



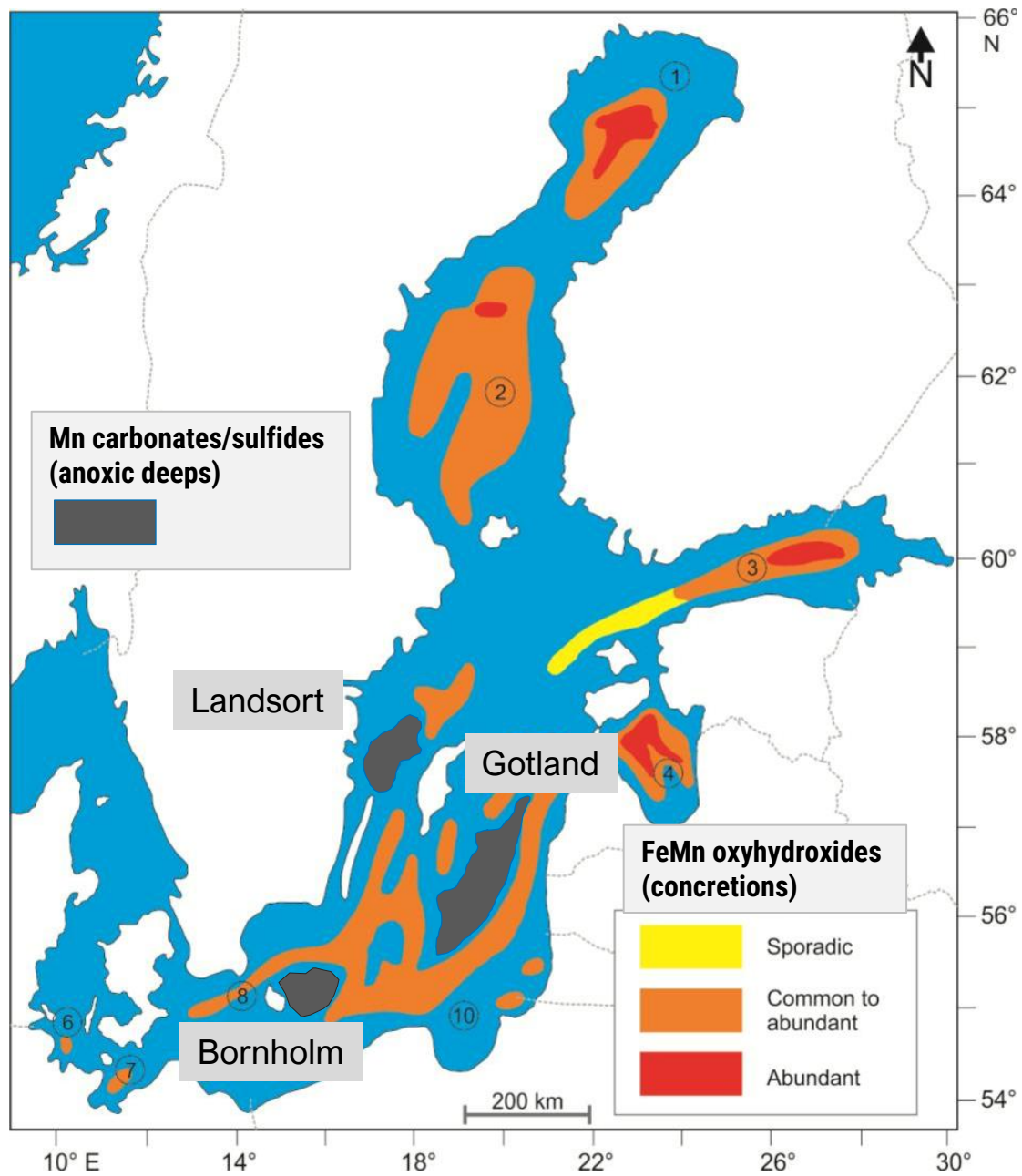
GEOLOGICAL SURVEY OF ESTONIA

Seafloor Fe-Mn precipitates and pockmarks of the Gulf of Finland: formation controls and possible genetic links

Aivo Lepland, Beata Szymczycha, Wei-Li Hong, Michael Böttcher, Joonas Virtasalo,
Martin Liira, Hannah Mikenberg, Vladimir Karpin, Atko Heinsalu, Johanna Maria Ojap,
Markus Ausmeel, Krete Roopõld, Sten Suuroja

