ARBEITSKREIS GEOLOGIE UND GEOPHYSIK DER POLARGEBIETE

IN DER

DEUTSCHEN GESELLSCHAFT FÜR POLARFORSCHUNG

46. Treffen des Arbeitskreises

20./21. April 2023 in Hannover

Überblick mit ausgewählten Beiträgen

Im Arbeitskreis „Geologie und Geophysik der Polargebiete“ innerhalb der Deutschen Gesellschaft für Polarforschung haben sich an der Arktis und Antarktis interessierte Geowissenschaftler zusammengeschlossen. Ihr wesentliches Ziel ist es, neben der gemeinschaftlichen Formulierung und Ausführung polarbezogener geowissenschaftlicher Forschungsprogramme einen intensiven Informationsaustausch zu pflegen. Dies geschieht durch jährlich veranstaltete Arbeitstreffen, über die in schriftlicher Form wie in vorliegendem Heft berichtet wird.

Derzeitige Sprecher des Arbeitskreises sind:

Prof. Dr. Frank Lisker
Fachbereich Geowissenschaften
Universität Bremen
Klagenfurter Straße 2-4
28359 Bremen

PD Dr. Nikola Koglin
Bundesanstalt für Geowissenschaften und Rohstoffe
Stilleweg 2
30655 Hannover

Bremen und Hannover, im April 2023

INHALTSVERZEICHNIS

VORWORT

Das 46. Treffen des Arbeitskreises fand am 20. und 21. April 2023 in der BGR in Hannover statt. Für die Organisation haben die vielen helfenden Hände der Polargeologie gesorgt. Vielen herzlichen Dank dafür!

Mit 16 sehr spannenden Fachvorträgen sowie anschließenden Diskussionen wurde ein guter Überblick über die laufenden und zukünftigen Forschungsarbeiten in Arktis und Antarktis vermittelt. Die Kurzfassungen der Beiträge sind im Anhang in alphabetischer Reihenfolge nach Autoren geordnet dem Bericht angefügt. Der erste Tag des Treffens klang am Abend im Gasthaus „Fiedel“ aus, wo die Zeit für weitere interessante und angeregte Diskussionen bei Speisen und Getränken genutzt wurde. Neben den wissenschaftlichen Vorträgen wurde über die geplanten Programme und Expeditionen von AWI und BGR in Arktis und Antarktis berichtet.

Für die Organisation des nächsten Arbeitskreistreffens haben sich Conny Spiegel und Frank Lisker bereit erklärt. Daher soll nächste Arbeitskreistreffen Ende April/Anfang Mai 2024 in der Universität Bremen stattfinden. Ein weiteres kurzes Treffen des Arbeitskreises wird es während der Polartagung in Salzburg geben.

Nikola Koglin und Frank Lisker

TEILNEHMERLISTE

	Nachname	Vorname	Institution
1	Berg	Sonja	Uni Köln
2	Damaske	Detlef	Ruhestand (ehem. BGR)
3	de Vera	Jean-Pierre	DLR
4	Ebbing	Jörg	CAU Kiel
5	Eberlein	Lutz	TU Dresden
6	Estrada	Solveig	Ruhestand (ehem. BGR)
7	Gaedicke	Christoph	LUH
8	Gohl	Karsten	AWI
9	Hermichen	Wolf-Dieter	
10	Ivanova	Alina	AWI
11	Kanzler	Louisa	Universität Hamburg
12	Koglin	Nikola	BGR
13	Läufer	Andreas	BGR
14	Lembke-Jene	Lester	AWI
15	Lisker	Frank	Universität Bremen
16	Meier	Katrin	Universität Bremen
17	Piepjohn	Karsten	BGR
18	Reinhardt	Lutz	BGR
19	Riller	Ulrich	Universität Hamburg
20	Ruppel	Antonia	BGR
21	Spiegel	Cornelia	Universität Bremen
22	Streuff	Katharina	Marum
23	Weigelt	Estella	AWI

Programm

46. Treffen des Arbeitskreises

"Geologie und Geophysik der Polargebiete"

20./21. April 2023

Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover,
Stilleweg 2 Großer Sitzungssaal

Donnerstag 20. April 2023

14:00	LISKER, F. & KOGLIN, N.	Begrüßung und Einführung

Generelles und Bipolares

14:05	LISKER, F.	Antarktis-SPP: Antragsrunde und aktuelle Entwicklungen
14:15	LÄUFER, A. & GOHL, K.	Geplante Programme & Expeditionen von AWI & BGR
14:30	DE VERA, J.P.	Polarforschung als Brücke zur Raumfahrt
14:50	EBBING, J.	Estimating basal conditions with geophysical inversion and petrophysics

Antarktis I

15:10	LÄUFER, A.	Geological drilling in Antarctica: The SWAIS 2C project and the Sub-EIS-Obs initiative

15:30 – 16:00 h K a f f e e p a u s e

16:00	LISKER, F.	The Mountaineer Range: peaks at the rim of the Transantarctic Mountains
16:20	LÄUFER, A.	Connecting Geology and Geophysics for Bridging On- and Offshore Structures at the Pacific Coast of North Victoria Land, Antarctica: The joint BGR-PNRA GANOVEX-BOOST project
16:40	RUPPEL, A.	High-resolution aeromagnetic surveys over the Lanterman-Mariner Fault Zone in northern Victoria Land, Antarctica
17:00	LISKER, F.	The Rennick Glacier: New ice in an old trough?

