SCAR Sub-Group	CGG
SG	GS
Person Responsible:	Joachim Jacobs

SCAR Delegates Report 2020

Connecting Geology and Geophysics (CGG)

Summary

Report Author(s)
Joachim Jacobs, Norway
Fausto Ferraccioli, UK
Andreas Läufer, Germany

Summary of activities from 2018-20

Field activities, other activities:

Isotopic profiling along the Dronning Maud Land Mts. to gain insights into the crustal evolution across a major accretionary plate margin in Neoproterozoic/early Paleozoic times, several papers in preparation (Jacobs, J., et al.)

Comprehensive Ar/Ar dataset of eastern DML to delineate the protracted Neoproterozoic/early Paleozoic deformation and cooling history of this part of East Antarctica (Läufer, A., et al.)

High-resolution aeromagnetic survey over the western margin of the Mariner Glacier, combined with extensive geological field work in Victoria Land, Transantarctic Mountains during BGR expeditions GANOVEX XIII (2018-19) and GANOVEX XIII/2 (2019-20)

Pre-site survey “Sub-EIS-Obs III” jointly organized by AWI and BGR with core sampling under the Eckstrom Shelf Ice at Neumayer III station in the 2018-19 Antarctic season following extensive vibroseismic surveys in the two previous seasons

Comprehensive seismic bathymetry data set beneath Eckstrom Shelf Ice collected during joint AWI/BGR project Sub-EIS-Obs (Smith, Läufer et al.)
High resolution aerogeophysical surveys of Thwaites Glacier (2018-19 & 2019-20) flown by BAS in collaboration with LDEO as part of the International Thwaites Glacier Collaboration led by NSF & NERC (Jordan, Tinto et al.)

Four European Space Agency funded research projects (PolarGAP, GOCE+Antarctica, ADMAP 2.0+ & 4D Antarctica) with BAS leading and/or contributing to airborne and satellite geophysical data analyses and modelling to investigate subglacial geology, crustal and lithospheric architecture, global supercontinent linkages and geothermal heat flux heterogeneity (Ferraccioli, Ebbing, Forsberg, et al.). Several papers published & in preparation.

Geological and geophysical contributions to new SCAR-SERCE international and interdisciplinary Geothermal Heat Flow Sub-Group, including the 2020 White Paper (Alex Burton-Johnson et al.) and contributions to the new SCAR INSANT SRP proposal development.

Application of remote sensing techniques combined with geological field and lab and geophysical data to identify bedrock and structures in northern Victoria Land, one paper published, one in preparation (Läufer, Crispini, et al.)

Full waveform ambient noise tomography to investigate the structure of East Antarctica, work in progress (Hansen, S. et al.)

Regional-scale interpretation of magnetic anomaly field for the Mac. Robertson Land − Princess Elizabeth Land region, integrated with surface geology (Mikhalsky & Leitchenkov, 2018)

Tectonic map of Antarctica, 2nd edition. (Grikurov & Leitchenkov 2019)

Meetings:

- Session "*Structure, evolution and heterogeneity of Antarctica's lithosphere*" at the XIII International Symposium on Antarctic Earth Science (ISAES), 22.-26.07.19, Incheon, South Korea; largest session at the conference with 54 contributions
- *CGG Action Group meeting* at the XIII International Symposium on Antarctic Earth Science (ISAES), 22.-26.07.19, Incheon, South Korea
- Session "*Geological History of Victoria Land; Reviews and New Findings*" at the XIII International Symposium on Antarctic Earth Sciences (ISAES), 22-26.07.19, Incheon, South Korea; second largest session at the conference with 33 contributions
- 36 presentations in several Potential Field & Tectonophysics sessions at the IUGG 2019, AGU 2019 Fall Meeting and EGU 2020, including an *Invited Plenary Talk* at the XIII International Symposium on Antarctic Earth Science (ISAES), 22.-26.07.19, Incheon, South Korea

Summary Budget 2019 to 2022

	2019	2020	**2021**	**2022**
	Spent	Allocated	Request	Request
(US$)	0	2500	2500+2500	2500

Budget for 2019/20 had been earmarked for participation at SCAR meeting in Hobart. We request that the funds are carried forward into 2021.

