

Palynology of Holocene Lake Baikal sediments

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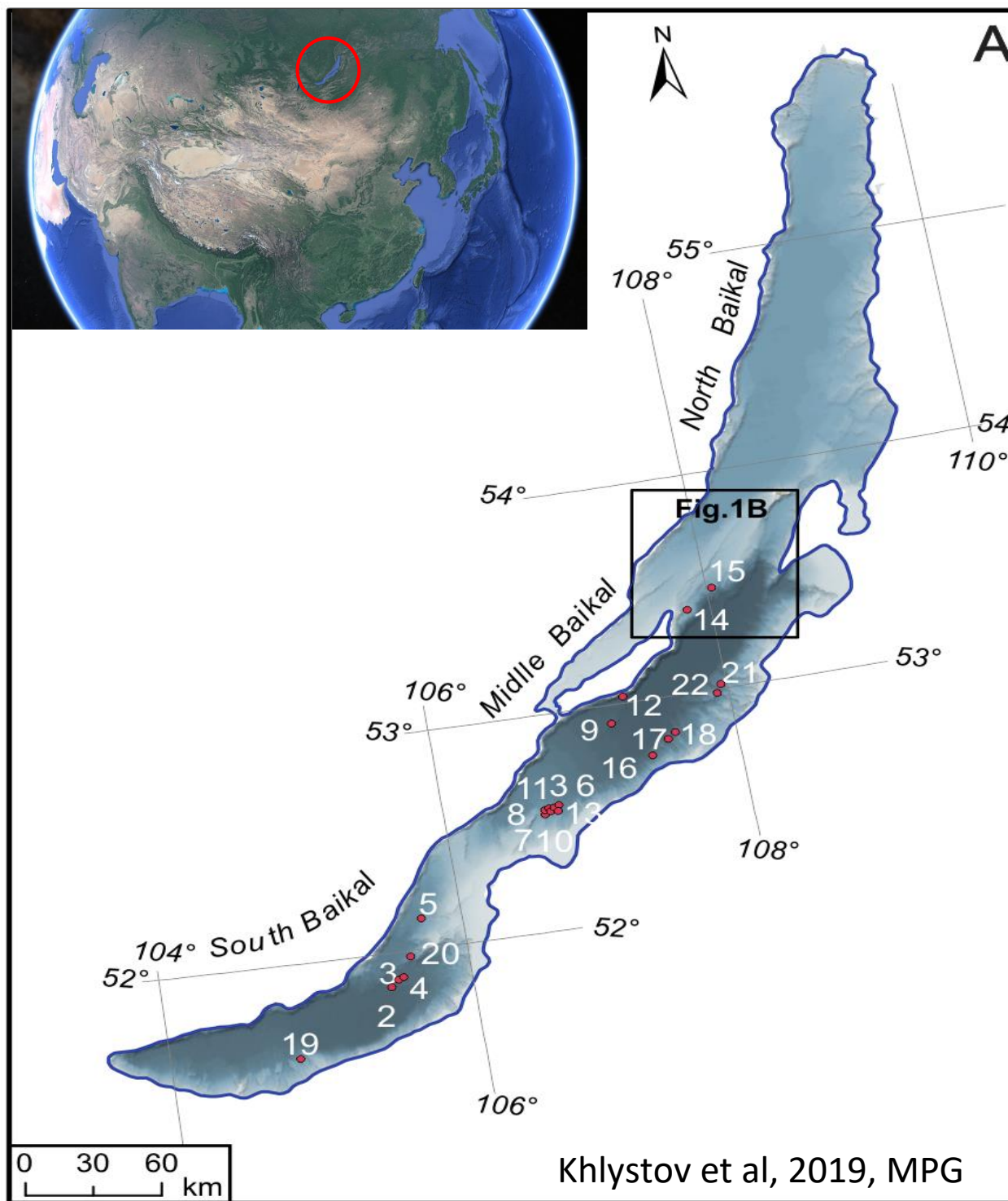
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TTR-BL19 Class@Baikal expedition

Baikal is the largest freshwater lake by volume in the world, containing 23% of the world's fresh surface water. The Lake fills the central depression of a 25 million years old continental rift zone and provides a large variety of active geological features. Morphologically the lake comprises three basinal areas:

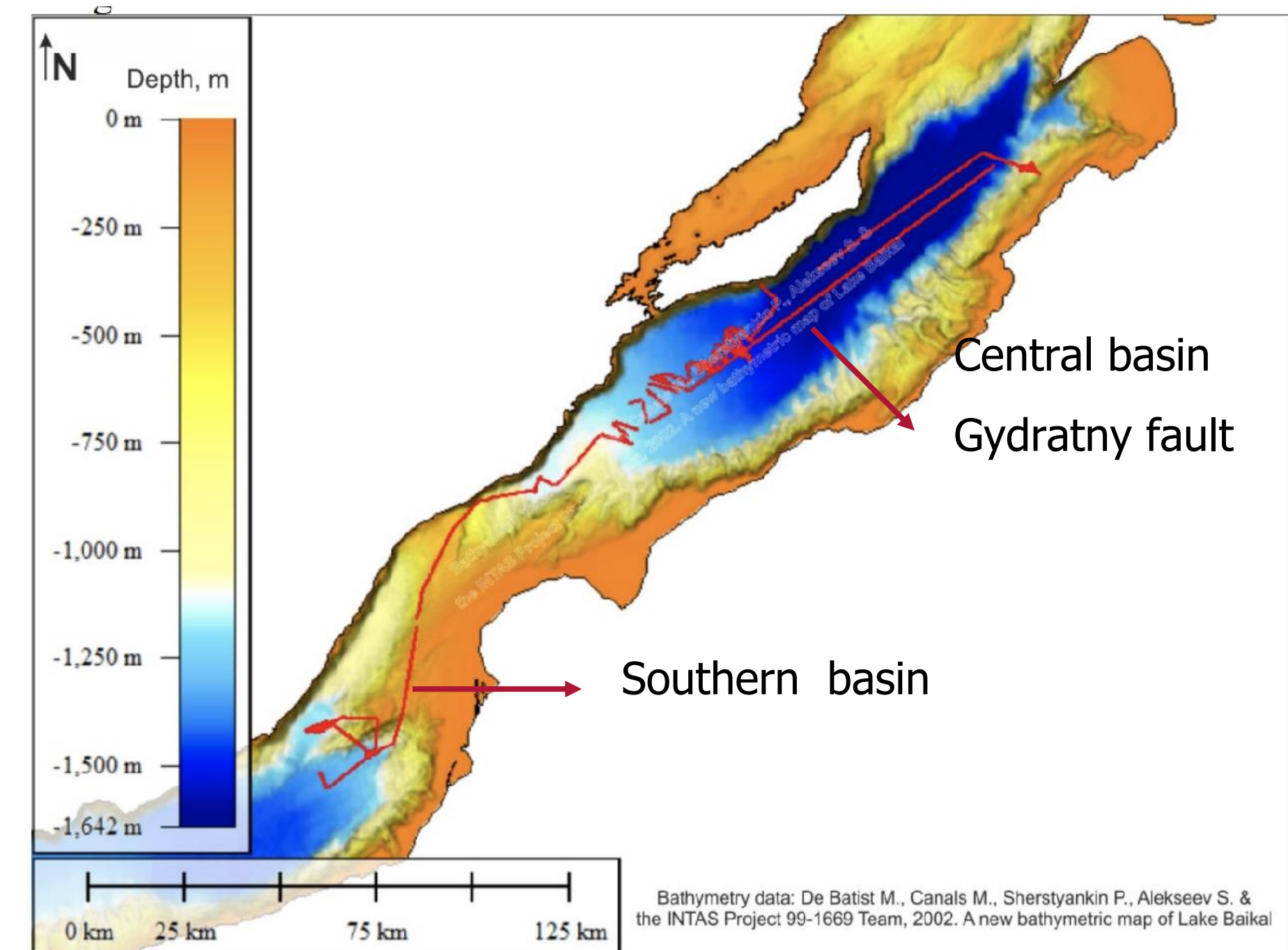
1 & 2. - The southern and central depressions divided by a depositional high resulting by the deltas of the Buguldeyka and Selenga Rivers.



