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Polarstern Expedition

ARK XX/3

August 31 to October 03, 2004

Tromsø – Bremerhaven

Chief Scientist: Prof. Dr. R. Stein

Coordinator: Dr. E. Fahrbach

Summary and itinerary

RV „Polarstern“ left the port of Tromsø/Norway on August 31, 2004. The scientific program of the Polarstern ARK-XX/3 expedition was concentrating on geophysical and geological aspects in the Fram Strait/Yermak Plateau area and the East Greenland continental margin (Figs. 1 and 2). As part of the geology program, a Hydrosweep (bathymetry) and Parasound profiling program was carried out. These geoscientific studies have to be seen in context with a drilling proposal submitted to the Integrated Ocean Drilling Program (IODP). In addition, a pilot study devoted to the lost „Deutsche Arktische Expedition 1912“ was included in the expedition program. As undone work taken-over from the preceding ARK-XX/2 oceanography program, three PIES (Pressure Inverted Echo Sounder) were deployed west of Spitsbergen (Fig. 2).

The main scientific objective of the geophysics program was to enlarge the geophysical database in the Fram Strait to provide further constraints on the deeper structure and the tectonic evolution of this region. In detail the following problems should be addressed:

- Seismic investigations across the northern Yermak Plateau to identify the continent-ocean transition.
- Deep seismic investigations to identify the deeper structure of the Yermak Plateau. With the wide-angle reflection data it should be possible to make estimates on the magmatic underplating, if any is present, of the Yermak Plateau.
- Try to sample basement rocks in order to date and constrain the evolution of the plateau

The seismic network concentrated on the Yermak Plateau area and additional site survey boxes along the East Greenland margin (Fig. 2). The geophysical experiments were conducted to acquire multi-channel seismic data with a 800 m long streamer. As source we used an airgun array with a total volume of 24 l. During the ARK-XX/3 expedition, in total 2920 km of new seismic data were obtained in the areas of investigation. These data will allow to determine in an optimum way the locations of IODP drill sites within a recent IODP preprosal.

Parallel to the seismic profiling across the Yermak Plateau an aeromagnetic survey was performed by helicopter. The scientific goal was to densify the existing magnetic data sets in order to resolve more details on the magnetic structure of the Yermak Plateau. Within nine days and 20 flights most of the survey area was successfully completed and more than 7250 line-kilometres were flown. The helicopter flight tracks are shown in Figure 3.

One of the key marine-geology objectives is the study of sediment dynamics of megaslides along the Svalbard continental margin (as part of the ESF Program „EUROMARGINS“), using Hydrosweep (bathymetry) and Parasound profiling data, multi-sensor-core-logging data, and long sediment cores. In this context, the characterization of sediment facies within debris flow and turbidites sequences as well as undisturbed pelagic sequences, the dating of sediment mass flows, and estimates of sedimentray budgets are of interest. Furthermore, detailed multidisciplinary (i.e., sedimentological, mineralogical, micropaleontological, and geochemical) studies will be performed on the sediment cores for high-resolution

reconstructions of paleoclimate, paleooceanic circulation patterns, paleosea-ice cover, and paleoproductivity and their variability during late Quaternary times. In order to reach these goals, an intensive sampling program was performed using large-volume box corer, multicorer, gravity corer, and kastenlot corer. Coring locations were carefully selected based on Parasound profiling.

Geological sampling concentrated on the slide area north of Spitsbergen (Fig. 2). In addition, gravity cores were taken from the central part of the Yermak Plateau as well as the East Greenland continental margin as part of the IODP Site survey work (Fig. 2). In total, 7 multicorer and 16 giant box corer cores were obtained to sample near-surface sediments, and 33 gravity corer and 3 kastenlot cores with lengths between 0.1 and 7.7 m were obtained to sample late Quaternary sedimentary records. In addition, three sediment dregdes were run on the Yermak Plateau to sample stones from the seafloor. In total, 7800 km of Hydrosweep and Parasound profiles were run.

Along the ice-edge area in the Yermak-Plateau area, a sea-ice sampling program was carried-out. In total, 9 stations were sampled for snow, sea ice, and sea-ice sediments. These samples will be investigated for mineralogy, grain size, organic carbon content and composition, and/or major and minor element composition.

