Tectonics and Environment at the western end of the Baikal Rift:

Paleolake sediment record from Darhad Basin, Northern Mongolia

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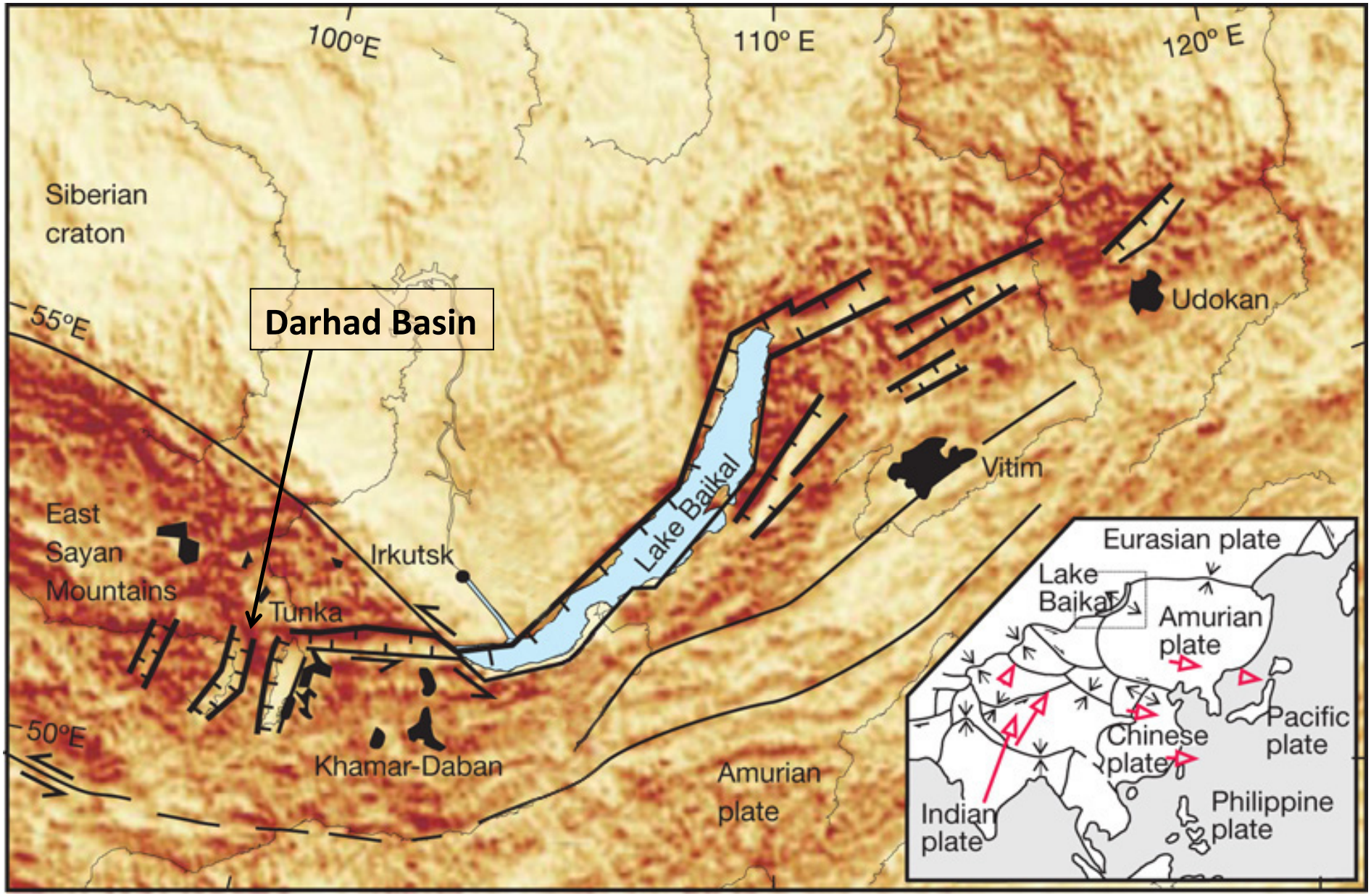
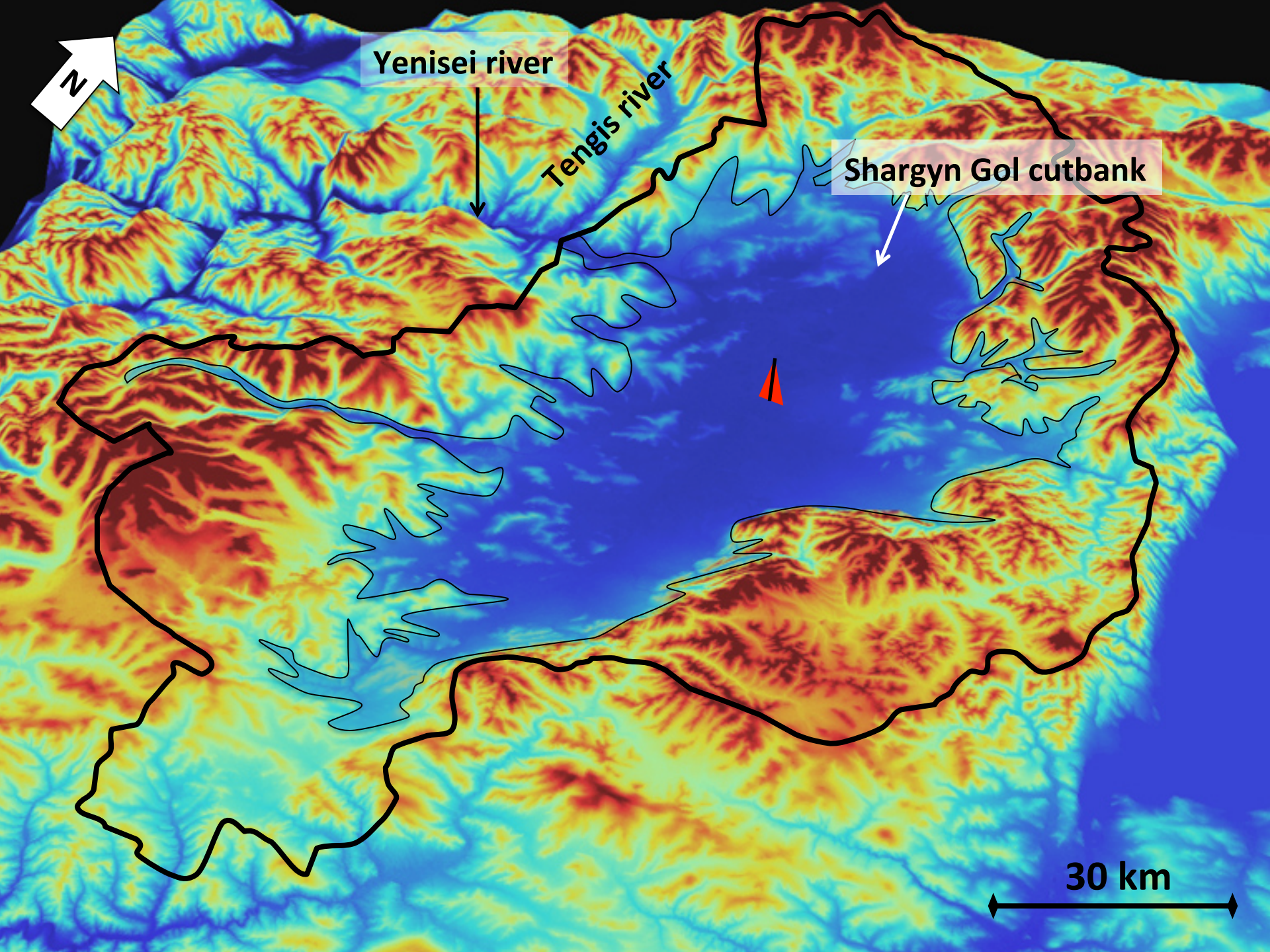


