FINDING WHAT LIES BENEATH

From geophysical clues to deep drilling at Blötberget

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1. Research Director-SERC | 2. Nordic Iron | 3. Epiroc

October 21 | 2026

SERC also have Supporters and Friends: SGU, NGU, GEUS, GTK, Metal Earth, Anglo American, BHP, Viridien, Viscaria, Stryde, Inertial Sensing & EMerald Geomodeling



SERC Multidisciplinary



12 CORE PARTNERS

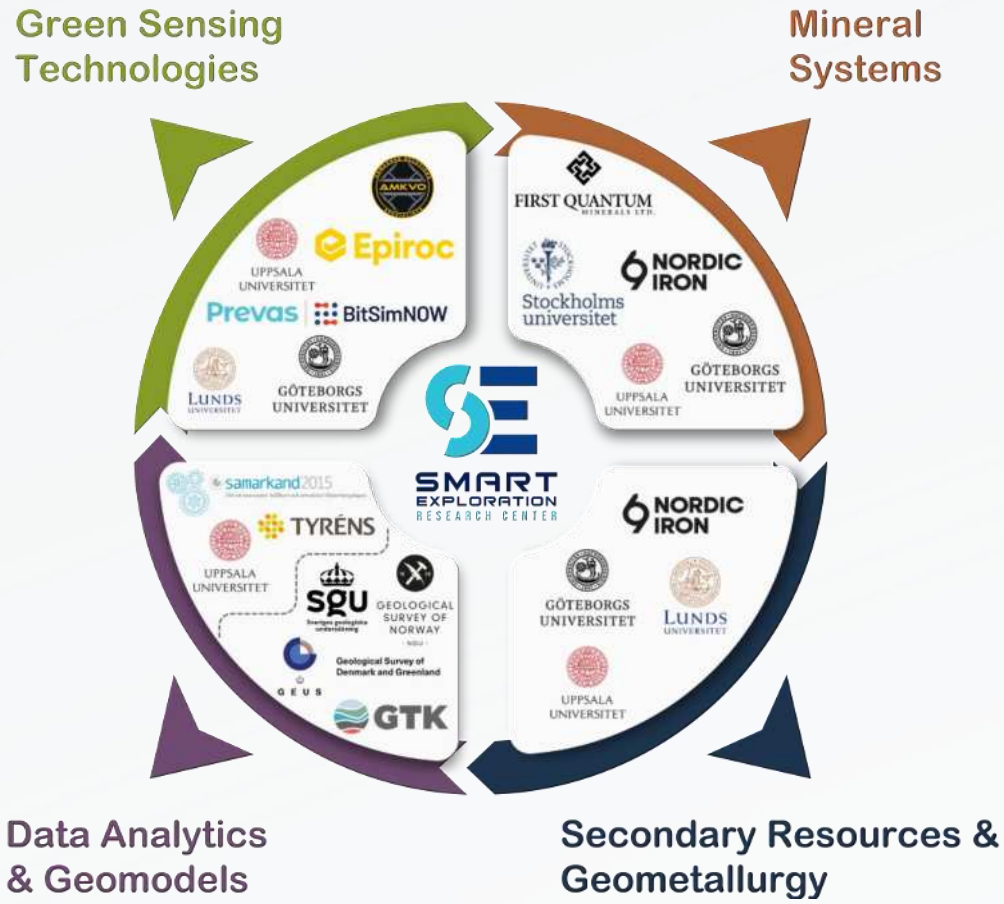
Four universities, three mining companies, four tech and solution providers, and one regional business developer. Diversed skills incl. economic & structural geology, geophysics, tech, nano, robotics, data analytics, drilling, ESG and SDG

4 WORLD-CLASS THEMATIC HUBS

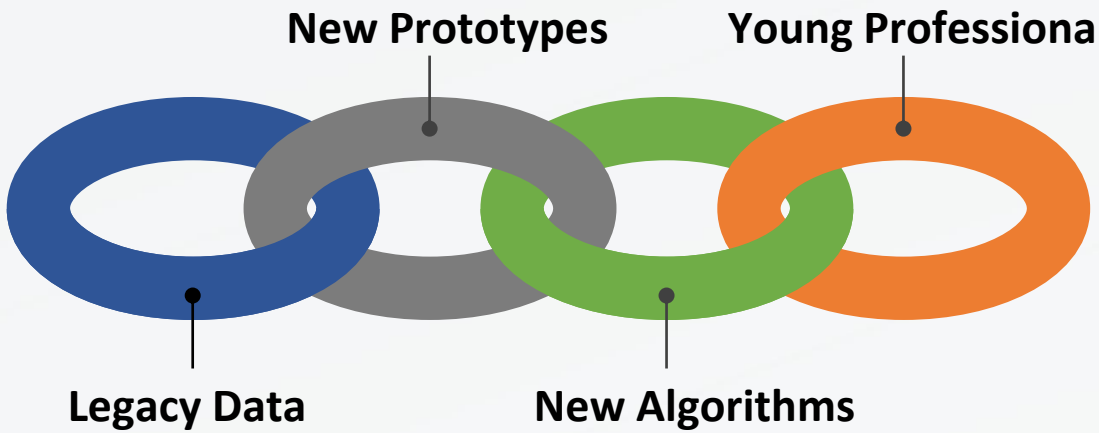
For emerging needs of critical raw materials exploration in Sweden, Nordic region and beyond

4 VALIDATION SITES

Primary focus on Sweden and Nordic region for iron-oxide-apatite REEs, P & Sn deposits, incl. secondary resources, Li-pegmatite, carbonatite (REE-enriched), magmatic Ni-Cu-PGEs, graphite, blackshale-enriched V, Bi, Ge, P & Co



Born from a H2020 project



Connecting the dots …
Research-Innovation and Actions with a focus to also Young Professionals

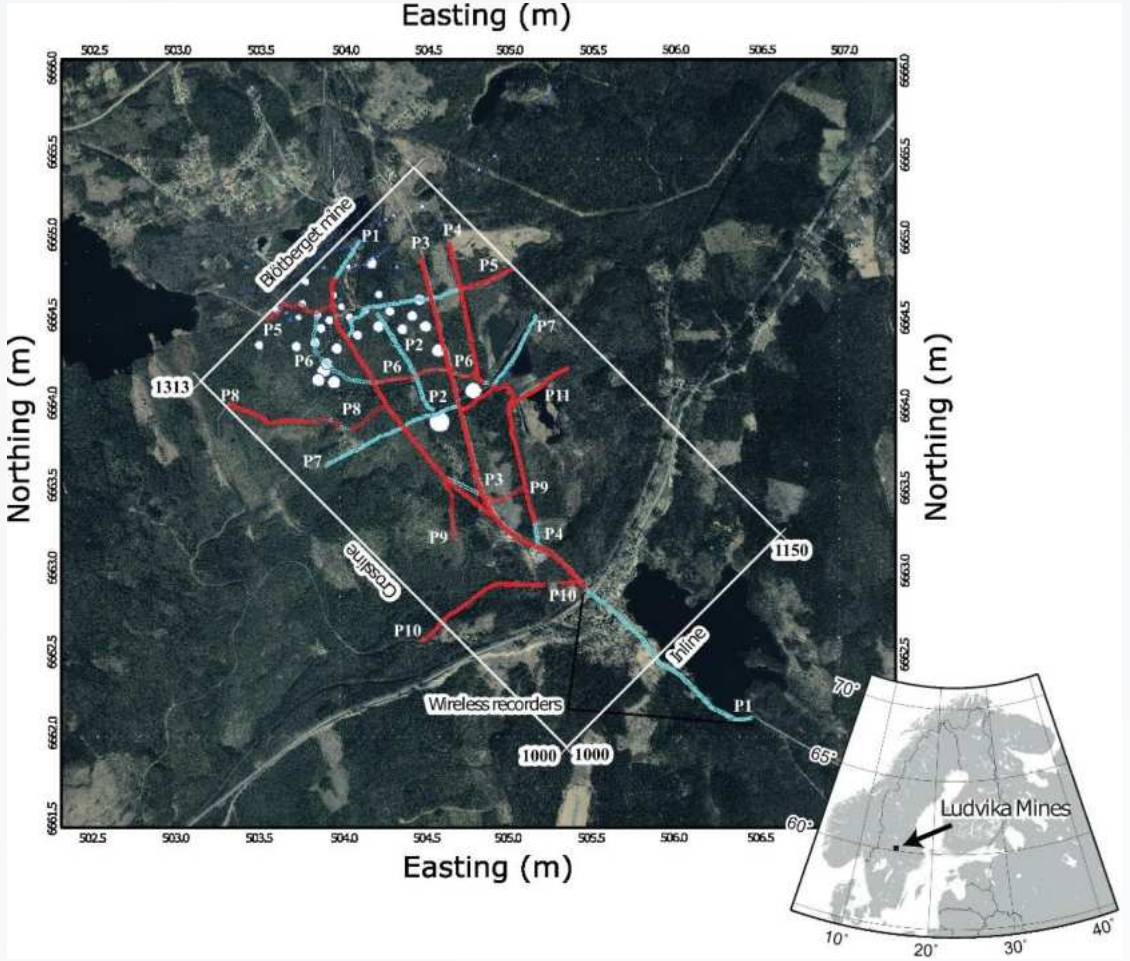


2017-2020
27 EU partners!

SMARTEXPLORATION
new ways to explore the subsurface

Blötberget: a testbed for innovation

- Easily **accessible** (2.5 hrs from Uppsala)
- Hitachi and high-voltage valley (Ludvika)
- Several **types of deposits** e.g., skarn, VMS, iron ores (magmatic and BIF)
- Many **boreholes** with downhole logging data
- Historical **tailings**
- Complex **tectonics**
- Several **open access data and publications** from e.g., StartGeoDelineation, Smart Exploration, Future, SERC, …



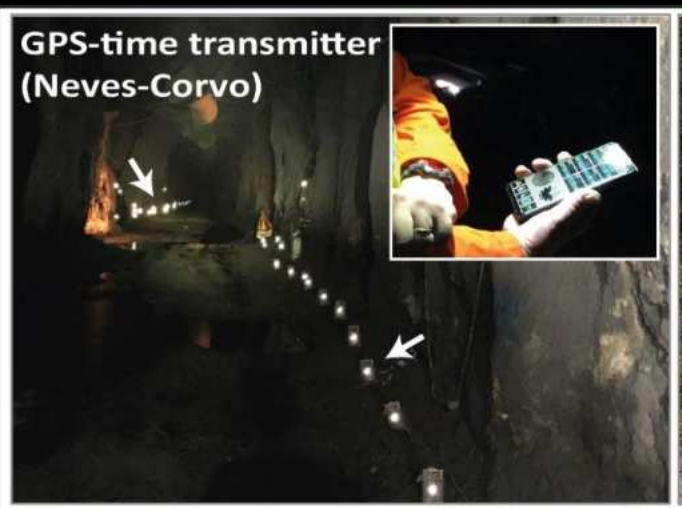
Collaboration & Synergy

Nationally and Internationally

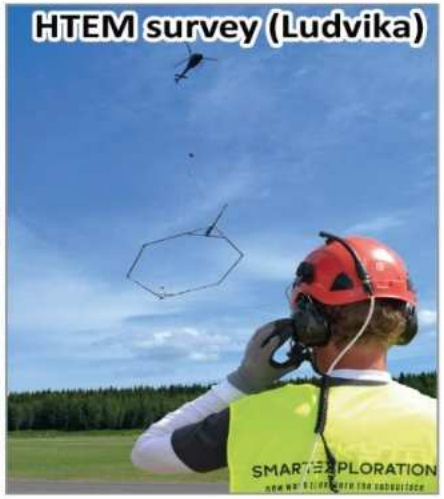
- **2014: landstreamer 2D seismics** for the first time attempted for deep targeting
- **2016: Downhole logging** in 6 boreholes
- **2016:** Two **2D cross-profiles** acquired
- 2017: Pilot **UAV mag**
- **2019:** A **sparse 3D seismic** (first in Sweden)
- **2019: Evib 2D survey**
- **2020: UAV mag and EM** surveys
- **2020:** Deep-probing **HTEM**
- **2020: Slimhole** seismics
- **2022: Fiber-optic and broadband** MEMS and 3C surface and downhole
- **2024: Tailing seismics incl. DAS, nano etc.**
- **2025: Deep Targeting and Extensions**
- **2026: Experimental works**



