

Nowe możliwości badawcze w Antarktyce: Stacja Dobrowolskiego

New research opportunities in Antarctica: Dobrowolski Station
(Bunger Hills, East Antarctica)

39th Polar Symposium
Sopot, 18th May, 2023

Marek Lewandowski
Institute of Geophysics, Polish Academy of Sciences



Acknowledgements

Project SPUB Dobrowolski

founded by the Ministry of Science and Higher Education
(currently: Ministry of Education and Science)

Polish Polar Consortium
support

IGF Dobrowolski Task Force members: (October 2019- June 2022)

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Dagmara **Bożek** (since Sept. 2021)
Dominika **Woch** (since May 2020)
Krzysztof **Otto** (since May 2020)
Marcin **Ruszczak**
Marek **Lewandowski** (chairman)
Mirosław **Ciołek** (since May 2020)
Monika **Kusiak**
Przemysław **Kapuściński** (until April 2020)
Włodzimierz **Sielski**
Wojciech **Piotrowski** (until May 2020)

IGF managers:

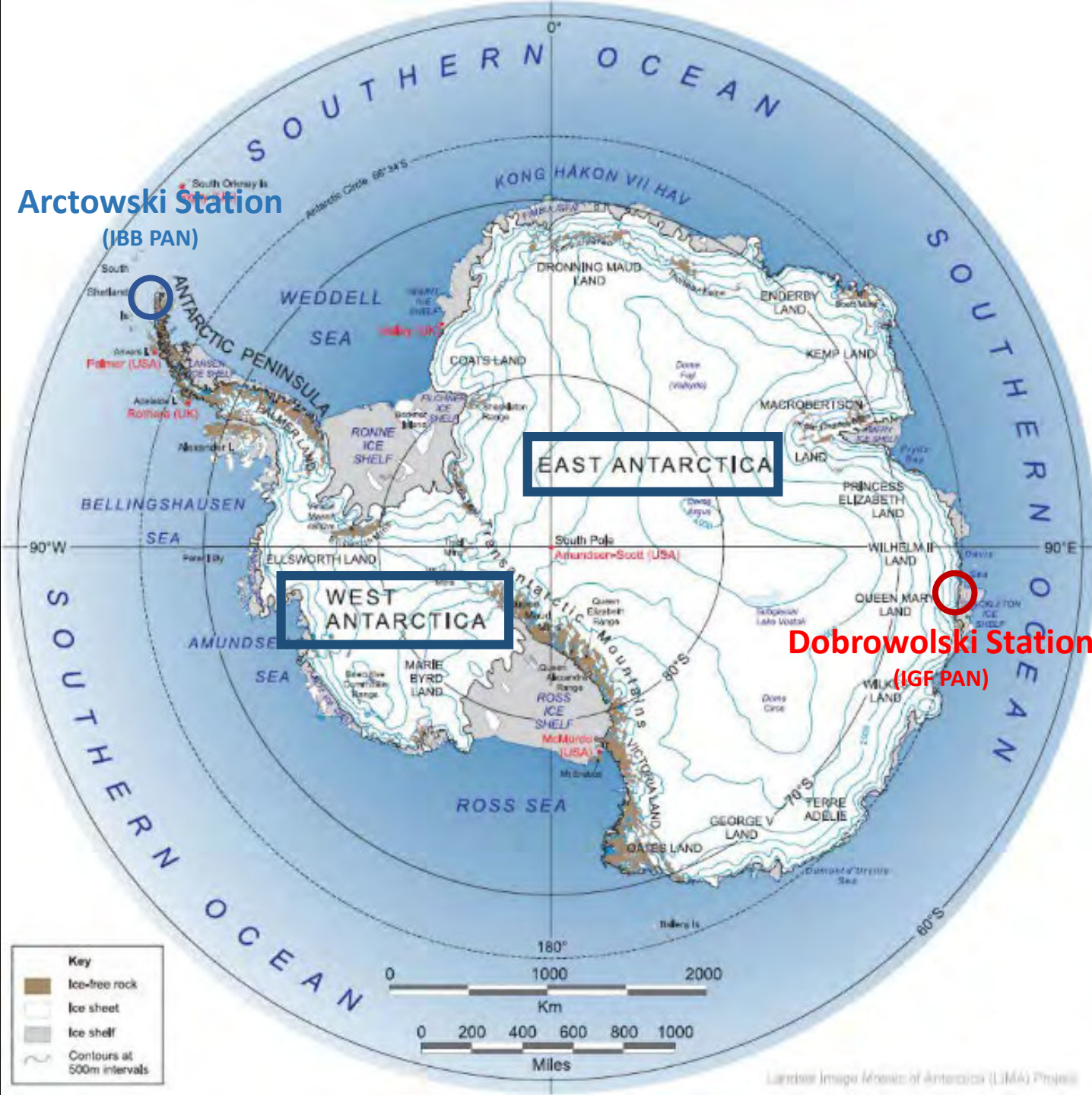
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Mariusz **Majdański**
Krzysztof **Otto** (supervisor)

Photographs by:

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Marek Lewandowski
Wojciech Miloch
Adam Nawrot

PARE team members:

Marek Lewandowski (geophysicist, the leader)
Monika A. **Kusiak** (geochemist)
Wojciech J. **Miloch** (physicist)
Adam **Nawrot** (geomorfologist)
Daniel **Dunkley** (geologist, reserve member)



Henryk Arctowski and Antoni B. Dobrowolski were two prominent Polish polar scientist at the turn of XIX and XX centuries.

Introduction

4th Polish Antarctic Research Expedition (4th PARE)