Estonia-Poland-Sweden-Germany-Finland-Norway collaboration

17.11.2023

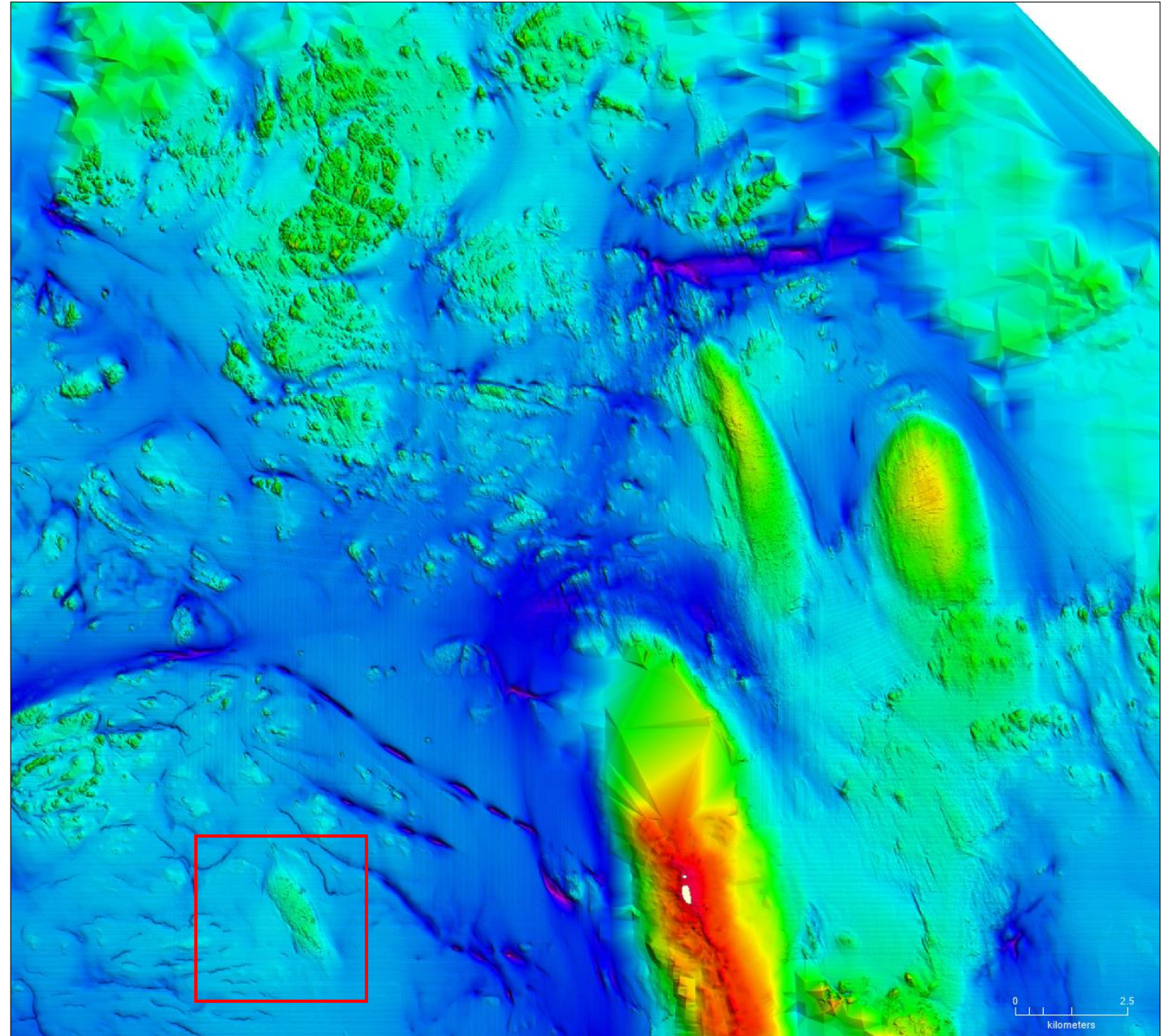
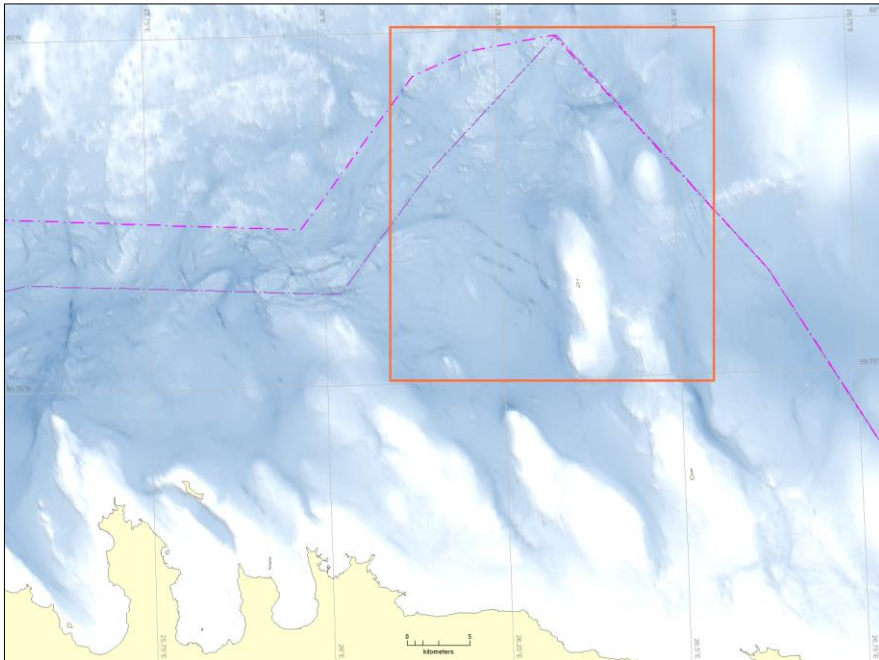
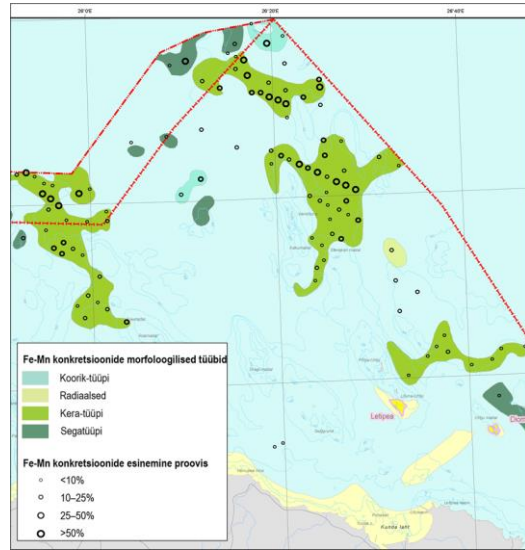


Distribution of authigenic Fe-Mn precipitates on the seafloor and in bottom sediments of the Baltic Sea