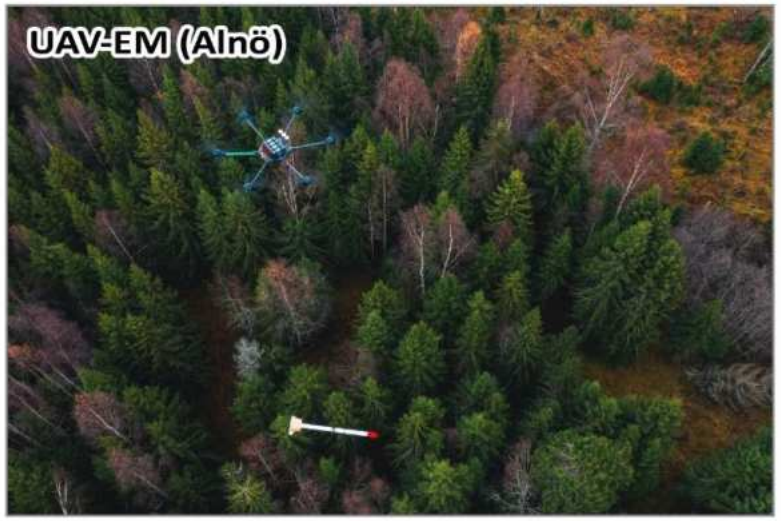
Prototypes











SMART EXPLORATION
new ways to explore the subsurface

UPPSALA UNIVERSITET

seismic mechatronics

SGU
Sveriges geologiska undersökning
Geological Survey of Sweden

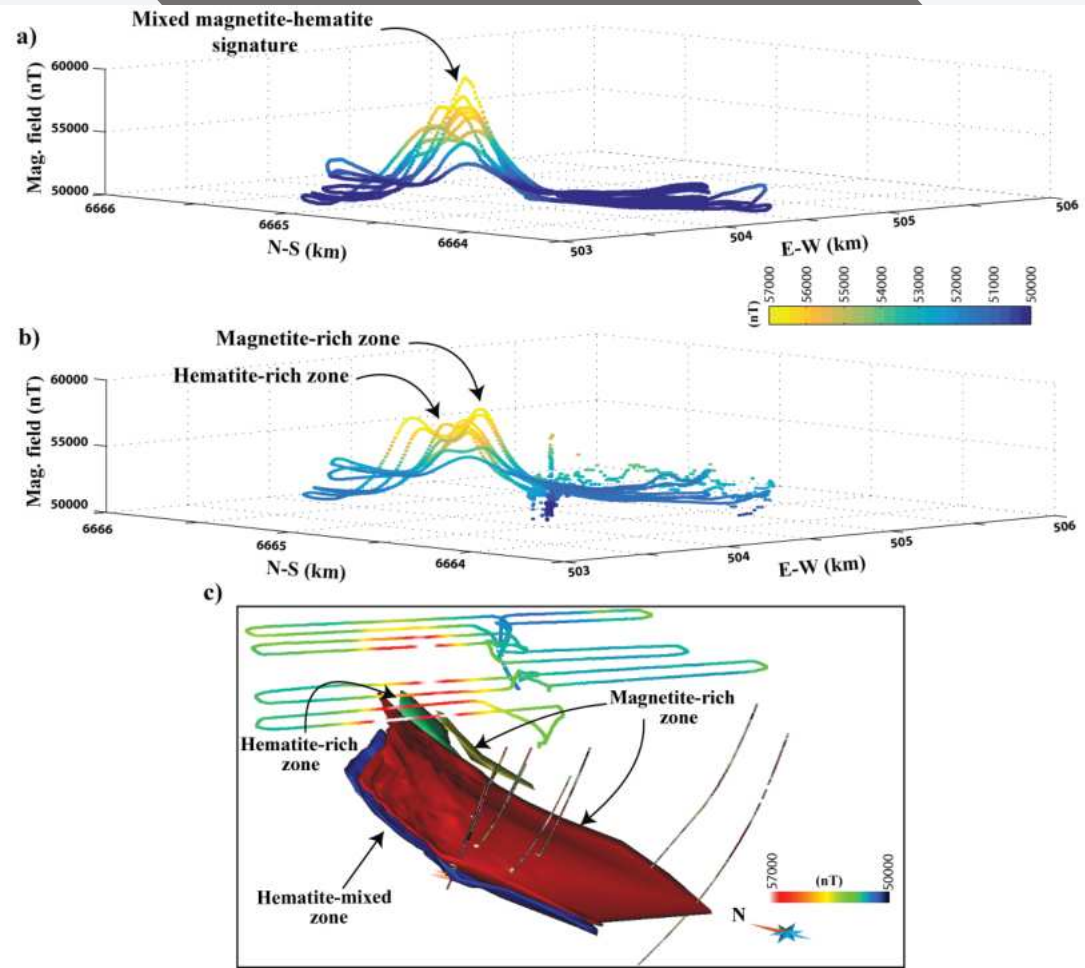
BitSim

SKYTEM

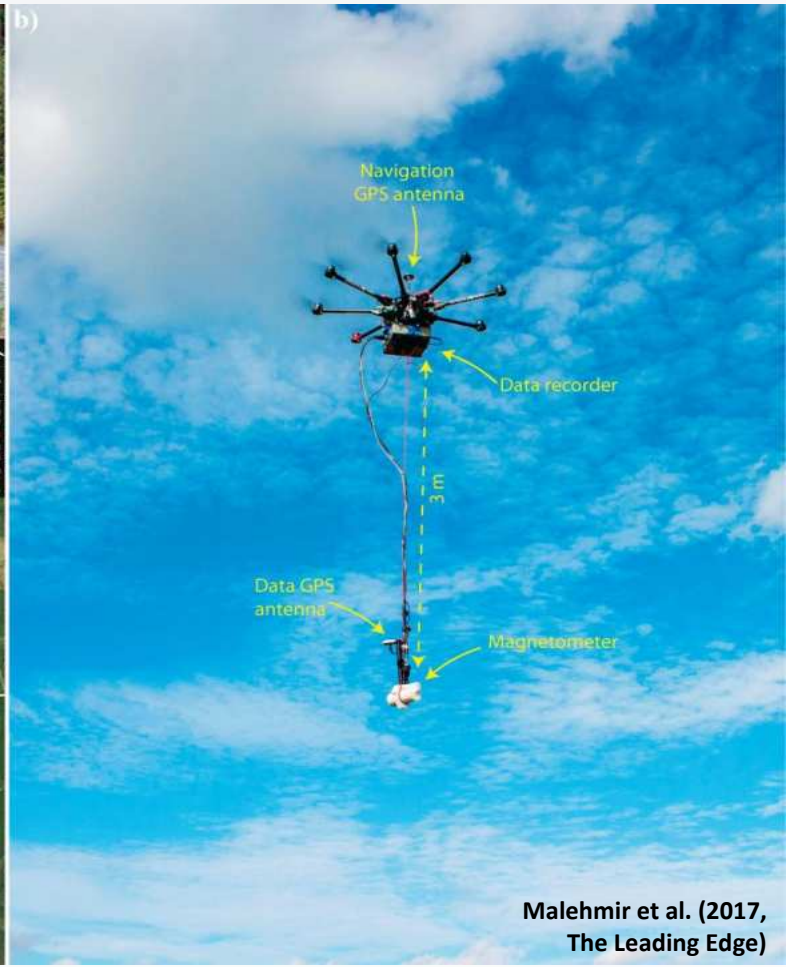
AMKVO

MIC

Why drone matters?







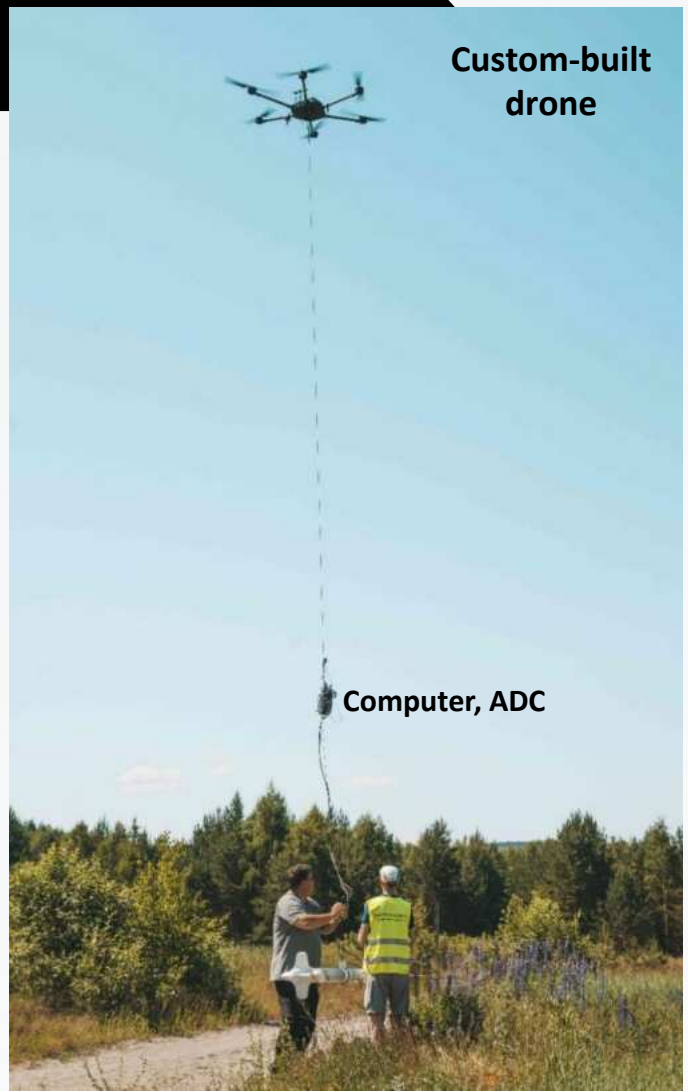
Malehmir et al. (2017, The Leading Edge)

Not all go as planned!

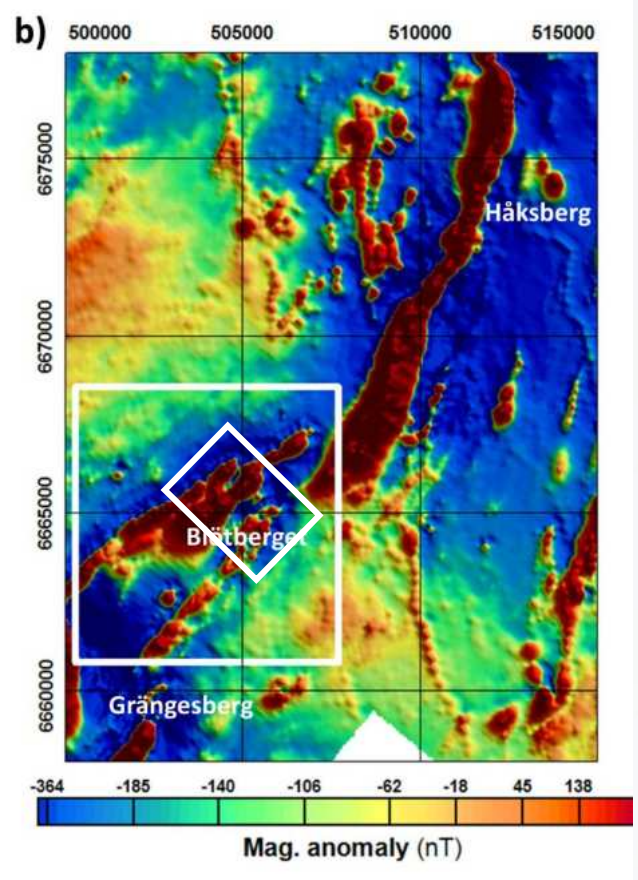


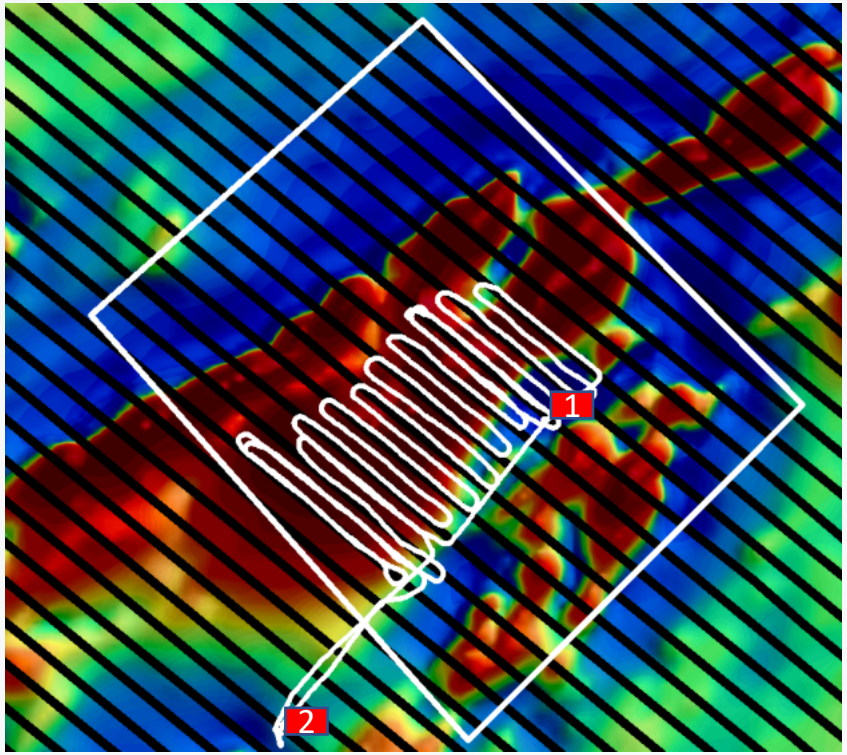
Custom-built hexacopter (from quadrocopter)

