

PS SVALBOX: A Geoscientific Database for High Arctic Teaching and Research*

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Search and Discovery Article #70407 (2020)**

Posted May 4, 2020

*Adapted from poster presentation given at 2019 AAPG Annual Convention and Exhibition, San Antonio, Texas, May 19-22, 2019

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Abstract

Competitive advantage is granted those that can quickly analyze all relevant data sets within a study area. This is equally valid in industry as in academia, where we train students for careers within, amongst others, the energy sector. On Svalbard, the Norwegian high Arctic archipelago, we at the University Centre in Svalbard (UNIS) educate over 300 geology undergraduate and postgraduate students every year. We also host field excursions held for oil companies interested in better understanding the geological evolution of the Barents Shelf. All field activities on Svalbard are highly dependent on the seasons (polar darkness vs midnight sun), transportation (snowmobiles, boats, or walking) and HSE considerations (harsh weather, polar bears etc.). To overcome some of these challenges we utilize emerging technologies like photogrammetry to produce cost-efficient virtual outcrop models of key outcrops and use these both when planning field excursions and for post-excursion analyses. The virtual outcrop models form an integral part of the Svalbox database, which links existing surface and subsurface data in a 3D environment within an industry-standard software package, Petrel. Svalbox includes georeferenced maps (geological, tectonic, paleogeographic) at different scales, terrain models, bathymetric data, published stratigraphic logs, seismic data, TEM/MT data, exploration well logs with well tops, grav-mag data, published cross-sections, and satellite images. Web map services with relevant information are streamed directly to Svalbox. All data are correctly placed in geographical and depth position, and the database is continuously updated through new publications. A simple velocity model allows the correlation of the onshore depth-domain data sets with the time-domain seismic data. Some data sets are available under certain restrictions, manageable by having different projects feeding data based on permissions. The Svalbox database generates course-based projects for students at UNIS, essentially a three-dimensional reading list. In addition, it allows saving time on building databases when establishing new research projects or compiling regional studies of the Svalbard archipelago. Furthermore, we have developed a public portal at www.svalbox.no that allows anyone interested to see some of the data available on Svalbard's unique geology. In this contribution, I will present the internal and external parts of Svalbox and outline some of the user experiences from two years of activity.

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www.Svalbox.no. Accessed April 2020

MOTIVATION

The objective of Svalbox is to construct a state-of-the-art interactive digital database of key data sets in Svalbard for use in research, education and industry training.