Bremerhaven, 10th Nov., 2021

„Akademik Fedorov”
turns off the shore

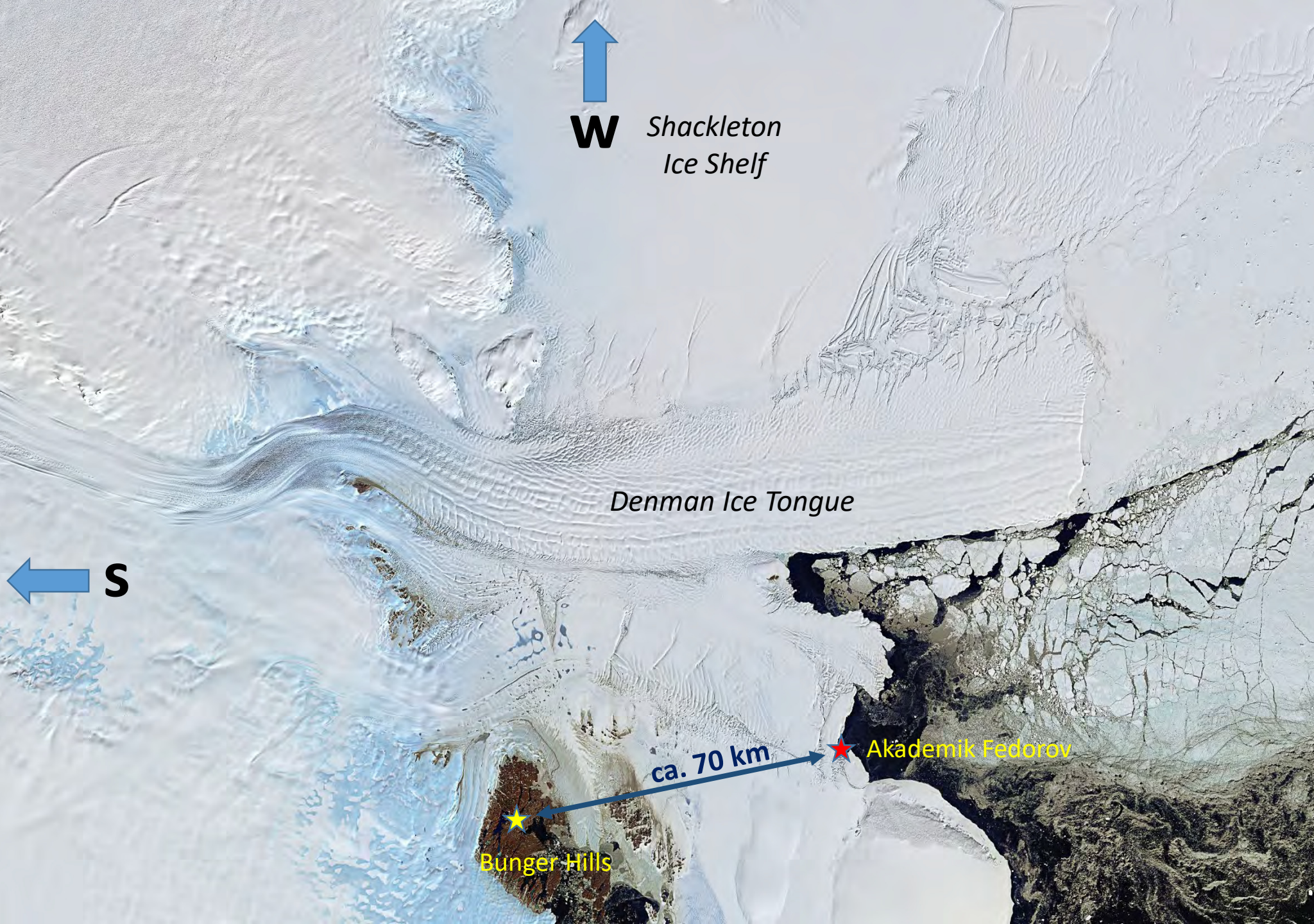
Adam
Nawrot

Marek
Lewandowski

Monika A.
Kusiak

Wojciech
Miloch





W *Shackleton
Ice Shelf*

Denman Ice Tongue

S

ca. 70 km

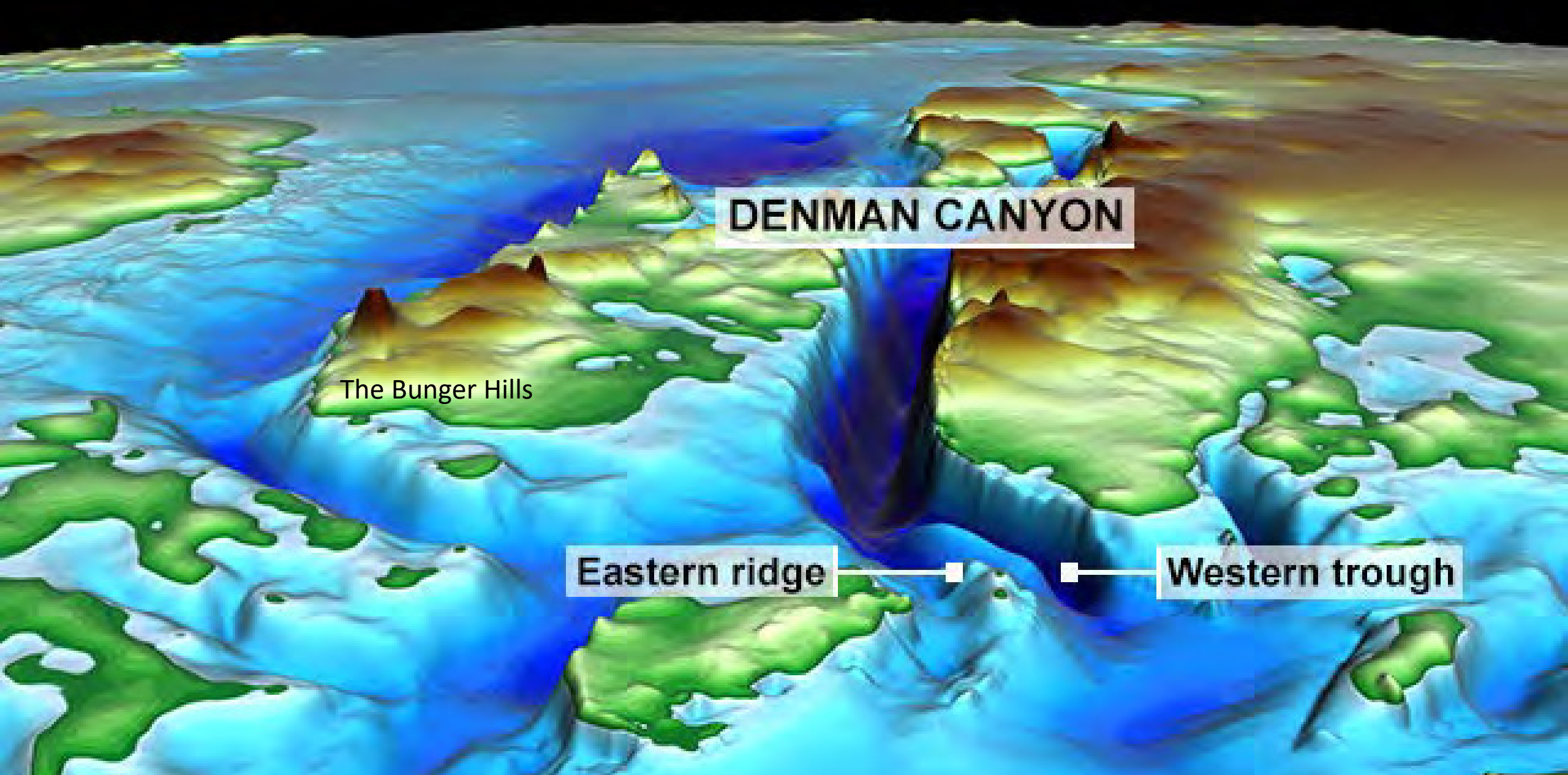
Bunger Hills

Akademik Fedorov

Denman Glacier,
a major glacier
in East Antarctica
that holds an ice
volume equivalent
to a 1.5 m sea level
rise.

Source:
Brancato, V. et al. (2020),
Geoph. Res. Letters, 47 (7)





The deepest point on continental Earth being 3,500 m (11,500 ft) below sea level.

Morlighem et al. 2019, Nature Geoscience. Figure from the NASA repository.



After 63 days of journey,
the 4th PARE members are landing
at the Bunger Hills

From a mess to scientific data

Stage 1: against the entropy





„Kraków” hut.
The vestibule



„Kraków” hut. The corridor



„Kraków” hut. The photographic darkroom





„Warszawa”. Old toilet (left) and the new incineration one (right)



„Warszawa”. The bedroom





„Warszawa” hut.
Everyday life in a new mesa



„Warszawa”. A stove heated with diesel fuel





REDMI NOTE 9
ADAM NAWROT

„Kraków” hut. Home office





„Kraków” hut. Home office and hydrochemical lab in the old pantry



From a mess to scientific data

Stage 2: scientific instrumentation and data acquisition



Testing research potential

at the area free of anthropogenic disturbances:
from the Space to the Earth's core

- **Ionosphere**, to observe its dynamics, along with variations observed at the magnetically conjugated, the Polish Polar Station Hornsund (Svalbard, Arctica)
- **Environment, geodesy (GNSS), geochemistry, geology, and meteorology** - studies and monitoring
- **Seismology**, to provide new seismological records to enrich the poor resources of seismic data from Antarctica continent, for better understanding of Earth's structures at depth.
- **Geomagnetism**, to monitor the geomagnetic field behavior in the vicinity of the South geomagnetic pole, including magnetotelluric test measurements