Future plans

Planned activities in 2020 to 2022

Planned activity
High-resolution aeromagnetic survey and geological field work in northern Victoria Land during the planned BGR expedition GANOVEX XIV (2021-22)
New aerogeophysical surveys of the Princess Elizabeth Land frontier, as part of a proposed international project- GEOEAIS- led by India & UK (earliest target field seasons 2021-22 & 2022-23)
4D Antarctica modelling efforts to help constrain crustal and lithosphere structure and its influence on Antarctic geothermal heat flux heterogeneity (2020-2022)
Contributions to new International Lithosphere Programme on East Antarctica (2020-2025).
Sampling/analyses of ice-rafted debris/moraine material off/in Dronning Maud Land
EGU/AGU, conference sessions
SRP planning meeting in Bergen, Norway, in early 2021

Planned use of funds for 2020 to 2022

Year	Purpose/Activity	Amount (USD)	Contact Name	Contact Email
2021	EGU/AGU session	2500	Jacobs/Ferraccioli/Läufer	jja083@uib.no
2021	Planning SRP	2500	Jacobs/Ferraccioli/Läufer	jja083@uib.no
2022	SCAR OSC	2500	Jacobs/Ferraccioli/Läufer	jja083@uib.no
Total		**7500**		

Any additional detail on funds usage and desired results/outcomes
We would like to request to forward the budget from 2020 that was earmarked for participation at the SCAR OSC – Hobart to 2021. New usage: planning meeting SRP proposal for 2022 of leadership.

Percentage of the budget to be used for support of early-career researchers
2021: 20%
2022: 20%

Percentage of the budget to be used for support of scientists from countries with developing Antarctic programmes
2021: 20%
2022: 20%

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
	Joachim	Jacobs	Univ. Bergen	Norway		2012	
	Fausto	Ferraccioli	BAS	UK		2013	
	Andreas	Läufer	BGR	Germany		2018	

*Please identify early-career researchers with * in first column*

Other members

First Name	Last Name	Affiliation	Country	Email
Alex	Burton-Johnson	BAS	UK	alerto@bas.ac.uk
Antonia *	Ruppel	BGR	Germany	antonia.ruppel@bgr.de
Rafael *	Fragoso	Univ. Rio de Janeiro	Brasil	rafael.araujo.fragoso@gmail.com
Laura	Crispini	Univ. Genoa	Italy	laura.crispini@unige.it
Christine	Siddoway	Colorado C	USA	csiddoway@coloradocollege.edu
Jaqueline	Halpin	Univ. Tasmania	Australia	jacqueline.halpin@utas.edu.au
John	Goodge	Univ. of Minnesota	USA	jgoodge@d.umn.au
Karsten	Gohl	AWI	Germany	karsten.gohl@awi.de
German	Leitchenkov	VNIIO	Russia	german_l@mail.ru
Samantha	Hansen	Univ. Alabama	USA	shansen@ua.edu
Cheng-Cheng*	Wang	Univ. Bergen	Norway	Cheng-Cheng.Wang@uib.no
Geoff	Grantham	Univ. of Johannesburg	South Africa	geoff.grantham@uj.za
Eugeni	Mikhalsky	St. Petersburg	Russia	emikhalsky@mail.ru
Tom	Jordan	BAS	UK	
Hallgeir*	Sirevaag	Univ. Bergen	Norway	hallgeir.sirevaag@uib.no
Synnøve	Elvevold	Norweg. Polar Institute	Norway	synnøve.elvevold@np.no