- Assembled by AMKVO
- Designed for at least 20 min flight time with 5 kg payload



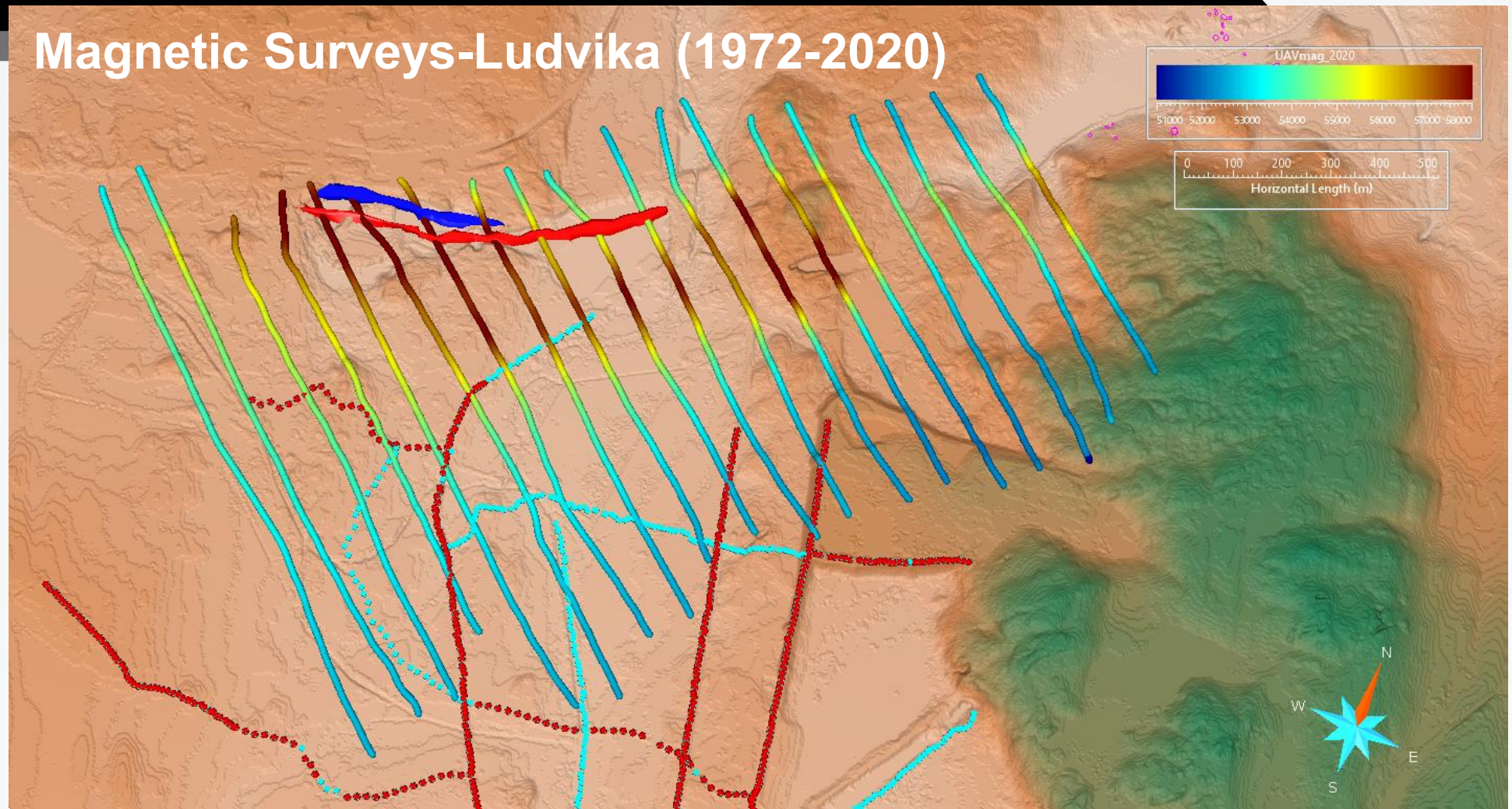
Drone over Blötberget



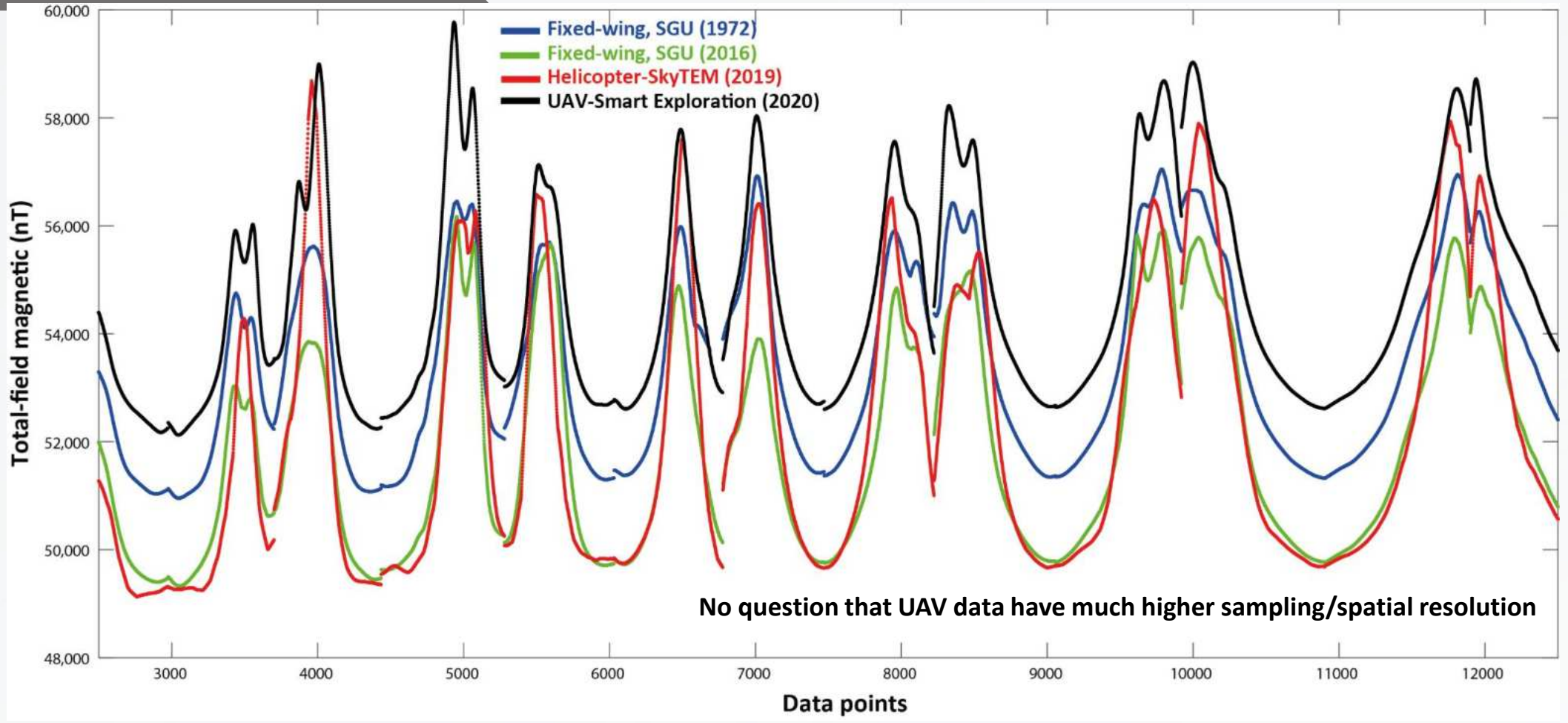


Bastani et al. (2020, First Break)

Closer look!


Magnetic Surveys-Ludvika (1972-2020)
UAVmag_2020
51000 52000 53000 54000 55000 56000 57000 58000
0 100 200 300 400 500
Horizontal Length (m)
N
W
E
S

Why drone matters?

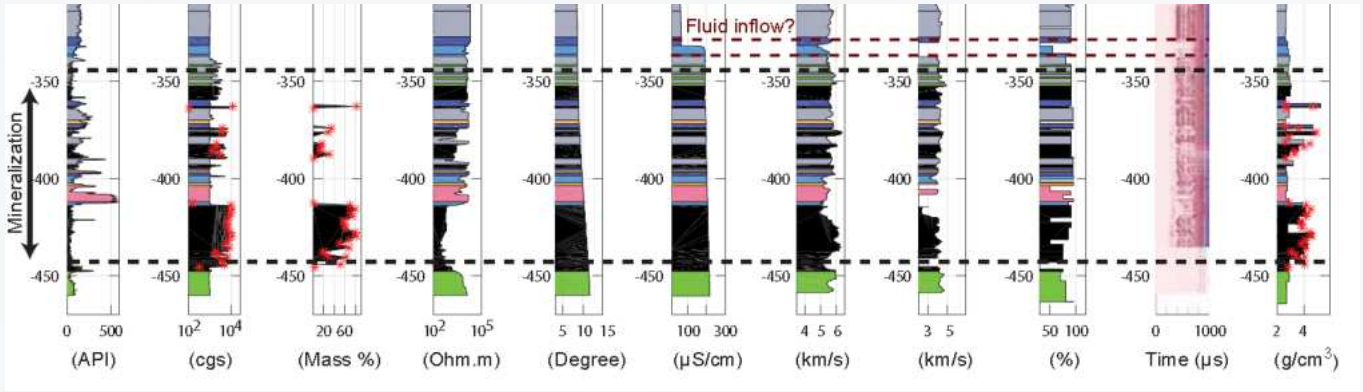


Systematic workflow!