A pilot study was devoted to the lost Deutsche Arktische Expedition (DAE) 1912, also known as Schroeder Stranz expedition: a trial expedition to the North East Land of Spitsbergen thought to be a forerunner of the ambitious plan to cross the North East passage. During POLARSTERN cruise ARK-XX/3 two reported places of historical interest were visited by helicopter (Fig. 4) to locate and to document: (a) the landing place of the DAE in the Duvefjord and (b) the landing place of the Lerner relief expedition 1913 in search for Schroeder Stranz. The expedition vessel of Lerner got entrapped in the pack ice and sunk off the Beverlysund near the North Cape. With the help of historical stereo-photographs and ARK-XX/3 field observations, the wreck site could be identified more accurately. The wreck is the most northern wreck of the world, and it is planned to investigate it for various research purposes during a submersible expedition in 2006.

As undone part of the oceanography working program of the Polarstern Cruise ARK-XX/2 (see Report “11.3.04, 16.7.-29.08.04 Jnr. 04/3904”), three pressure inverted echo sounder (PIES) were deployed west of Spitsbergen along 78°50´N (Fig. 2):

PIES 71	78°50.25´N, 02°48.20´E	2496 m water depth
PIES 141	78°49.87´N, 05°00.93´E	2708 m water depth
PIES 62	78°50.03´N, 08°19.91´E	793 m waterdepth

After the conclusion of the work program, RV “Polarstern” steamed towards Bremerhaven/Germany and reached port on October 03, 2004.