H. Thybo and C. A. Nielsen (2009)


N
Yenisei river
Tengis river
Shargyn Gol cutbank
30 km

Depth

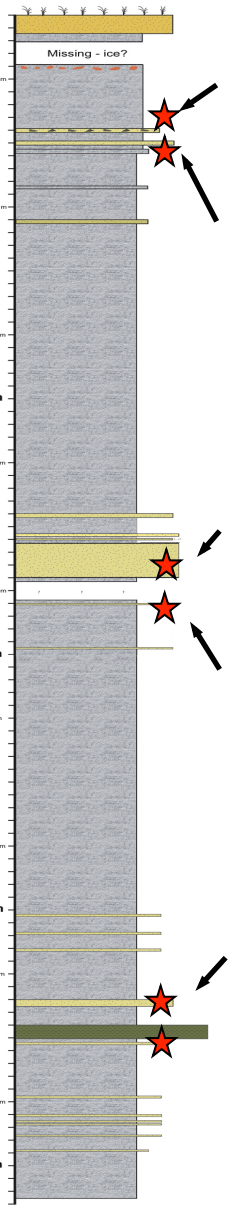
0 m

20 m

40 m

60 m

80 m



18.3 ±3.6 ka quartz OSL
25.3 ±0.3 ka feldspar (min.)