Freitag 21. April 2023

Antarktis II

09:00	GOHL, K.	Polarstern-Expedition PS134: West Antarctic Ice Sheet history and processes in the Bellingshausen Sea (WAIS-BELL)
09:20	LEMBKE-JENE, L.	East Antarctic Icesheet Instabilities: Initial Results from Expedition PS128 EASI-1 Sediment Coring and an Outlook to Future Works
09:40	IVANOVA, A.	Potential for bottom current reconstructions on the formerly glaciated South Georgia continental shelf by application of sortable silt size and XRF-scanning
10:00	BERG, S.	„East Antarctic Ice Sheet Instabilities" Expeditions EASI-1 to -3. Initial results and planed work in terrestrial areas
10:20	EBERLEIN, L.	Geodätische Arbeiten zur Bestimmung der glazial-induzierten Krustendeformation in Ostantarktika

10:40 – 11:10 h K a f f e e p a u s e

11:10	STREUFF, K.	Sediment cores, bathymetry and Parasound data - illuminating marine depositional archives around sub-Antarctic South Georgia

Arktis

11:30	PIEPJOHN, K.	CASE 23-Svalbard – geplante Geländearbeiten an der Westküste von Spitzbergen und der Nordküste von Nordaustlandet im Sommern 2023
11:50	MEIER, K.	Shallow thermal anomalies along the conjugated margins of North Greenland and Svalbard
12:10	WEIGELT, E.	A Review of Seismic Surveys on the Lomonosov Ridge: Conclusions on its Structural Segmentation and Influence on Arctic Ocean Paleoceanography
12:30	LISKER, F. & KOGLIN, N.	Termine, Organisatorisches, Verabschiedung

E n d e g e g e n 13:00 h

Berg, S., Melles, M., Wagner, B., Bennike, O., Leicher, N., Kappelsberger, M., Heidrich-Meisner, K., Scheinert, M., Gore, D., White, D.

„East Antarctic Ice Sheet Instabilities" Expeditions EASI-1 to -3. Initial results and planed work in terrestrial areas

The response of the East Antarctic Ice Sheet (EAIS) to global climate change and the associated feedbacks in the ice - solid earth - ocean - climate system are insufficiently understood so far. In order to better understand processes and drivers of ice-sheet stability, climate- and ocean feedbacks, paleo-studies can provide information on rates of changes beyond the observational period and under climate conditions different from present-day, and also provide important constraints to improve model projections of Antarctic climate change.
Extensive fieldwork is conducted within the frame work of the three RV Polarstern expeditions PS128, PS140 and PS141, to investigate past East Antarctic Ice Sheet Instability (EASI 1-3) and its interaction with circulation changes in the Southern Ocean based on marine and terrestrial geological records. The terrestrial sites of interest are unglaciated coastal regions, where we carry out coring of sediments from lakes, marine bays and geomorphological investigations to obtain information on the ice retreat history and climate conditions in the past. The terrestrial geological work is complemented by geodetic GNSS measurements on bedrock to measure GIA-induced (glacial-isostatic adjustment) vertical deformation rates that are used to infer the modern-day Antarctic ice-mass balance.

During the first cruise PS128 (EASI-1) the Thala Hills, Enderby Land, were visited for 12 days. The maximum ice sheet extent during the Last Glacial Maximum (LGM, 19-23 ka) as well as the subsequent retreat history is still largely unconstrained for Enderby Land. The western part of Thala Hills (where the Russian Molodezhnaya station is located) hosts several lakes, including the 30 m deep Lake Glubokoye. During our stay in February 2022 most lakes were ice covered by multi-year lake ice, often exceeding 3 m in ice thickness. Lake sediment coring of six lakes showed that the post-glacial sedimentation in all lakes is dominated by biogenic sedimentation, which is reflected in centimeter to multi-decimeter thick deposits of microbial/algae mats that overlay clastic sediments or bedrock. First 14C ages obtained from a 1.3 m long sediment core from Lake Niznee indicate that the onset of biogenic sedimentation started around the early to mid-Holocene. In order to constrain the ice-sheet retreat history, we sampled glacial erratics for the analysis of terrestrial cosmogenic nuclide (TCN), which will provide information on the timing of ice retreat and subsequent fluctuations of the ice sheet margin in Thala Hills.