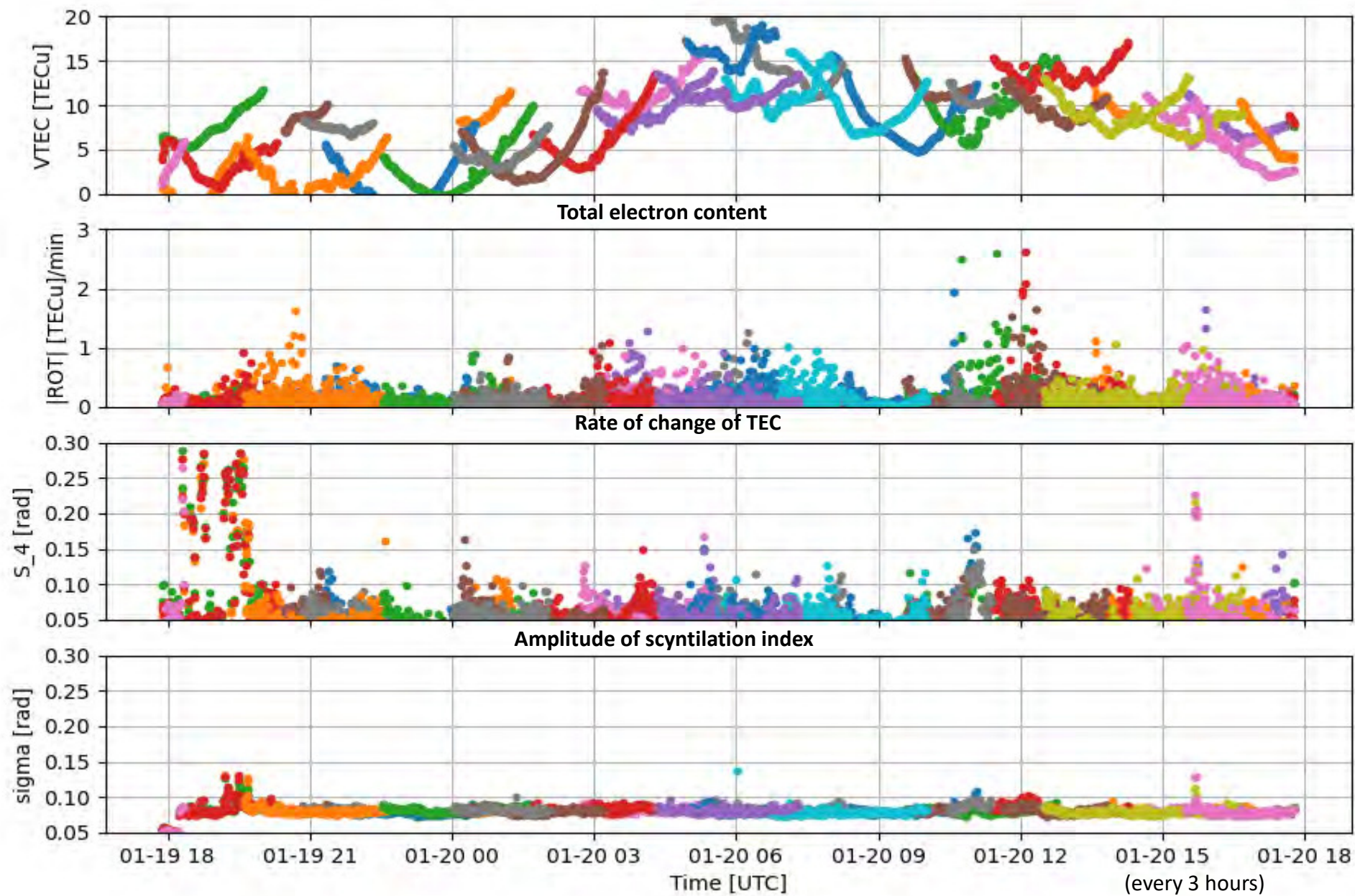


Wojtek Miloch and his ionospheric antenna mounted at the roof of the „Warsaw” hut.

A reciver was installed inside the hut.

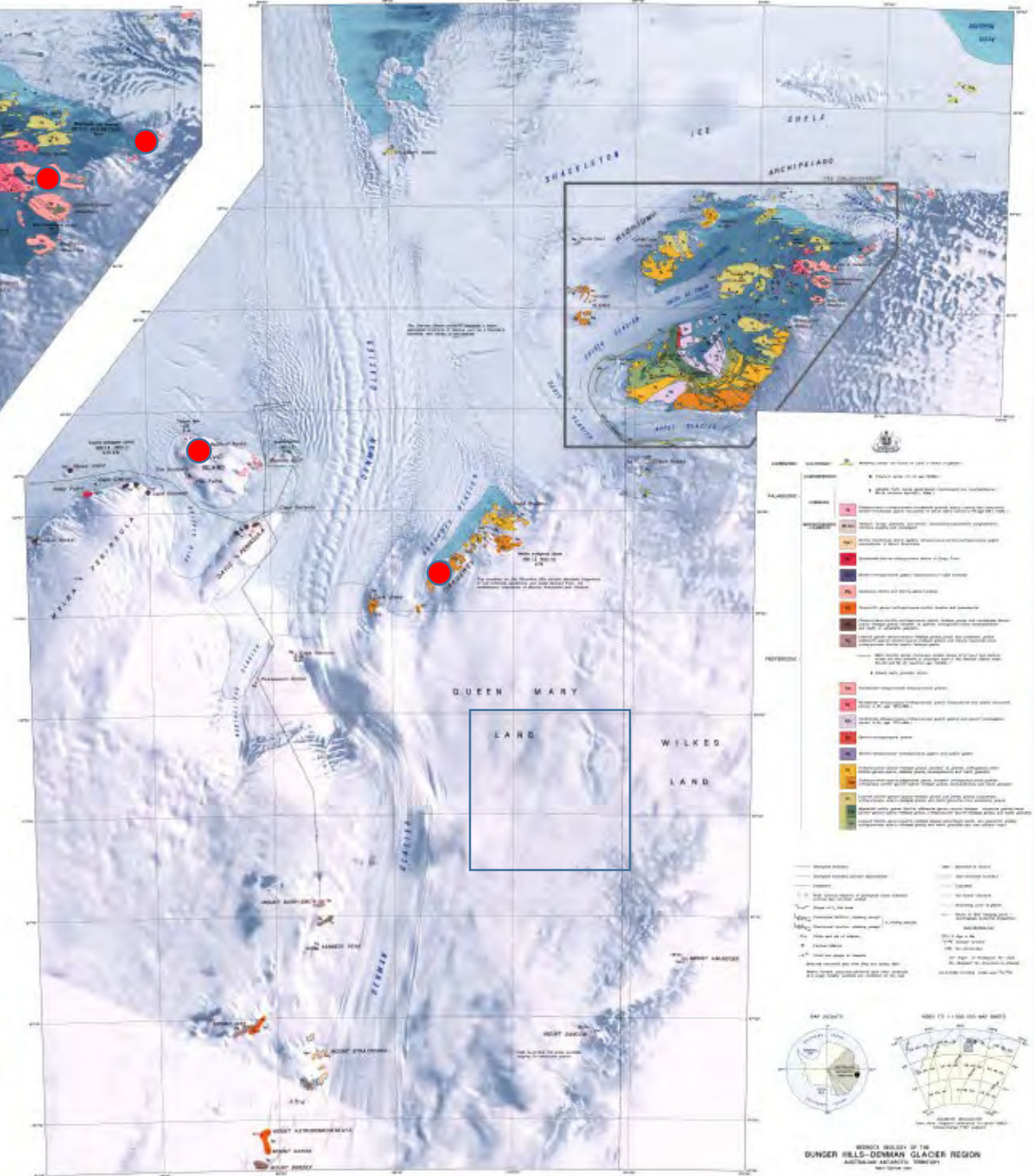
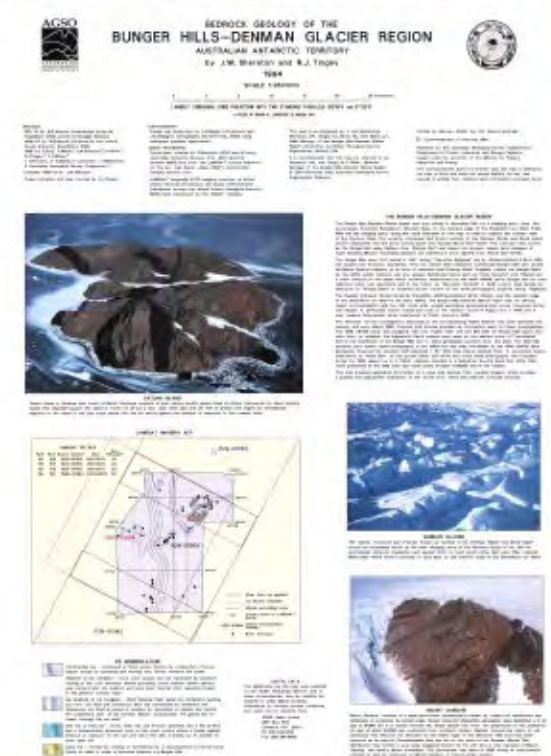
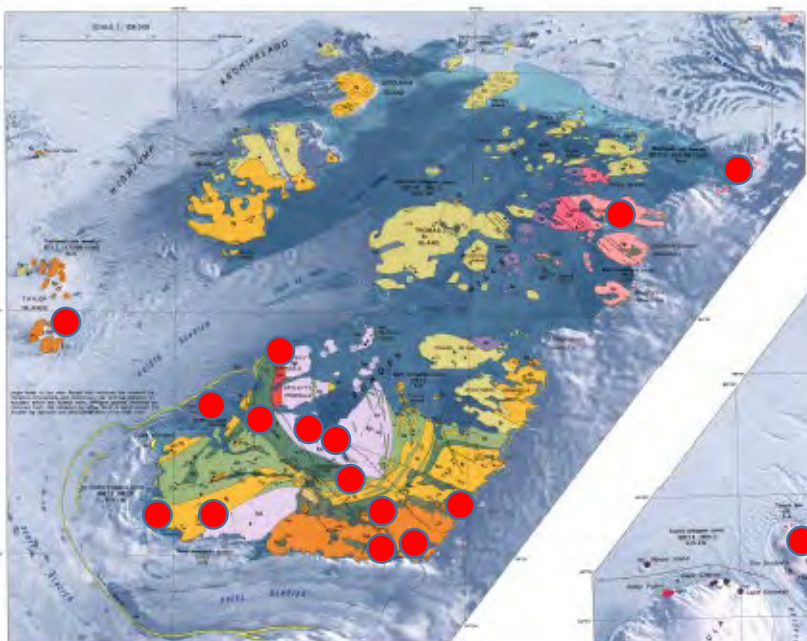
Dobrowolski Station, 19-20 January 2021