27.0 ±4.1 ka quartz OSL
20.1 ±0.2 ka feldspar (min.)

42.7 ±7.8 ka quartz
~42 ka feldspar (min.)

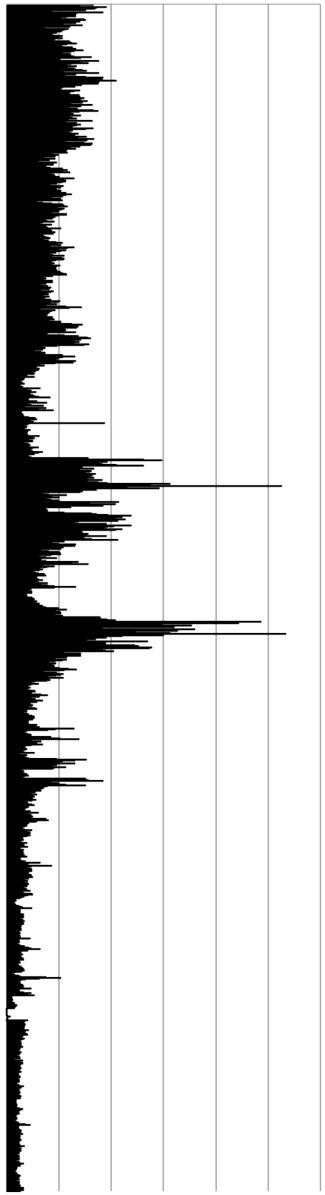
45.2 ± 4.9 ka quartz
61.0 ± 6.0 ka feldspar (min.)

123.6±19.8 ka (fine OSL)
135.0±21.3 ka (fine IRSL)

?