*Please identify early-career researchers with * in first column*

Notable Papers, 10 *most notable papers*

1. Daczko, N. R., Halpin, J. A., Fitzsimons, I. C. W., Whittaker, J. M., 2018. A cryptic Gondwana-forming orogen located in Antarctica. ***Scientific Reports***, 8, 8371.
   This work proposes that the cryptic Kuunga suture, where Indo-Antarctica and Australo-Antarctica collided during Gondwana assembly lies close to Mirny Glacier. A follow-up paper published in Geology in 2019 further hypothesizes that it also links to the major Gamburtsev Suture in interior East Antarctica.
2. Goodge, J., 2020. Geological and tectonic evolution of the Transantarctic Mountains, from ancient craton to recent enigma. ***Gondwana Research***, 80, 50-122.
   This paper provides a state of the art review and the most complete geodynamic picture of the Trans Antarctic Mts. do far, integrating all available data.
3. Jacobs, J., Mikhalsky, E., Henjes-Kuns, F., Läufer, A., Thomas, R.J., Elburg, M.A., Wan, C.-C., Estrada, S., Skublov, G., 2019. Neoproterozoic geodynamic evolution of easternmost Kalahari: Constraints from U-Pb-Hf-O zircon, Sm-Nd isotope and geochemical data from the Schirmacher Oasis, East Antarctica. ***Precambrian Research****,* 342, 105553.
   This work demonstrates that one of the major late Neoproterozoic/Early Paleozoic sutures in East Antarctica is a long-lasting active continental margin that evolved when Rodinia turned inside out, finally leading to the assembly of Gondwana.
4. Mikhalsky E.V. and Leitchenkov G.L. (Eds). 2018. Geological map of Mac.Robertson Land, Princess Elizabeth Land, and Prydz Bay (East Antarctica). Scale 1:1000000. VNIIOkeangeologia, SPb. 1 Sheet. Explanatory notes to geological map of Mac.Robertson Land, Princess Elizabeth Land, and Prydz Bay (East Antarctica) in scale 1 : 1 000 000 **(**Ed. By E.V. Mikhalsky and G.L. Leitchenkov. VNIIOkeangeologia, SPb. 82 p. ISBN 978-5-88994-121-7.
   Detailed work integrating geology and geophysics, outlining the contrast between stable and mobile crustal domains. The authors suggest key geological transects across major crustal domains.
5. Mikhalsky, E.V., Andronikov, A.V., Leitchenkov, G.L., Belyatsky, B.V. 2020. The age of continental crust in the northern Prince Charles Mountains (East Antarctica) as evidenced by zircon xenocrysts from Cretaceous alkaline-ultramafic rocks. ***Lithos***, 368−369, 105599.
   This work provides a unique window on the age of deeper continental crust in the Prince Charles Mountains sector of East Antarctica using xenocrysts as probes.
6. Pappa, F., Ebbing, J., Ferraccioli, F., & van der Wal, W., 2019. Modeling satellite gravity gradient data to derive density, temperature, and viscosity structure of the Antarctic lithosphere. ***Journal of Geophysical Research*****: Solid Earth**, 124, 12,053–12,076. https://doi. org/10.1029/2019JB017997.
   This work provides the first 3D model for the Antarctic lithosphere derived from GOCE satellite gravity gradient data, with key implications for crustal and lithosphere thickness, density and thermal structure, and upper mantle viscosity.
7. Ruppel, A., Jacobs, J., Läufer, A., Ratschbacher, L., Pfänder, J., Sonntag, B.-L., Krasniqi, K., Elburg, M., Krohne, N., Damaske, D., Lisker, F., 2020. Protracted Late Neoproterozic/Early Paleozoic deformation and cooling history of Sør Rondane, East Antarctica, from 40Ar/39Ar and U-Pb geochronology. **Geological Magazine**, in press.
   This work presents new geochronological data (Ar/Ar and U-Pb data) in an important region of East Antarctica that help constrain the Late Neoproterozoic/

Early Paleozoic tectono-thermal history of the eastern part of the East African-Antarctic Orogen.