3- The central and northern depressions separated by a SW-NE oriented tectonic high comprising terrestrial and subaqueous segments.

During the TTR6 Class@Baikal expedition (2019) a multidisciplinary survey completed set of geophysical and sampling profiles intersecting

- 1) The Gydratny fault in the central basin of the lake and
- 2) Several piercements structures in the southern and central basins.



Red line shows the areas investigated during the TTR-BL19 cruise.

Purpose of this study

This study shows the preliminary results of palynological studies on sediments recovered from two distinct areas where different geological phenomena occurred.

1. Central Basin- Gydratny fault region

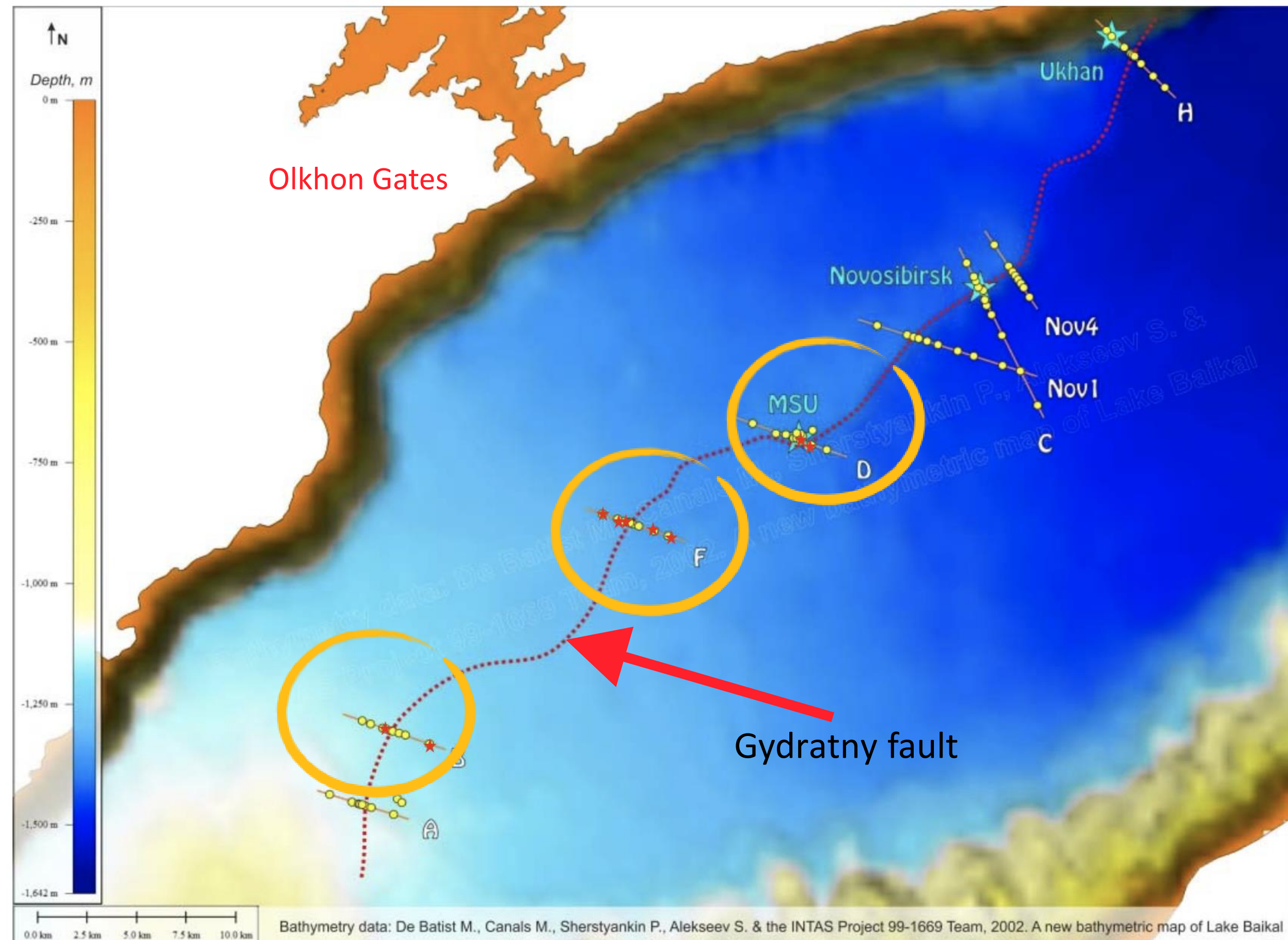
Profiles through the fault revealed the presence of turbidites and «woody turbidites». The source area and dating of these units remain unknown.

2. Piercements in central and southern basin

Several mud volcanoes and putative mud volcanoes have been cored. The age of the erupted sediments is unknown and a proxy to distinguish mud breccia sediments has not been found yet.

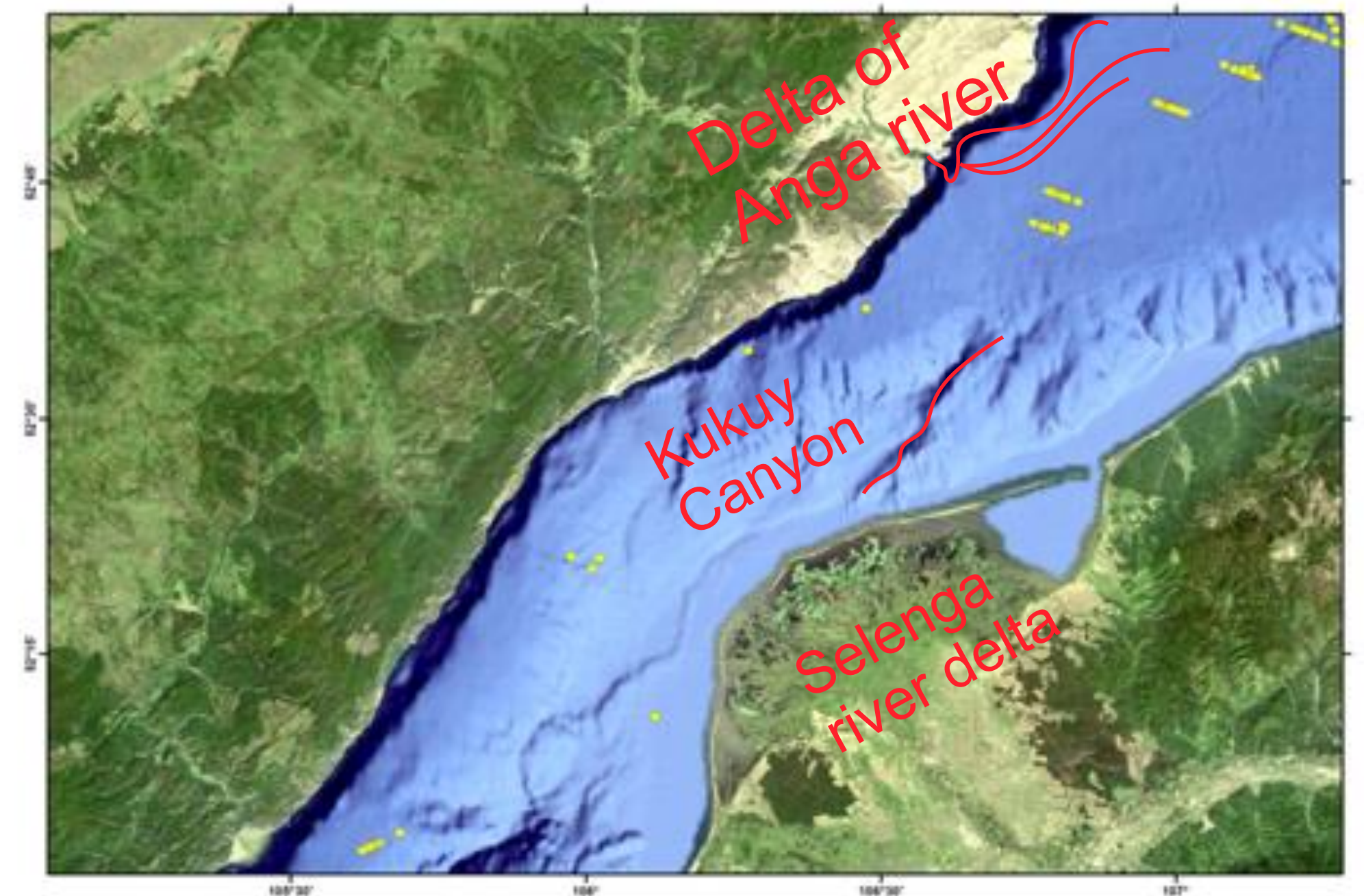
Gydratny fault woody turbidites: setting