For the upcoming cruises extensive geological and geomorphological field work is planned for the Vestfold Hills (PS140 from November to January 23/24) and for the Bunger Hills and Windmill Islands (PS141 from February to April 24). There, the sediment coring will not only include lakes, but also marine inlets and isolation basins for paleoclimate and relative sea level reconstructions.

De Vera, J.P.

Polarforschung als Brücke zur Raumfahrt

Die Polarforschung ist im letzten Jahrzehnt besonders in den Fokus der Raumfahrt gerückt. Die Planeten und Monde im Sonnensystem, die von besonderem Interesse in der Planetenforschung und der Suche nach Leben sind, sind zumeist eisige Welten. So weisen diese Himmelskörper einige Analogien zu unseren Polargebieten auf unserer Erde auf, die für Technologietests unter Extrembedingungen, zu operationellen Aktivitäten mit Prototypen von Sonden und ihren Nutzlasten bis zur Erkundung der Umwelt reichen. Ein besonderer Trigger ist die Frage und Suche nach Leben im All und die Erforschung von habitablen Nischen in Extremwelten was nur über die Naturwissenschaften und speziell die Fachbereiche der Geologie und Geomorphologie sowie Biologie konkreter bearbeitet werden kann. Es werden in diesem Beitrag vergangene Arbeiten insbesondere aus dem Arbeitskreis vorgestellt und durchleuchtet und zukünftige Perspektiven gezeigt, wo die Reise über die Polargebiete zu den Sternen und ihren Planeten hingehen kann.

Ebbing, J., Lösing, M., Wansing, A., Lowe, M., Moorkamp, M.

Estimating basal conditions with geophysical inversion and petrophysics

Sub-ice geology is of interest to understand basal boundary conditions under the ice-sheets of Antarctica and Greenland, but limited by direct sampling. Joint inversion of gravity and magnetic data – two data sets which have covered large parts of the Polar regions - can provide an image of crustal structures, but need to be constrained. For validation of the results, we can rely on existing petrophysical and geochemical databases. However, there is still a disconnect between the geophysical results and the rock properties, which can either indicate limits in the resolution of the geophysical models or the sparsity of the available rock measurements. Still, using data from well-covered regions in adjacent, ice-free areas, we can stipulate parameters, such as for example heat production, to the interior of the regions and demonstrate that such coarse information improves predictions of basal conditions.

Eberlein, L., Buchta, E., Scheinert, M., Knöfel, C., Horwath, M.

Geodätische Arbeiten zur Bestimmung der glazial-induzierten Krustendeformation in Ostantarktika

Der Antarktische Eisschild hat eine Schlüsselrolle im System Erde inne. Seine langfristige Entwicklung und Wechselwirkung insbesondere mit der festen Erde und dem Ozean besser zu verstehen ist unabdingbar, um die Zuverlässigkeit der Voraussagen zur Klimaentwicklung und Meeresspiegeländerung zu erhöhen. Die für den Antarktischen Eisschild fesgestellte negative Massenbilanz (ca. 100 Gt/Jahr Verlust) ist mit größeren Unsicherheiten behaftet.
In diesem Vortrag möchten wir über die geodätischen Feldarbeiten in den letzten drei berichten. Hier ist vor allem ein DFG-gefördertes Projekt im Dronning-Maud-Land zu nennen, in dessen Rahmen in den Saisons 2019/2020 und 2022/2023 umfangreiche Feldarbeiten realisiert werden konnten. Auf 13 speziell vermarkten Felspunkten wurden geodätische GNSS-Messungen wiederholt. Damit wird es möglich, die vertikale Deformation der Erdkruste über einen Zeitraum von ungefähr 20 Jahren abzuleiten. Ausserdem konnten wir 2020 an zwei Lokationen neue permanent aufzeichnende GNSS-Stationen einrichten (Forstefjell und Kottas-Berge). Diese Arbeiten erfolgten in enger Kooperation mit der AWI-Geophysik.
Wir werden über die vorläufigen Ergebnisse berichten. Weitergehende Analysen werden sich mit der Reaktion der festen Erde, insbesondere in Hinblick auf die elastische Auflastdeformation in Abhängigkeit von den rheologischen Eigenschaften der Lithosphäre sowie dem langfristigen glazial-isostatischen Ausgleich beschäftigen.
Ausserdem soll ein Ausblick sowohl auf die Antarktis-weite Analyse aller verfügbaren geodätischen GNSS-Daten 1995 - 2021 im Rahmen des GIANT-REGAIN-Projekts also auch die geplanten Arbeiten während der Polarstern-Fahrten PS140 und PS141 im Rahmen des EASI-Projekts gegeben werden.

Gohl, K.