(by Wojciech Miloch)



Geological, environmental, geochemical,
geodetic, and meteorological studies

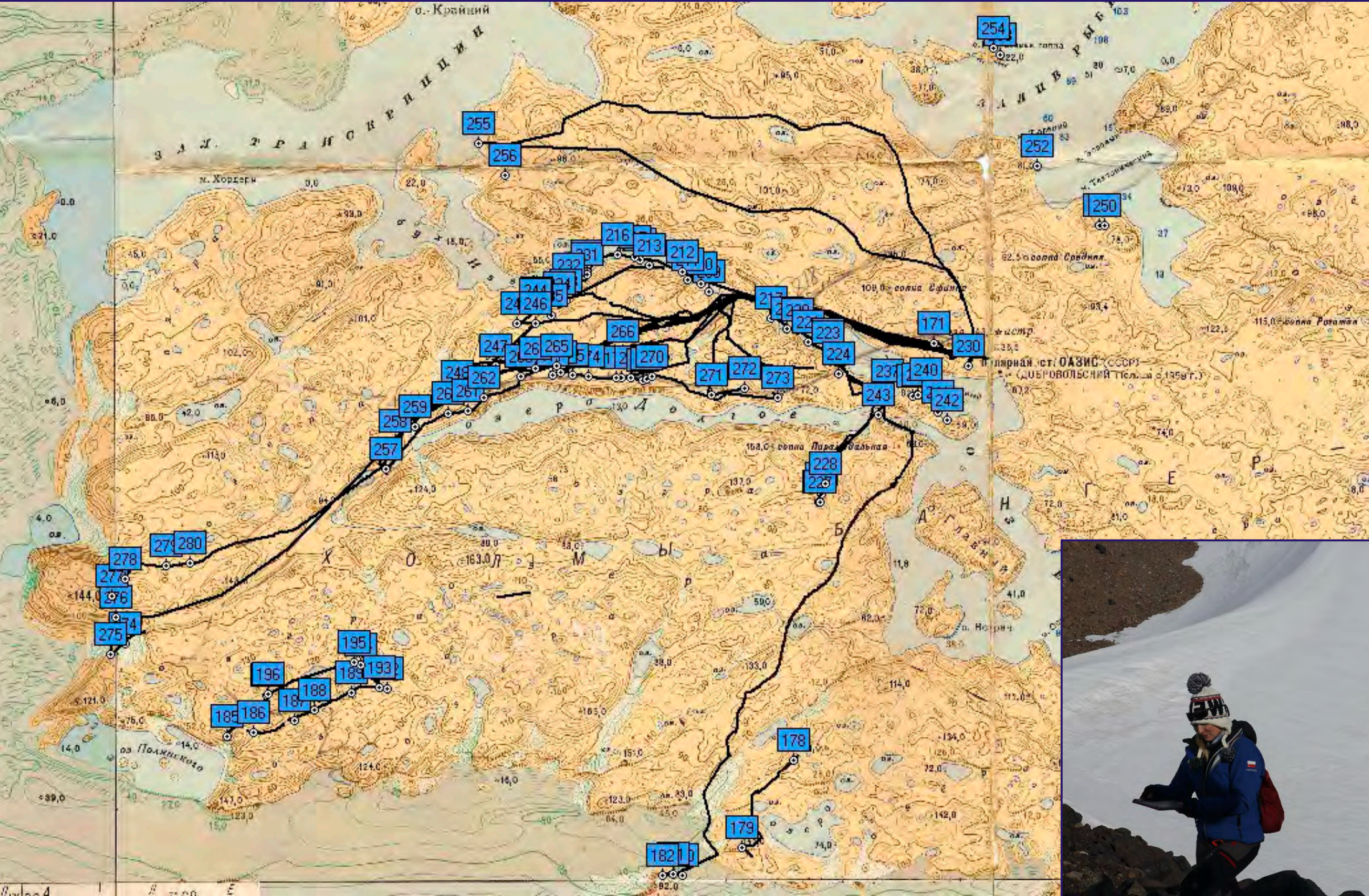




A vast area of the Bunger Hills have been covered on foot and by a helicopter ●

Geological map by Sheraton & Tingey, 1994





Geology
(by Monika Kusiak)



Hydrochemistry
(by Adam Nawrot)



150 samples (60 kg) of snow, soils, and water have been collected for environmental studies

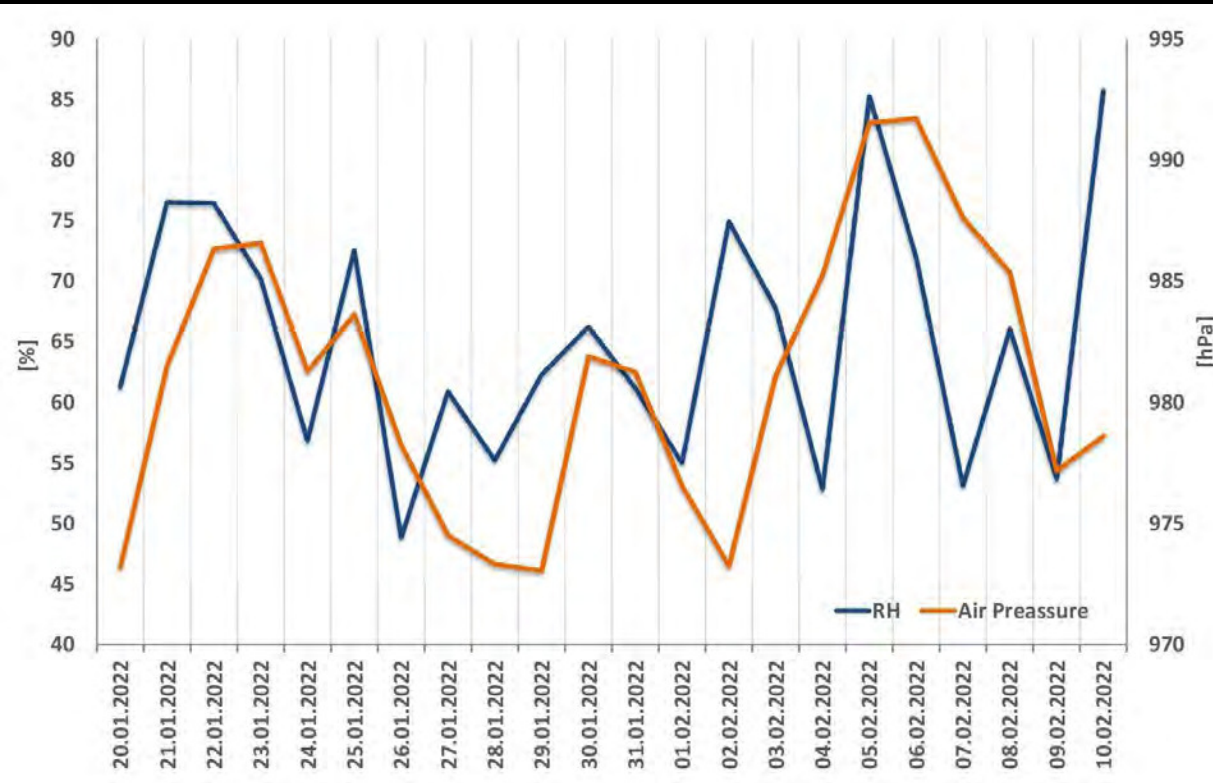
First hydrochemical analyses were performed in a newly established lab in the „Kraków” hut