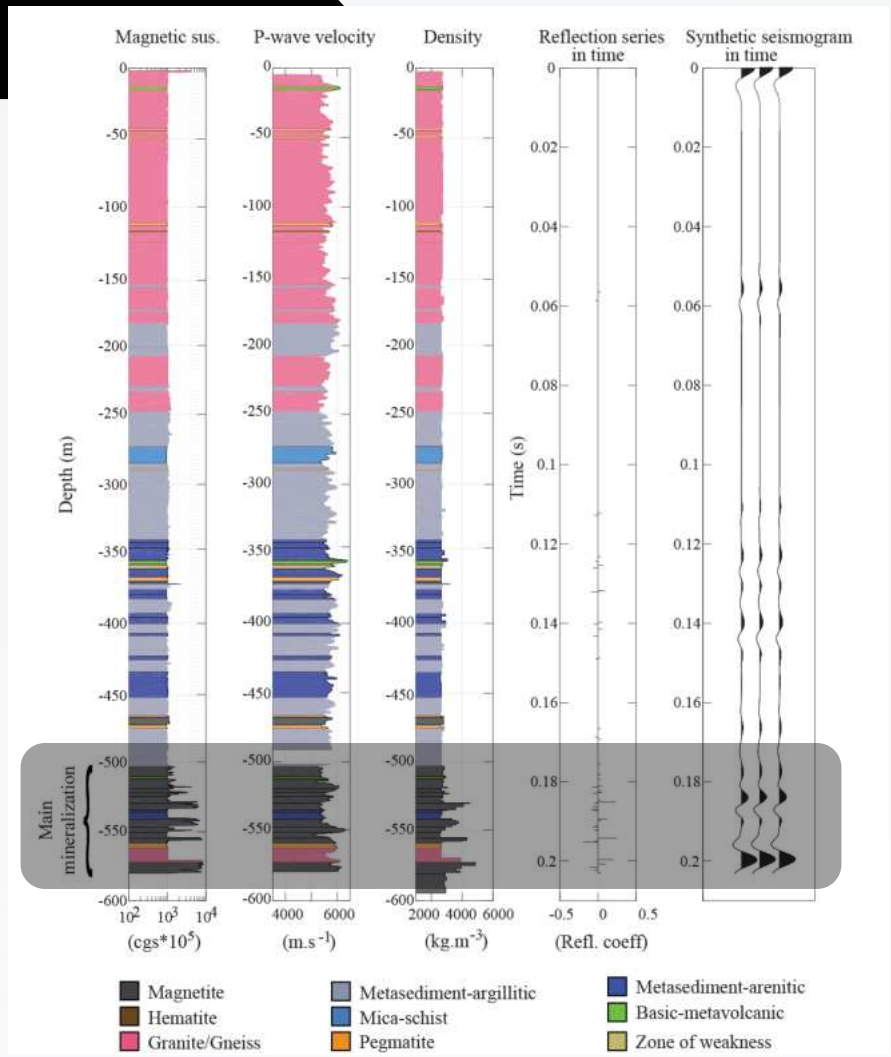
Iron ores are seismically reflective given their density contrasts!



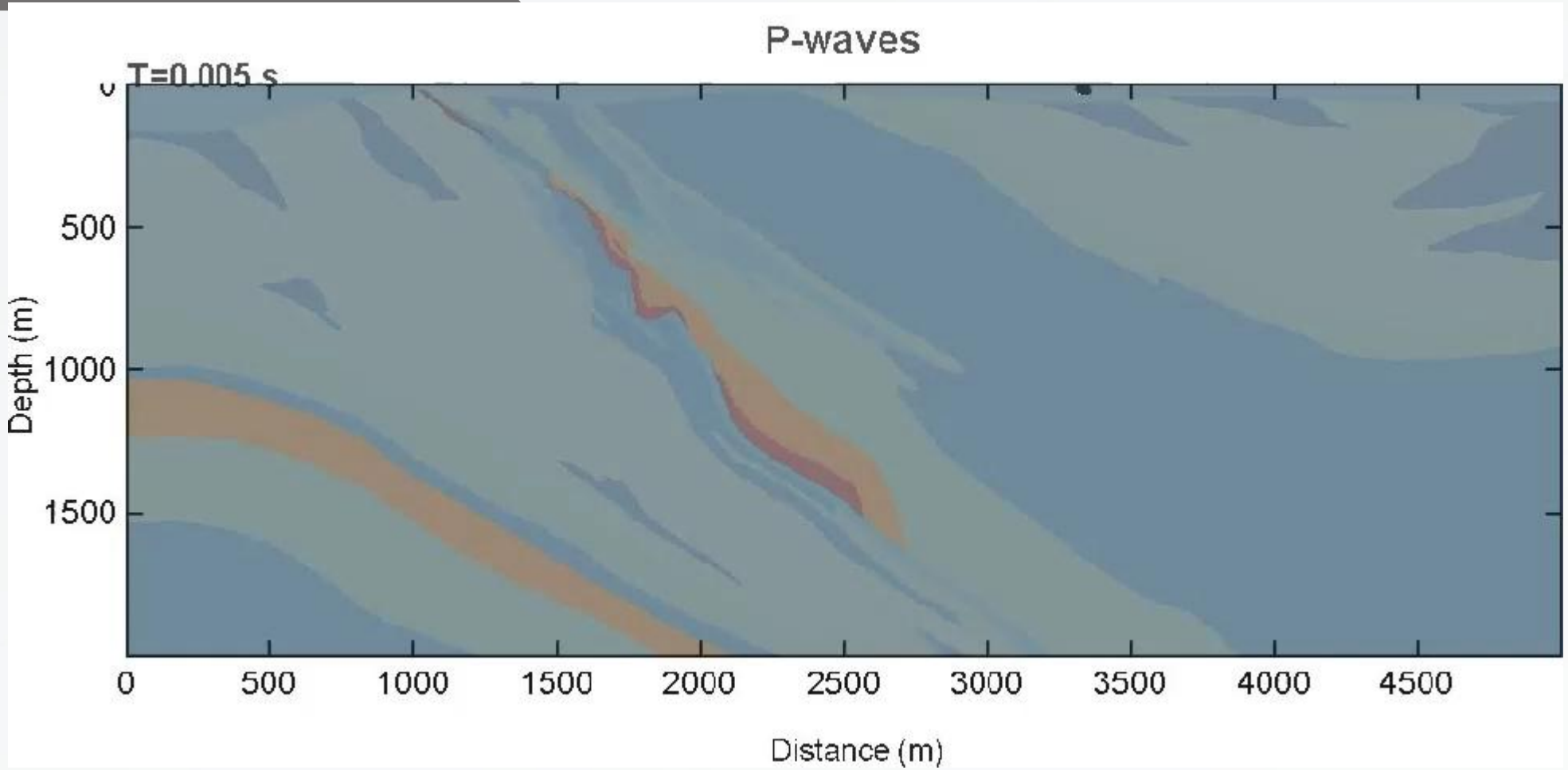
Blötberget Discovery borehole 25-001



Maries et al. (2017, Ore Geology Reviews)



Wavefield Demo



Our gears!

Recorders (1000s):
Geophones (nodals), accelerometers (MEMS), or Distributed Acoustic Sensing using fibre-optic cables





Sources (1-2):
Active – Drophammer, Vibrotrucks, blasts etc.
Passive – Ambient noise

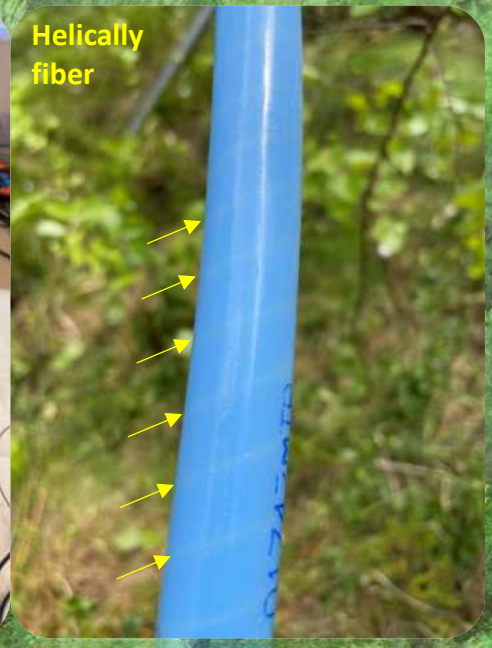



Nomad 15 (9t, 77 kN)
2-200 Hz linear 18s


3 single 1C=3C, 10 Hz
collocated with WINGs
(MEMs) and straight fiber




3C-10 Hz


Helically
fiber

5 m
WINGs
(MEMs)
3C (10 Hz)
Straight fiber (surface array)

Quick demo!



Unmigrated stack

Main road

???



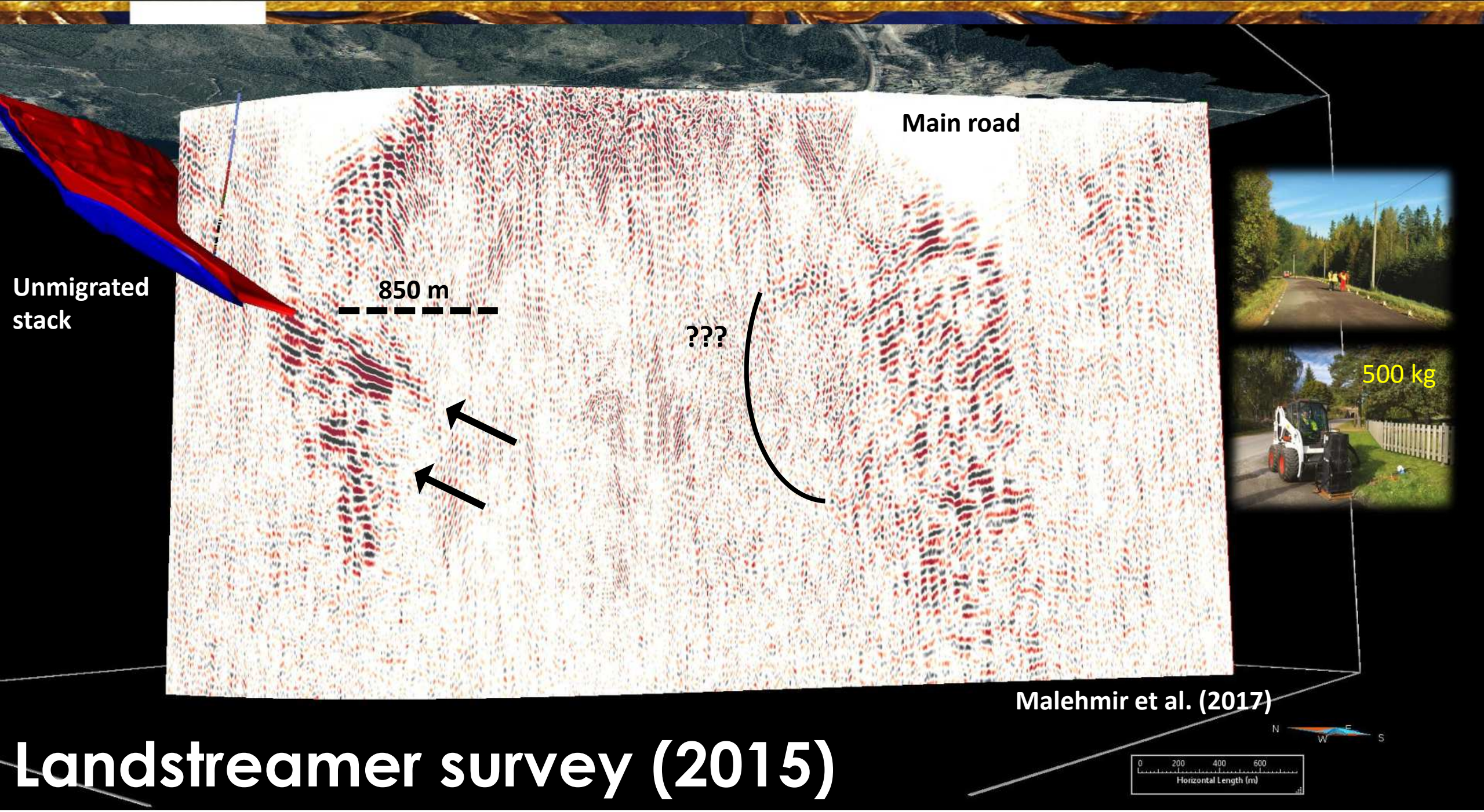


Malehmir et al. (2017)