Polarstern-Expedition PS134: West Antarctic Ice Sheet history and processes in the Bellingshausen Sea (WAIS-BELL)

Die Eisschilde der Westantarktis und der Antarktischen Halbinsel haben in ihrer Entwicklungsgeschichte vermutlich sehr dynamisch auf klimatische Veränderungen reagiert, da ein Großteil der Basis des westantarktischen Eisschildes unter dem Meeresspiegel aufliegt und das Eis der Antarktischen Halbinsel einer Oberflächenerwärmung ausgesetzt ist. Beiträge dieser Eisschilde zu Meeresspiegeländerungen in Zeiten, in denen Klimabedingungen ähnlich denen einer sich gegenwärtig erwärmenden Erde zu erwarten sind, erfordert eine Rekonstruktion der glazialen Vor- und Rückzüge in Relation zu den bathymetrischen, topographischen und ozeanographischen Bedingungen. Mittels Daten und Proben, die auf dieser Expedition erhoben wurden, sollen Prozesse der Paläoumwelt des südlichen Bellingshausenmeeres entschlüsselt werden, da gerade diese Region und der benachbarte Amundsenmeer-Sektor gegenwärtig einen dramatischen Eisschildrückzug erleben. Hypothesen besagen, dass diese Regionen schon immer am sensitivsten mit ersten Eisschildrückzügen der Antarktis am Ende der Glazialepochen reagierte. Daten von reflexionsseismischen Messprofilen, geothermischen Wärmestrommessungen, Fächersonaraufnahmen des Meeresbodens und der Sedimentechographie dienen der Identifikation den Untersuchungen der Transport-, Ablagerungs- und Erosionsprozesse von glazialen Schelfsedimenten und dem glazial beeinflussten strukturellen Aufbau des Kontinentalhangs. Thermochronologische Daten und Analysen kosmogener Nuklide von Gesteinsproben des küstennahen Festlandes liefern Daten über Hebungsprozesse der Erdkruste sowie über die Rückzugsgeschichte des Eisschildes. In einem biologischen Nebennutzerprojekt wurden antarktische Quallen für das Verständnis über deren Diversität, Verbreitung und trophische Rolle im Südozean beprobt. Weiterhin erfolgte ein walbiologisches Begleitforschungsprogramm zur Validierung der Mitigationsverfahren bei der Anwendung von hydroakustischen und seismischen Messmethoden.
Die Expedition begann am 23. Dezember 2022 in Kapstadt (Südafrika) und führte nach dem Transit über den atlantischen Südozean und der Bergung einiger ozeanographischer Verankerungen am Maud Rise zuerst zur Neumayer-Station III im westlichen Dronning-Maud-Land der Ostantarktis, um die Station zu versorgen. Nach dem Transit über das Weddellmeer und entlang der westlichen antarktischen Halbinsel wurde das Hauptarbeitsgebiet im Bellingshausenmeer erreicht. Dort fand der Großteil der wissenschaftlichen Arbeiten statt, bevor die Rückreise nach Punta Arenas (Chile) angetreten wurde, wo die Expedition am 6. März 2023 endete.

Läufer, A., Klages, J.P., Gaedicke, C., Gohl, K., Koglin, N., SWAIS2C Science Team

Geological drilling in Antarctica: The SWAIS 2C project and the Sub-EIS-Obs initiative

Geological drilling in Antarctica and on its margins has been initiated in 1970s (Dry Valley Drilling Project) and was followed by several drilling projects including the Cape Roberts Project (1997–1999) and the ANDRILL project (2006–2007) as well as ship-based drilling operations on the continental shelf (IODP, MeBo). These deep drilling operations recovered cores from the mid- to outer continental shelves, hence distal from modern grounding zones and the interior of the ice sheet. The “Sensititvity of the West Antarctic Ice Sheet to +2°C” (SWAIS 2C) project aims to drill Neogene to Quaternary sediments proximal to the grounding zone of the West Antarctic Ice Sheet (WAIS) at Kamb Ice Stream and Crary Ice Rise, both located at the western Ross Sea’s Siple Coast. The overarching scientific questions are: Did the WAIS collapse in a 2°C-warmer world compared to pre-industrial times? In other words – how would the WAIS react, if the +2°C global warming threshold defined in the Paris Climate Agreement would be reached or even exceeded, and which lessons can we learn from the geological past to make more robust predictions for future cryospheric change? To achieve this goal, a new light-weighed hot water/rock drilling system has been developed, capable of recovering up to 200 m-long sediment cores from beneath the ice shelf at combined ice thickness-water depths of <1000 m. SWAIS 2C is a New Zealand-led international collaborative effort (Australia, Germany, Italy, Japan, Netherlands, New Zealand, South Korea, Spain, UK, USA) and co-financed by the International Continental Drilling Project (ICDP). Drilling is planned for Austral summers 2023-24 and 2024-25. The AWI-BGR-led “Sub-Ekström Ice Shelf-Observations” (Sub-EIS-Obs) initiative aims to recover sediment records from beneath the Ekström Ice Shelf (EIS), close to Neumayer III station on the Dronning Maud Land margin. Since 2016, pre-site survey data include ca. 615 km of vibroseis profiles from the EIS, several short sub-ice shelf sediment cores, and general seafloor observations such as videos. Additionally, ship-based multi-channel seismic data across the continental shelf, rise, and slope offshore the EIS were collected on RV Polarstern Expedition PS128 in early 2022 to link with vibroseis on-ice and earlier marine survey data. The project targets sedimentary strata covering the volcanic Explora Wedge, a seaward dipping volcanic unit of mid-Mesozoic age related to the early break-up of Gondwana. Sediments on top of this wedge document the post-break-up geological and environmental evolution of East Antarctica and the East Antarctic Ice Sheet. We aim towards a solid evaluation of the location and its suitability for inducing the process towards an international drilling proposal for better understanding the tectonic, environmental, and ice sheet evolution of East Antarctica in the late Mesozoic to Cenozoic. (For SWAIS2C Science Team cf. Patterson et al., Scientific Drilling, 30, 101–112, 2022)