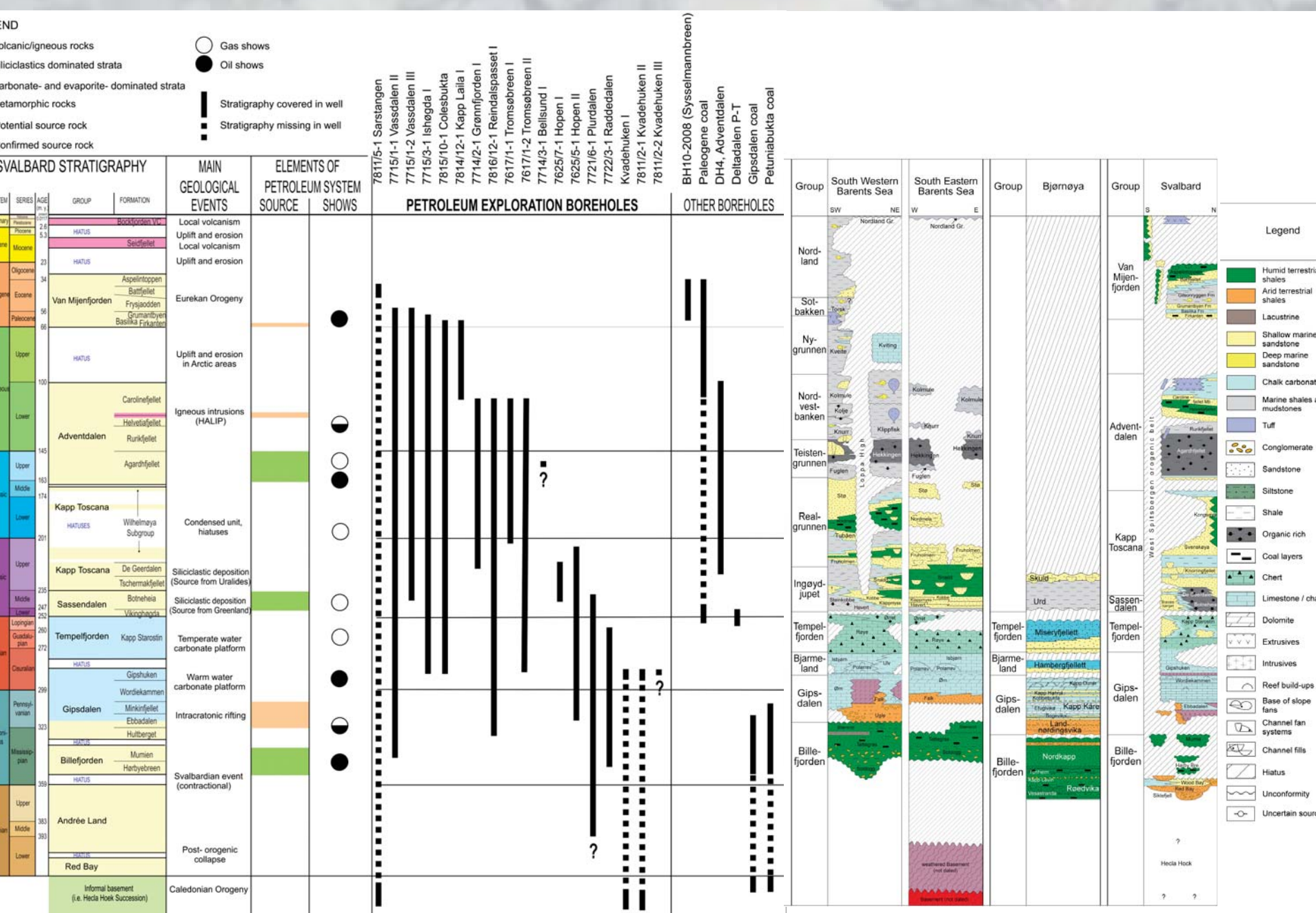
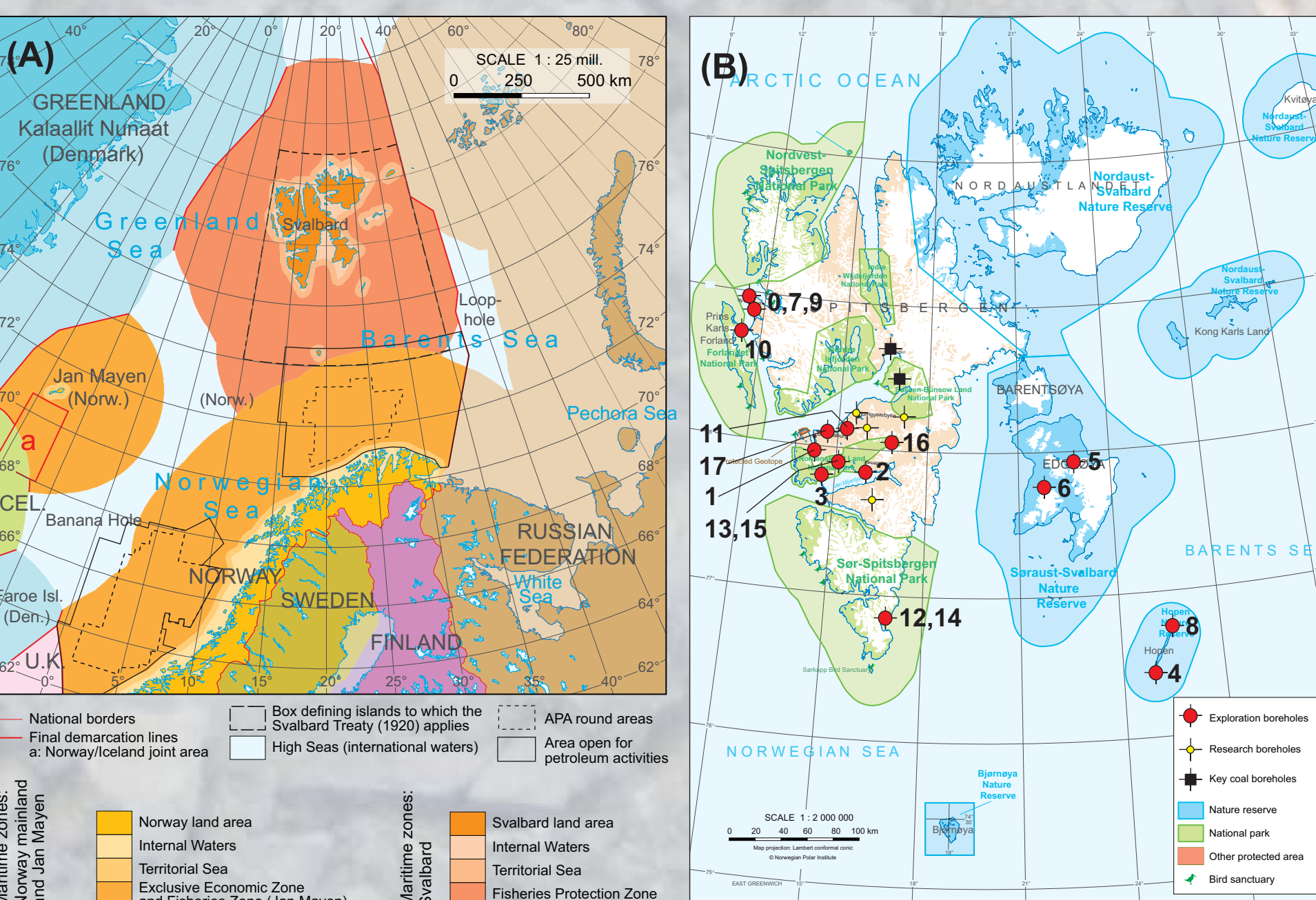
The key aspects of Svalbox are:

1. **Multi-scale, multi-physics and multi-data** approach using an «all-can-be-integrated» attitude
2. From paper publications and books to **3D** and **e-learning** --> the interactive reading list
3. From numerous data sources to a **single stop solution**

The first phase of Svalbox is finalized and is operational. At present we strive to expand the existing database, both with respect in more data and more data types. In particular, new virtual outcrop models are being uploaded to Svalbox regularly.

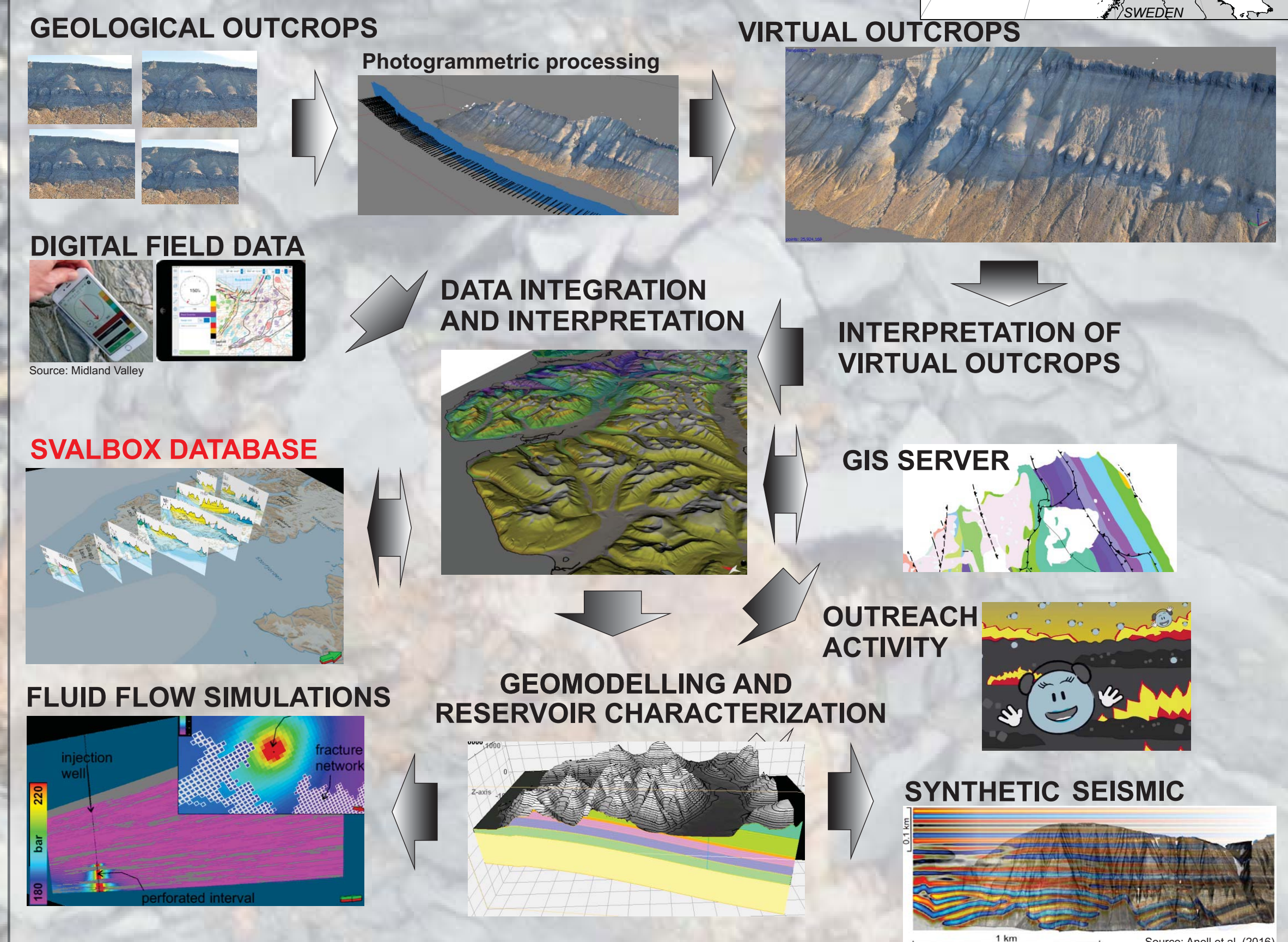


SVALBARD: A GEOLOGICAL PARADISE



FROM OUTCROP TO GEOMODEL: Integrated workflows at UNIS

As the world's northernmost educational institution the University Centre in Svalbard must optimize its research and educational activities to the strongly seasonal annual cycle. One key aspect is the utilisation of **virtual outcrop models** - precise, georeferenced and cost-effective 3D representations of real outcrops. These are integrated with field observations and surface and subsurface data sets within the 3D environment of Svalbox.