Magnetic Susceptibility
k x 10^{-6} CGS

0 150 300



Geologic events

Holocene: Lake dried

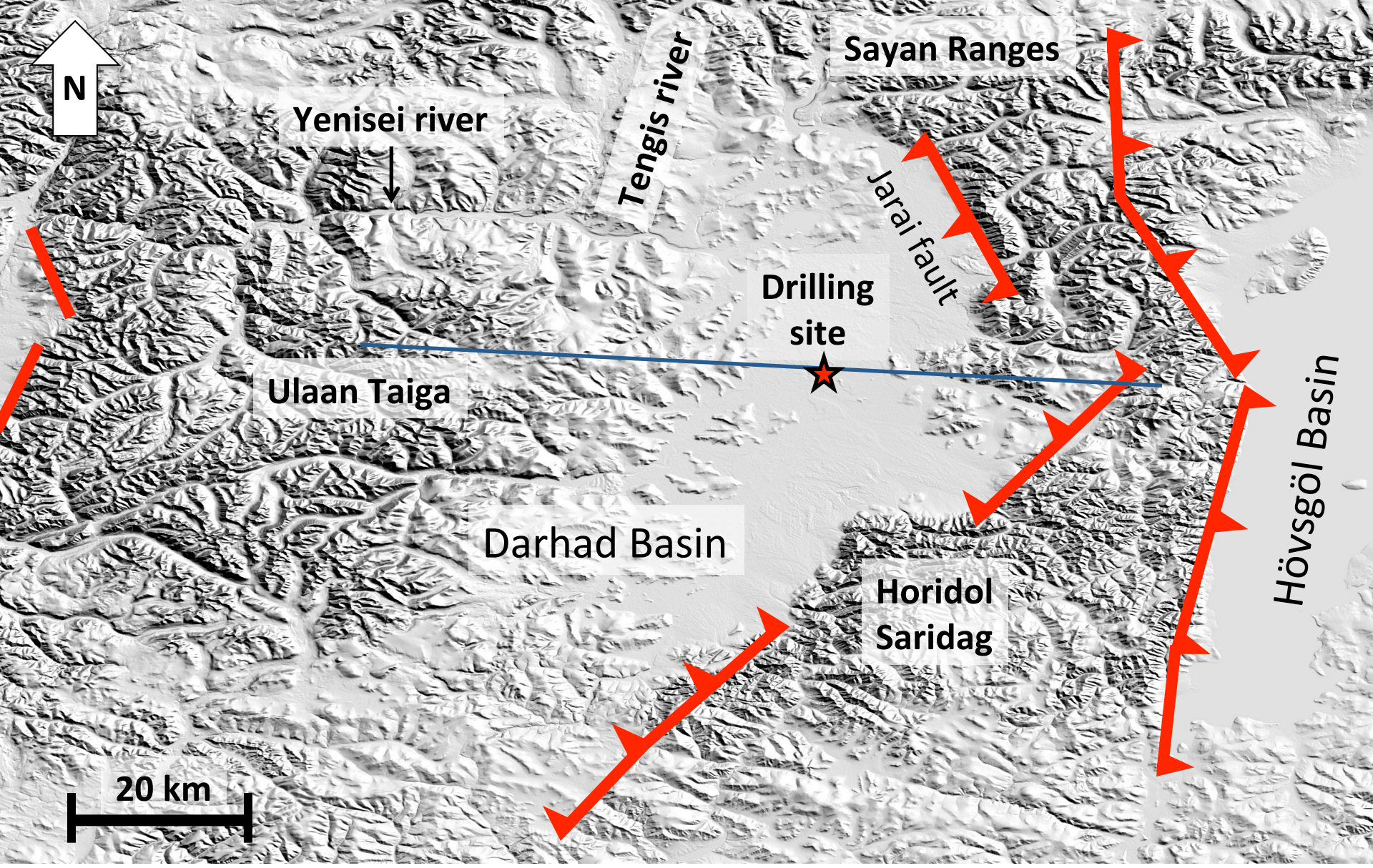
~20 ka: Last Glacial Maximum

~35 ka: Glacial Maximum

High magnetic susceptibility:
Intensive erosion

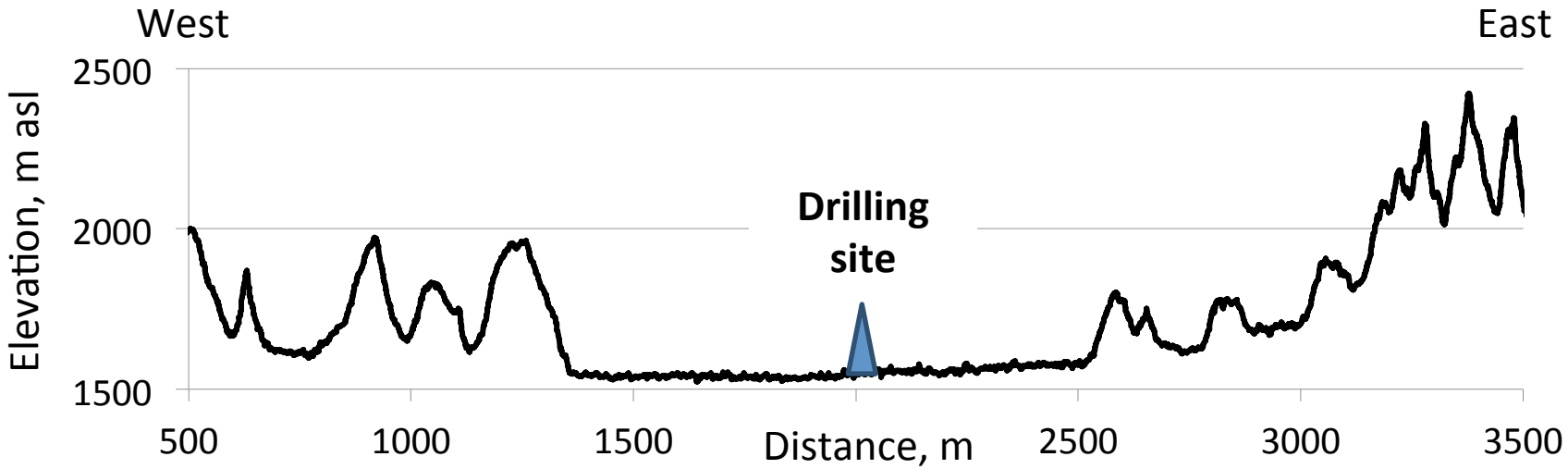
Basin closed for 1000 (?) yr

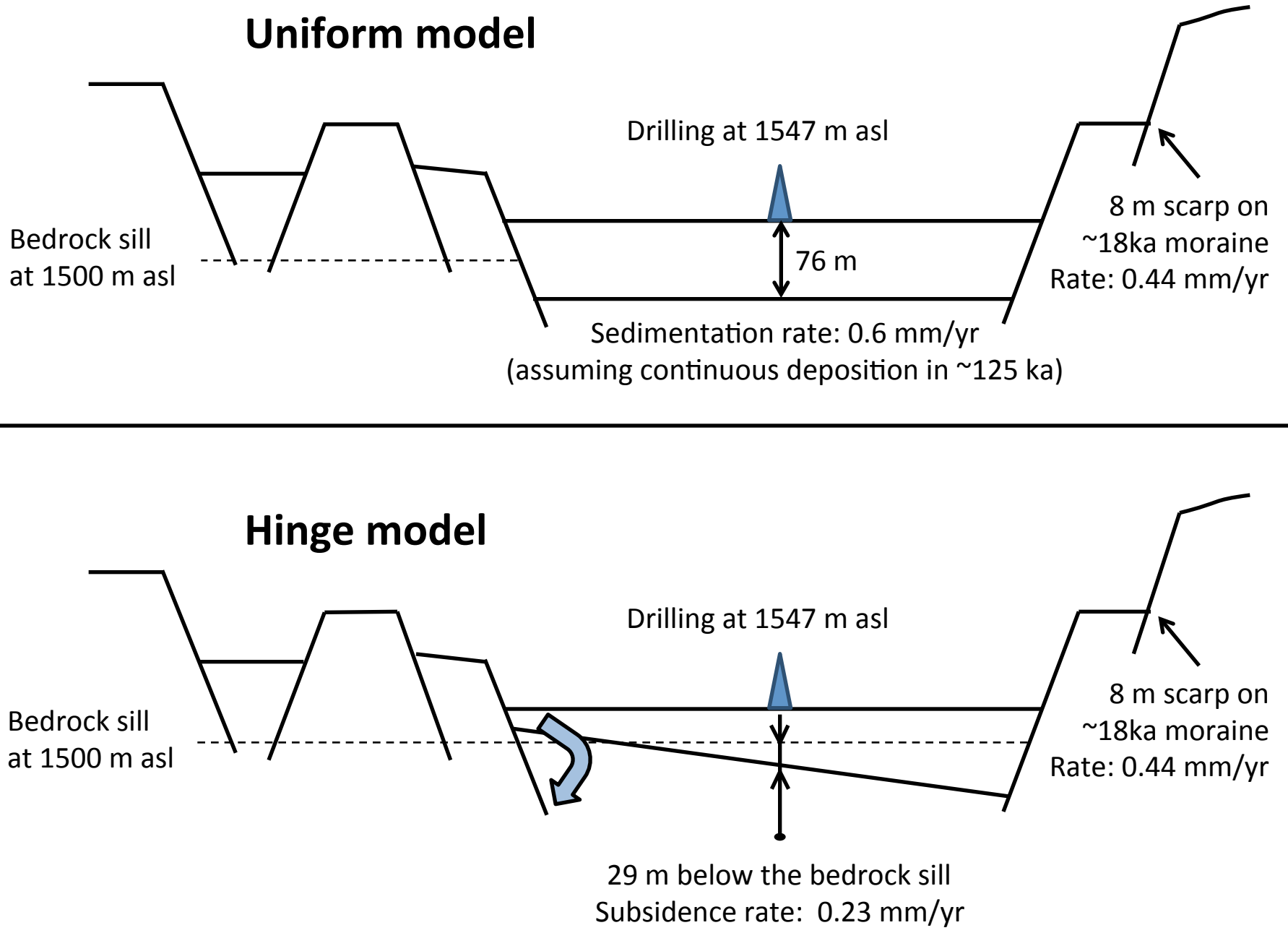
? ka: Glacial Maximum



Major faults near Darhad Basin

Calais et al. (2003)
Bayasgalan et al. (2009)


West
East
2500
2000
1500
Elevation, m asl
Drilling site
500
1000
1500
Distance, m
2500
3000
3500


Uniform model
Drilling at 1547 m asl