Läufer, A., Crispini, L., Civile, D., Salvini, F., Ruppel, A., Koglin, N., Volpi, V., Locatelli, M., Morelli, D., Ferrante, G.M.

Connecting Geology and Geophysics for Bridging On- and Offshore Structures at the Pacific Coast of North Victoria Land, Antarctica: The joint BGR-PNRA GANOVEX-BOOST project

The joint BGR-PNRA project GANOVEX-BOOST (German Antarctic North Victoria Land Expedition- Bridging Onshore-Offshore Structures at the Pacific Coast of North Victoria Land, Antarctica: an integrated approach) targets the on- and offshore regions at the Pacific coast of northern Victoria Land (NVL). In many aspects, the Oates and Pennell coasts there are still widely under- to unexplored, despite their location in a key position at the East-West Antarctic boundary. Multiple geodynamic processes related to Australian-Antarctic-Zealandia plate fragmentation, passive margin evolution, West Antarctic rifting and uplift of the Transantarctic Mountains (TAM) have contributed to the present state of the lithosphere, cryosphere, and sub-ice topography in the region. Tectonic control of the rugged bathymetry at the NVL continental margin was suggested to relate to a possible prolongation of fracture zones in the Pacific Ocean (e.g., Balleny Fracture Zone) into the shelf and continental crust of NVL and further into the Ross Sea. This link has tentatively shaped the present structural architecture of NVL in terms of an intraplate dextral strike-slip belt. The geomorphology of pre-glacial fluvial valleys in NVL indicate a close link to pre-existing bedrock tectonics. BOOST involves an amphibian-style approach towards a new morphotectonic model to correlate on- and offshore structures and geomorphological features to link Cenozoic geodynamic processes and ice sheet evolution by collecting geological and geophysical data on land and at sea as well as integrating existing data. The results will provide new insights on the transition of oceanic and continental lithosphere at the Antarctic margin and the shaping of the Antarctic lithosphere during the evolution of Gondwana and the Australian-Antarctic-Zealandia plate configuration. The first phase of the project involved the BGR-led land-based GANOVEX XIV-BOOST campaign (2021-22). Geological fieldwork in the Rennick/Lillie glaciers area particularly connected to a parallel high-resolution aeromagnetic survey flown over the lower Rennick Glacier, northern Bowers Mountains and western Lillie Glacier up to the Pacific coast. The second PNRA-led phase (early 2023) collected new data over a ca. 5000 km² large area crossing the continental shelf and the present-day grounding zone of the ice sheet off the Pennell coast during the XXXVIII Italian PNRA expedition onboard R/V Laura Bassi. The survey included multi-channel seismic reflection measurements along a ca. 350 km long profile, magnetic and sub-bottom TOPAS measurements and multibeam morphobathymetry and ship-based magnetics. 3 multicores and 3 gravity cores were recovered from the continental shelf. These data will serve as the base to evaluate the possibility of a consecutive joint BGR-PNRA high-resolution aeromagnetic survey connecting to the marine survey and the existing onshore data planned for the final stage of the project in the Austral summer of 2023-24.

Roehnert, D., Lisker, F., Balestrieri, M.L., Grewe, L., Balbi, E., Läufer, A., Ruppel, A., Crispini, L., Spiegel, C.