Seismic and sampling profiles collected through the Gydratny fault. Sampling stations are marked by yellow dots, and the red dots represent identified woody turbidites. Wood deposits most abundant on F and D lines.



Candidate sources for input of sedimentary and wood deposits include:

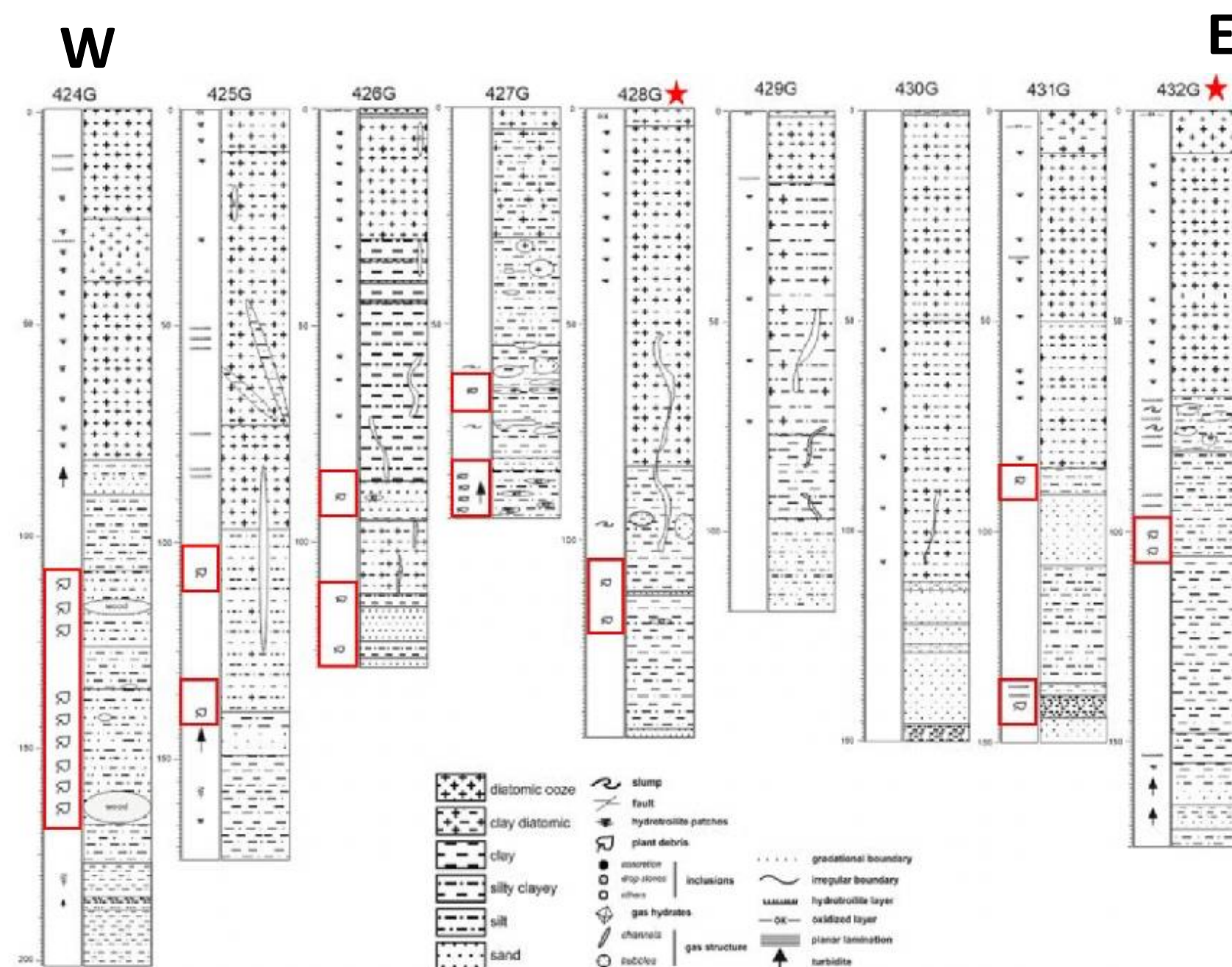
1. Selenga river delta through Kukuy canyon
2. Anga river delta
3. Olkhon Gates
4. Khuray region
5. Landslides from Northern shore



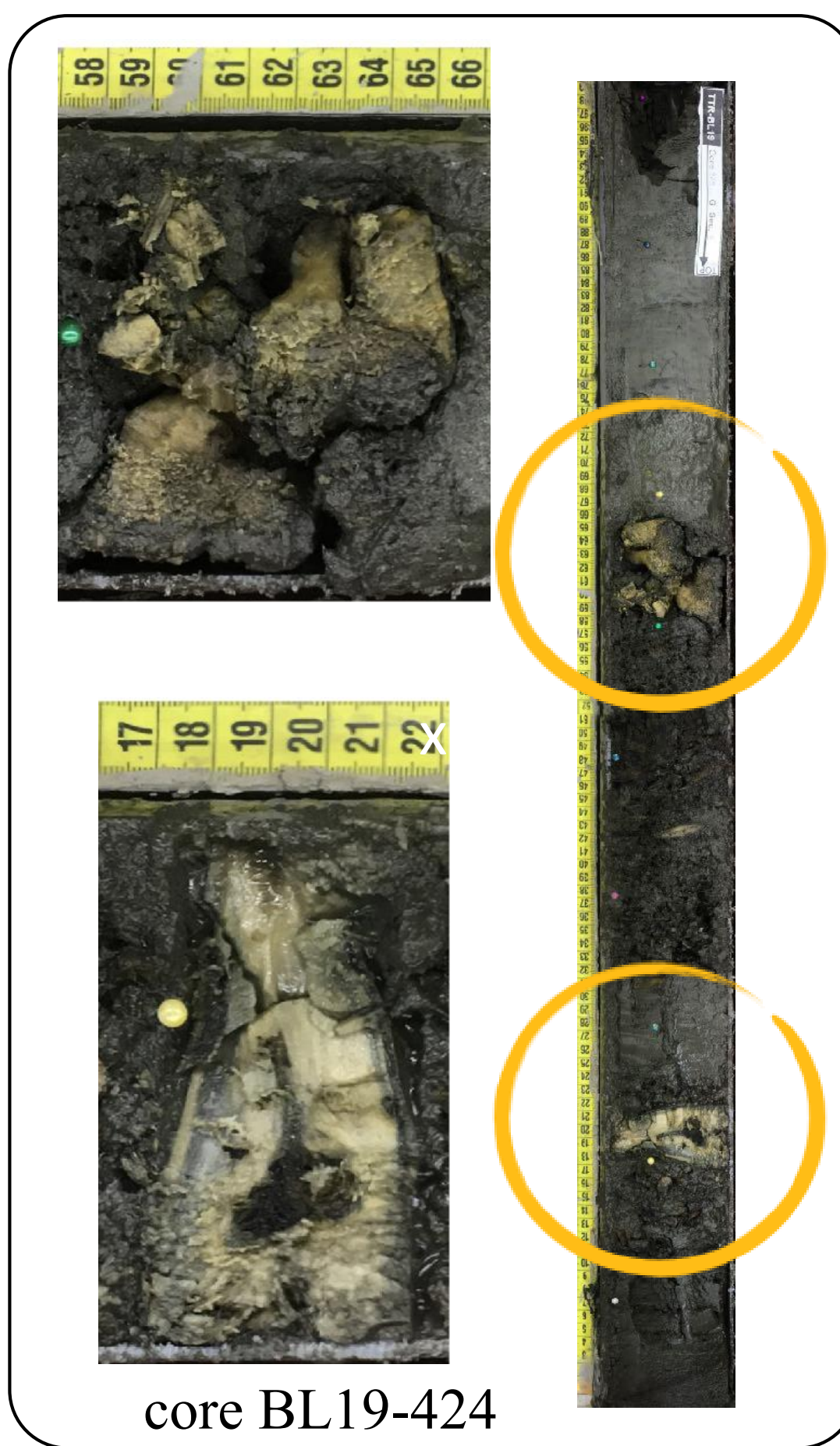
Gydratny fault woody turbidites: observations