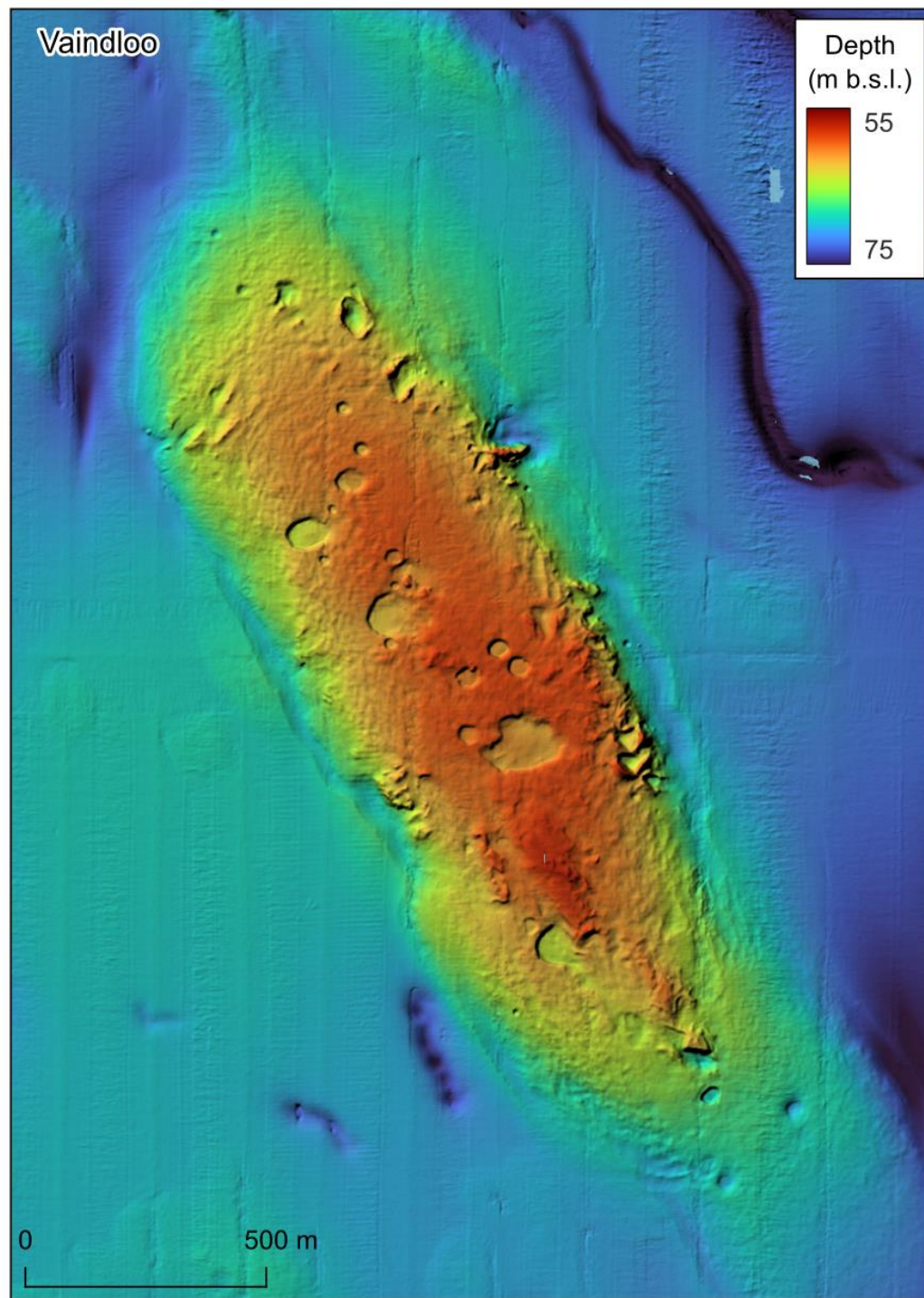
Modified after Glasby et al. 1997 & Wasiljeff 2015

Current focus:

**Mn-Fe-nodules,
seafloor processes
and groundwater
discharge in central
Gulf of Finland**



Submarine ridges, pockmarks, microbial mats and Fe-Mn-nodules



0.00

UTM 32
N 6756540.28
E 1457628.6

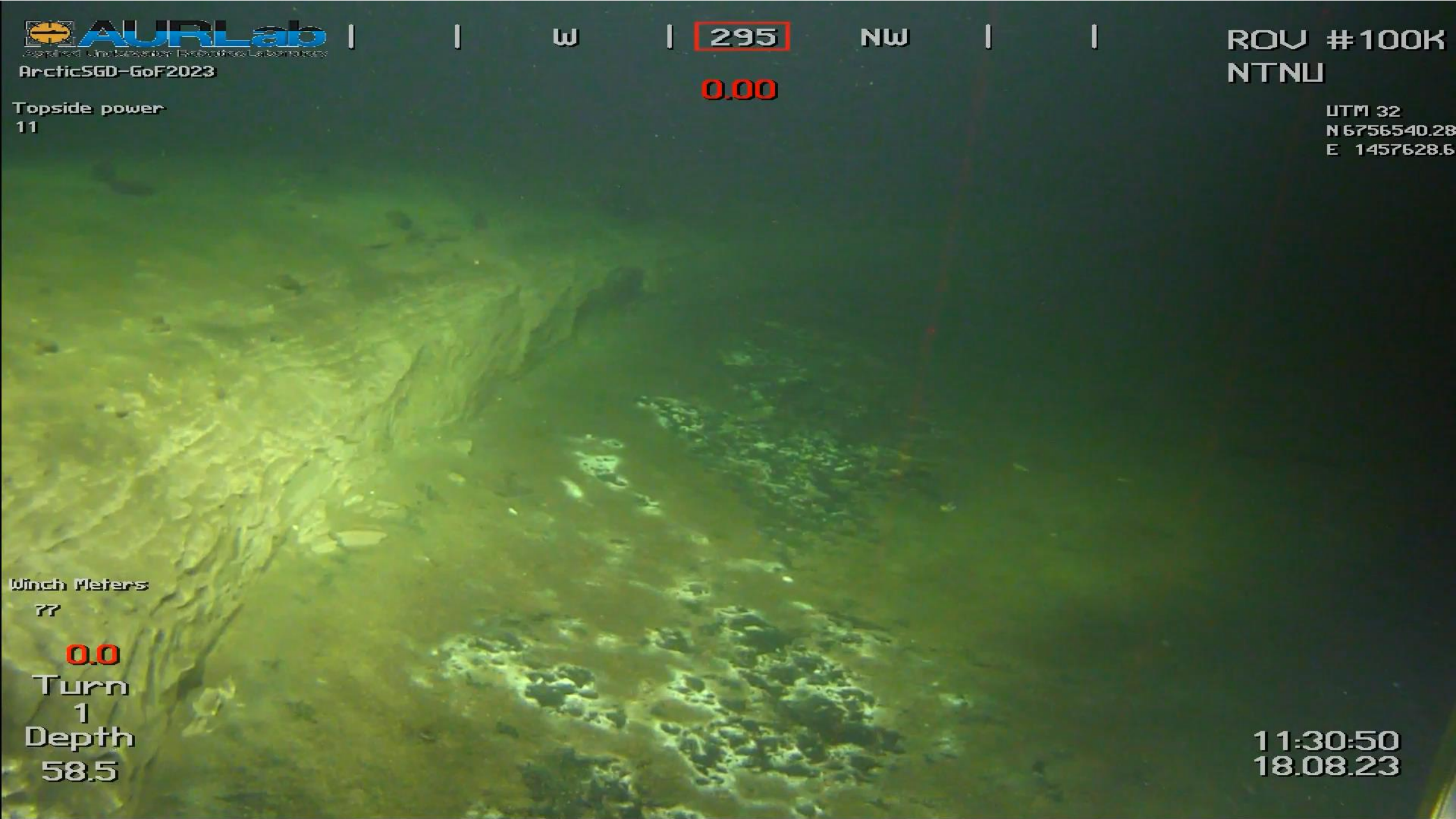
Topside power
11

Winch Meters
??