Bedrock sill
at 1500 m asl
76 m
8 m scarp on
~18ka moraine
Rate: 0.44 mm/yr
Sedimentation rate: 0.6 mm/yr
(assuming continuous deposition in ~125 ka)
Hinge model
Drilling at 1547 m asl
Bedrock sill
at 1500 m asl
8 m scarp on
~18ka moraine
Rate: 0.44 mm/yr
29 m below the bedrock sill
Subsidence rate: 0.23 mm/yr

Which one is more likely?

Uniform model:

Uplift at 20 ka < Sedimentation rate at 125 ka
Was subsidence rate different at ~125 ka?

Hinge model:

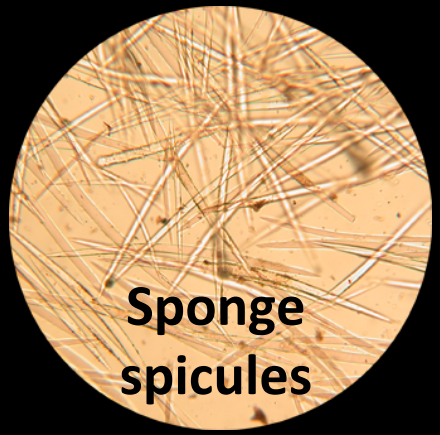
Subsidence rate at the center ≈ Uplift in the east
Requires closed basin at ~125 ka