CORES OBSERVATIONS

- Decreasing thickness of the deposits towards the eastern side of the lake
- Multiple events identified and can be correlated
- Similar observations can be done for other profiles



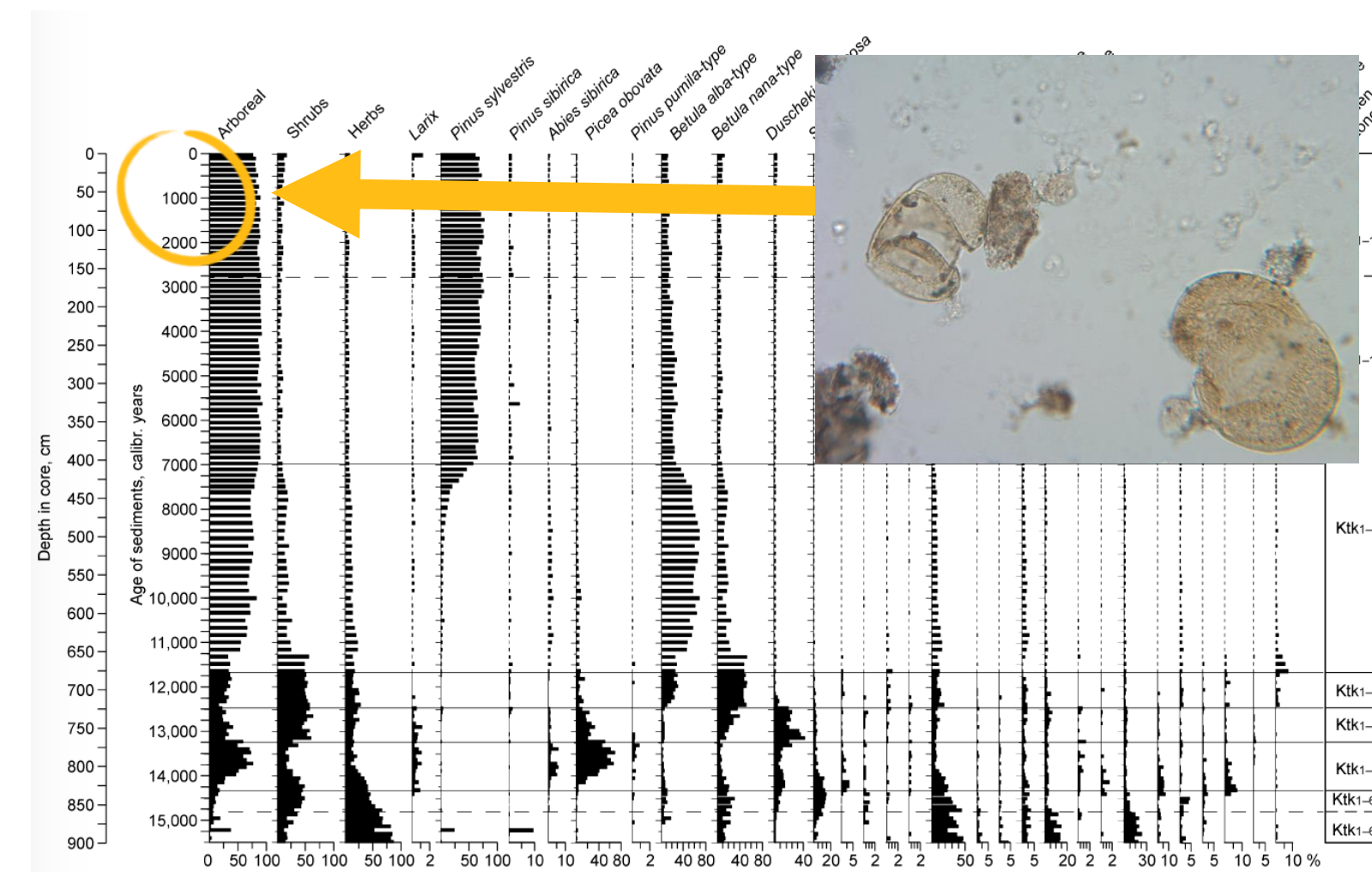
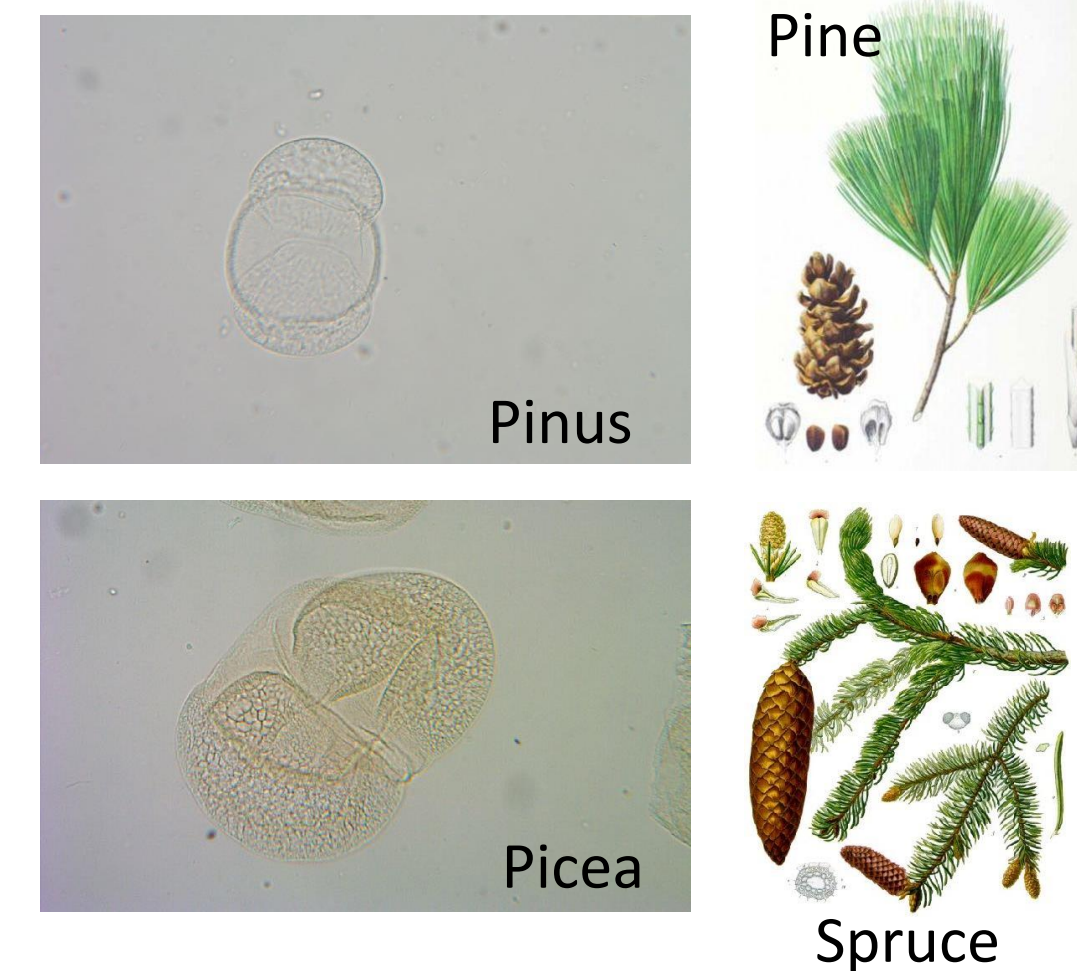
Example of cores collected along profile F with identified woody turbidites (red areas)