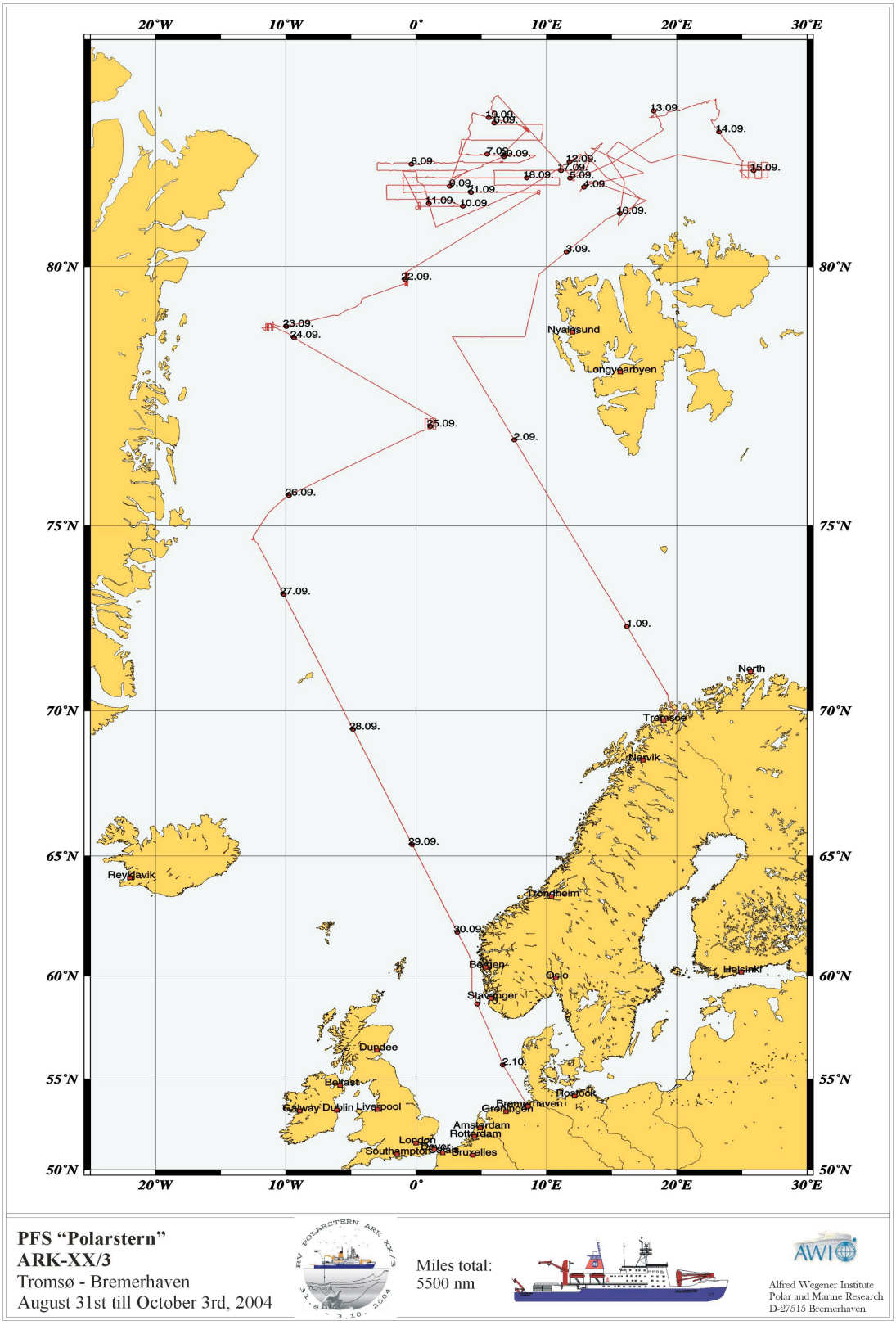

Fig. 1: Cruise track

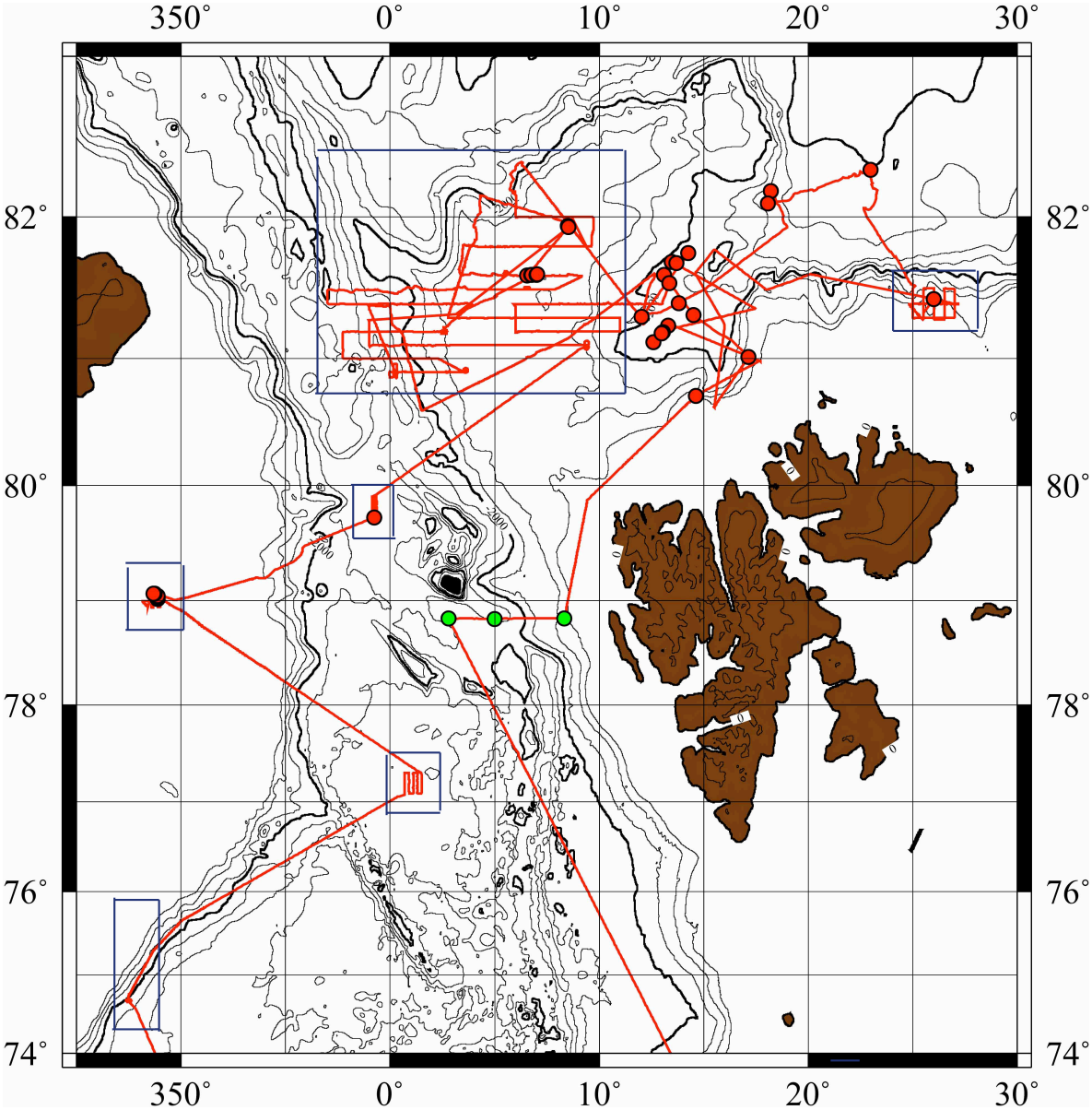

Fig. 2: Station map of ARK-XX/3. Red dots indicate geological stations, green dots indicate PIES stations. Boxes of seismic profiling are marked as light blue squares. Along the cruise track (red lines), a Hydrosweep and Parasound profiling survey was carried out.

