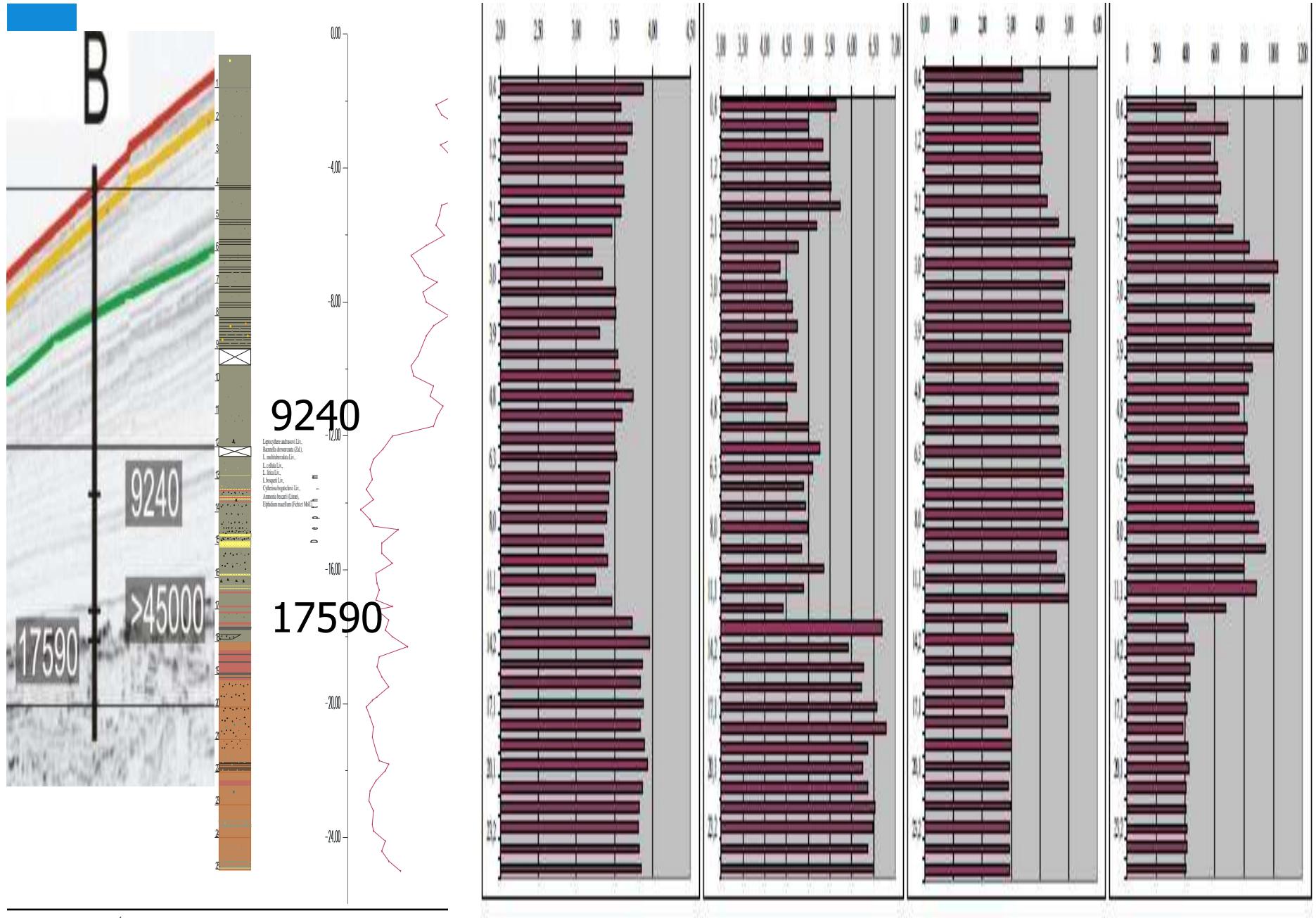
Log, ayes, C_{org}





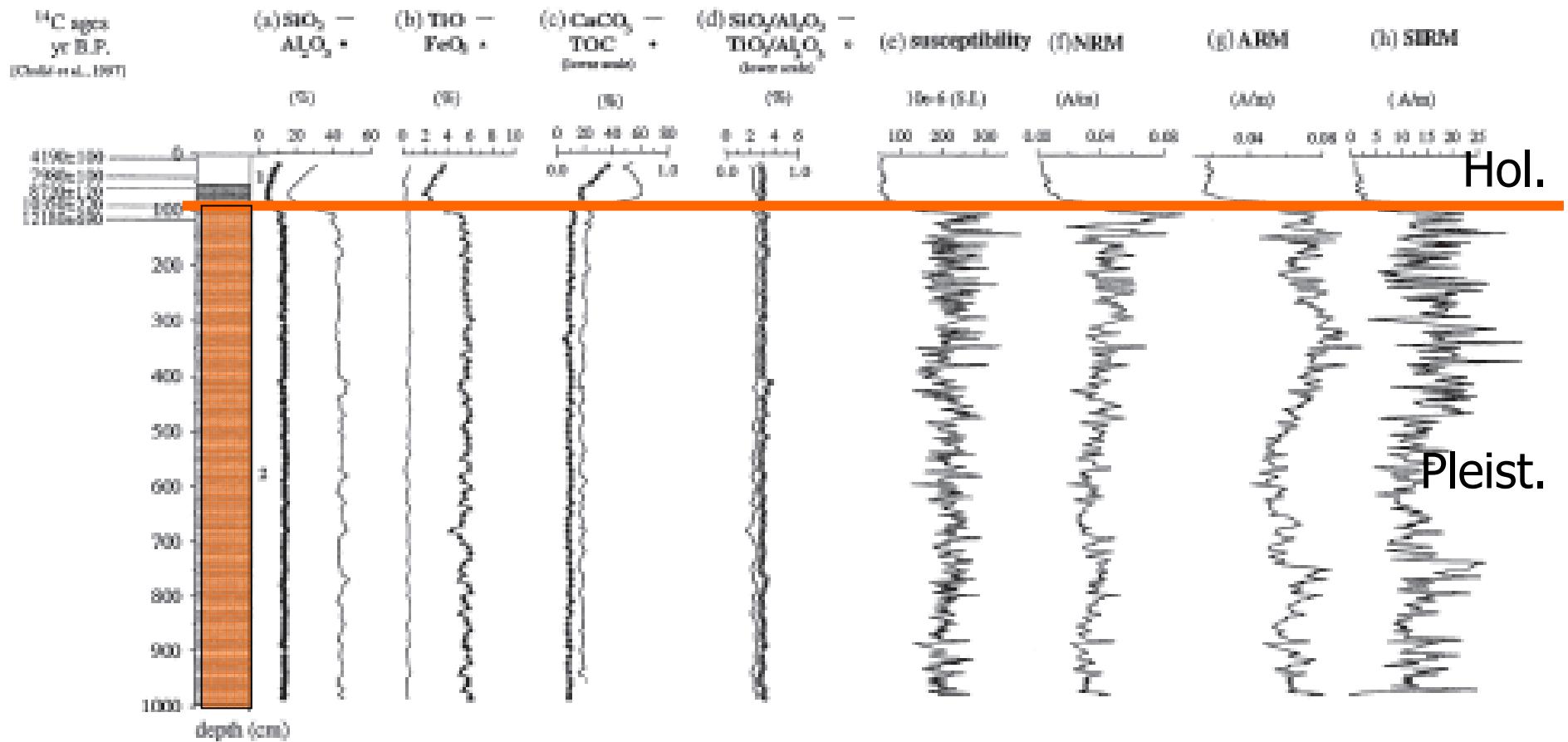
Core B, line Kura 02



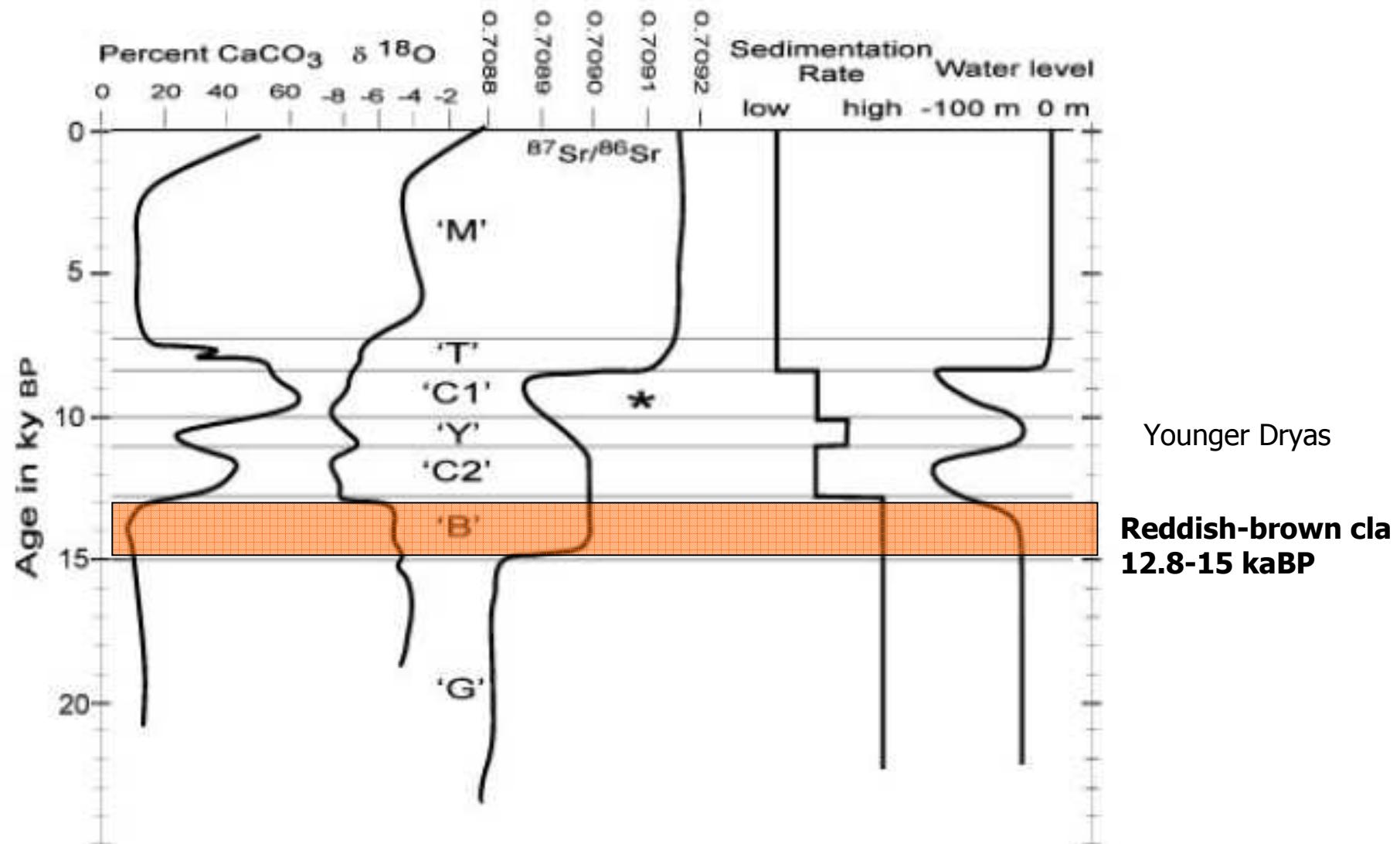


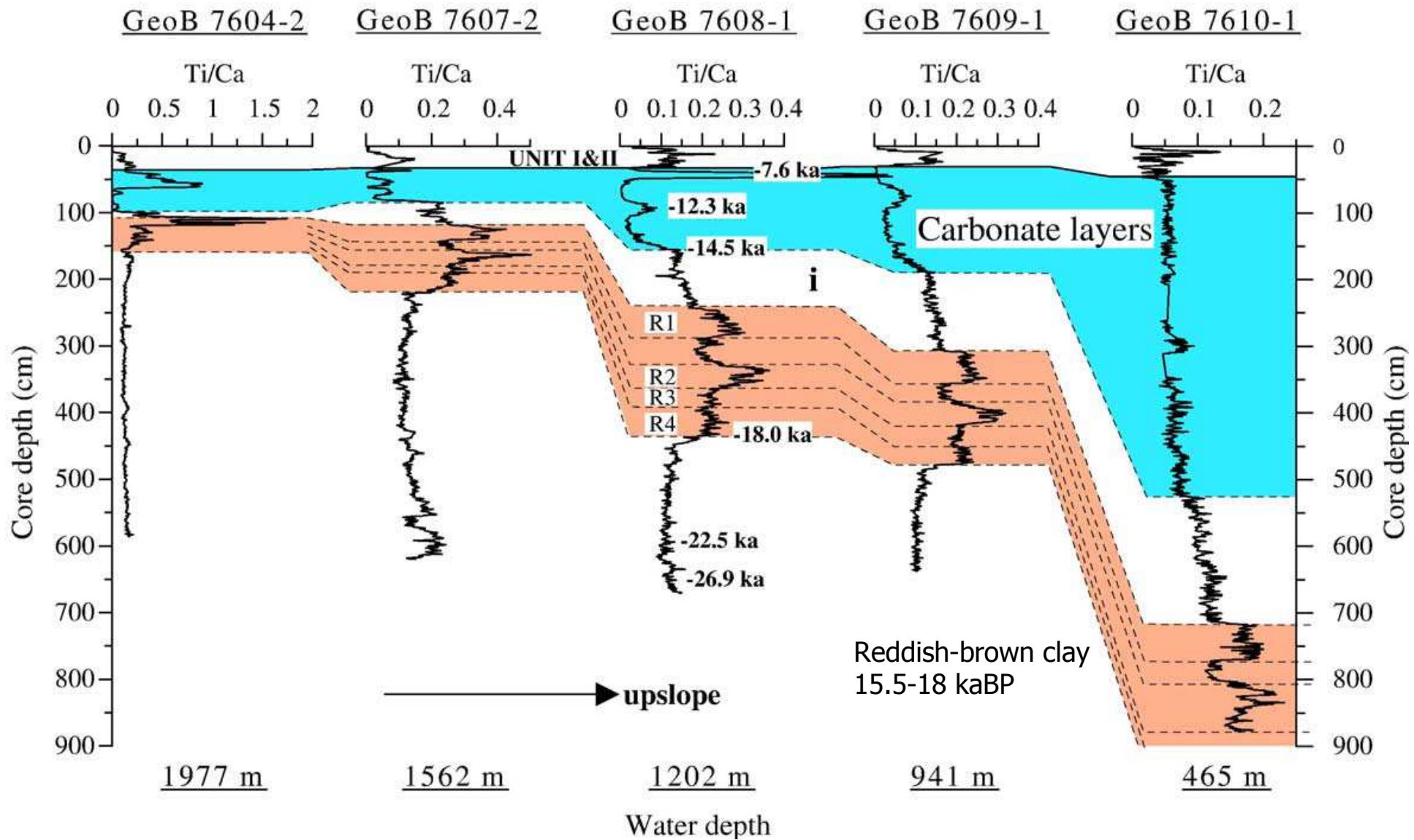
Sequence of events:

- (1) Glacial(?) deposits, sandy bottom Core A, ~ >40-~27ka BP
- (2) **Late Glacial highstand + 50m**, deposition reddish clays, "chocolate clays", *Pinus* from Volga
- (3) **Late Glacial/Holocene lowstand -92 m** ~ 12 ka, salt marsh with halophytes at -92 m, erosional unconformity
- (4) **Holocene highstand ~-22 m +2600 ka**, transgression since <9 ka encompassed several cycles
- (5) **6th-12th century AD Derbent lowstand -48m**
- (6) **Little Ice Age highstand -22m**, diversion towards Kızılıağac Bay
- (7) **Regression since LIA, -27 m now**, Kura resumes position, small cycles 20th C.