Example of core with thick woody deposits studied for palynology

PALYNOLOGY OBSERVATIONS

pollen types dominated by recent species



Grains reveal age ranging between 500-2000 years old.

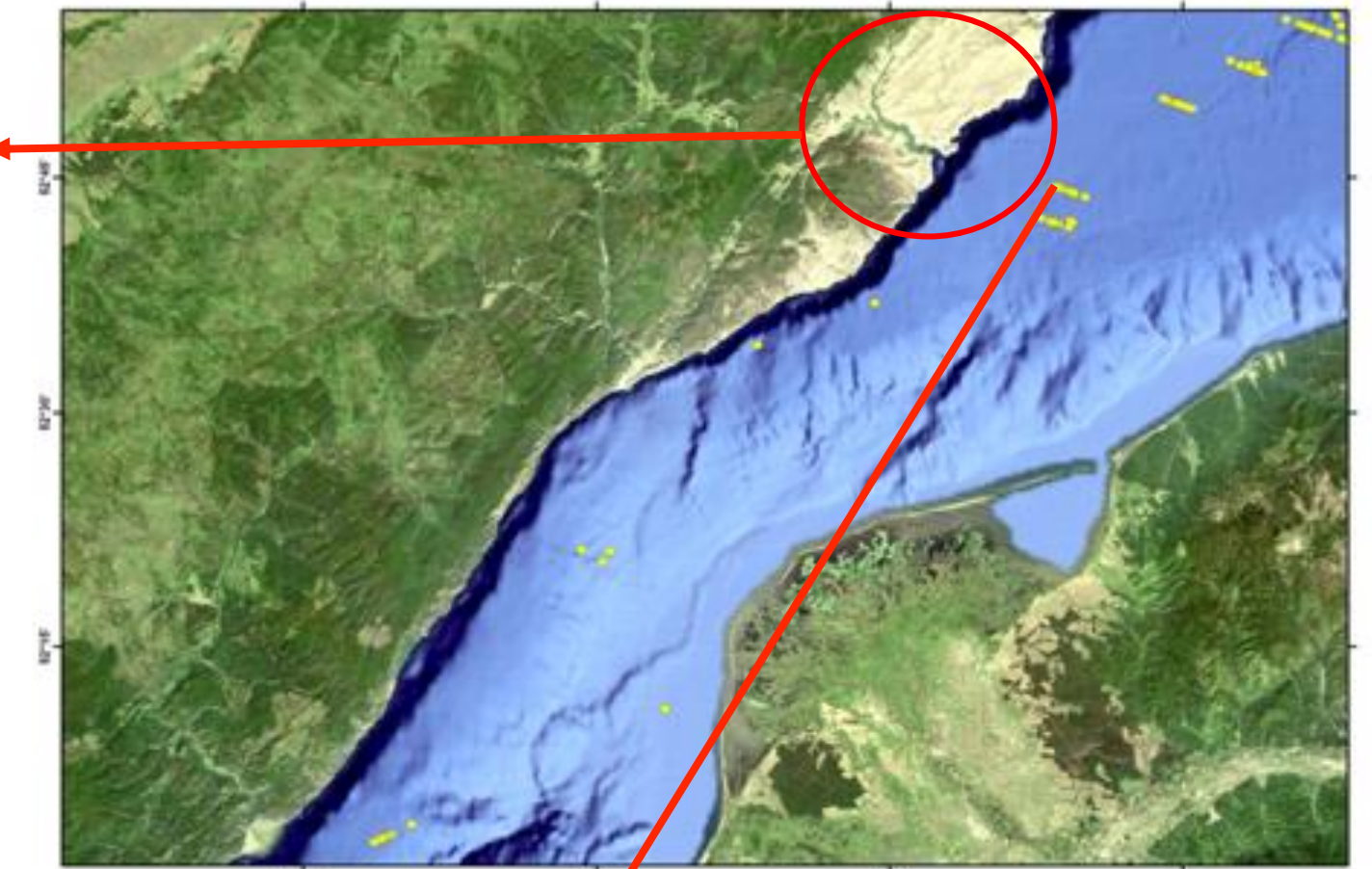
Gydratny fault woody turbidites: scenario

OBSERVATION SUMMARY

- Young age of dated woody turbidites (500-200 yrs) correlates them with recently triggered events
- Woody deposits thinning towards the east suggest a source area from the west- north-west
- Buoyancy of the wood suggests that these deposits were transported to the lake floor with a significant amount terrigenous material