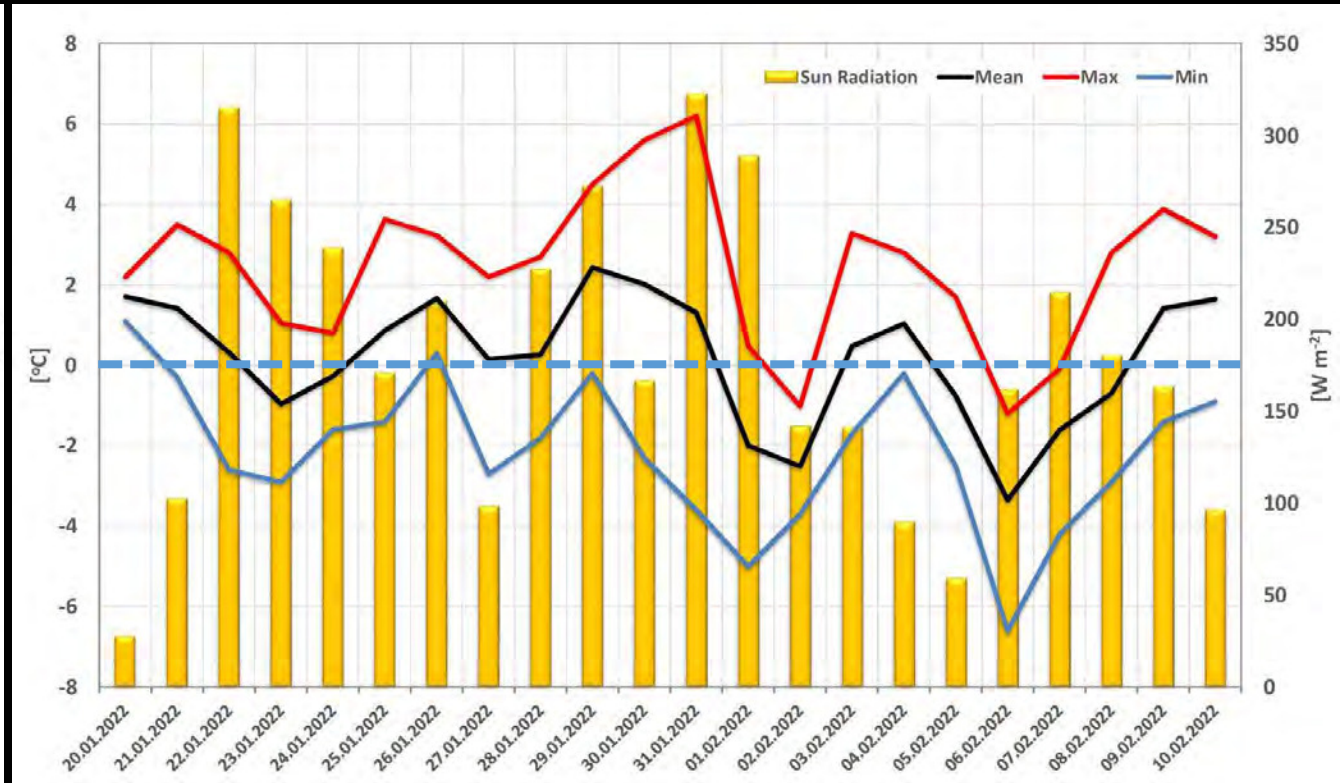
Vaisala
station
installed

Dobrowolski Station, meteorological garden selected observations

(by Adam Nawrot)



Blue line - relative humidity
Red line – atmospheric pressure



Red line – daily max. T°C
Black line – daily avg. T°C
Blue line – daily min. T°C
Yellow bars – solar radiation

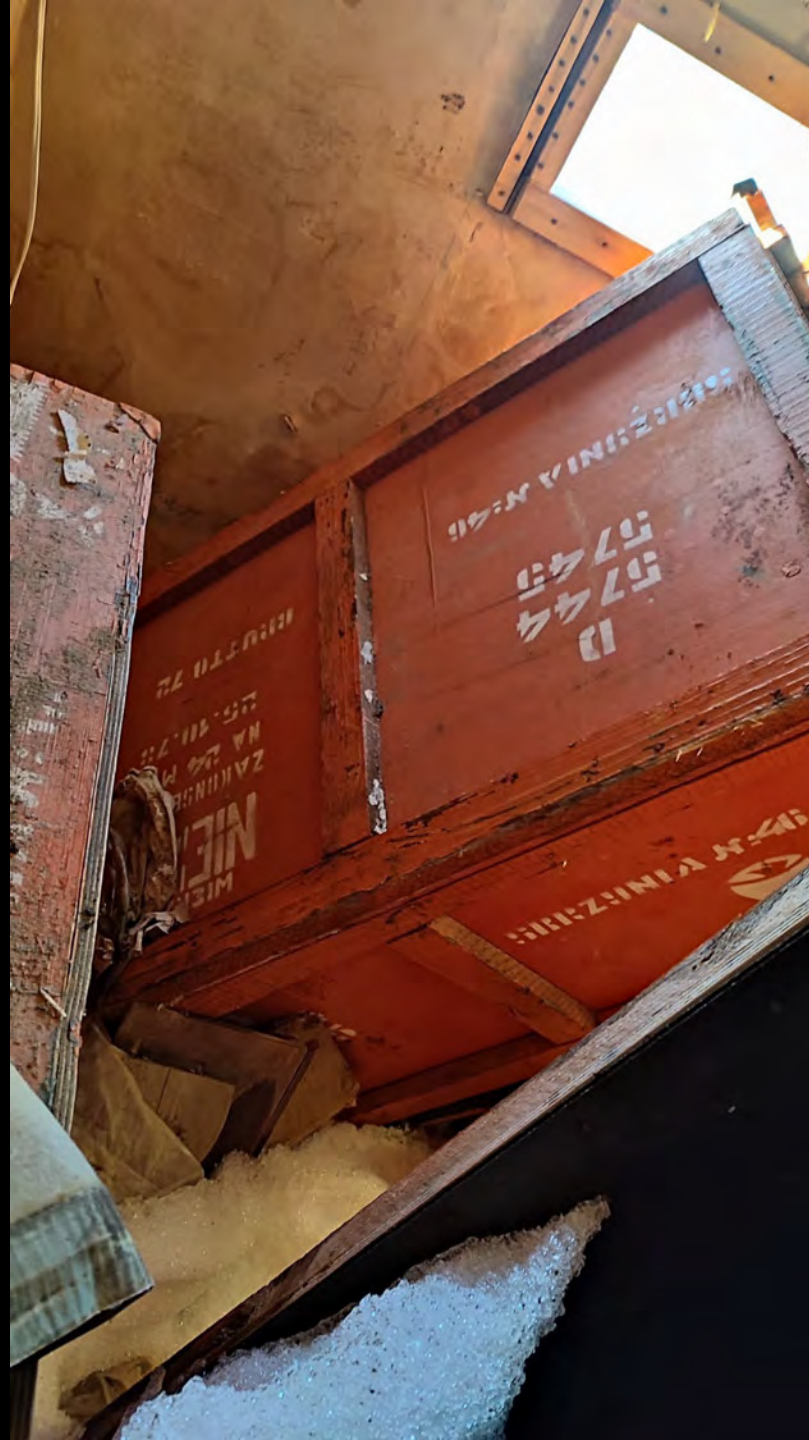


Down to the Earth's core...



E





Magnetic house:
vestibule (left)
and
main room (right) before....