0.0

Turn
1
Depth
58.5

11:30:50
18.08.23

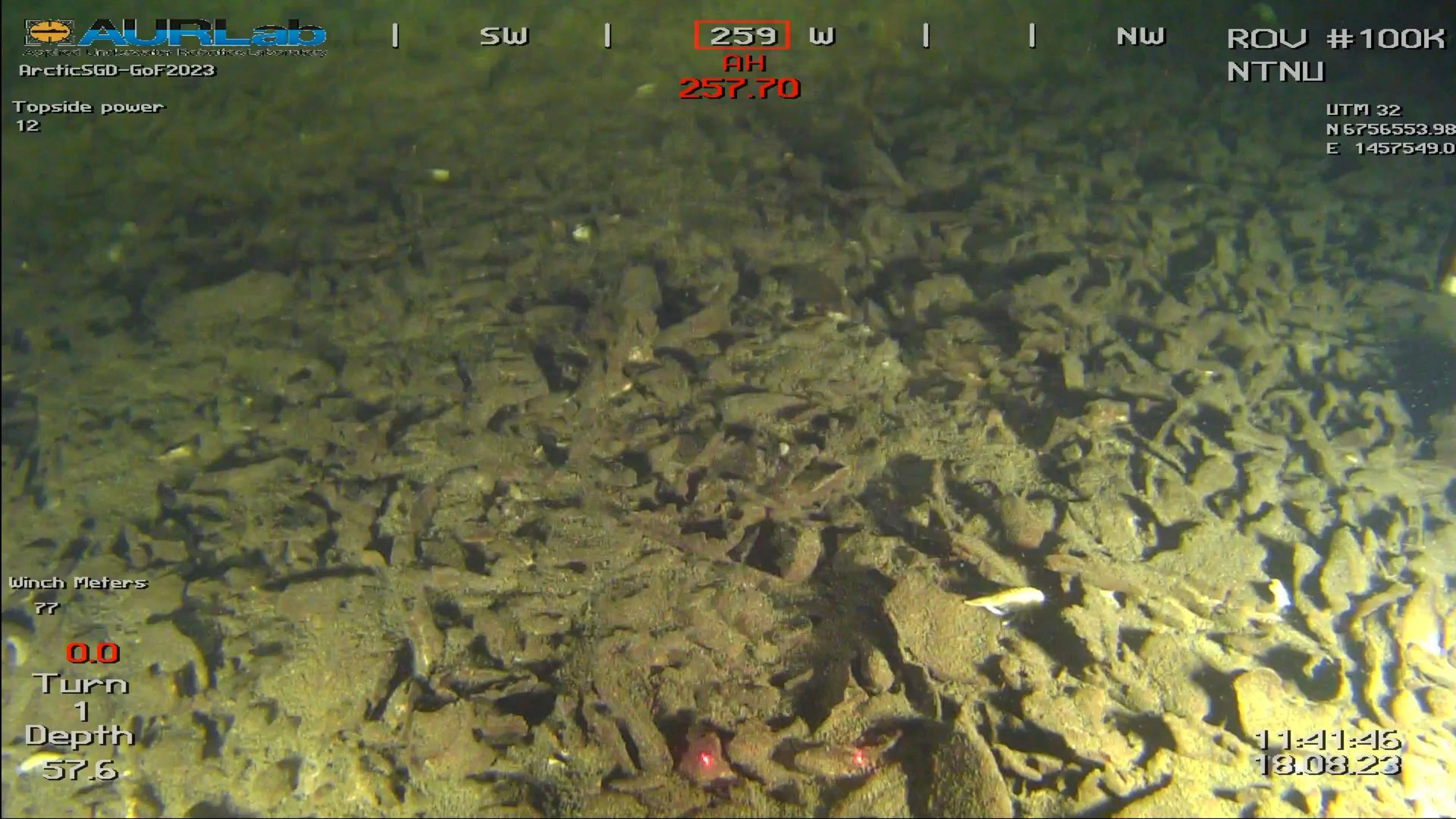


Topside power
12

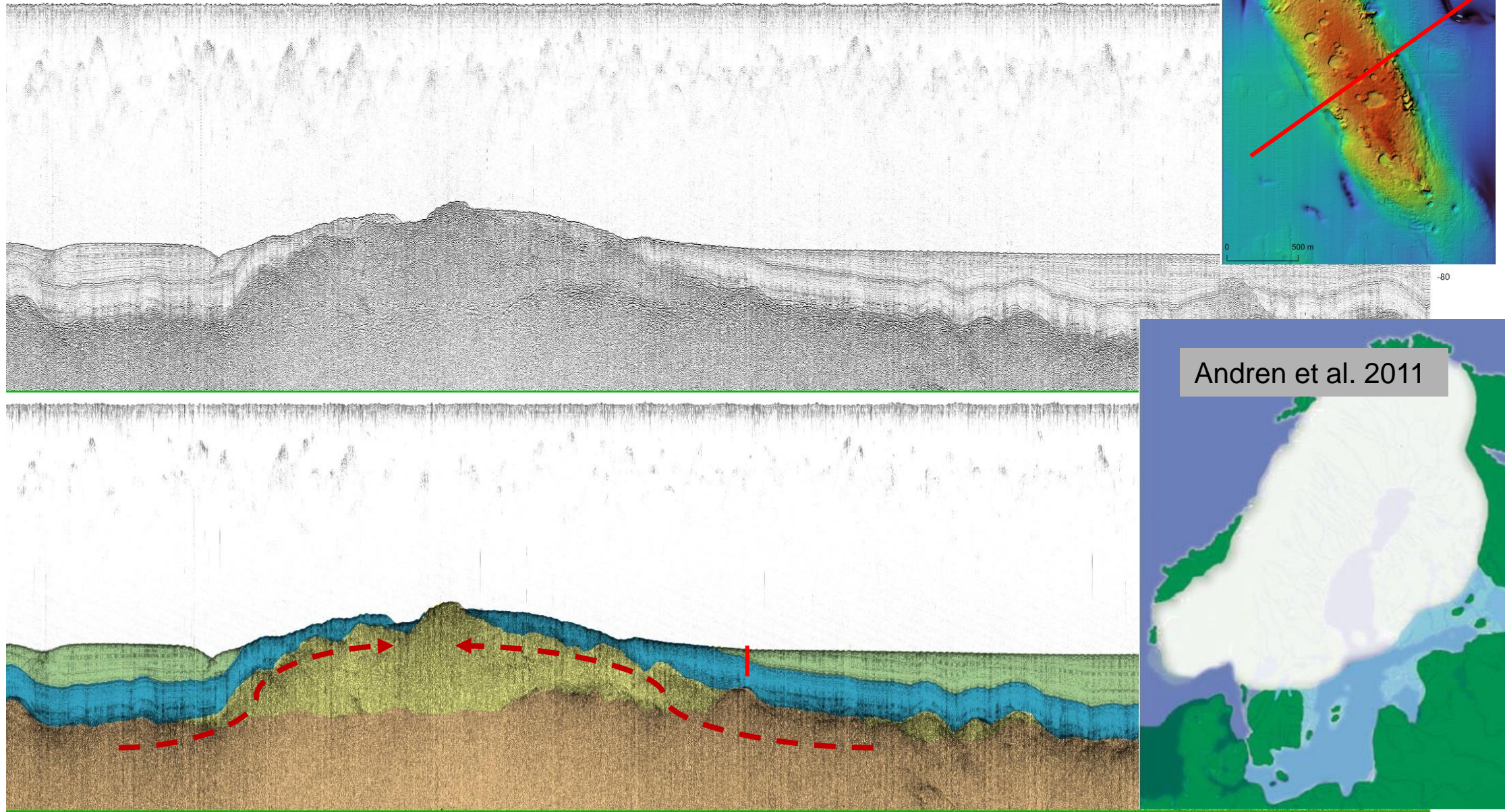
Winch Meters
??

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Turn
1
Depth
57.6