Unique layer at 79 m depth

No clastic material:
- Subsidence >> sediment influx (suggests closed basin in order to accommodate 1 m thick biogenic carbonates)
- Minimal erosion: Interglacial

Abundant in mollusc shells:
- The lake was not completely dried up as of today
- Shallow and mildly alkaline lake

Fresh water diatoms (only one species):



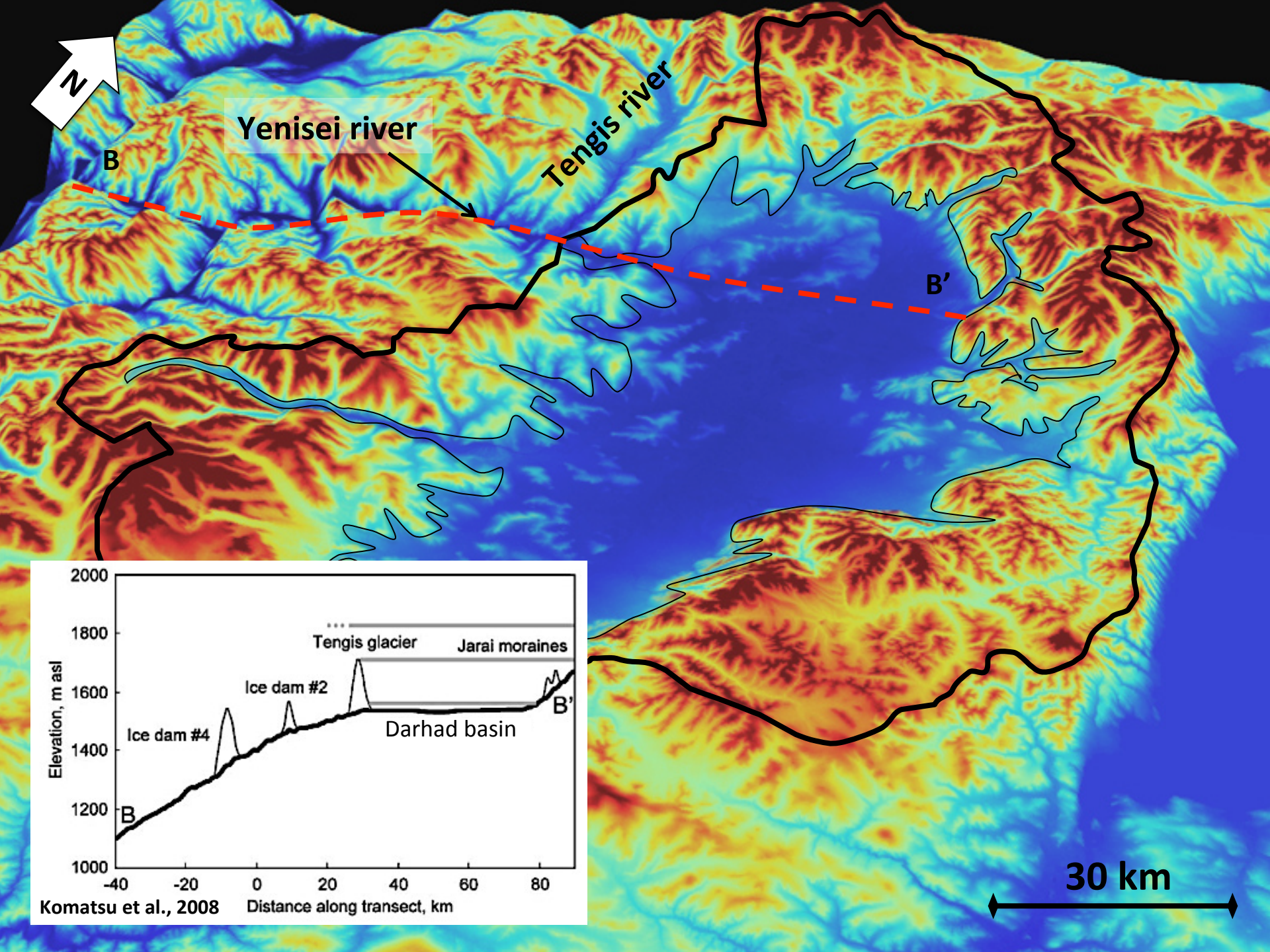
High abundance of sponge spicules:
Restricted environment with relatively still water