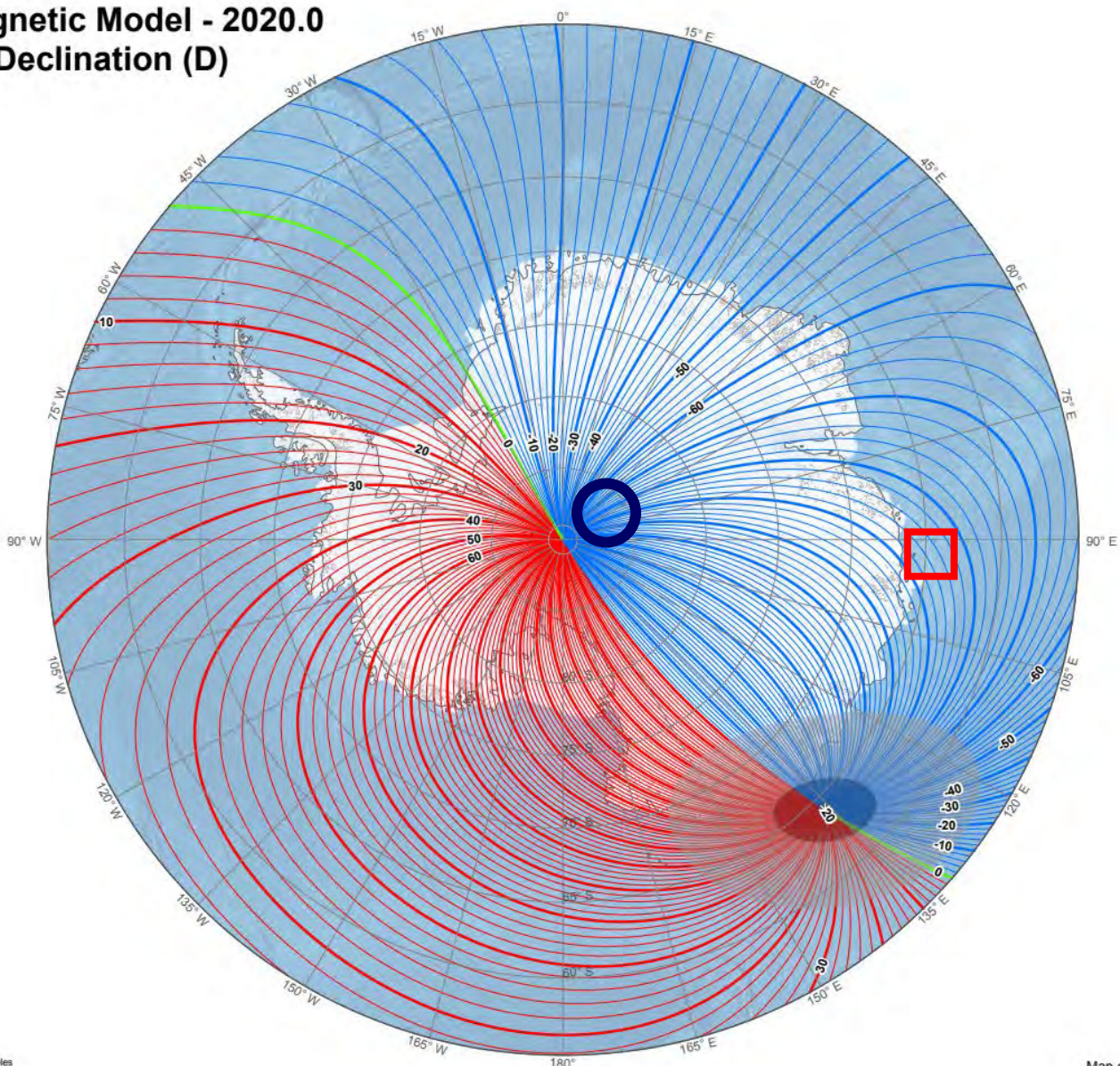


Geomagnetism
(by Marek Lewandowski)

and after the cleaning.



S/UK World Magnetic Model - 2020.0
Main Field Declination (D)

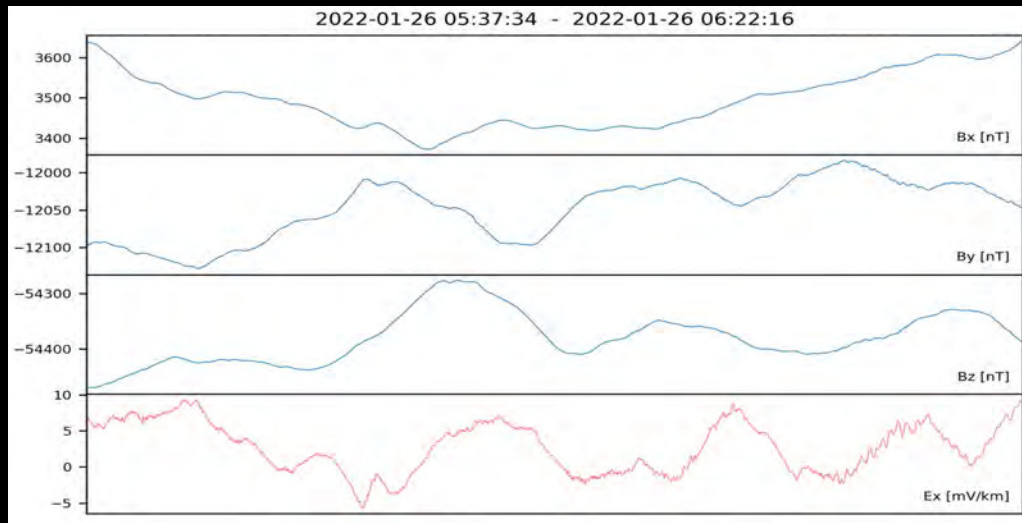


Main Field Declination (D)
South Polar Region
Polar Stereographic Projection
Contour interval: 2 degrees
— Positive (east)

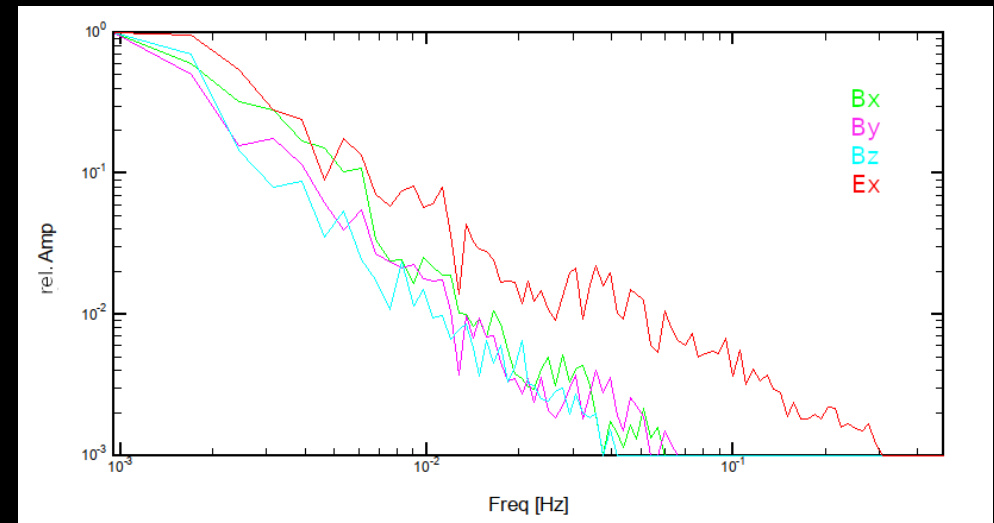
⊙ Position of Dip Poles
Blackout Zones
Horizontal Field (H) Strength:

Map developed by NOAA/NCEI and CIRES
<https://ngdc.noaa.gov/geomag/WMM>
Published December 2019





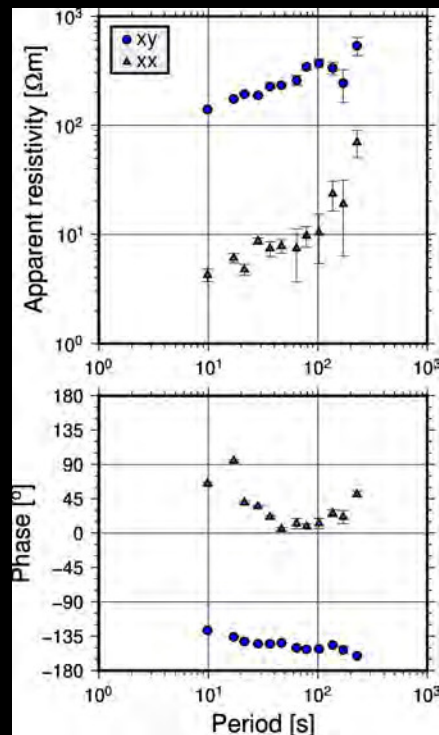
45-minutes time series of three magnetic and one telluric (red line) field components



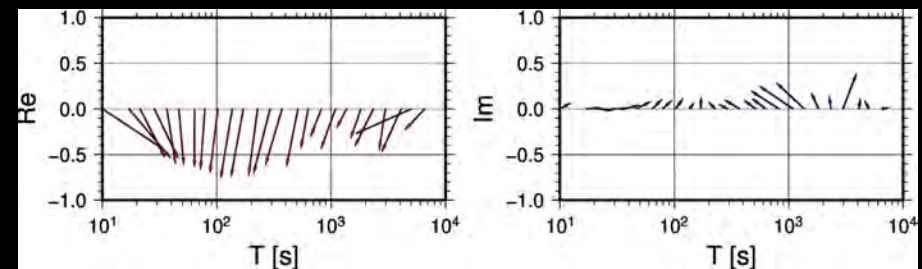
Relative amplitude spectra of magnetic and telluric components

Geomagnetic and magnetotelluric data interpretation

(by Anne Neska)



Sounding curves for the xx and xy components of the impedance tensor



Real (left) and imaginary (right) induction arrows over period T



Seismology
(by Marek Lewandowski)