11:41:46
18.08.23



Seismic profile crossing the submarine ridge: Pockmarks are cut into late glacial varved clays

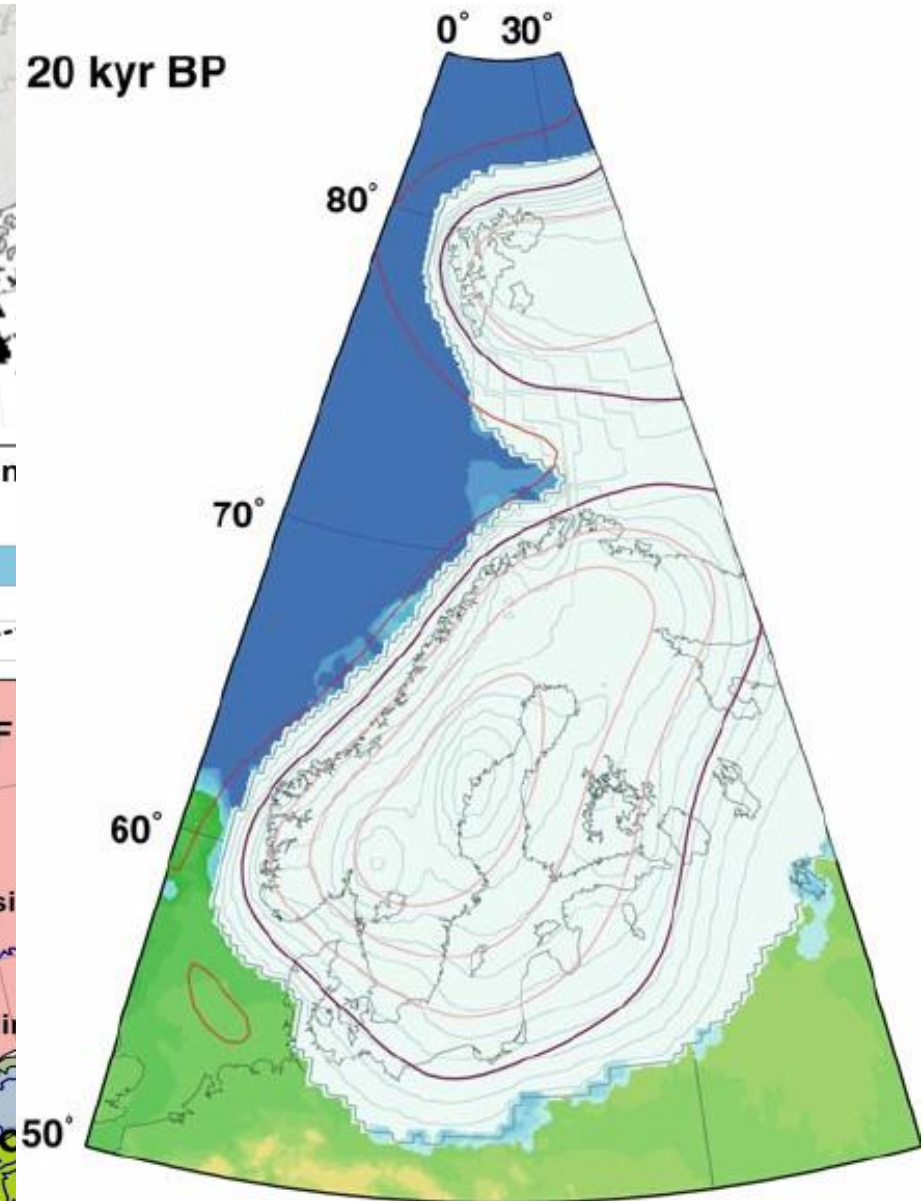
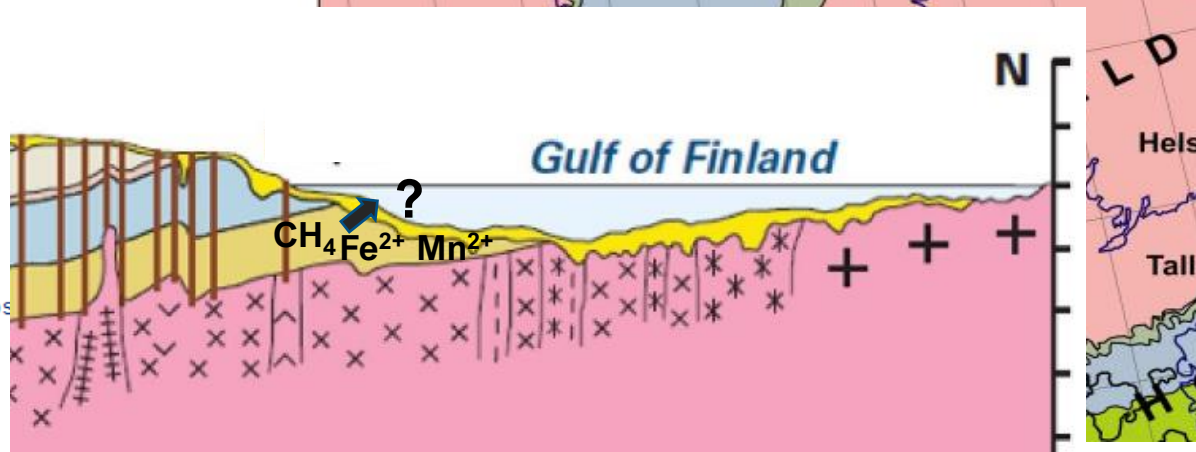
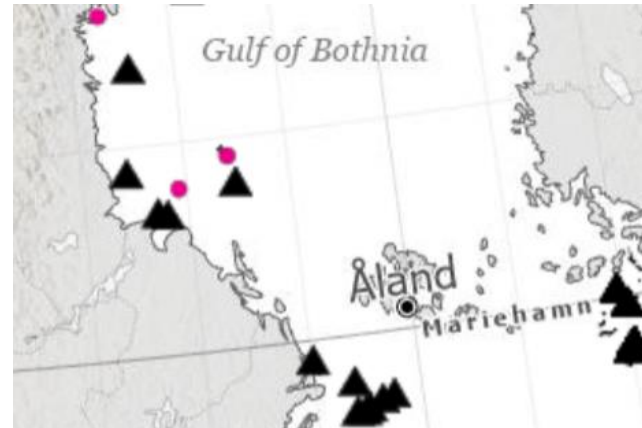