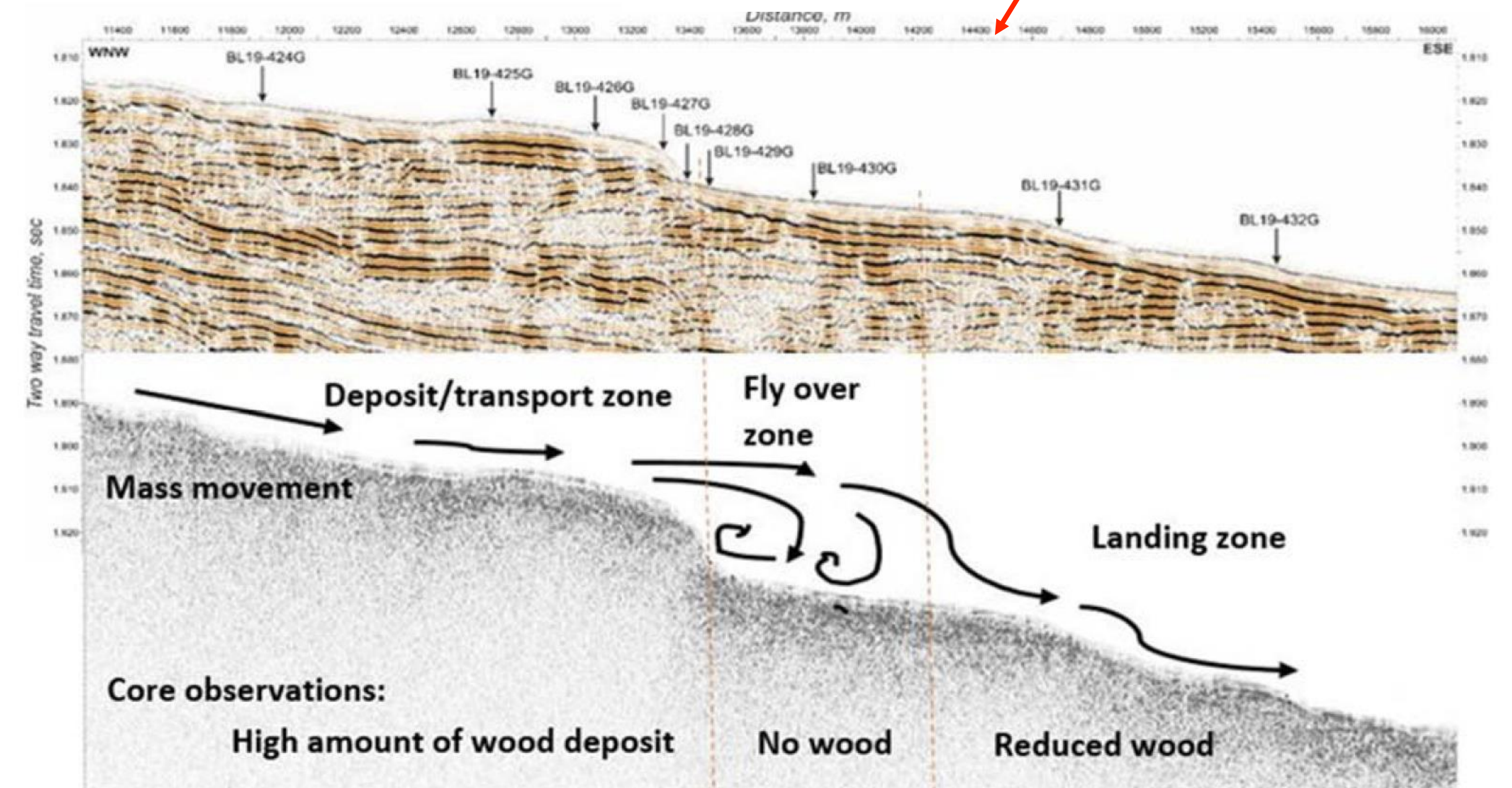


Example of onshore landslide



PROPOSED SCENARIO

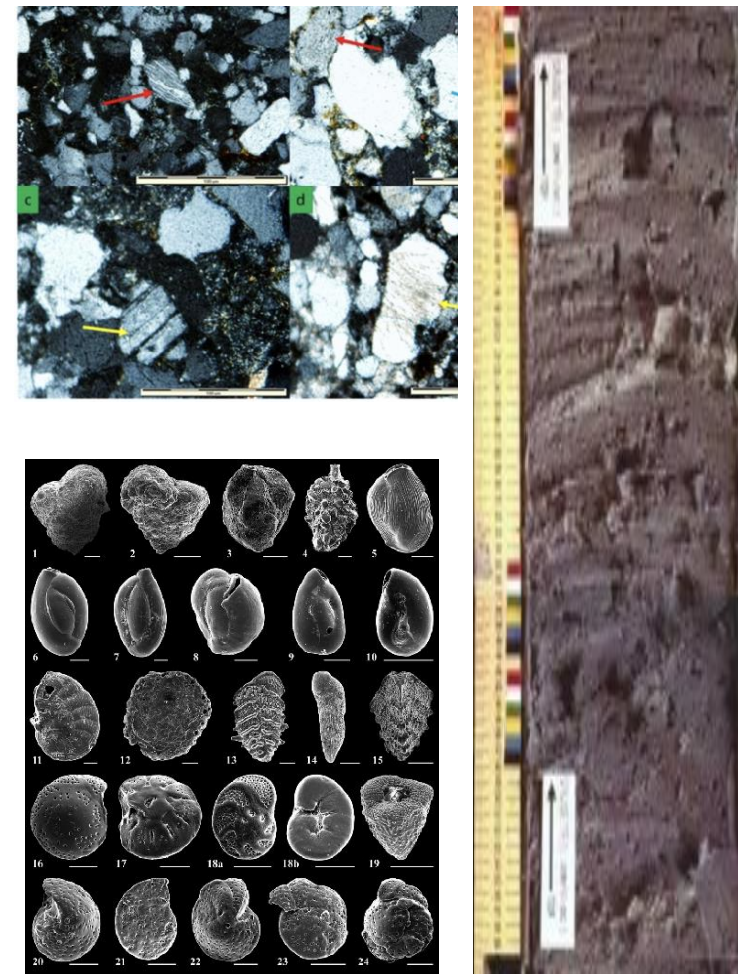
- Multiple gravitative mass movements from onshore landslides in the northern coast are the source of large amounts of sediments and wood debris
- The acceleration prompted by the steep slopes on the northern coast allowed transport of the slumped material over great distances ultimately reaching the center of the central lake Baikal basin



Mud volcanism in Baikal: Challenges

Typical mud volcano (MVs) deposits

- Consists of erupted mud breccia (i.e. fine grained matrix incorporating clast of the different lithologies brecciated throughout the MV conduit and expelled at the surface)
- Dating can be done through micro-paleontological studies, petrography of the clasts, and the surrounding matrix



Examples of mud breccia clasts from Mediterranean MVs and relative petrography and micropaleontology studies

Challenging identification MVs in Lake Baikal: hard to prove that extrusion of sediments occurred at the lake floor:

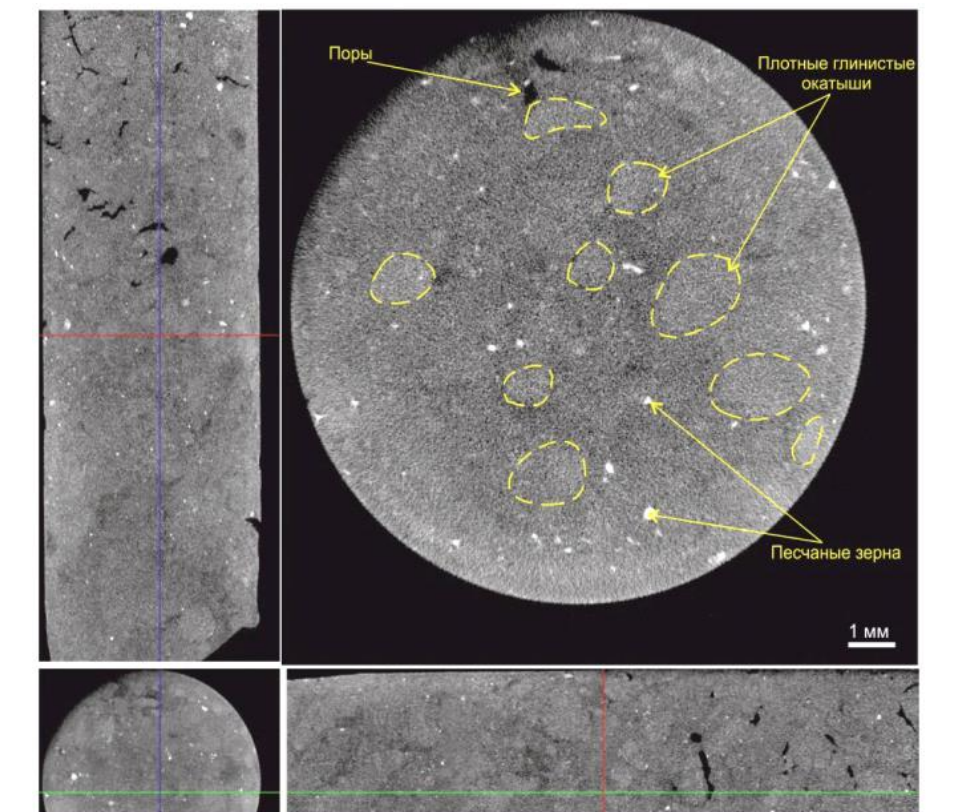
- Typical presence of gas hydrates that once dissociating homogenize the sediments
- Lack of classic mud breccias deposits (I.e. NO clasts)
- Absence of microfossils except for diatoms
- As Baikalian MVs are shallow rooted diatoms assemblages have limited variations at shallow depths

Potential proxies used to study sediments of putative Baikalian mud volcanoes:

- Study or semi-lithified clasts (petrography/grainsize) extracted from cored sediments
- Tomography of the cores to observe chaotic structure
- Palynological analysis of semilithified clasts, surrounding matrix and compared with surface sediments