Svalbard represents the emergent and uplifted margin of the Barents Shelf, and its exceptionally exposed Devonian-Neogene stratigraphic record provides unique analogues to the petroleum provinces in the southern Barents Sea. These include, amongst others:

- Early Carboniferous pre-rift coal-bearing deposits of the Billefjorden Group
- Mid-Late Carboniferous syn-rift deposits in local half-grabens (e.g., Billefjorden Trough)
- Late Carboniferous-Permian carbonate successions of the Gipsdalen and Tempelfjorden Groups
- Early Triassic organic-rich shales of the Steinkobbe and Botneheia Formations
- Middle-Late Triassic north-westerly prograding system of the Kapp Toscana Group
- Late Triassic-Middle Jurassic sandstone reservoirs, targeted for CO₂ sequestration in Svalbard and as petroleum reservoirs south of Svalbard
- Late Jurassic organic-rich shales of the Hekkingen and Agardhjellet Formations

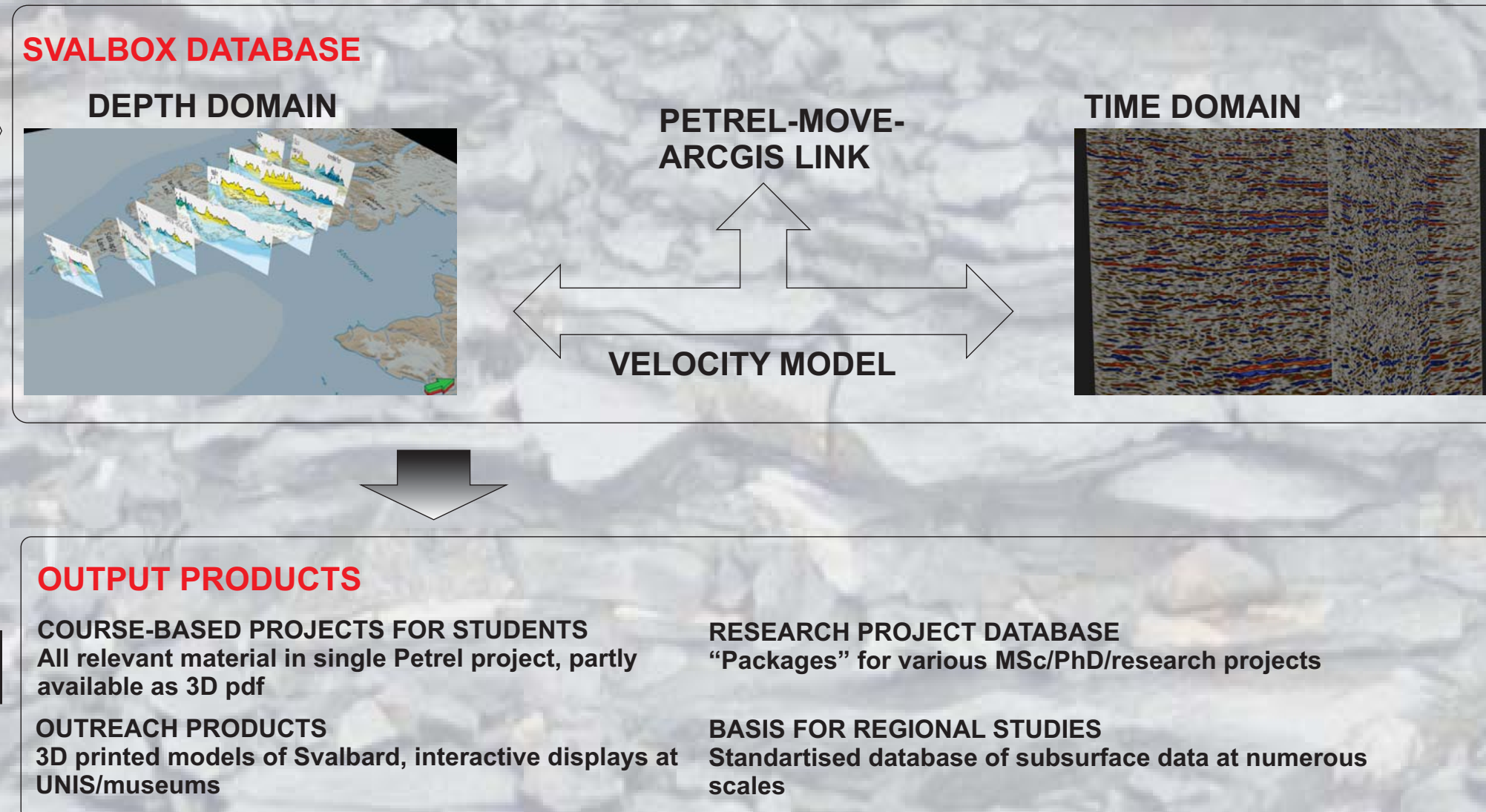
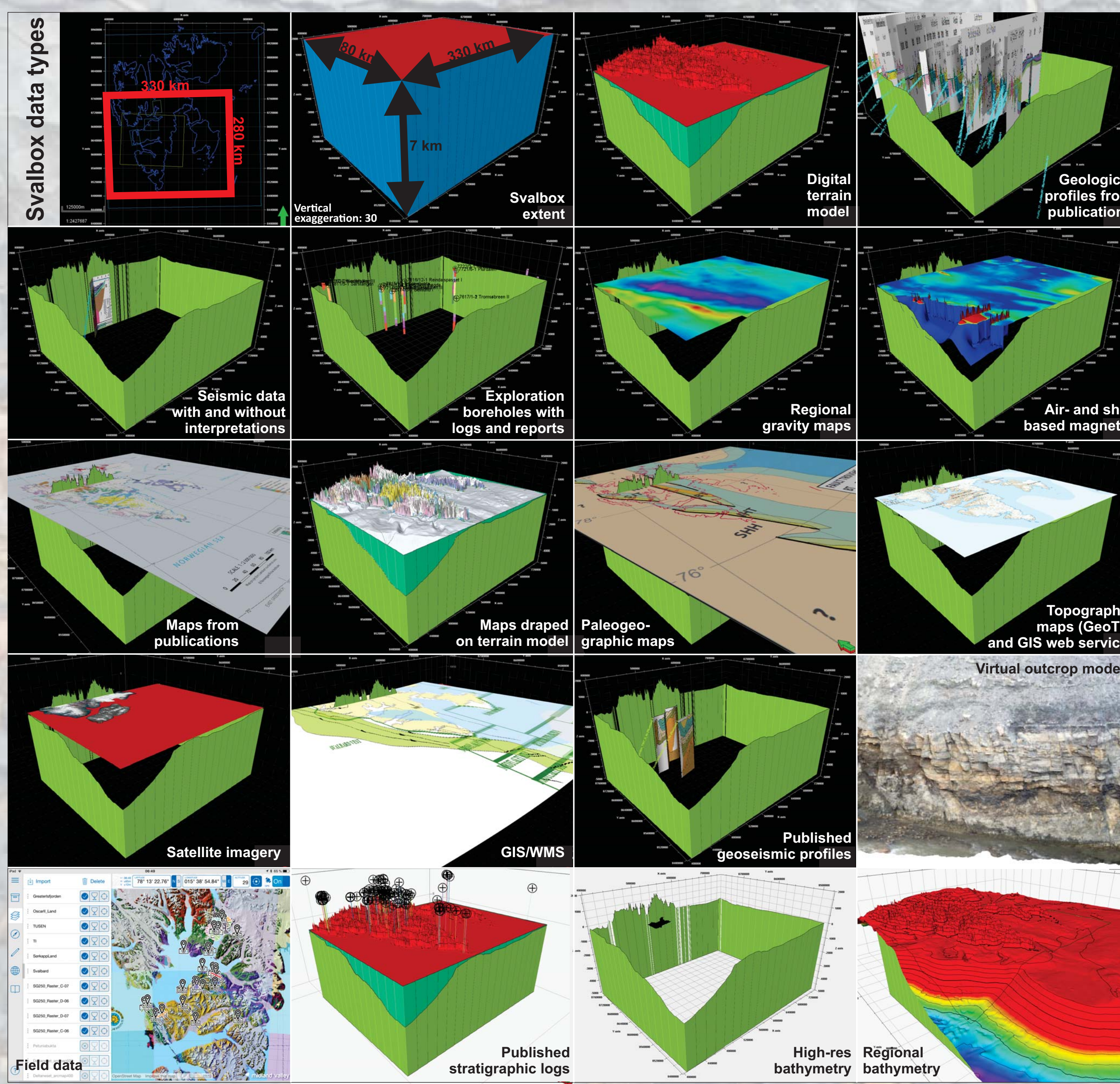
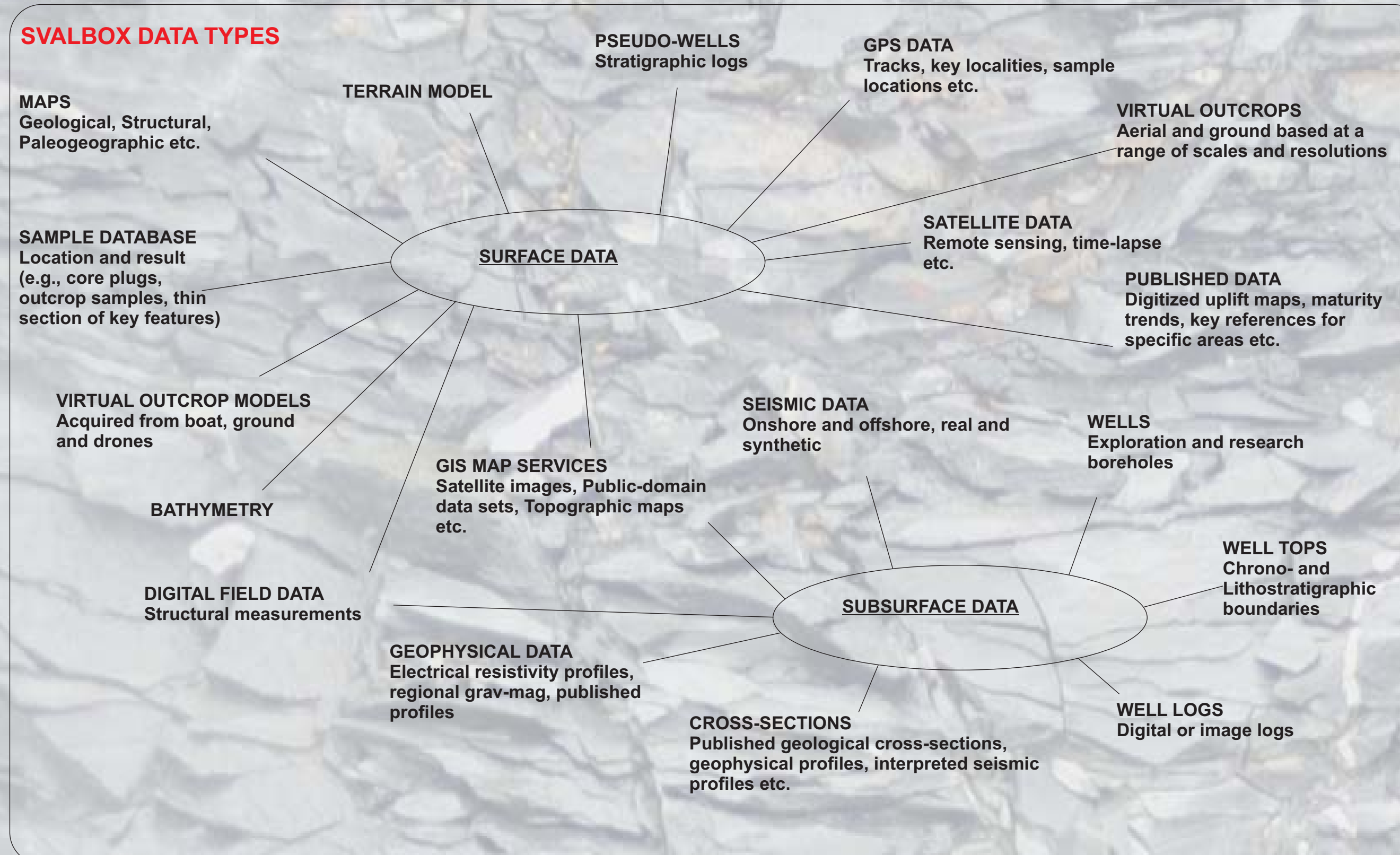
Furthermore, 18 petroleum exploration boreholes were drilled onshore Svalbard from 1961 to 1994.