Seismological Pavilion
seen from the North

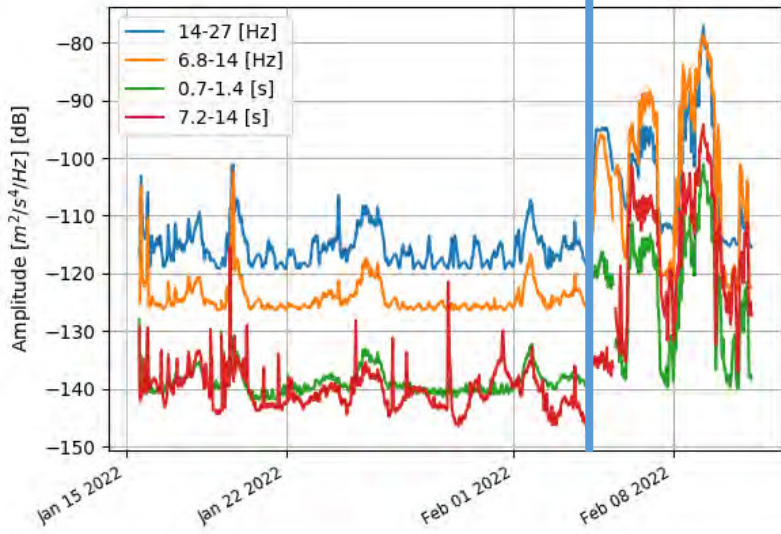


Nanometrics broadband seismic station



Digital recorder

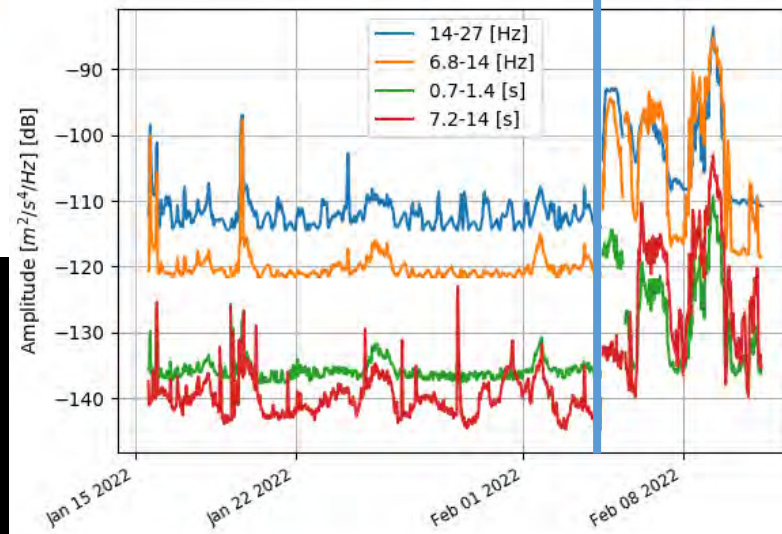
X



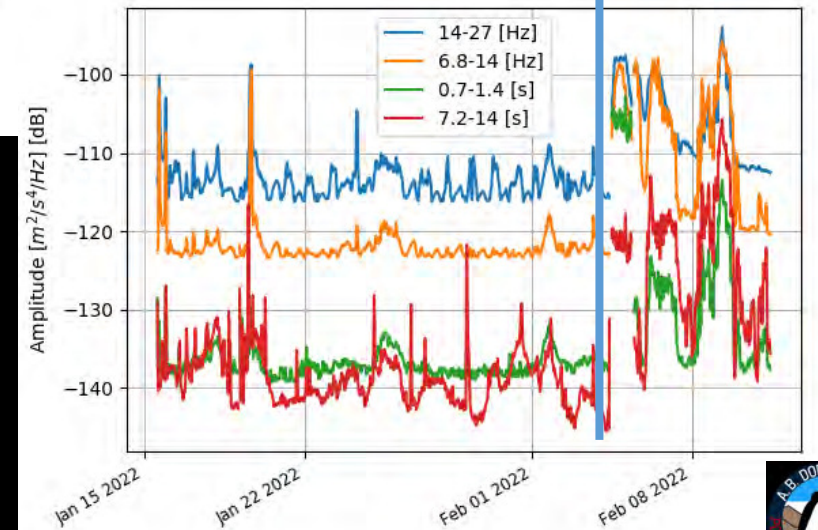
Seismic data interpretation

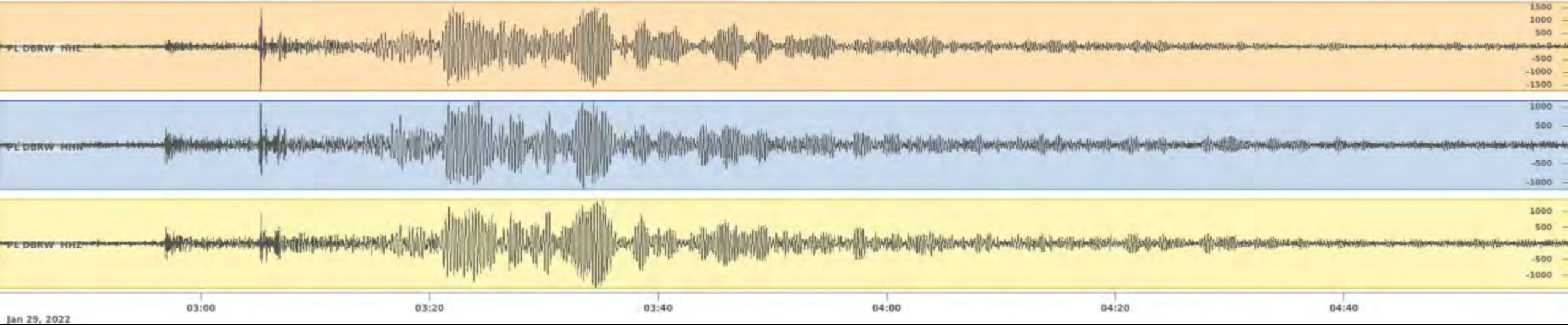
(by Janusz Mirek)

Y



Z





USGS:

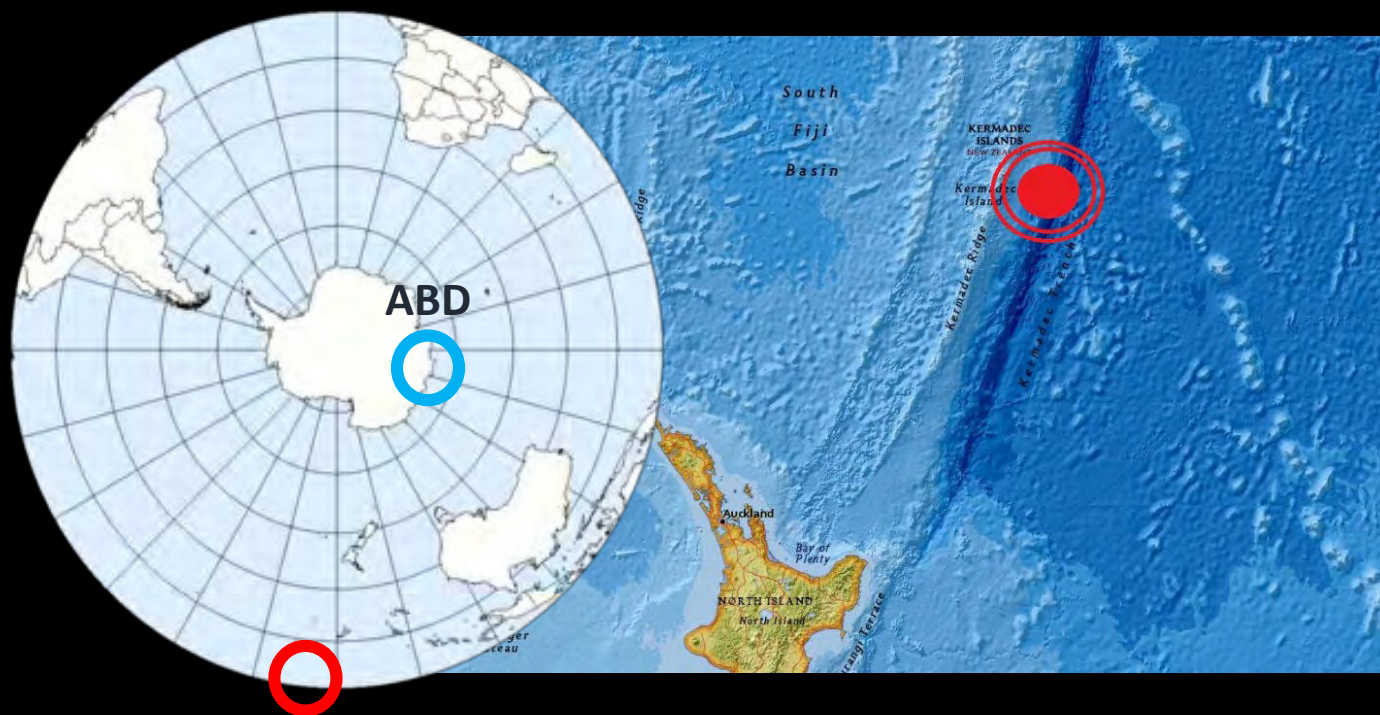
M 6.5 - Kermadec Islands region

Time 2022-01-29 02:46:39

Location 29.564°S 176.722°W

Depth 8.0 km

The islands are a volcanic island arc, formed at the convergent boundary where the Pacific Plate subducts under the Indo-Australian Plate.