Statospores suggest summer desiccation:
Dry climate

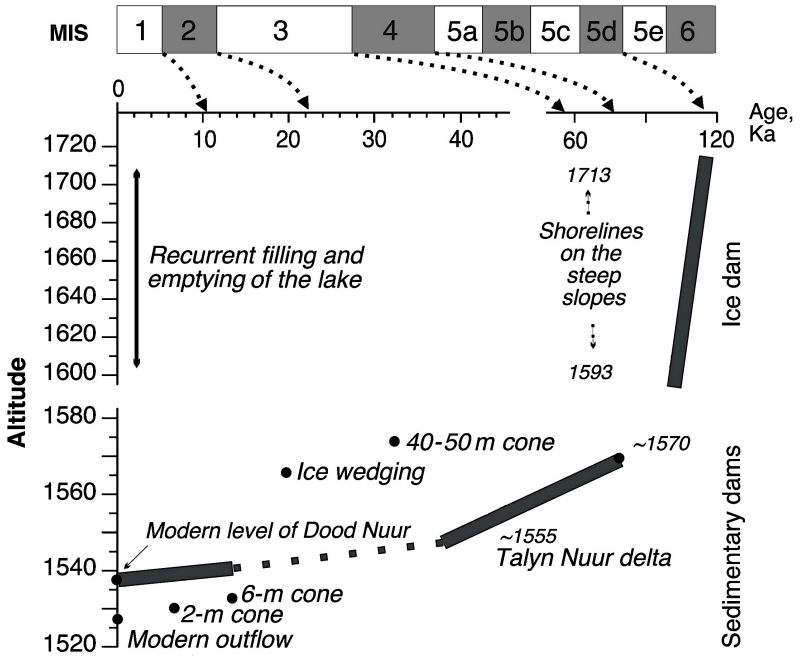
Hinge model is more likely!

- 0.23 mm/yr at the center (@ ~125 ka)
- 0.44 mm/yr in the east (@ ~18 ka)

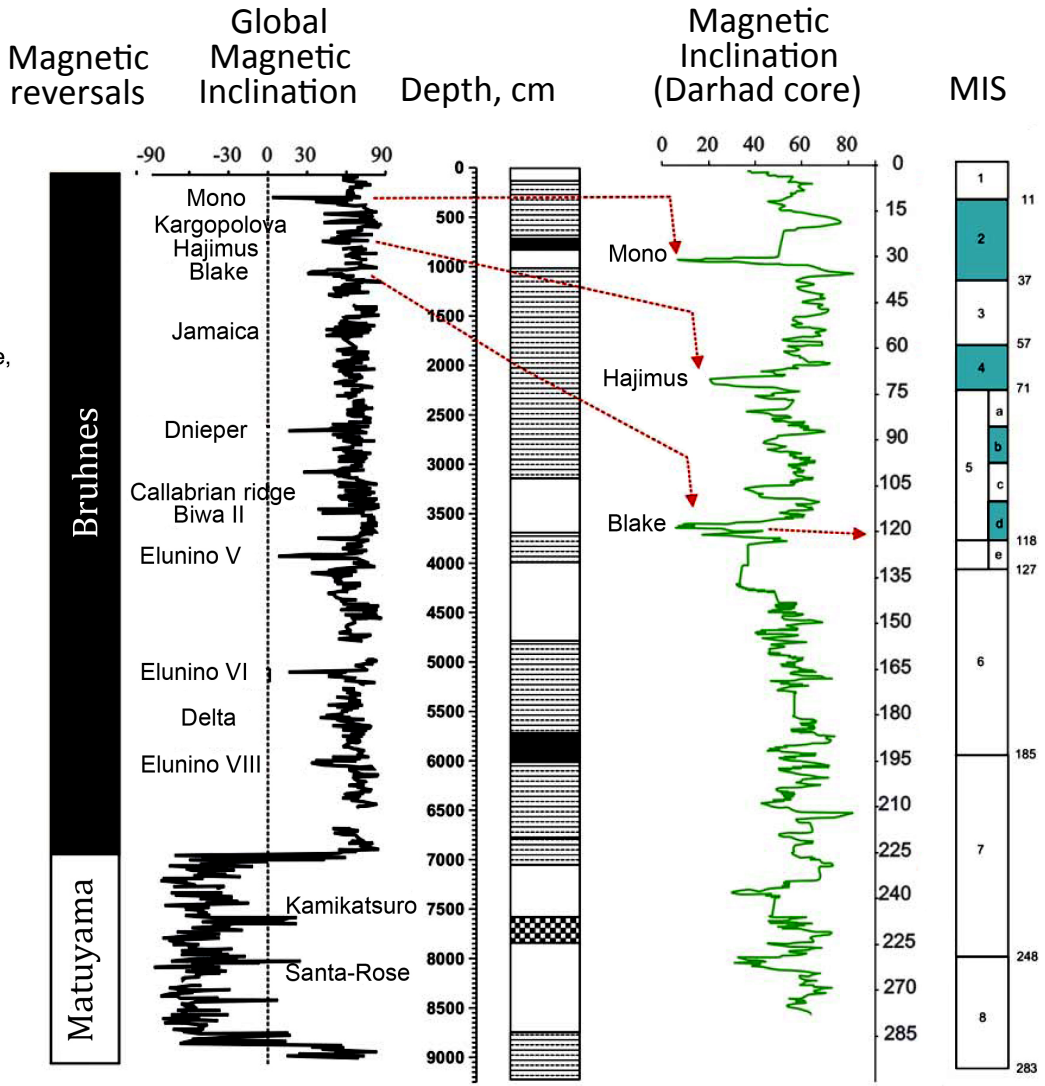
Subsidence rate on the 10^5 yr time scale is ~same as on the 10^4 yr time scale in Darhad Basin.