Semi-lithified clasts



Tomography studies

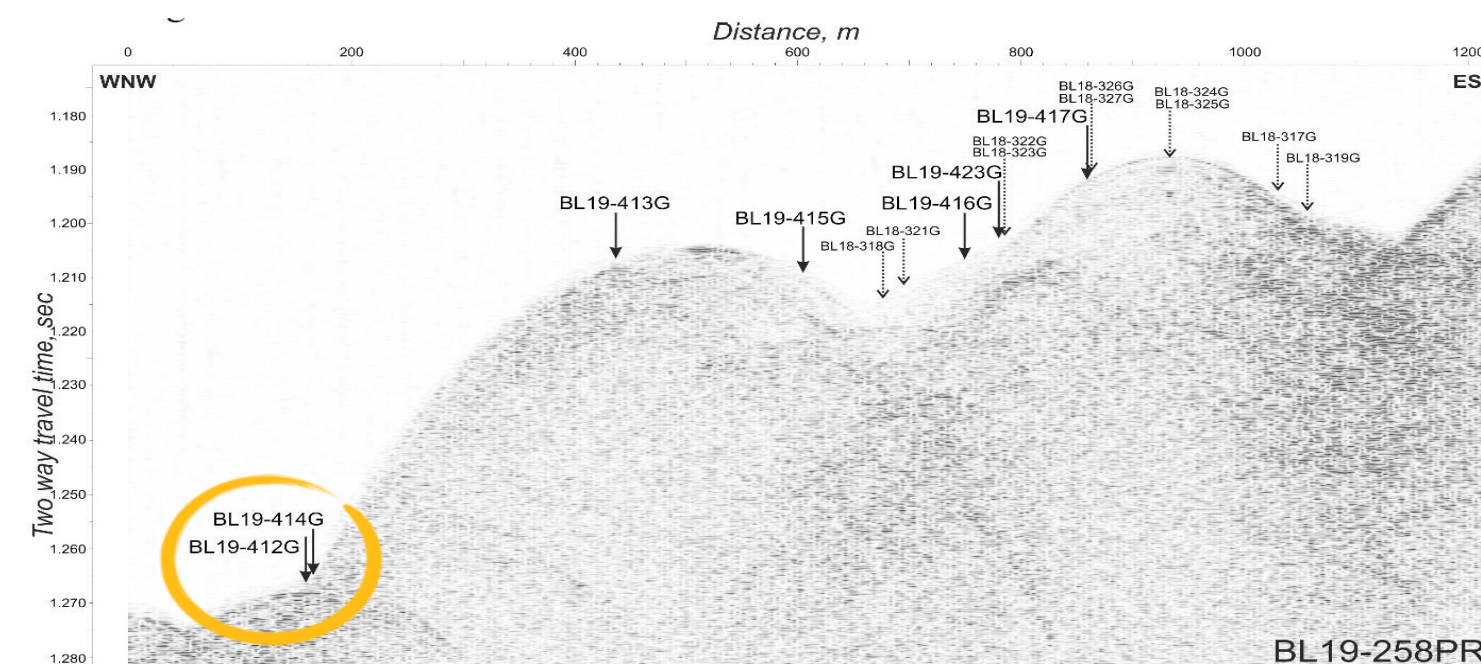
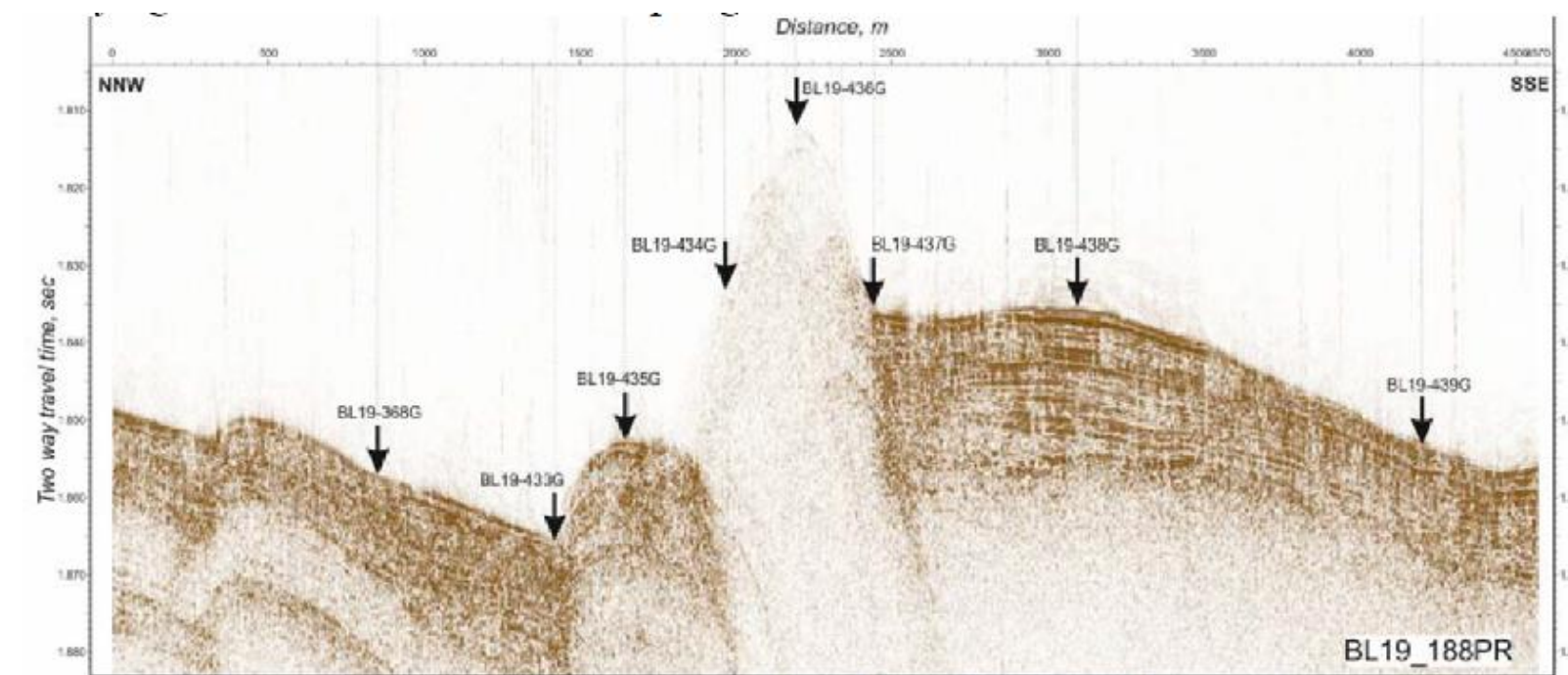
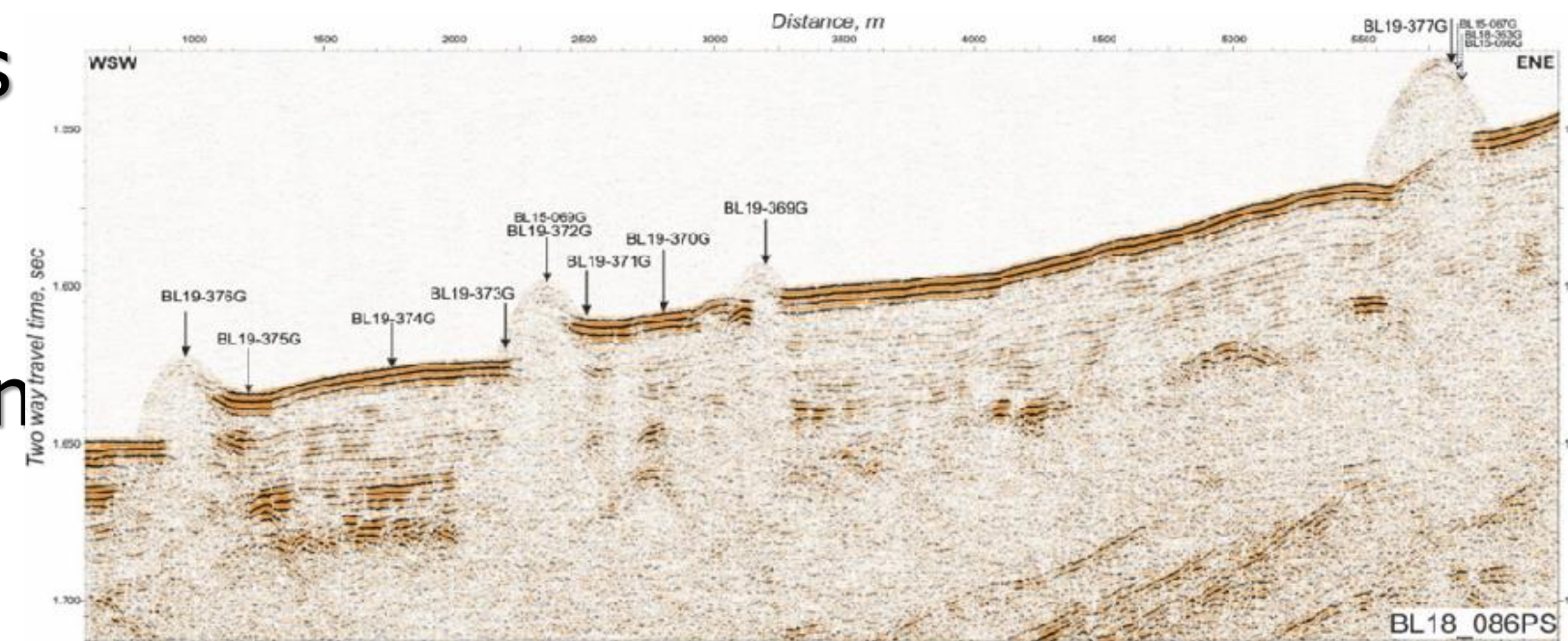