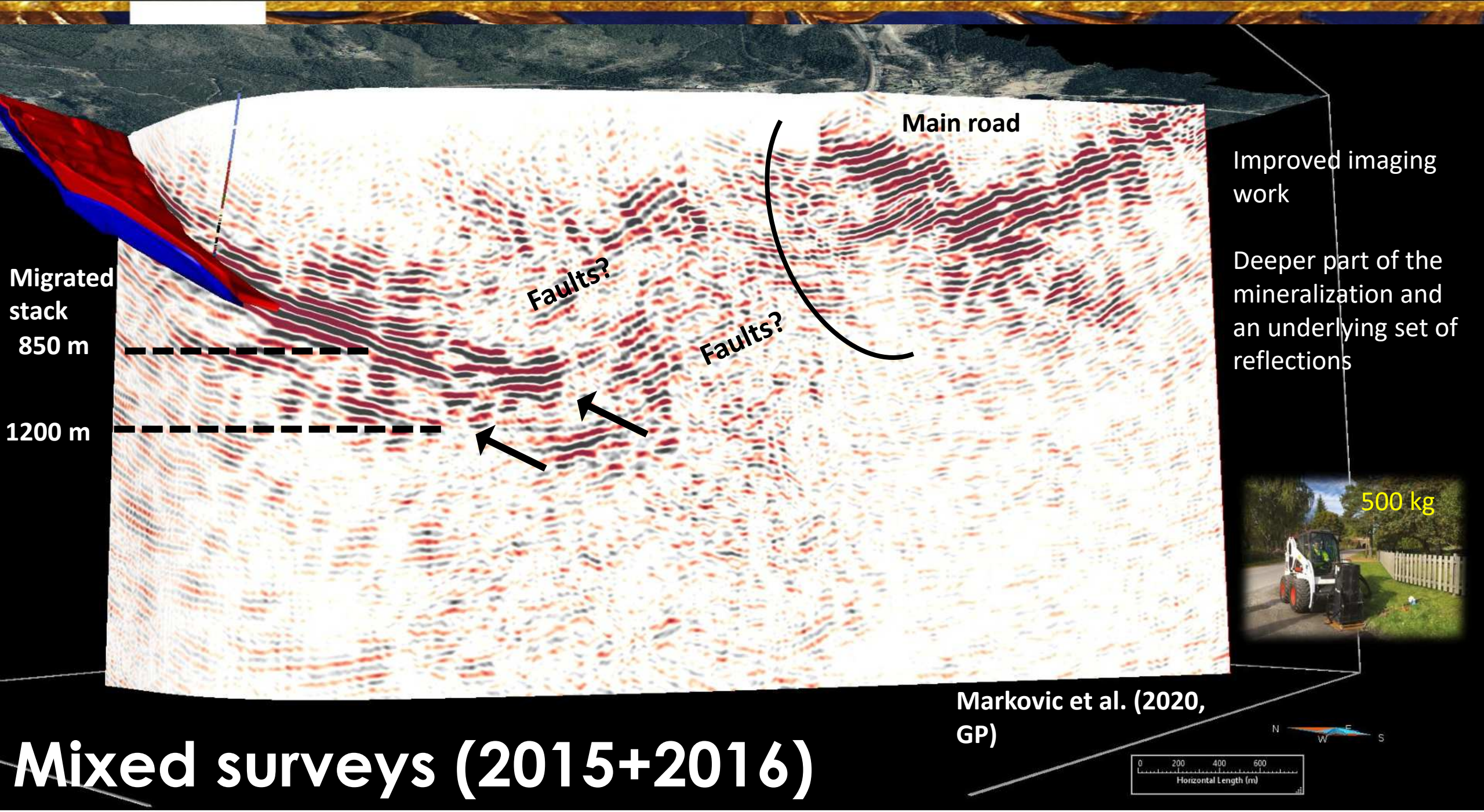




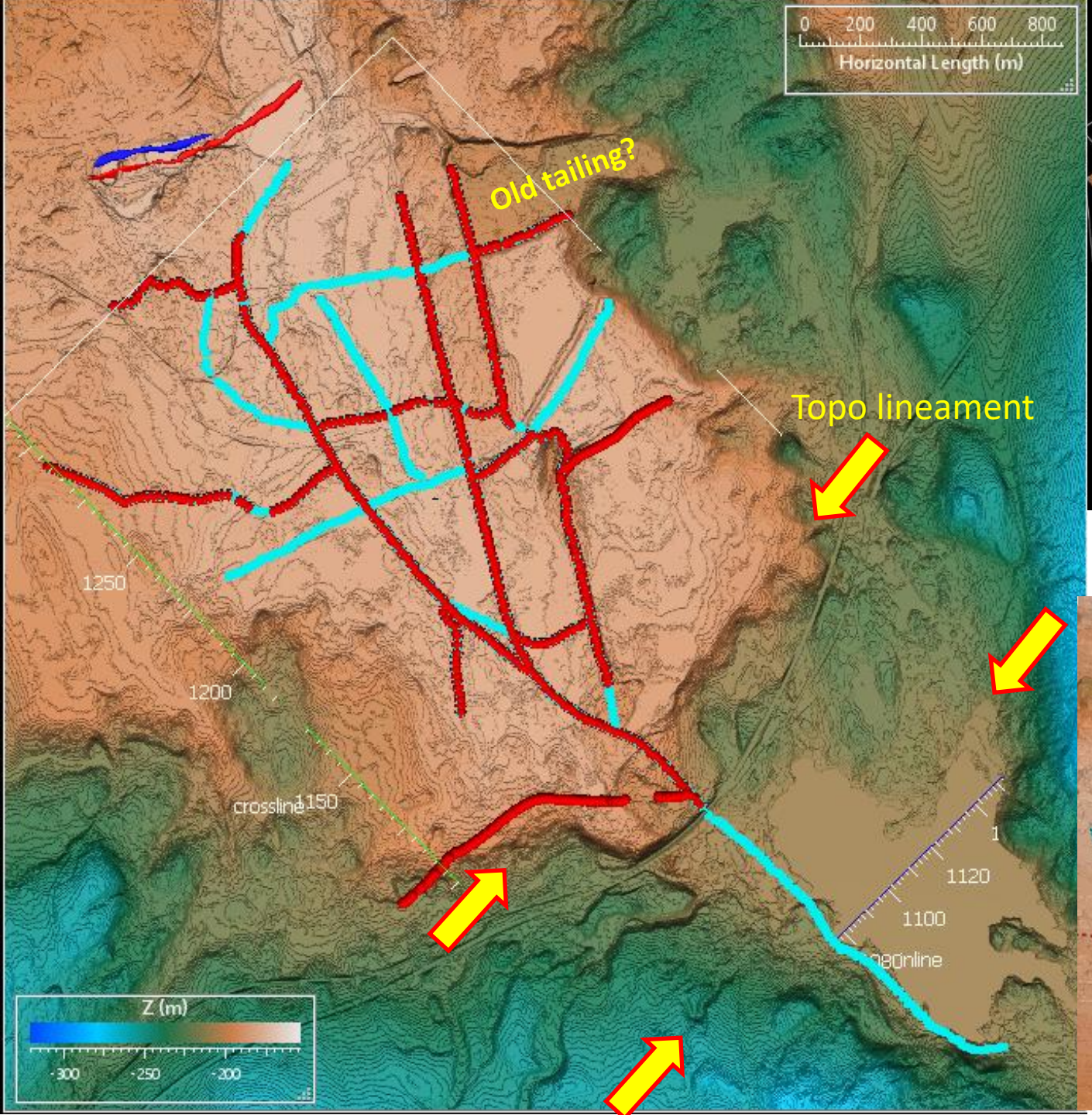
Landstreamer survey (2015)

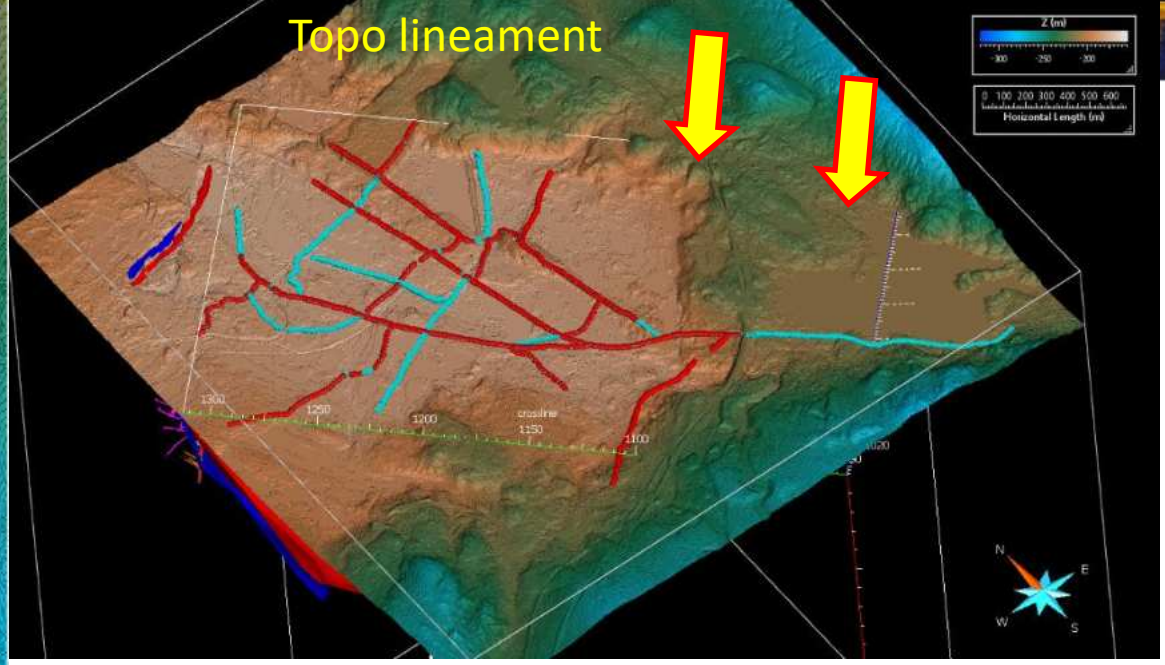


Landstreamer survey (2015)

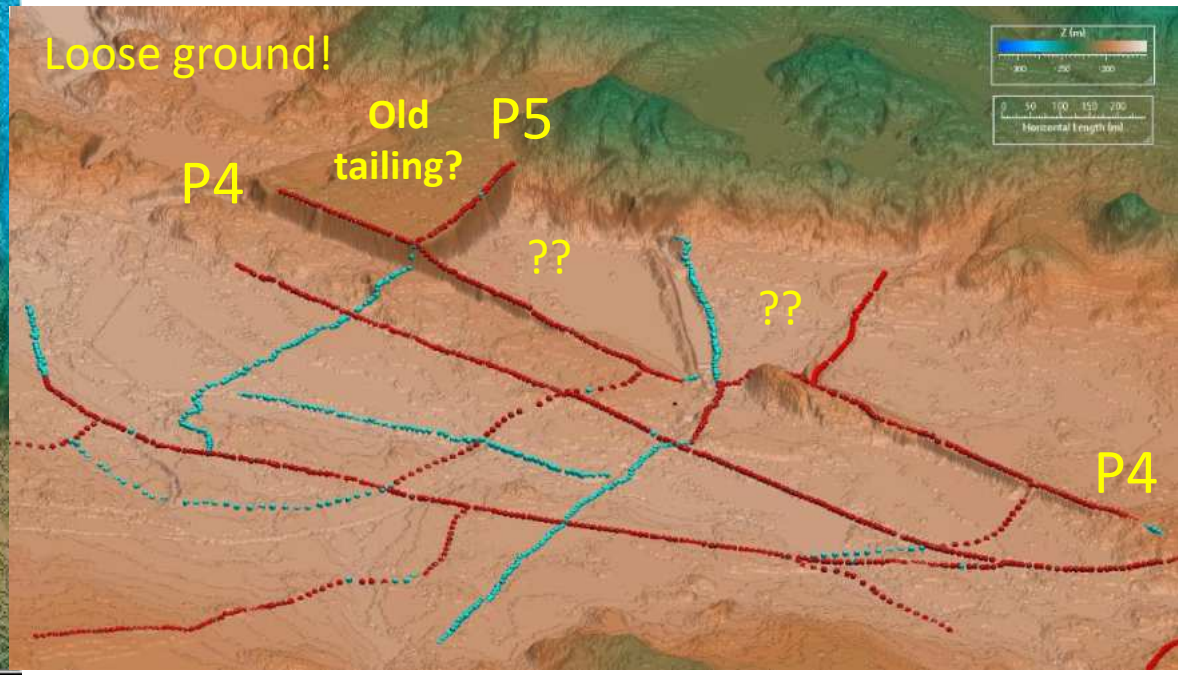


Mixed surveys (2015+2016)