INPUT DATA			
Virtual outcrop models (VCM)	VCM acquisition and processing	VCM location and 3D petro	Svalbox NO
Other data types	Other data types	Other data types	Other data types
DATA STORAGE, QC AND MANAGEMENT			
Database	Database	Database	Database
VISUALIZATION			
3D visualization	3D visualization	3D visualization	3D visualization
2D visualization	2D visualization	2D visualization	2D visualization
1D visualization	1D visualization	1D visualization	1D visualization

SVALBOX: DATA TYPES AND COVERAGE

The Svalbox database incorporates all available data types in the Svalbard archipelago. All data are included in the correct spatial position, including depth. The **Svalbox database** is primarily organized within the Petrel E&P software, but complementary databases are constructed within ArcGIS and accessible through

an online map-based interface on **Svalbox.no**. Data types include both subsurface data and relevant surface data, and the resulting Petrel projects serve as an interactive data package for students and researchers alike. The online data portal utilizes public-domain data sets and complements these with virtual outcrop models

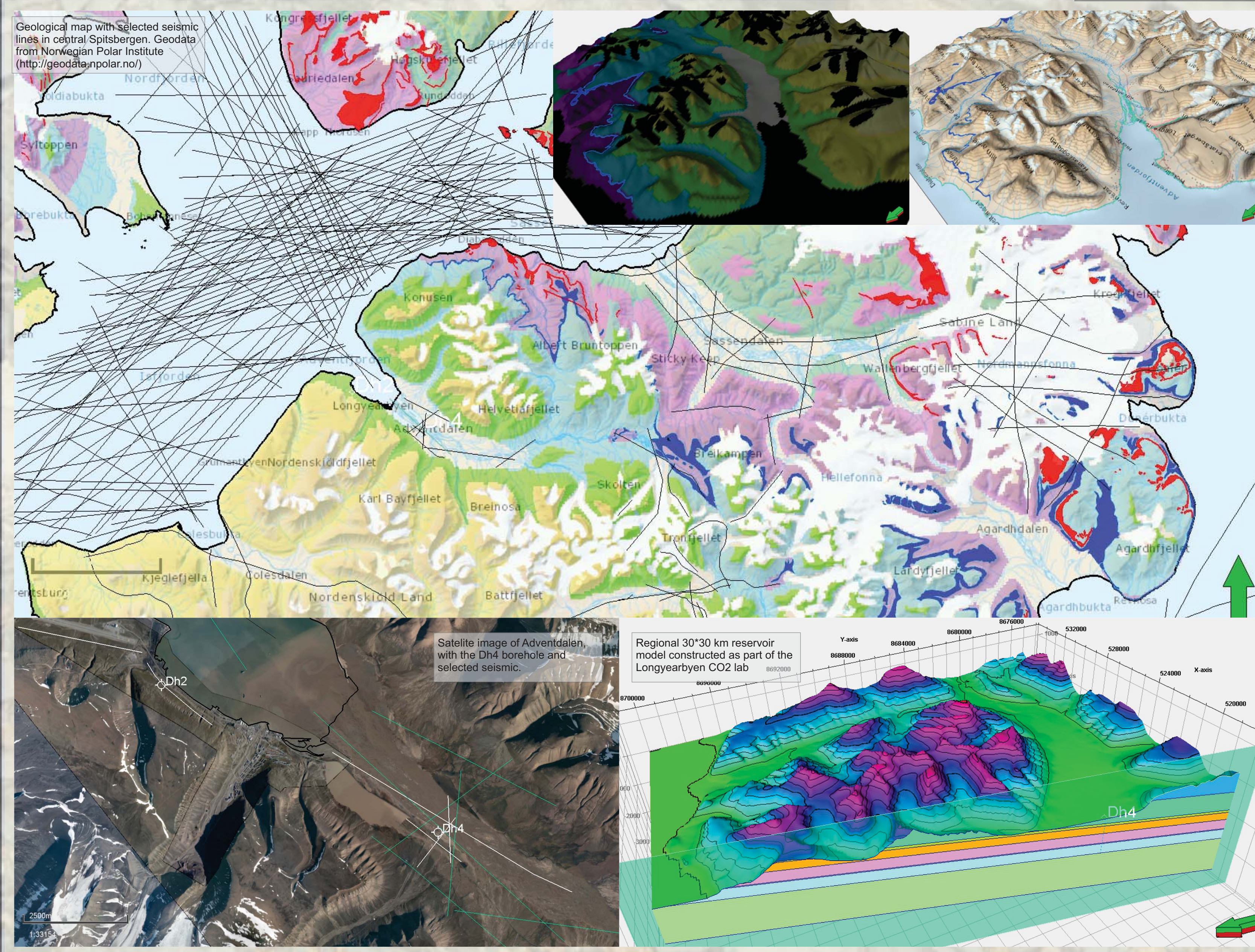


CASE STUDY: THE LONGYEARBYEN CO2 LAB

The Longyearbyen CO₂ lab project (<http://co2-ccs.unis.no>) was initiated in 2007 with the aim to sequester locally produced CO₂ in a saline aquifer beneath Longyearbyen. The

10-year R&D project resulted in an immense multi-disciplinary data collection campaign, including fully cored boreholes, wireline logging, 2D seismic, EM profiling, outcrop studies,

water injection tests and much more. The data package is available for spin-off research projects, and is included in the Svalbox database.