8. Wang, C.-C., Jacobs, J., Elburg, M., Läufer, A., Thomas, R.J., Elvevold, S., 2020. Grenville-age continental arc magmatism and crustal evolution in central Dronning Maud Land (East Antarctica): Zircon geochronological and Hf–O isotopic evidence. ***Gondwana Research***, 82, 108-127
   This work provides new evidence for Grenvillian age continental arc magmatism in central Dronning Maud Land that is relatively younger compared to the juvenile island arc terranes of the Namaqua-Natal belt in Southern Africa.
9. Smith, E.C., Hattermann, T., Kuhn, G., Gaedicke, C., Berger, S., Drews, R., Ehlers, T., Franke, D., Gromig, R., Hofstede, C., Lambrecht, A., Läufer, A., Mayer, C., Tiedemann, R., Wilhelms, F., Eisen, O., 2020. Detailed Seismic Bathymetry Beneath Ekström Ice Shelf, Antarctica: Implications for Glacial History and Ice-Ocean Interaction. ***Geophysical Research Lett***., 47, e2019GL086187.
   This work provides vibroseis seismic survey data used to map the ice-shelf cavity beneath Ekstrom Ice Shelf in Antarctica, evidence for past ice streaming and retreat through a deep trough with transverse sills and overdeepenings, and two ocean circulation regimes inferred in the shallow and deep parts of the cavity.
10. Stål, T., Reading, A.M., Halpin, J.A., Whittaker, J.M., 2019. A Multivariate Approach for Mapping Lithospheric Domain Boundaries in East Antarctica. ***Geophysical Research Lett***., 46, 10,404–10,416. https://doi.org/10.1029/2019GL083453.
    This work presents a tool to statistically map the location of cryptic lithospheric domain boundaries in East Antarctica, by combining different methodologies such as gravity, seismology and geological imaging.

Major collaborations your Science Group has with other SCAR groups and with organisations/groups beyond SCAR

Within SCAR

1. ADMAP
2. GEOMAP
3. SERCE
4. PAIS
5. INSTANT
6. Geothermal Heat Flux

Outside SCAR

1. IGCP 628: Gondwana map project, by involving CGG specialists to review various key areas
2. IGCP 648: Supercontinent cycles & global geodynamics
3. IUGG
4. ESA Antarctic initiatives and projects

Outreach, communication and capacity-building activities

- Press release on GOCE+Antarctica on satellite gravity gradient views of the lost continents under the ice related to the Nature journal *Scientific Reports* paper of Ebbing et al., (2018) that generated over 300 news items worldwide
- Press release on the first 3D model of the Antarctic lithosphere related to the *JGR* paper of Pappa et al., (2019) that generated over 20 news items.
- Press release 2019 on completion and first scientific achievements of BGR geological-geophysical expedition GANOVEX XIII to Victoria Land (2018-19 season)
- Contribution to public exhibition on Antarctica in Überseemuseum Bremen, Germany 2018 with article on Antarctic geology
- Contribution to publication "The Arctic and Antarctic – Extreme, Climatically Crucial and In Crisis" in World Ocean Review 6 (2019).
- Elvevold, S., Myhre, P.I, Engvik, A., Jacobs, J., 2019: Geological mapping of Norway's least explored mountains. Research Notes, Fram Forum 2019, 128-131.

SCAR fellowship reviewers

As part of SCAR's Capacity Building efforts, such as the Fellowships and Visiting Scholar Awards, we are looking for people from all the SCAR groups to form a 'review panel' so if applications in your field are submitted we have people to contact to help assess relevant applications. Please list one or more people (name and email address) from your group who would be willing to serve as reviewers for the next few years, along with 1-3 keywords on their principal expertise.

First Name	Last Name	Email	Principal Expertise
Joachim	Jacobs	joachim.jacobs@uib.no	Tectonics, geodynamics, geochronology
Fausto	Ferraccioli	ffe@bas.ac.uk	Potential fields, tectonophysics, geodynamics
Andreas	Läufer	andreas.laeufer@bgr.de	Tectonics, geochronology, geodynamics
Laura	Crispini	andreas.laeufer@bgr.de	Structural geology geodynamics
Antonia	Ruppel	antonia.ruppel@bgr.de	Geophysics, geodynamics