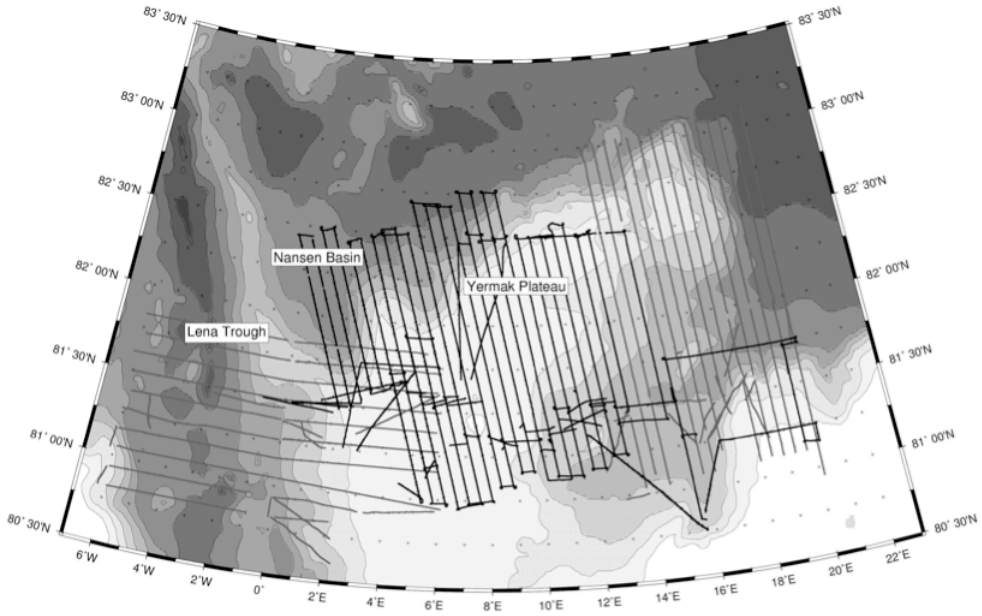

Fig. 3: Survey area for the magnetic measurements performed with the Polarstern helicopters

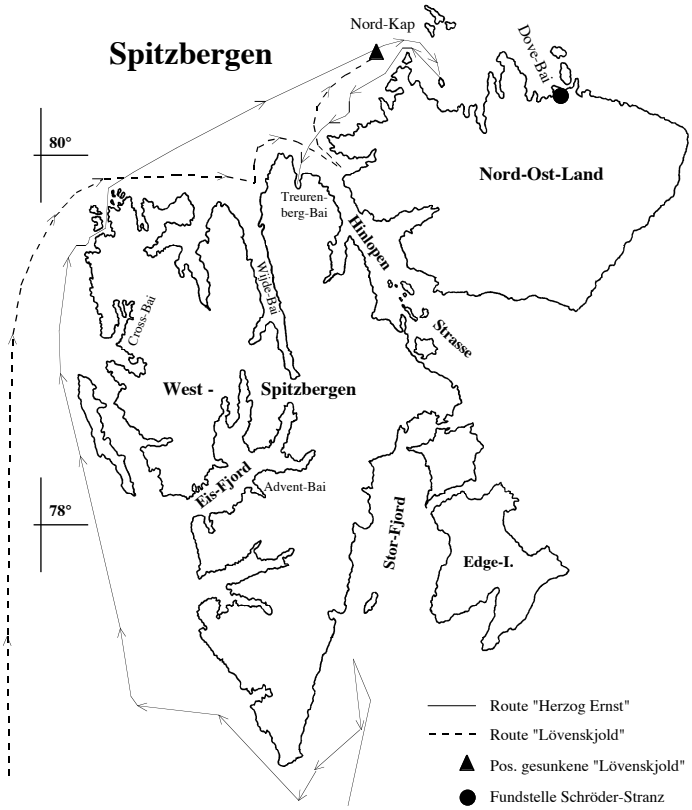

Fig. 4: Map of study sites devoted to the lost „Deutsche Arktis Expedition (DAE) 1912