Dobrowolski Station practical and research potential

Conclusion

Since 2022, the station may work as:

- Summer base for geological and environmental field works
- Year-round base, equipped with a set of automatic geophysical instruments



PS.

From the Earth toward the Mars





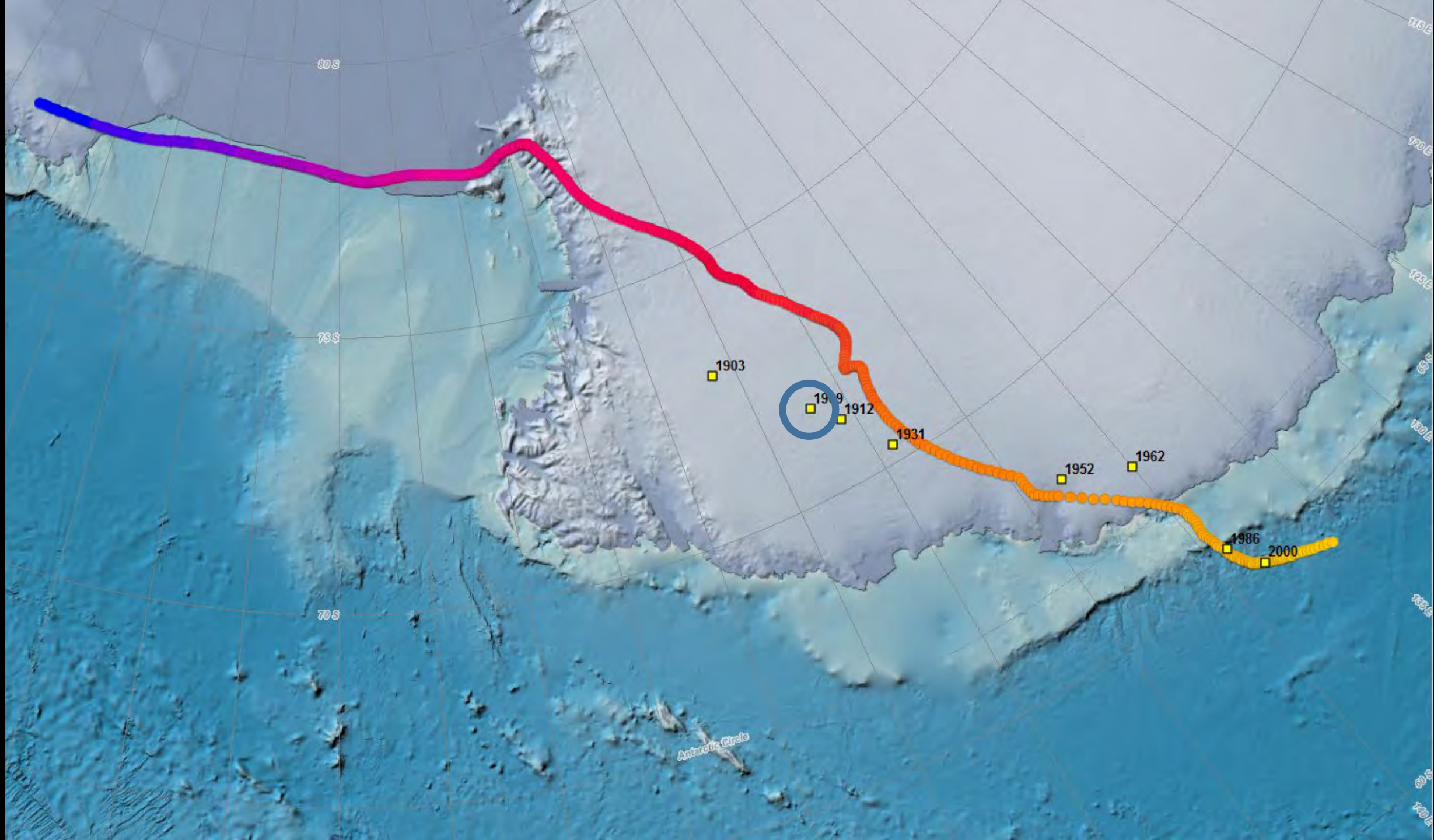


On 16 January
1909 three men from Sir
Ernest Shackleton's
Nimrod Expedition
claimed to have found
the south magnetic pole.
They planted a flagpole
at the spot and claimed it
for the British Empire.

Alistair Mckay
Welshman

Edgeworth David
Englishman

Douglas Mawson
Scotman







Breaking through the sea ice of the Southern Ocean
The first ice field, lat. 69° S





Parking by the Shackleton Ice Shelf.
The day of departure to the Bunger Hills



Australasian Antarctic Expedition headed by Douglas Mawson 1911–1914

The Western Group,
under Frank Wild's command,
wintered at the glacier,
later named after Ernest Shackleton



Denman Glacier

Shackleton Ice Shelf

Bunger Hills



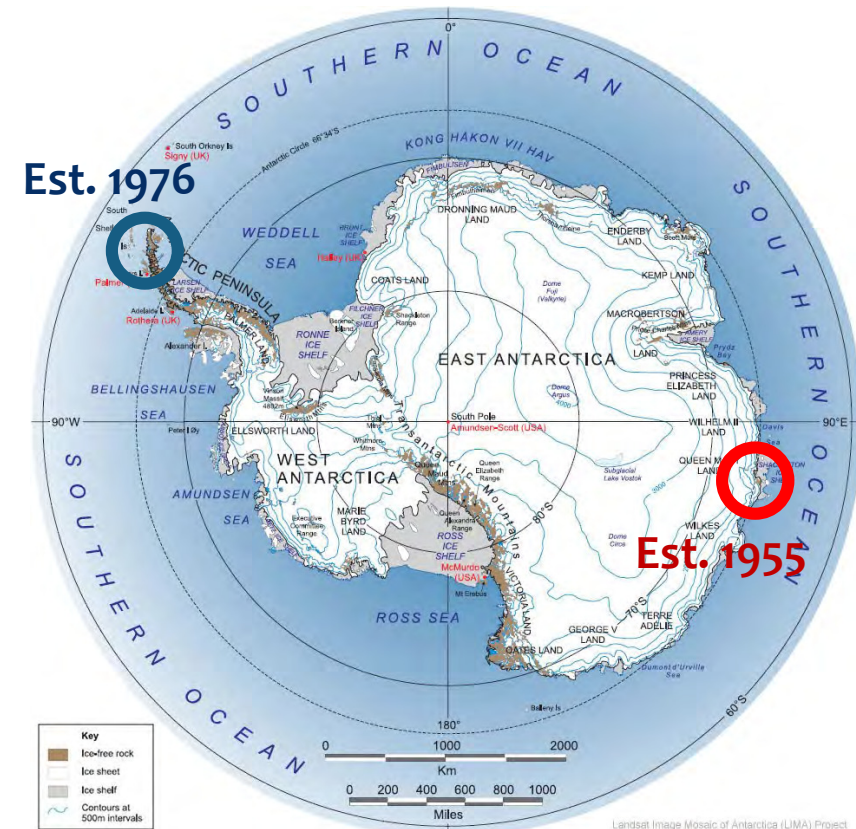


First Poles in the Antarctic Exploration

1897-99 Adrien de Gerlach led the Belgian Antarctic Expedition on the ship “Belgica”, and spent the winter in the pack-ice offshore Shetlands.

Crew members were, among others:

- * Roald Amundsen
- * **Henryk Arctowski**
- * Frederic Cook
- * **Antoni B. Dobrowolski**



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