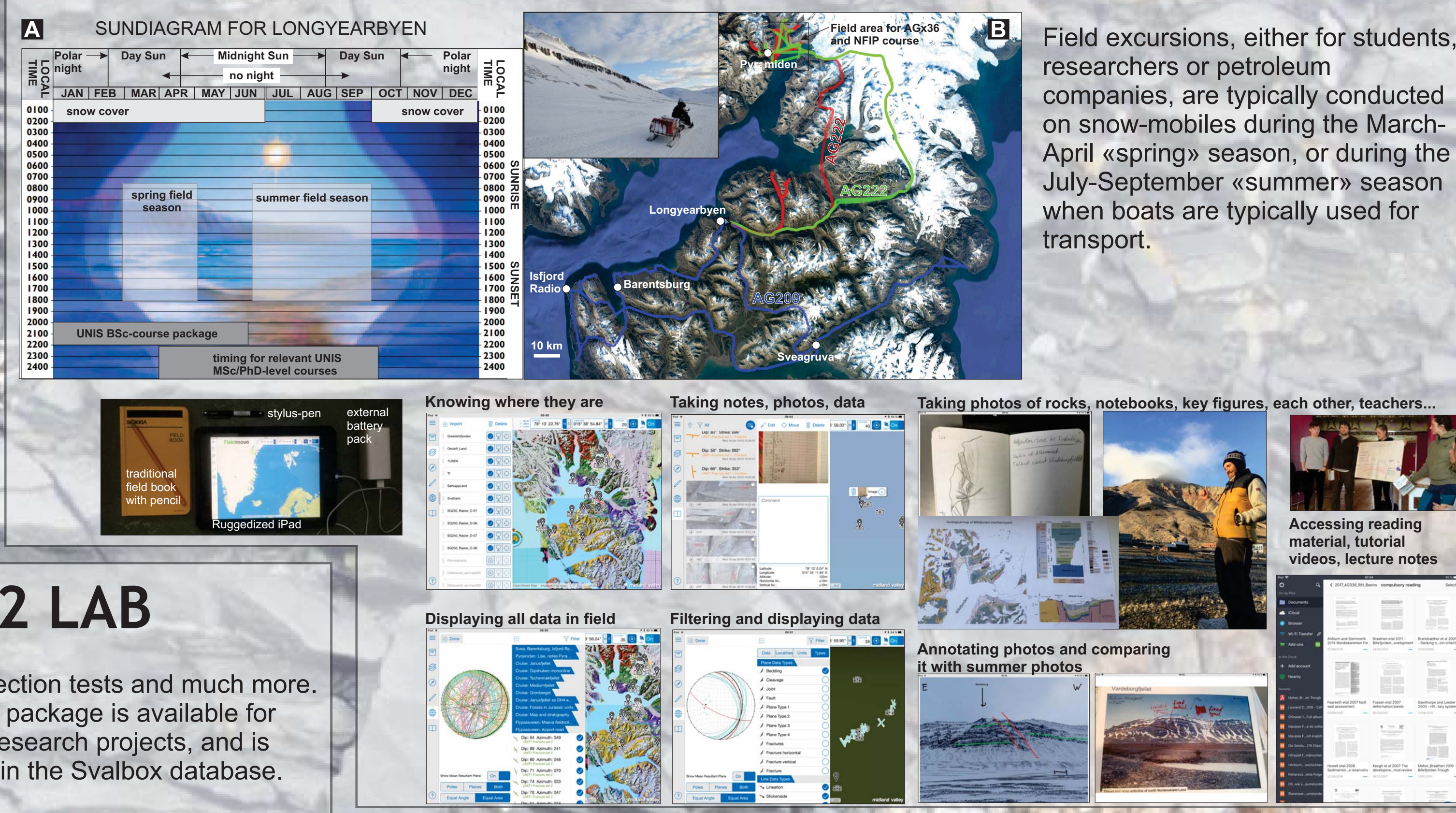


EDUCATION AND LEARNING IN THE FIELD

Field learning at UNIS is strongly seasonal dependant, governed by both light (polar night vs midnight sun) and ground (snow-cover vs short summer) conditions. Polar bears, harsh weather conditions and costly

transport further puts pressure on conducting efficient field work. The Svalbox concept allows students (and researchers) to gather information prior to a field excursion, and place own

observations in a broader concept. To facilitate this, we implement digital field notebooks that allow much of the information from the Svalbox database to be taken to the field.



PRESENT PERSPECTIVES: VIRTUAL REALITY

Virtual reality allows direct field «work» on the virtual outcrop models, including measuring distance, orientation and making notes. For more information see: Gonzaga Jr, L. et al. (2018): MOSIS - Multi-Outcrop Sharing & Interpretation System. IEEE Geoscience and Remote Sensing Magazine.



ACKNOWLEDGEMENTS Hungry for more? Check out these!

- UArctic for providing funds to purchase equipment and share experiences with other universities
- UNIS for financing the fieldwork and courses
- Software providers, including Schlumberger, Cegat, Midland Valley, Badleys, NORSAR and VOG
- Data providers, including Norwegian Polar Institute, Geological Survey of Norway, the Norwegian Petroleum Directorate, Statoil (now Equinor) and the University of Bergen
- Geophox for website design and scripting
- Aleksandra Smyrak-Sikora for the Svalbox name