Palynology studies

Studies of putative mud volcanoes

Palynological analysis on inferred mud volcanoes was achieved in the following areas:

- **Elovsky area sampling line-** located in the north part of lake Baikal southern basin and to the west from Selenga river delta
- **Malen'ky sampling area-** located in the South basin of the lake Baikal on the proposal continue of the Gydratny fault at the south-west side of the Selenga river delta
- **Gorevoy Utes sampling area-** Located in the eastern-central part of lake Baikal.



- These targeted structures are gas hydrate bearing
- Sediments are highly disturbed after clathrates dissociation
- So far it remain unknow if these can be classified as mud volcanoes

Palinology of Gorevoy Utes: some results

Clasts and matrix samples from the Gorevoy Utes sampling area were processed and analysed (core BL19-414):

Betula



Pinus



Picea



Larix

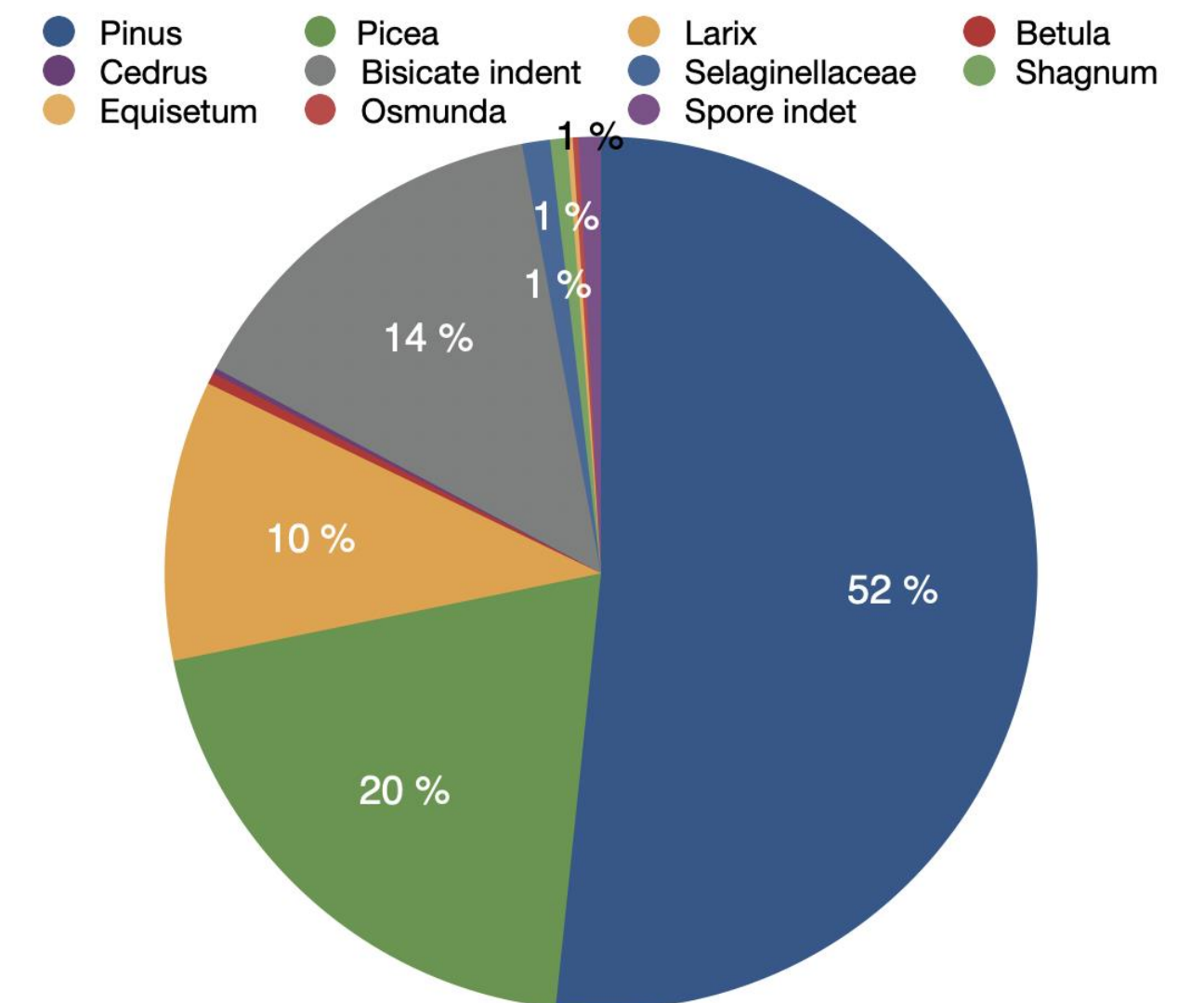


Preliminary palynology results from the surface sediments compared with the mud breccia matrix and the semi-lithified clasts show that:

- The matrix and the upper sediments contain younger, better preserved and more abundant pollen grains

Core 414 - Matrix

Pollen/Spore type	Counts
Pinus	249
Picea	97
Larix	50
Betula	2
Cedrus	1
Bisiccate indent	69
Selaginellaceae	5
Shagnum	3
Equisetum	1
Osmunda	1
Spore indet	4
Total count	482



Conclusions

- **Preliminary studies revealed that palynology is a useful tool to date Lake Baikal sediments**
- **Wood turbidite deposits through the Gydratny fault, revealed to be correlated to young events (500-2000).**
- **We propose a scenario where onshore landslides are the source for copious amounts of sediments and wood debris. These are transported and ultimately deposited at great distances from the shore.**
- **Semi-lithified mud clasts from putative mud volcanoes reveal older assemblages when compared with the surrounding matrix and the surface sediments.**
- **Additional palynology analysis will be conducted in further studies, and the dating of more samples from different core sections is planned.**

Thank you for your time!