The Mountaineer Range: peaks at the rim of the Transantarctic Mountains

The Transantarctic Mountains constitute along most of their length an extensive high-standing plateau consisting of early Paleozoic basement rocks and covered in places by Permian – Jurassic sedimentary strata and volcanic rocks. This pattern differs only in northern Victoria Land at the Pacific termination of the mountain chain where the plateau landscape changes to cone mountains and eventually to alpine topography.
The Mountaineer Range of northern Victoria Land exposes nearshore outcrops of Paleozoic basement and Cenozoic Meander Intrusives in a dissected high-relief topography up to 3500 m in elevation, which is substantially higher than the surrounding mesas. Thermochronological analyses (apatite fission-track and (U-Th-Sm)/He) of 41 samples from five vertical profiles range between 25 and 45 Ma and correlate with elevation. The ages coincide with the time of igneous activity between ~50 and ~25 Ma. Thermal history analysis of age data and proxies suggest a pulse of common cooling at ~35 Ma followed by differential cooling during Oligocene – Pliocene times.
This history refers to rapid inversion and downwearing of a shallow Mesozoic basin (the Mesozoic Victoria Basin) in the context of mid-Cenozoic granite emplacement and uplift, followed by incision and differential erosion depending on rheology and structural disintegration of the basement. Tectonic activity and uplift of the Mountaineer Range began earlier than in the main Transantarctic Mountains and amounts of both uplift and exhumation exceed those of the tableland areas further south. Evolving topography at the Eocene-Oligocene boundary may have served as nucleation centre of an early ice cap, qualifying the Mountaineer Range as a potential key area for initial ice sheet formation and glaciation of the Antarctic continent.

Lisker, F., Läufer, A., Ruppel, A., Spiegel, C.

The Rennick Glacier: New ice in an old trough?

The Rennick Graben extends for 320 km almost parallel to the main trend of the Transantarctic Mountains and hosts the largest glacier of the Ross Sea region and the world's second largest glacial drainage system. The graben recycles a zone of crustal anisotropy that is largely defined by the Paleozoic accretion suture of two volcanic and shallow marine terranes (Bowers Terrane and Robertson Bay Terrane) onto the East Antarctic Craton. Therefore, the two asymmetric graben shoulders expose basement rocks from different crustal levels and of varying composition. The trough of the graben is filled both with Permian – Jurassic sedimentary terrestrial "Beacon" deposits and ~180 Ma basaltic "Ferrar" volcanic rocks and sills.

The formation of the Rennick Graben as a large-scale extensional structure has been related in the past to (i) Cambrian Ross-orogenic collapse of a back-arc/oceanic arc system against the continental lithospheric backstop and Mesozoic or Cenozoic reactivation, (ii) Jurassic Rennick rifting, (iii) failed Cretaceous rifting at the locus of preceding Ferrar magmatism or (iv) the development of a shallow Triassic-Jurassic depression, the Transantarctic Basin, that has been re-used since the Eocene by rifting or strike-slip tectonics. Recent thermochronological data indicate that a shallow sedimentary basin existed throughout the Mesozoic along the whole present Transantarctic Mountains and was inverted at ~35 Ma. This scenario suggests that the Rennick Graben developed on thinned continental crust due to sudden increase of extension/ transtension since the latest Eocene/ early Oligocene in the context of the Cenozoic West Antarctic Rift System and was glacially shaped almost since the beginning of rifting. This hypothesis will be topic of a new research initiative relying on thermochronological, structural geology, and geophysical data and planned by the University of Bremen, the BGR, and Italian cooperation partners.

Meier, K., O'Sullivan, P., Jochmann, M., Wallrath, T., Monien, P., Piepjohn, K., Lisker, F., Spiegel, C.

Shallow thermal anomalies along the conjugated margins of North Greenland and Svalbard

North Greenland und West Svalbard are key areas to understand how the connection between the Northern Atlantic and the Arctic Ocean evolved from Cretaceous to final breakup in the Miocene. Vitrinite reflectance values > 7 % from Upper Cretaceous rocks along the east coast of northern Greenland indicate an unusually high thermal maturity. High thermal maturity values are exclusively observed along the coast and decrease further inland. High thermal maturation is also observed in Paleogene sediments further North and along the conjugated North Atlantic margin in western Svalbard. Here, the deposits yield vitrinite reflectance values up to 4% with values also decreasing towards the inland. The processes associated with heating and the timing of the heating event(s) are still a matter of debate
We address these open questions by applying low-temperature thermochronology to the sedimentary rocks associated with the high vitrinite reflectance values. In particular, we address the hypotheses that (i) both margins, the Greenland and the Svalbard side experienced heating contemporaneously, and (ii) that heating was connected to the final continental breakup and opening of the Fram Strait during the Miocene.
Our data, however, showed that the high thermal maturity along the conjugated margins reflect several thermal events. The oldest occurred in the late Cretaceous and we propose a connection to volcanic activity in due course of the opening of the Eurasian Basin. The two younger events occurred in the latest Paleocene to early Eocene and during the late Eocene, coeval with the first and second stage of the Eurekan orogeny. We associate the thermal events with the activity of the DeGeer Fault Zone and heat transfer along the transform faults, connecting active spreading centres in the north (Gakkel Ridge) and the south (Mohns Ridge). Overall, we conclude that the thermal anomalies are important features, thermally weakening the continental crust prior to final breakup.

Piepjohn, K.