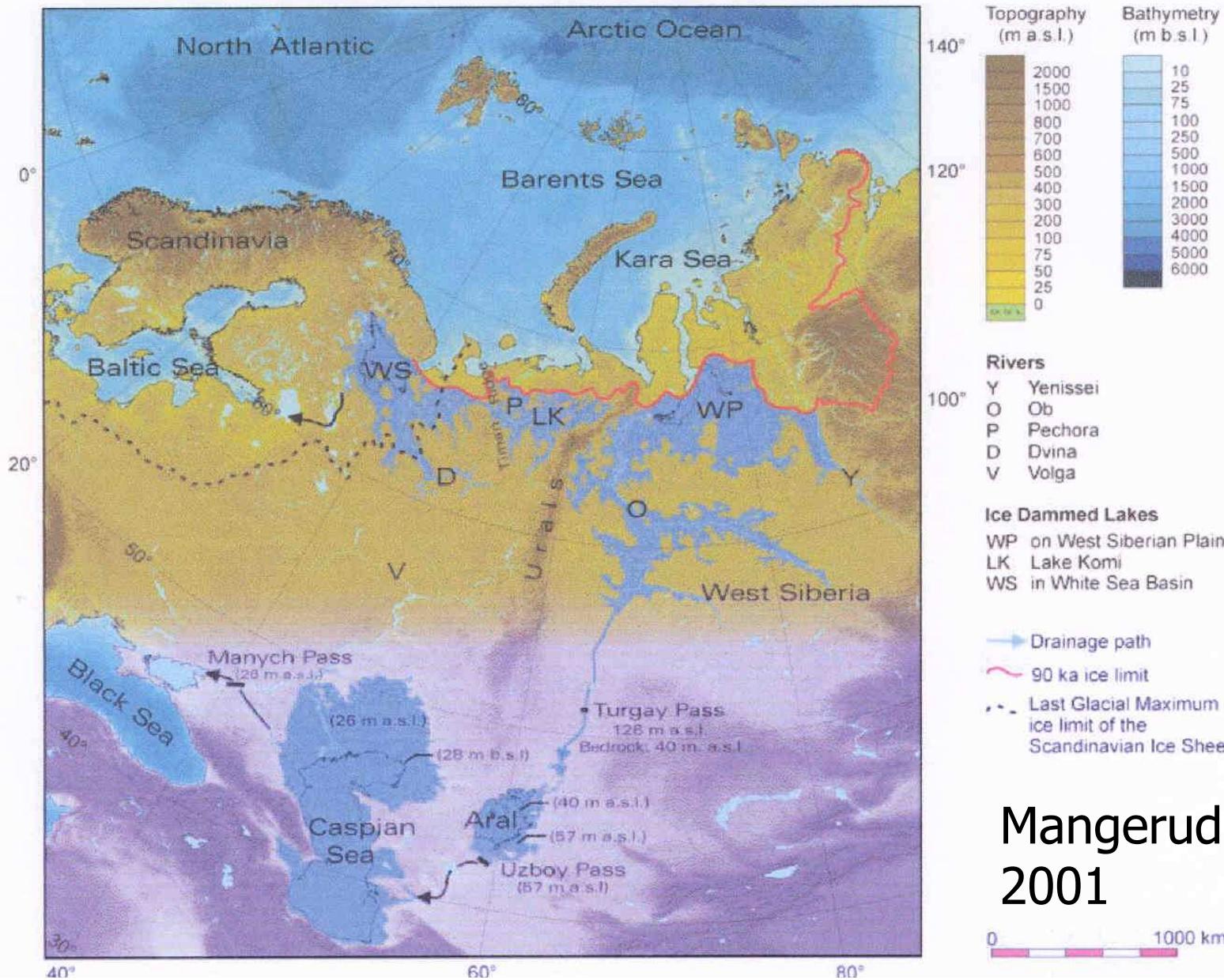


Jelinowska et al, 1998, chemistry, paleomag deepwater cores Caspian

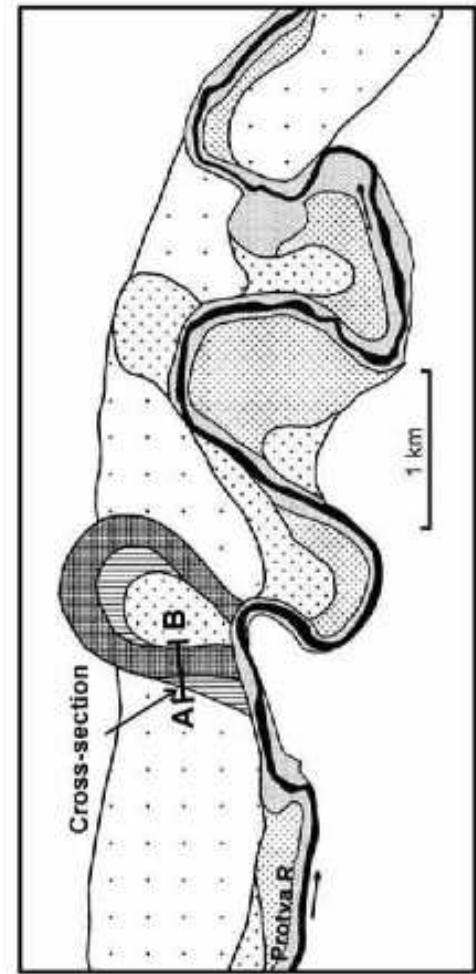
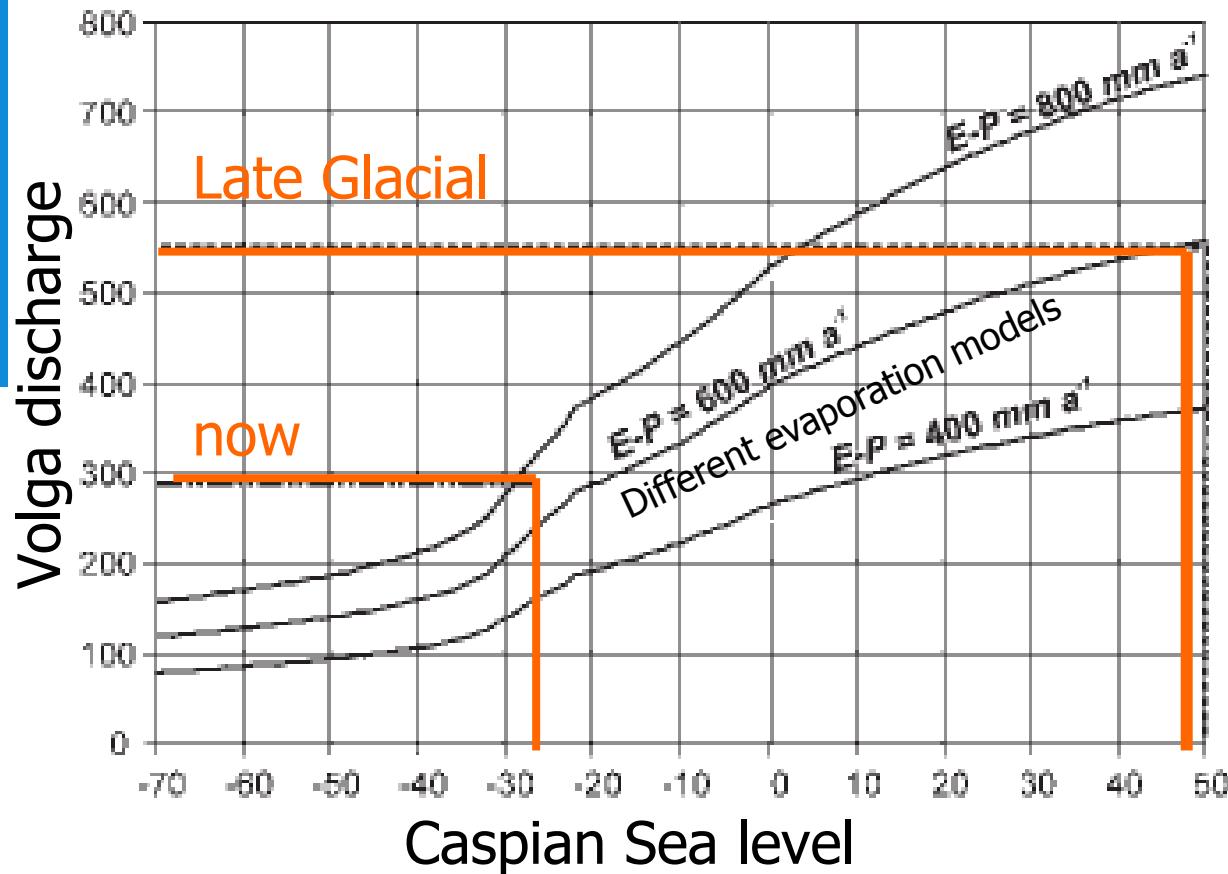




Late Pleistocene-Holocene stratigraphy NW Black Sea (Bahr et al., 2005)



Mangerud et al.,
2001



Or higher precipitation in Late Glacial (17-14 ka) in both basins as evidenced by larger meander loops? (Sidorchuk et al, 2009)

Conclusions

- Decadal highstands (3 m amplitude) Caspian follow ENSO/NAO, natural laboratory for sequence stratigraphy
- Centennial- millennial Caspian highstands (+25 m amplitude) during cool wet periods in Holocene (LIA, 2600 BP event)
- Late Glacial Caspian highstand (+50m ASL, red-brown clays), may also be the result of highly increased precipitation, with minor or no influence of deglaciation.
- Late Glacial histories Caspian and Black Sea are similar, through similar precipitation and discharge increases, deglaciation and/or overflow from Caspian



Thanks to sponsors:
EU-INTAS, NWO, RFFI, IGCP481, BP, Shell