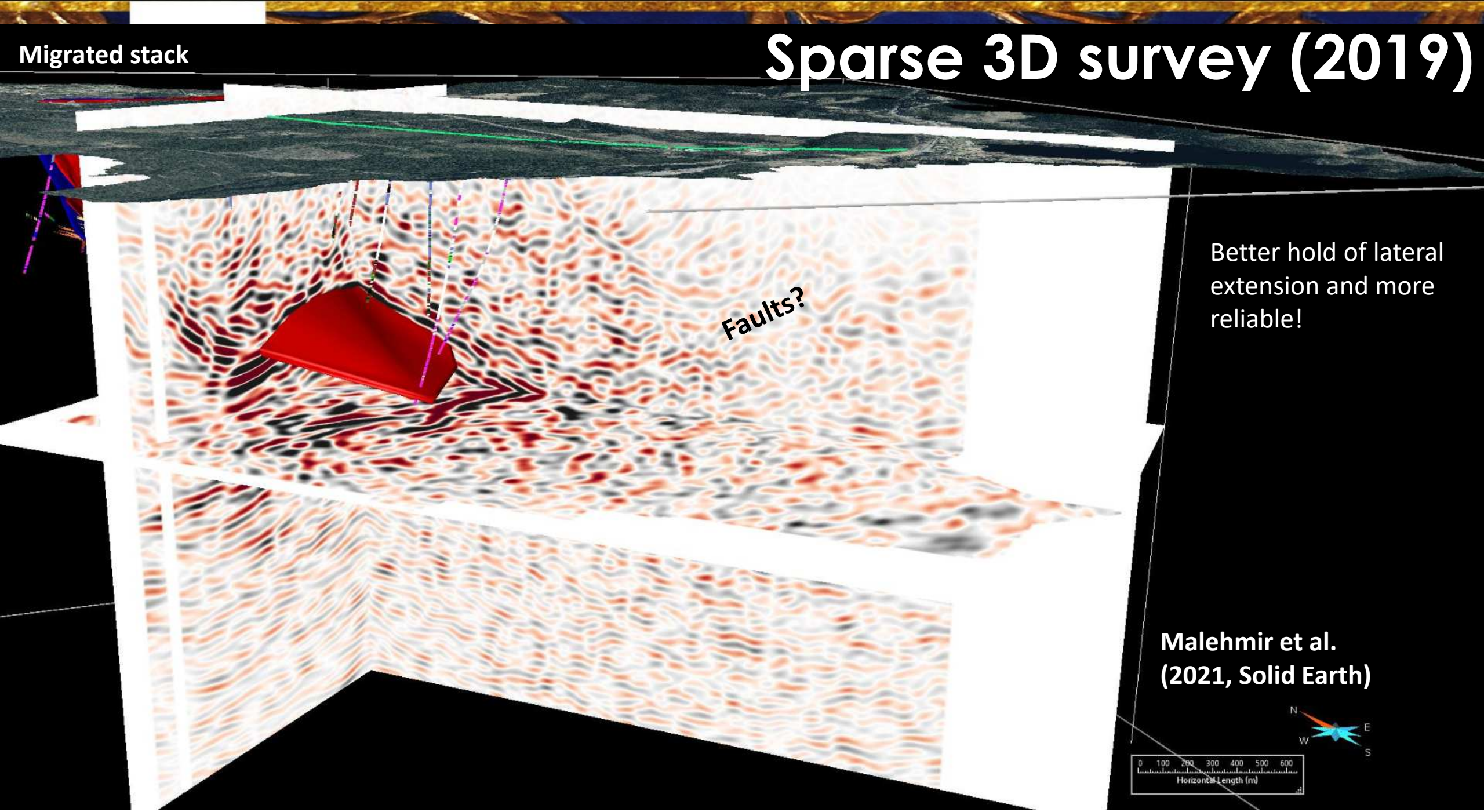


First semi-3D seismic survey in Sweden



Migrated stack

Sparse 3D survey (2019)

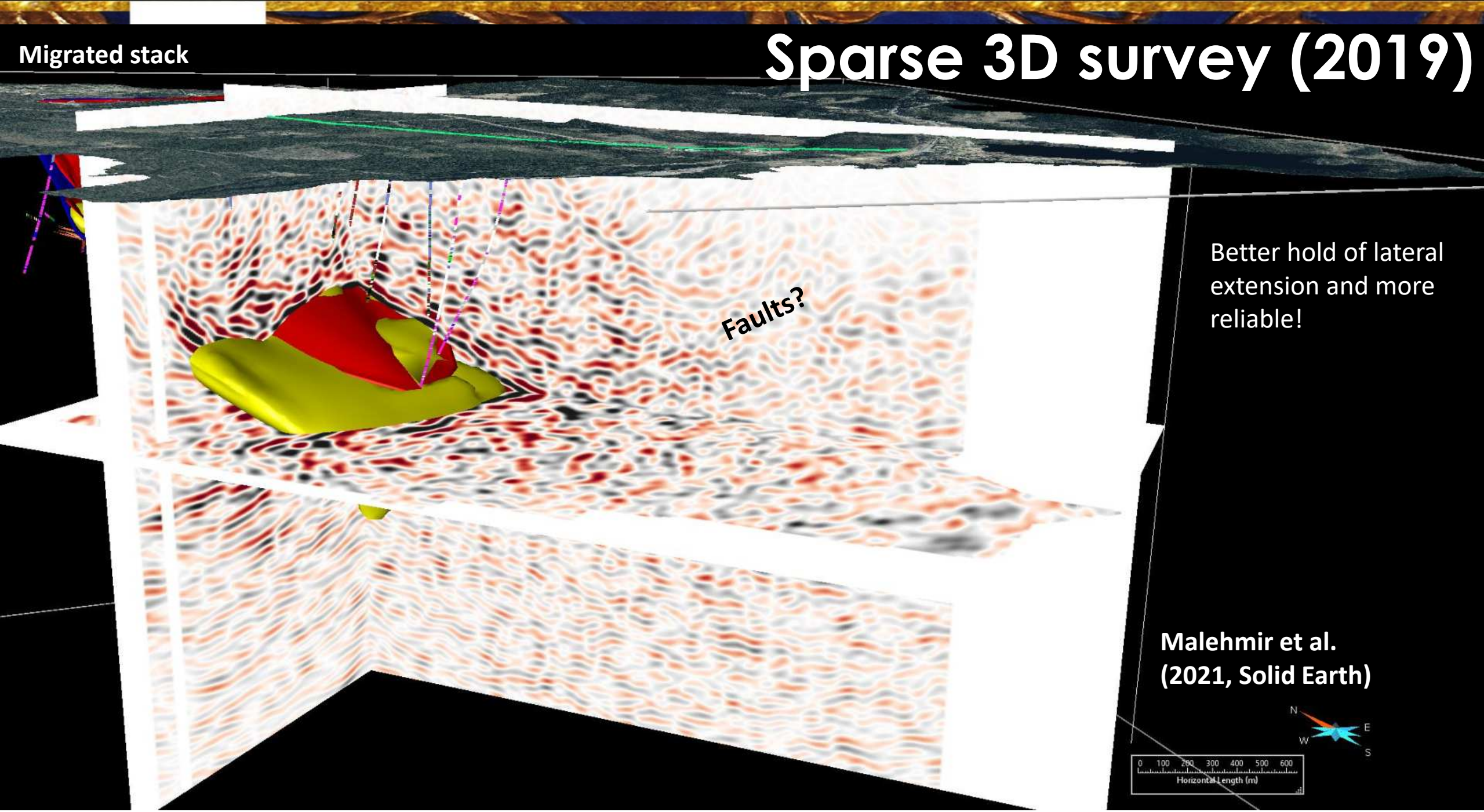


Better hold of lateral extension and more reliable!

Malehmir et al. (2021, Solid Earth)

Migrated stack

Sparse 3D survey (2019)



Better hold of lateral extension and more reliable!

Malehmir et al. (2021, Solid Earth)

Potential resources!

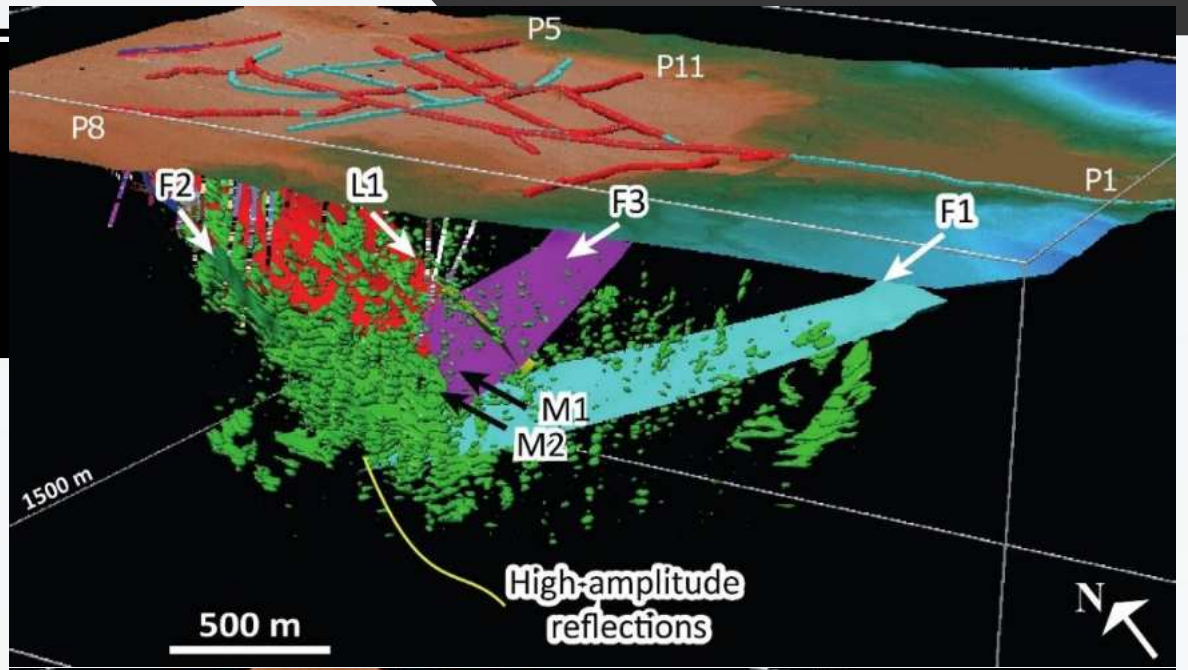
The 3D seismic volume helped to provide a **possible additional resources of approximately 10 Mt** via 300 m lateral and 300 m depth extension beyond borehole information!

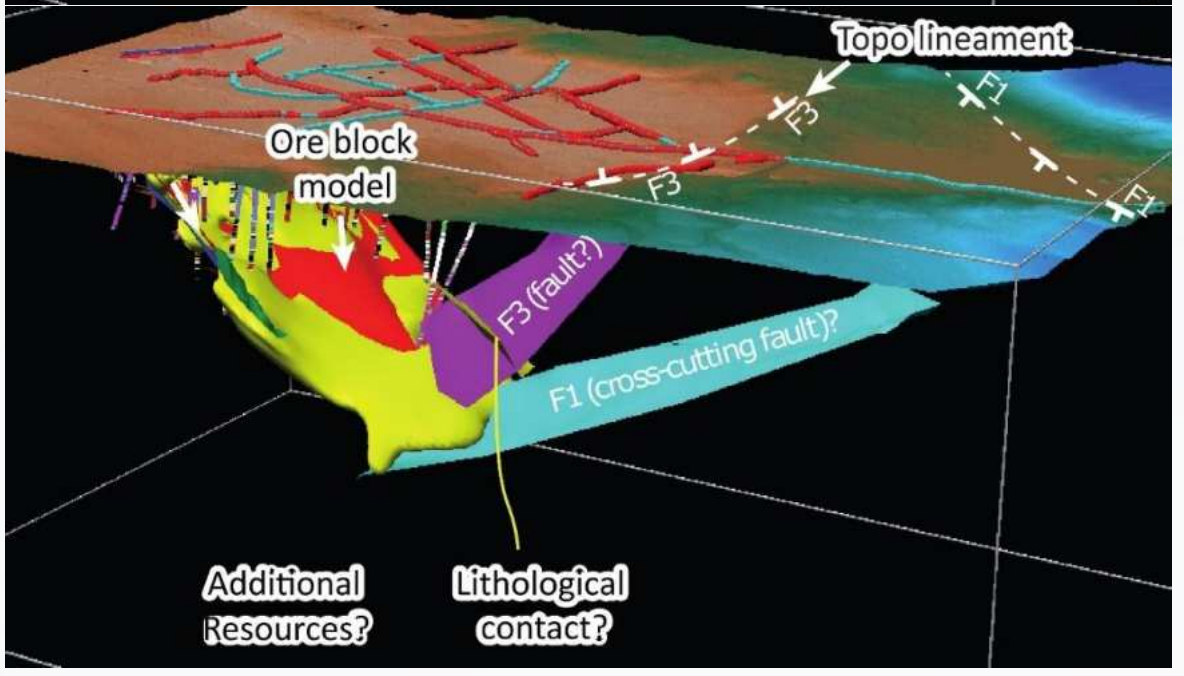
Nordic Iron Ore™

Press release: 2019
Granted: 2022

Nordic Iron Ore AB has applied for an additional exploration permit at Blötberget

Nordic Iron Ore AB has submitted an application to The Mining Inspectorate of Sweden (Bergsstaten) for an additional exploration permit in connection with the Blötberget mine. The background is the interesting indications obtained from the Smart Exploration research project. Which makes this area very interesting for exploration and, in the case of successful exploration, a possible expansion of Nordic Iron Ore's mineral resources.