CASE 23-Svalbard – geplante Geländearbeiten an der Westküste von Spitzbergen und der Nordküste von Nordaustlandet im Sommern 2023

Im Rahmen des CASE-Programms (Circum-Arctic Sturctural Events) plant die BGR im Sommer 2023 eine geowissenschaftliche Expedition „CASE 23 – Svalbard“ nach Spitzbergen durchzuführen. Es werden neben den BGR-Mitarbeiterinnen und Mitarbeitern auch Kolleginnen und Kollegen aus der Uni Hamburg, Uni Hannover, Uni Helsinki, Uni Tromsö und Uni Darmstadt teilnehmen. Die Expedition wird in zwei Abschnitten durchgeführt, die unterschiedliche Zielgebiete haben: die Westküste Spitzbergens (Zielgebiet 1) und die Nordküste Nordaustlandets (Zielgebiet 2). Für den Transport des CASE 23-Teams zu den Zielgebieten wird ein Schiff eingesetzt, welches gleichzeitig als Basislager während der Expedition dient.

Das wissenschaftliche Ziel des CASE-Programms ist die Erforschung der Struktur, des Aufbaus und der Entwicklung der arktischen Kontinenträndер mithilfe terrestrischer geowissenschaftlicher Methoden. Im Fokus steht dabei die Öffnung des Arktischen Ozeans und die plattentektonischen Prozesse, die zur Entstehung dieses fast vollständig von Kontinentplatten umschlossenen Meeresbeckens geführt haben. Ein Schlüsselgebiet, um diese Prozesse zu studieren, ist Svalbard.

Das Ziel des ersten Teils der Expedition, die Southwestern Basement Province, wird von einem komplizierten Puzzle mehrerer Terranes unterschiedlicher Deformationsgeschichte und Herkunft aufgebaut. Eine Aufgabe wird daher sein, die verschiedenen Deformationen in den einzelnen Terranes zu erfassen und zu charakterisieren, um Unterschiede beziehungsweise Gemeinsamkeiten herauszuarbeiten. Eine weitere Fragestellung befasst sich mit dem Einfluss der jüngsten paläogenen Eurekan Deformation auf das Gebiet und deren Auswirkungen auf die paläozoischen Deformationen (Timaniden, Kaledoniden) und auf die daraus resultierenden plattentektonischen Rekonstruktionen. Aus diesem Grund sind strukturgeologische Arbeiten geplant, um erstmals die Auswirkungen der Eurekan Deformation auf diese Basement-Gebiete untersuchen zu können.

Das zweite Zielgebiet in Nordaustlandet steht nach wie vor im Fokus der wissenschaftlichen Fragestellungen, die wegen der Eisverhältnisse 2019 und 2021 nicht bearbeitet werden konnten. Hauptgegenstand der Untersuchungen sind die Architektur, das Alter, die strukturelle Entwicklung und die Verbandsverhältnisse der verschiedenen prä-devonischen Gesteinseinheiten auf Nordaustlandet. In diesem Gebiet sind fünf Themen zu bearbeiten:
- Korrelierbarkeit der Brennevinsfjorden Group und der Helvetesflya Metapelite mit Hinsicht auf deren Unterschiede in Metamorphosegrad und Anzahl der Deformationen.
- Die Art des Kontaktes (tektonisch oder sedimentär) zwischen den klastischen und karbonatischen Ablagerungen der Murchisonfjorden Supergroup und den Vulkaniten der Kapp Hansteen Group sowie den Sedimentgesteinen der Helvetesflya Metapelite
- Strukturgeologische, petrologische, geochemische und geochronologische Untersuchungen des Kontaktberget und des Laponiahalvøya Granits sowie den sie umgebenden Sedimentgesteinen.
- Untersuchung der kaledonischen Deformation östlich der Vestfonna, der Auswirkungen prä-kaledonischer Deformationen als auch die Verbandsverhältnisse zu den kaledonischen Migmatit-Arealen und den silurischen Granitintrusionen.

- Aufnahme eines geologischen Profils durch Nordaustlandet.

Zusätzlich zum schiffsbasierten Teil der Expedition sollen auch helikoptergestützte Probennahmen neogener Vulkanite im Andrée Land und im Bereich des Woodfjorden stattfinden. Ein helikoptergestützter Einsatztest eines Fluggravimeters in Kombination mit dem BGR-eigenen Magnetikmesssystem wird unter arktischen Bedingungen von Longyearbyen aus durchgeführt werden.