N
Yenisei river
Tengis river
B
B'
Tengis glacier
Jarai moraines
Ice dam #2
Ice dam #4
Darhad basin
B'
B
Elevation, m asl
2000
1800
1600
1400
1200
1000
-40
-20
0
20
40
60
80
Distance along transect, km
Komatsu et al., 2008
30 km

Age models assuming continuous deposition



Krivonogov et al. (2005)



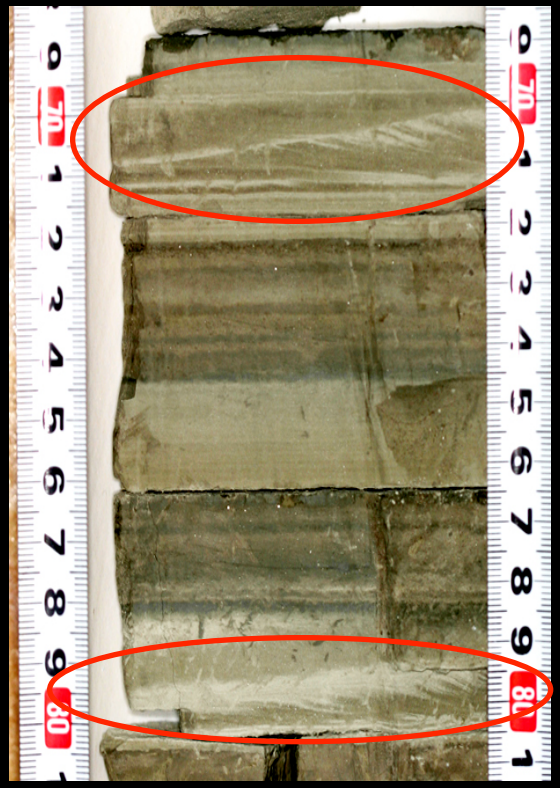
Narantsetseg et al. (2010)

Record from Darhad Basin is NOT continuous!

9.10 m

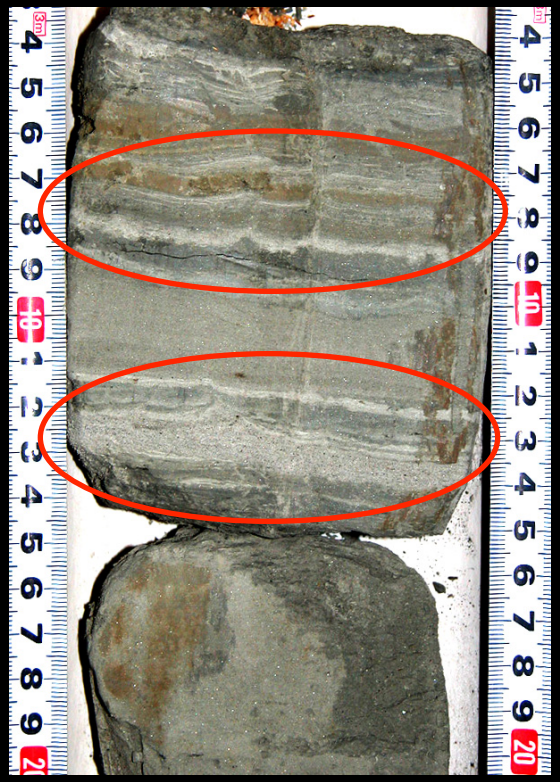
Slumping

31.0 m



Cross-bedding

71.0 m



Disconformity (?)

Conclusions

- Darhad Basin provides discontinuous record important to understand glaciation and tectonics in the region
- Subsidence rate on the 10^5 yr time scale ~same as on the 10^4 yr time scale.
- At ~125 ka, the basin was tectonically closed and hosted shallow lakes in a dry climate
- Last glacial maximum occurred at ~20 ka, in synchrony with global LGM.


Photo by Mathew Kuharic