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Nordic Iron Ore™

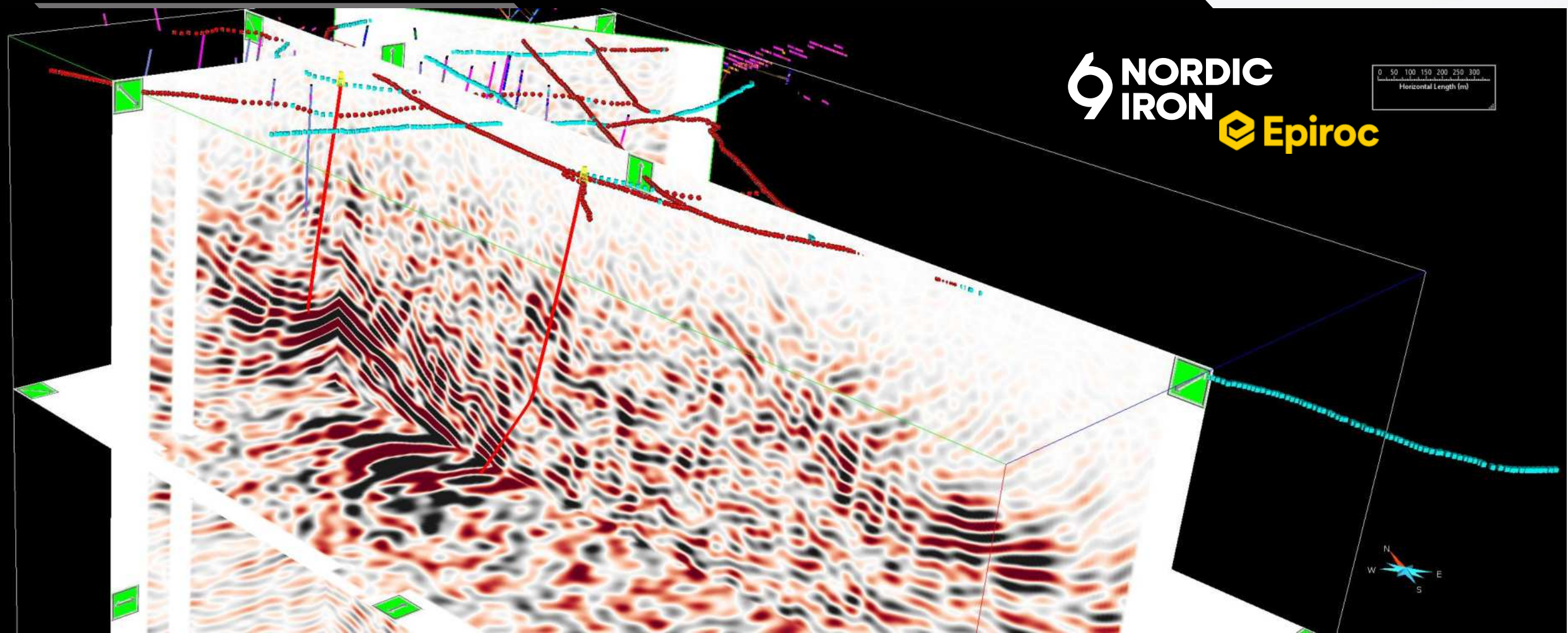
✓ Nordic Iron Ore hits mineralization at depth!