Distribution of Fe-Mn nodules in the Gulf of Finland: associate with Ediacaran rocks

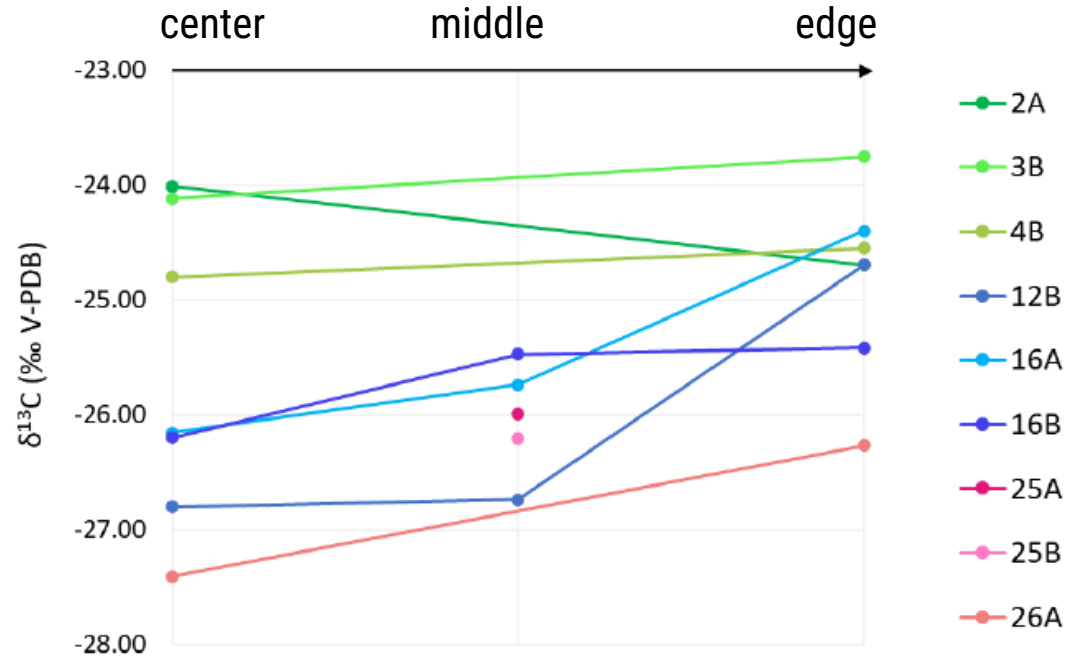
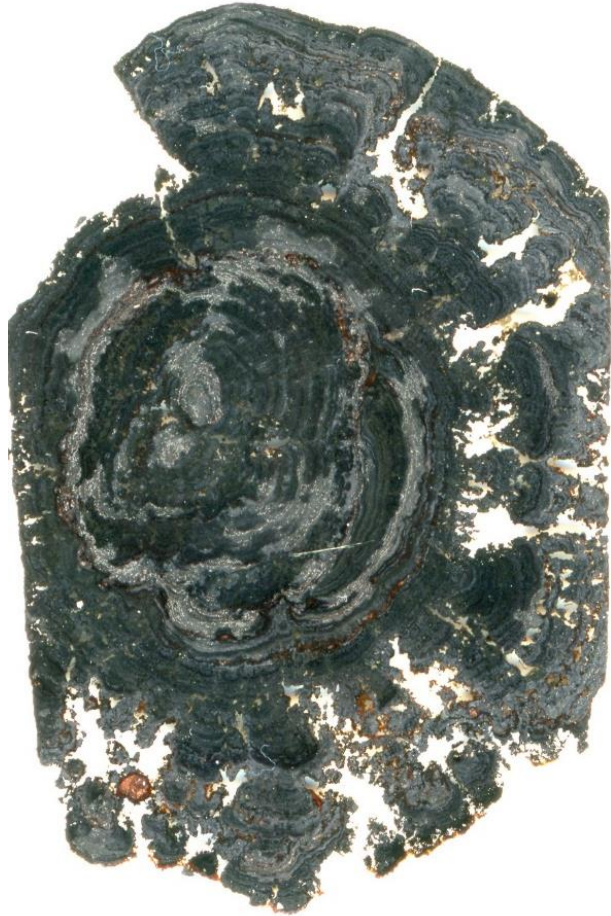