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High-resolution aeromagnetic surveys over the Lanterman-Mariner Fault Zone in northern Victoria Land, Antarctica

The Lanterman-Mariner Fault Zone (LMFZ) constitutes a major tectonic boundary in northern Victoria Land, at the Pacific end of the Transantarctic Mountains. It separates the inboard Wilson Terrane, from the outboard Bowers and Robertson Bay terranes. The three units formed due to subduction of the Palaeo-Pacific Ocean under the active continental margin of East Gondwana during the late Ediacaran-early Paleozoic Ross Orogeny. The LMFZ represents a complex and polyphase fault zone that runs more than 400 km from the Ross Sea coast northwestward to the Pacific Ocean.
We present new high-resolution aeromagnetic data from the Mountaineer Range/Mariner Glacier (Ross Sea coast), the Lanterman Range and its northern continuation across the lower Rennick Glacier and Bowers Mountains towards the Pacific Ocean. The surveys were carried out during several expeditions within the GANOVEX (German Antarctic North Victoria Land Expedition) research programme led by the Federal Institute for Geosciences and Natural Resources (BGR) between 2015 and 2022, in cooperation with the Italian National Antarctic Research Program (PNRA). The helicopter-based surveys with a setup of 2 km line spacing and 10 km tie lines were complemented by structural and petrological field work as well as ground truth magnetic susceptibility readings.
Magnetic signatures in the Mountaineer Range/Mariner Glacier tightly correlate with post-Ross igneous complexes, which most likely intruded along inherited Ross-aged structures and therefore help to trace fault systems within the LMFZ and define their crosscutting relationships. The magnetic signatures at the Pacific side of the study area are more complex and show various prominent, nearly parallel magnetic lineaments. These lineaments occur throughout the three terranes and their trends follow the strike of the Wilson-Bowers terrane boundary. Within the Lanterman Range, one of the magnetic lineaments correlates well with a tectonic mélange of mafic-ultramafic rock fragments, gneisses and meta-conglomerates defining the LMFZ at the Wilson-Bowers terrane boundary. The eastern magnetic lineaments cannot be directly associated to any exposed lithology in the area, which show rather low magnetic susceptibility values, but give new constraints on the complex collision process. Future modelling of the data set will help to identify the specific nature and origin of these anomalies.

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Sediment cores, bathymetry and Parasound data - Illuminating marine depositional archives around sub-Antarctic South Georgia

South Georgia is one of the largest sub-Antarctic islands and is located within the Southern Ocean. Accordingly, it is influenced by several important, and crucially dynamic, climate systems, including the atmospheric moisture-supplying Southern Westerly Winds and the oceanographic Antarctic Circumpolar Current, which, in turn, are highly susceptible to Southern Hemisphere climate variability. As a result, sediments around South Georgia provide an excellent archive for past climate change, as fjord and continental shelf sediments, together with the local bathymetry, record such changes at a high temporal resolution. Despite this, a significant lack of offshore data makes it difficult to constrain both the glacial and the palaeoclimatic history of the island and its remaining ice cap. This lack of offshore data has inspired multiple research cruises to the area in recent years. Indeed, multiple studies are currently carried out by the authors, using lithological and physical data from acquired sediment cores, as well as information about past sedimentary and glacial processes as shown in hydroacoustic records. Multidisciplinary approaches are employed not only to elucidate the glacial history of the island's remaining ice cap, but also the changes in Holocene sedimentary environments and the predominant processes, that are likely related to shifts in local, and probably regional, climate. A special focus is set on the numerous cross-shelf troughs identified from swath bathymetry, where sediment accumulation has proven to be highest, thus providing the most complete climate archives. Thus far, data has been made available from Drygalski Trough in southeastern South Georgia, while ongoing research concentrates on the complex King Haakon Trough on the southern and the extensive Cumberland Bay on the northern side of the island. Forthcoming studies will include Church Trough in northwestern South Georgia, and through collaboration with several research partners, also some other fjords around the island, the results of which will then be used to gain a more comprehensive overview of sedimentary and climate changes around South Georgia on a local, regional and even hemisphere-wide scale.

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A Review of Seismic Surveys on the Lomonosov Ridge: Conclusions on its Structural Segmentation and Influence on Arctic Ocean Paleoceanography

The Lomonosov Ridge presents a major morphologic feature in the Arctic Ocean. Its tectonic evolution influenced the development of the ocean current system, deposition realm, glacial processes and ecosystem essentially. Based on morphological differences, the Lomonosov Ridge can be divided into three segments: the North American leg north off Greenland, the central part, and the Siberian leg.
The contribution presents an overview on a set of seismic surveys along the Ridge, and across into the adjacent Eurasian and Amerasia Basins. The data image the entire sedimentary cover, as well as the ridge's basement surface. Prominent reflectors, reflector configuration, as well as the reflection pattern of seismic units were correlated with coring information and magnetic anomalies to establish a seismostratigraphic model.
Aim of the study is to investigate if the structure of the sedimentary cover can be related to the segmentation of the Lomonosov Ridge, and thus, can provide information on the subsidence history of the different legs. Drift bodies, sediment waves, and erosional structures are examined for indications on the Paleoceanography, such as first passages for water mass exchanges between the Amerasia and Eurasia Basins, and the onset of a modern ocean circulation system and paleo-bottom current activity in the Arctic Ocean.