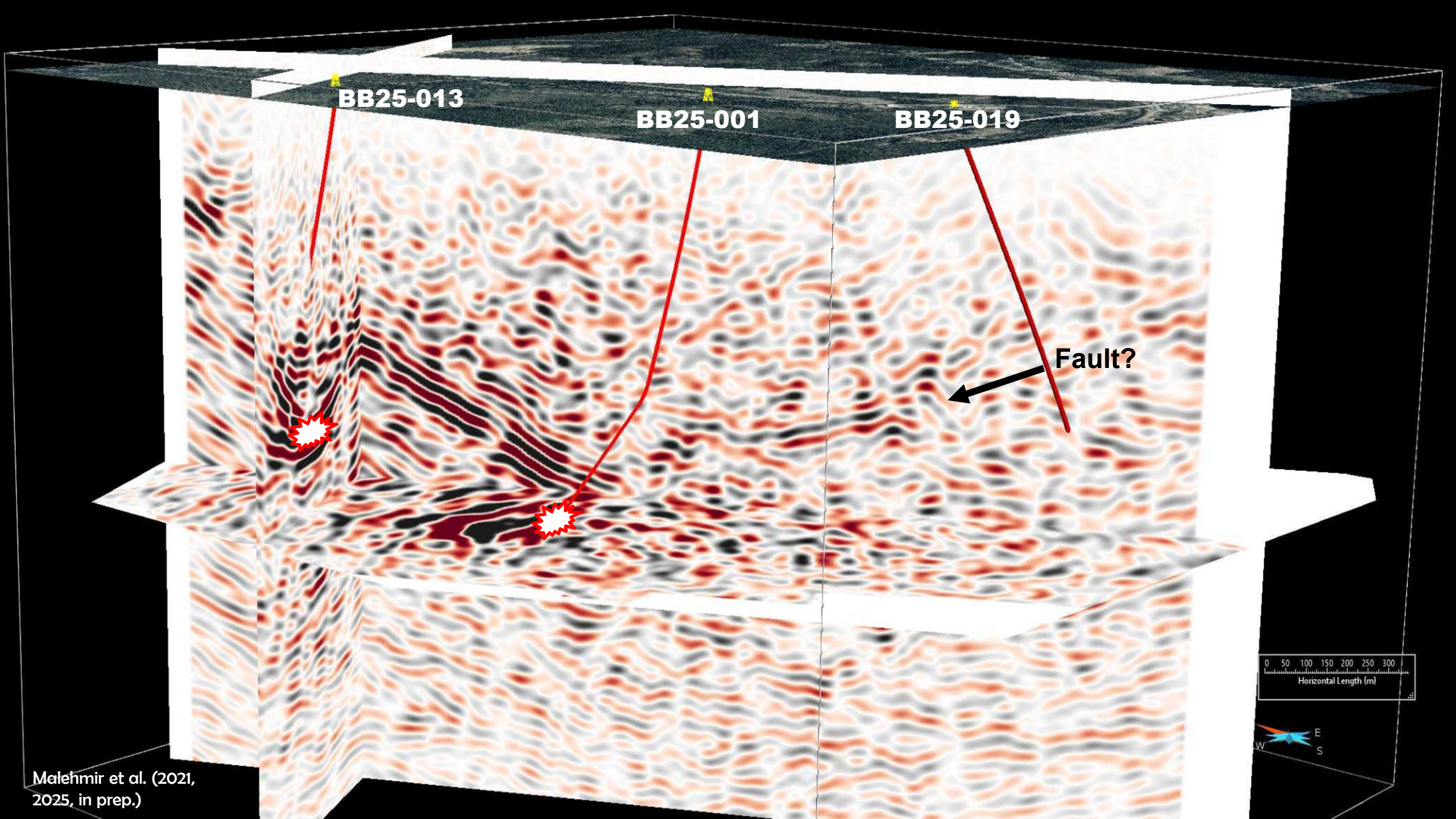
Intercepted mineralization-Blötberget

- *1044-1052 m → 60-65% Fe (Hematite)*
- *1063-1074 m → 40-45% Fe (Hematite)*

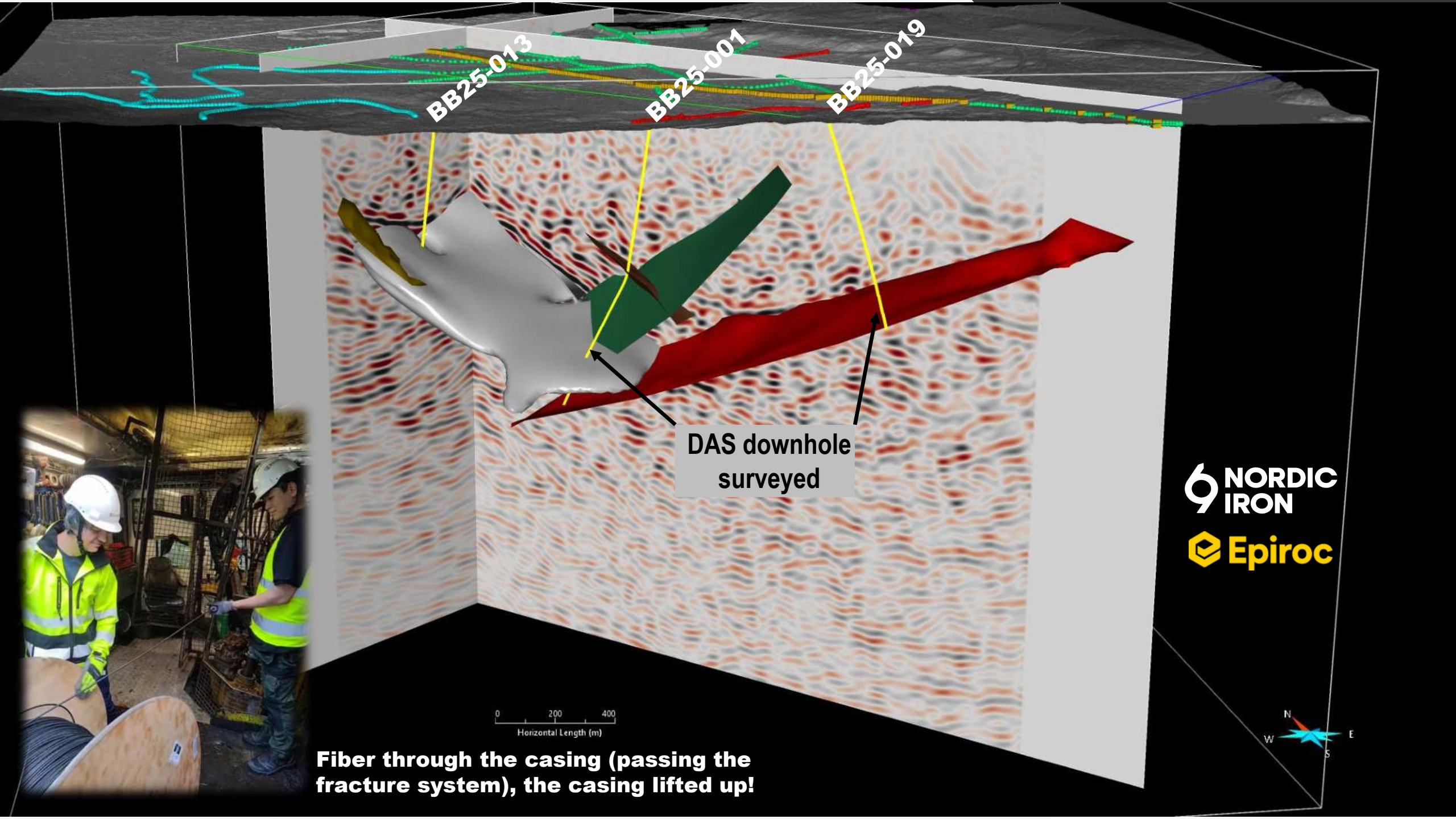
Earlier 2025 only

SMART EXPLORATION RESEARCH CENTER



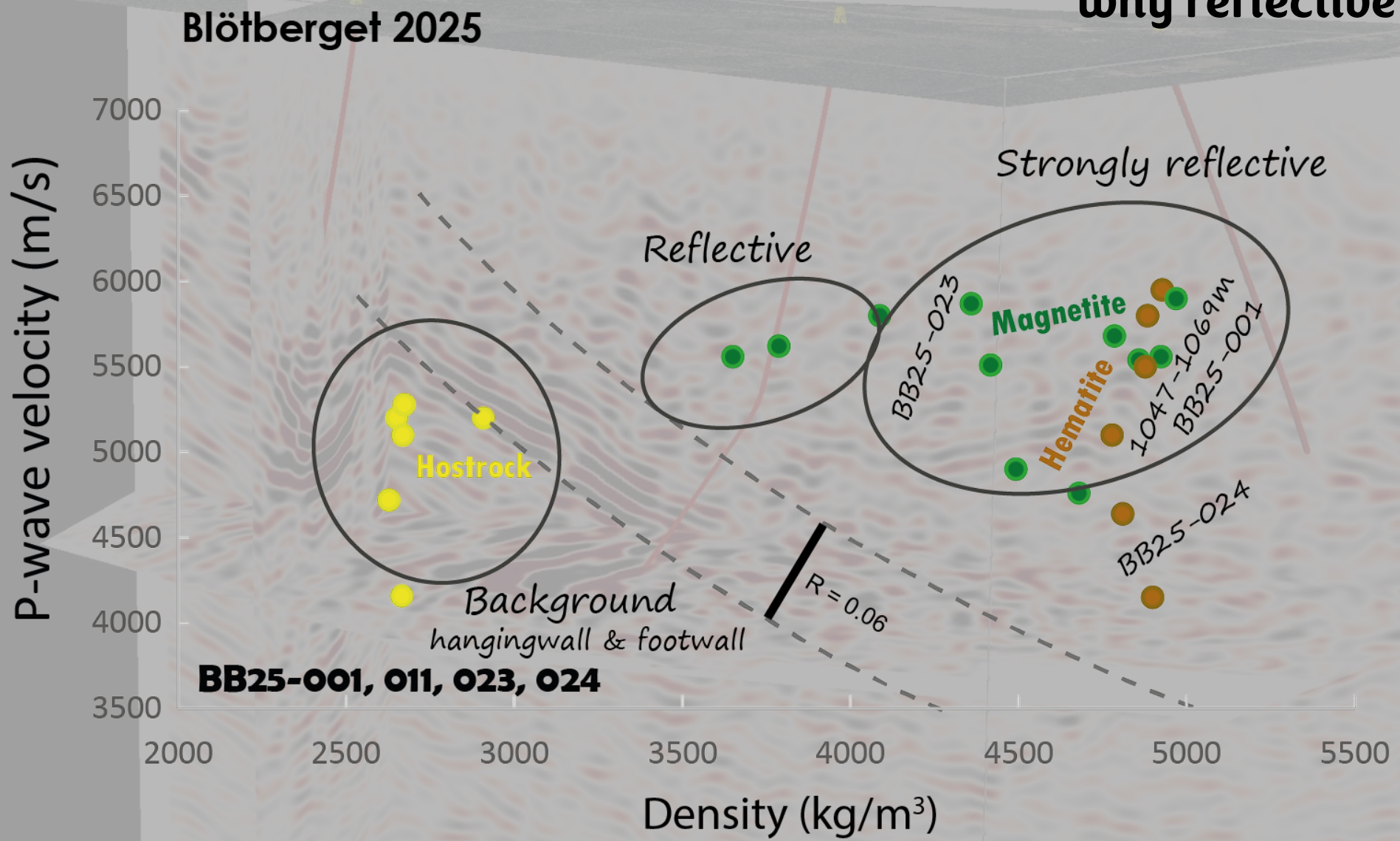


Malehmir et al. (2021, 2025, in prep.)



Fiber through the casing (passing the fracture system), the casing lifted up!

Building physical properties understanding, why reflective?



Malehmir et al. (2026, First Break)

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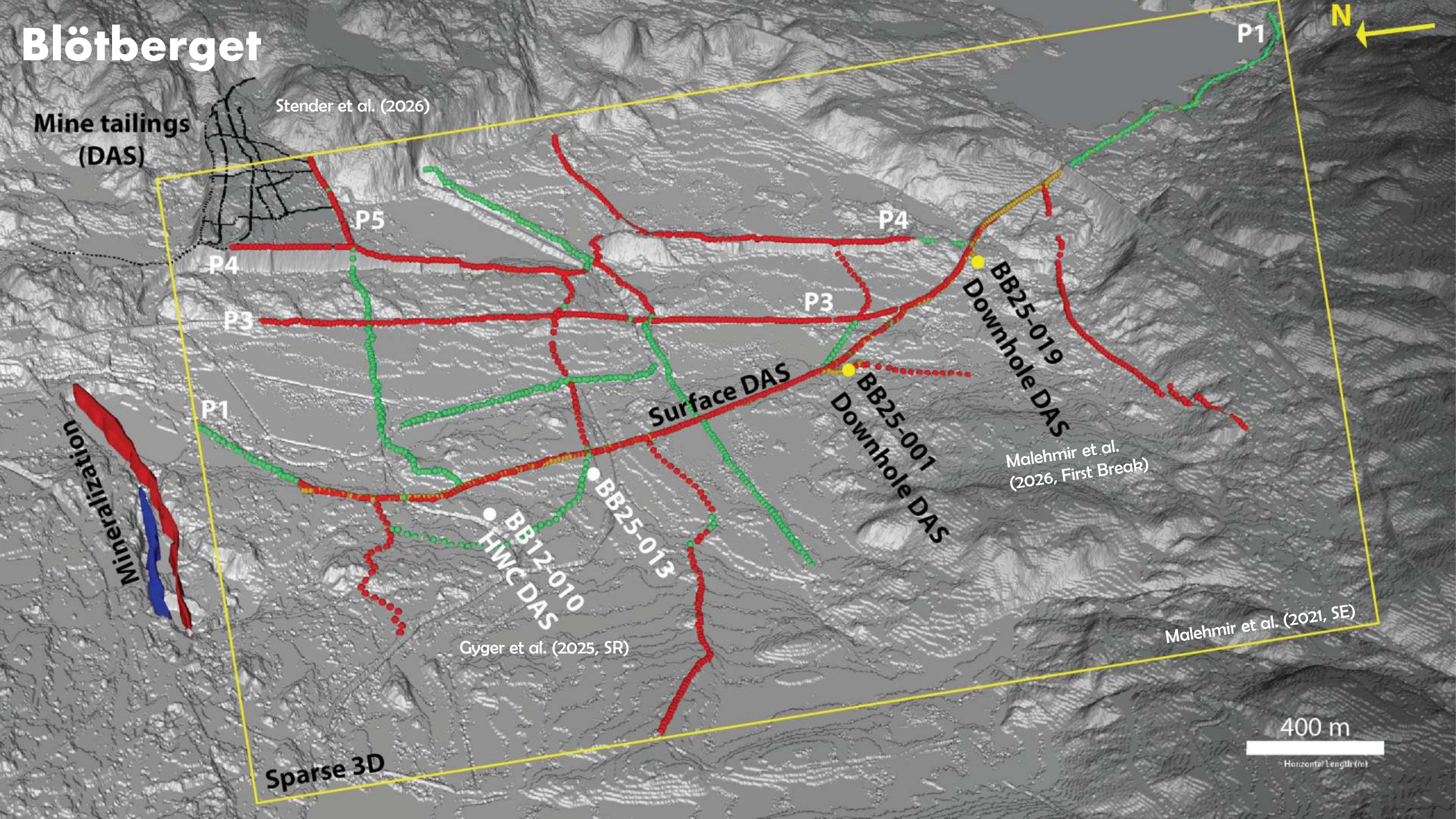
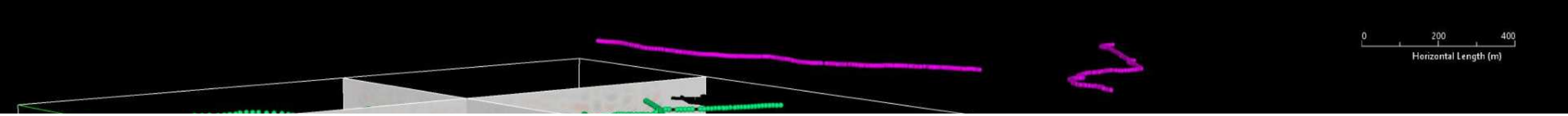

Blötberget
Mine tailings (DAS)
Stender et al. (2026)
P5
P4
P3
P1
P4
P3
P1
N
BB25-019 Downhole DAS
BB25-001 Downhole DAS
Surface DAS
Malehmir et al. (2026, First Break)
Mineralization
BB12-010 HWC DAS
BB25-013
Gyger et al. (2025, SR)
Malehmir et al. (2021, SE)
Sparse 3D
400 m
Horizontal Length (m)



Press Release
30 October 2025 12:40:00 CET

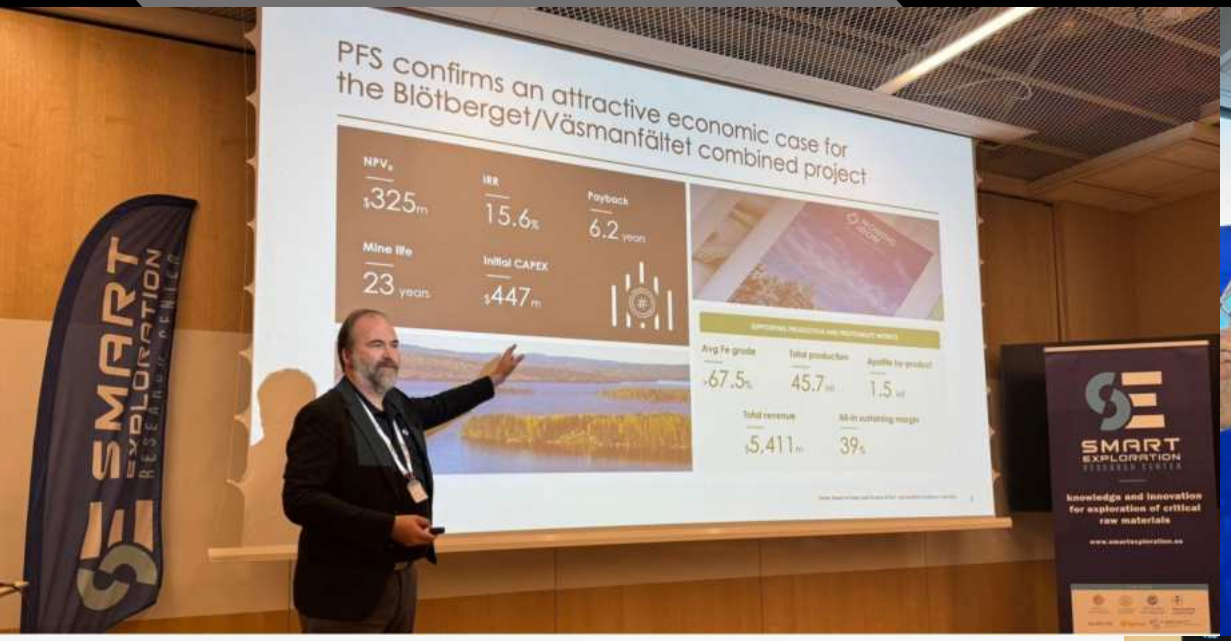
NORDIC IRON
Responsible mining

Nordic Iron has applied for an additional exploration permit at Blötberget

Nordic Iron Ore AB (“Nordic Iron”) has submitted an application to the Swedish Mining Inspectorate for an additional exploration permit in the vicinity of Blötberget. The reason is that ongoing exploration work has given signals that the area in question is of interest for exploration. A successful exploration of the area could mean a possible expansion of Nordic Iron's mineral resources.



NIO Updated 2026 Resources (Blötberget)











Blötberget is just the beginning! Ludvika may hold a deep iron-ore (plus REEs and Phosphates) treasure waiting to be unlocked!

SMART
EXPLORATION
RESEARCH CENTER







SMART EXPLORATION RESEARCH CENTER

THANK YOU!

Swedish Foundation for Strategic Research

Smart Exploration Research Center (SERC) has received funding from the Swedish Foundation for Strategic Research (SSF) agreement no. CMM22-0003

SMART EXPLORATION

new ways to explore the subsurface

THANK YOU

Smart Exploration has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.775971.