Marine minerals

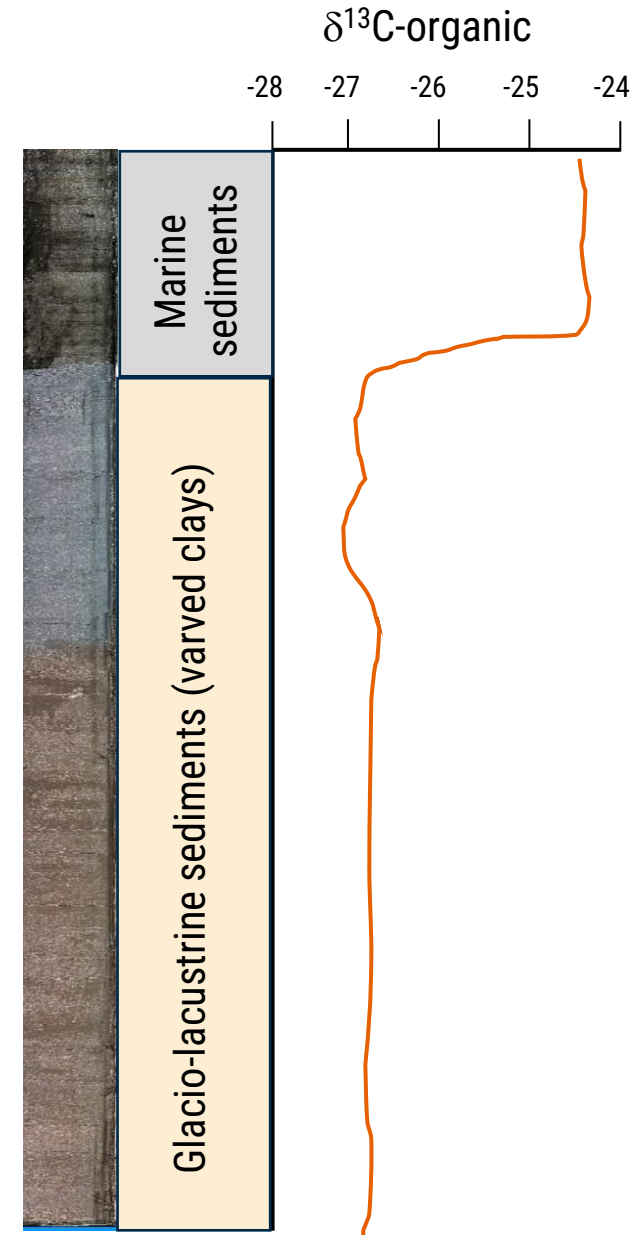
- Aggregate
- Cobalt rich ferromanganese crust
- ▲ Evaporite
- ▲ Gas hydrates
- + Hydrocarbon
- + Metal rich sediments
- ★ Phosphorites
- ▼ Placers
- ◆ Polymetallic nodules
- ▲ Polymetallic sulphides
- Rock, pegmatite and vein host
- ◆ Sapropel
- ▲ Sapropele



Organic matter $\delta^{13}\text{C}$ profiles through Fe-Mn-nodules: clear isotopic trend in some nodules with isotopically light organics characteristic of varved clays in centers



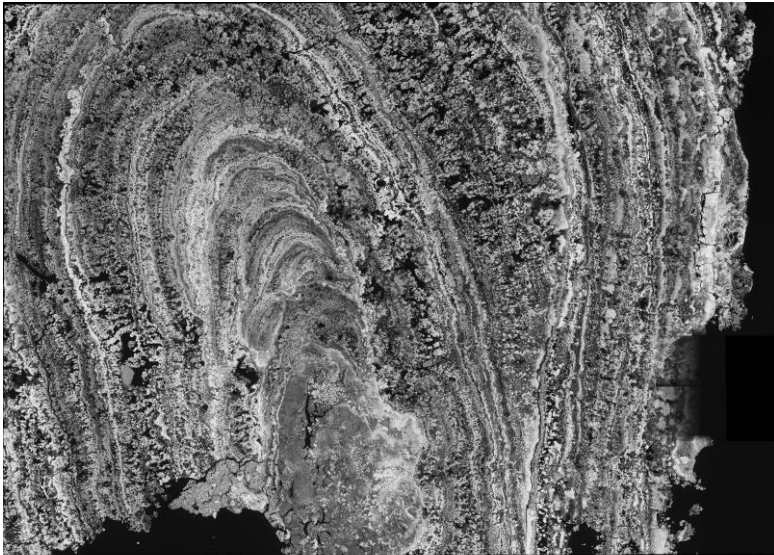
Ojap 2023



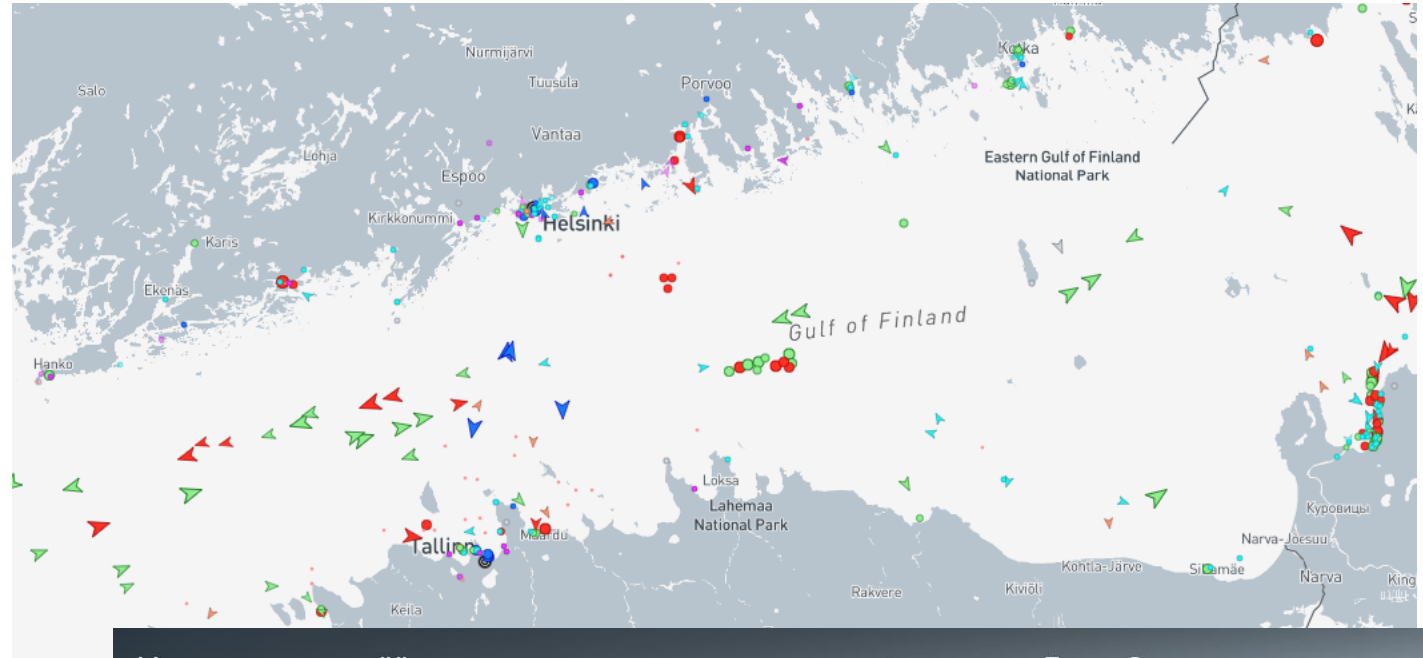
Mn-Fe nodules of the Gulf of Finland: work to do



- **Geologic and hydraulic context of nodule formation**
- **Sources of Fe and Mn**
- **Precipitation controls**
- **Precipitation timing and tempo**
- **Associating microbial processes and consortia**
- **Nodules as possible economic resource**
- **Environmental aspects of nodule stability**

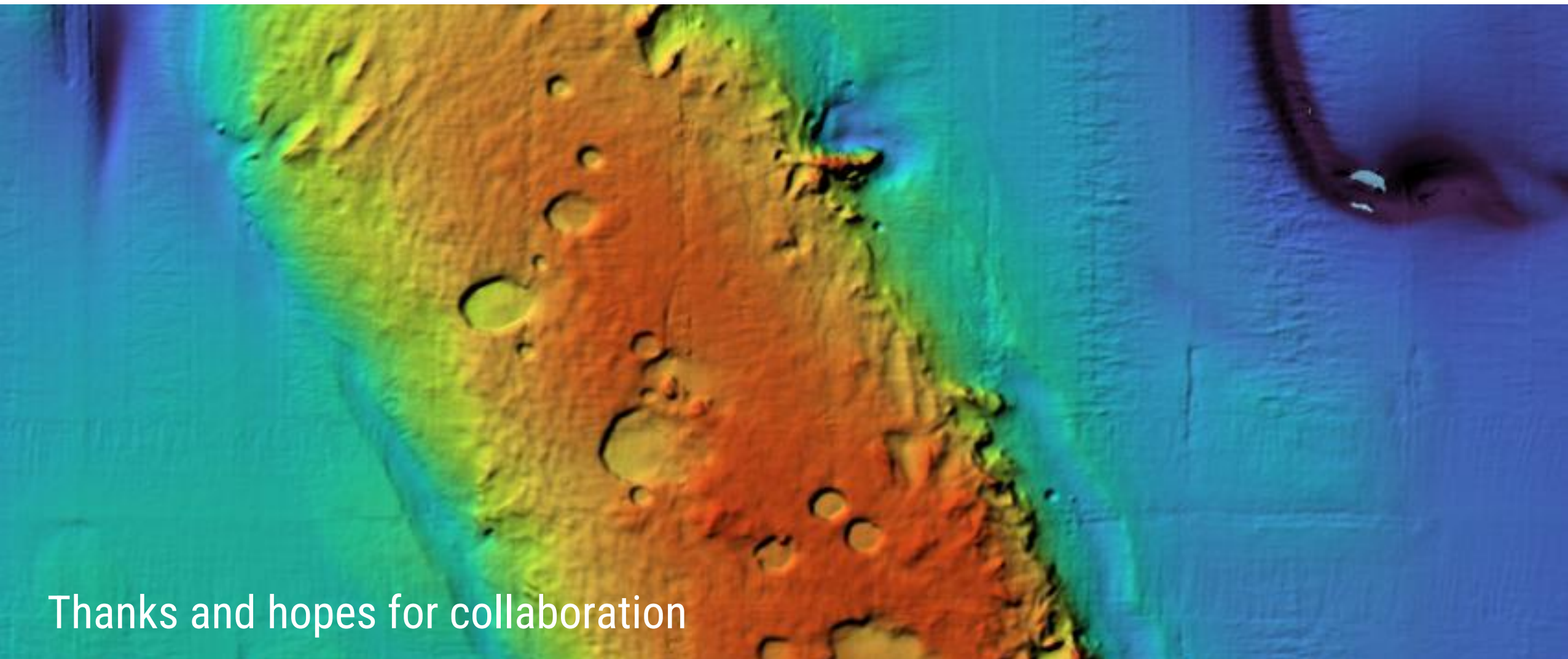


Fe-Mn-nodule fields: seafloor disturbance by anchoring – geovandalism





GEOLOGICAL SURVEY OF ESTONIA



Thanks and hopes for collaboration