



International
Science Council

Paper No: 03 Agenda item: 2.1

SCAR SG Geosciences

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SCAR Executive Committee Meeting 2023

Trieste, Italy, 15-16 September 2023

Geosciences Group (GSG) **2022-23 Report**

Report Authors

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Contributions of Chief Officers of Expert Groups and Action Groups

Summary

The Geosciences Group (GS) has reactivated most of the tasks developed by the action and expert groups following the pandemic contingency period. A virtual meeting of the GS was held on July 28, 2023, with a focus on the scientific advances of the Expert and Action Groups (EG/AG), as well as reactivating and promoting interactions.

The Geosciences Group consists of seven expert groups and four action groups, three of which are cross-disciplinary. When AGATA was approved by SCAR Delegates as a Programme Planning Group (PPG), GRAPE, an expert group, and its work were absorbed into the new PPG, leading to the conclusion of this expert group. Two new groups i.e. GEOCON EG and ICEPRO AG have successfully initiated their activities. The remaining EG/AG groups are continuing their activities without any major issues. For more information on their activities, please refer to the Progress reports submitted by each EG/AG.

The GS was requested to prepare an ATCM Information Paper on seismic activity and associated risks in Antarctica. This paper has been submitted and presented by SCATS at the XLV ATCM. Another Information Paper on volcanic activity and associated risks is currently being prepared by ANTVOLC EG.

A new PPG/SRP centred around Antarctic Geological Evolution (AGE) is being promoted within the Geosciences framework, with the intention of presenting it at the upcoming delegates' meeting.

Sub-group updates

Sub-group – what has been achieved?

Sub-group	Activity
AntArchitecture	Tracking and modelling internal layers across Antarctic ice sheet, papers led by ERC, workshops and network activities.
ANTPAS (Antarctic Permafrost and Soils)	<p>A review paper on the active layer thickness entitled: Active layer and permafrost thermal regimes in the ice-free areas of Antarctica on Earth Science Reviews, 242, 104458 led by Filip Hrbacek involved 16 authors of 9 different nations.</p> <p>One call for three grants to encourage the international exchange of early career researchers.</p>
AntVolc (Antarctic Volcanism)	<p>Maintaining a website, hosted at the Geosciences Barcelona (Geo3BCN-CSIC) (https://antvolcscar.wordpress.com/).</p> <p>New dedicated AntVolc Twitter (@antvolc) and Facebook accounts have been created.</p> <p>Digital outreach book published in June 2022.</p> <p>Review volume and AntVolc White paper.</p>
CGG (Connecting Geophysics with Geology)	<p>Coordination of several surveys and planning of a new SRP “Antarctica’s Geological Evolution (AGE)” focused on:</p> <ol style="list-style-type: none"> 1. What are the key geological, tectonic and geodynamic processes that shaped the Antarctic continent from the Precambrian to the present? 2. What do different Antarctic geological provinces reveal about the global supercontinent puzzle and its cycles? 3. How did continental margins and interior basins form and evolve? 4. How did oceanic gateways evolve and what influence did these have on geodynamics, climate and ice sheet initiation? 5. Which geological processes and heterogeneities influenced topographic evolution, geothermal heat flux and ice-sheet dynamics?
EG-Geocon (Geological Heritage and Geoconservation)	Have received several submissions for several sites to be evaluated as geological Heritage among Archean cratons, Cenozoic glacial history sites, Meteorites and evidence of impacts sites.
Geodetic Infrastructure in Antarctica (GIANT)	Fostering coordination for continued measurements by geodetic GNSS on bedrock in different sectors of Antarctica.

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IBCSO (International Bathymetric Chart of the Southern Ocean)	IBCSO as part of the Nippon Foundation – GEBCO Seabed 2030 Project provided the area south of 50°S for the General Bathymetric Chart of the Oceans (GEBCO) grid releases (GEBCO Bathymetric Compilation Group 2023).
ICEPRO (International Collaboration Effort for Improving Paleoclimate Research)	Development of international collaborations to undertake activities contemplated within ICEPRO. Collaboration in active funded collaborative proposals. Organization of ICEPRO activities on Antarctic cruises during the 2022-2024 seasons.
RINGS	Organizing workshops, working paper and information paper to ATCM and lessons from past airborne surveys at a COMNAP symposium, AGU's Eos article (doi: 10.1029/2022EO2202769).

Sub-group – what lies ahead?

Sub-group	Activity
ADMAP	A new compilation or update of ADMAP Version 2 that was published in 2018.
AntArchitecture	Requirements for database of 3D age-depth across Antarctica and how this can be achieved by marrying radiostratigraphy to deep ice cores. Submission planned late 2023. Building database of englacial layers/slopes across East Antarctica – paper and open access repository.
ANTPAS (Antarctic Permafrost and Soils)	Antarctic session during 12th ICOP (International Conference on Permafrost, Whitehorse, Canada) June 2024. New co-chair election.
AntVolc (Antarctic Volcanism)	Workshop on active Antarctic volcanism and the associated risk across Antarctica. An information paper to SCAR (for submission to the Antarctic Treaty). Completion of an online database of tephra analyses including major and trace elements data (when possible) for tephra identified in the continental, lacustrine and marine records of Antarctica, which is only partly complete so far (due to lack of funds) but already available for scrutiny online http://www.tephrochronology.org/AntT/index.html .

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CGG (Connecting Geophysics with Geology)	<p>New SRP AGE planning meetings.</p> <p>First SWAIS-2C drilling season at Kamb Ice Stream, Siple Coast, western Ross Sea in Antarctic season 2023-24.</p> <p>ERC Synergy Grant application on lithosphere influences on the East Antarctic Ice Sheet in the Wilkes Subglacial Basin region (to be submitted in Nov 2023).</p> <p>New work on crustal modelling based on ESA 4D Antarctica results and new supercontinental reconstructions by exploiting the latest World Magnetic Anomaly Map that includes ADMAP 2.0 data (presented at IUGG 2023).</p> <p>Session proposal on linking polar geology & geophysics for EGU 2024 & contributions to the International Lithosphere Programme on East Antarctica (potential splinter meeting @ EGU2024).</p>
EG-Geocon (Geological Heritage and Geoconservation)	Continue updating the list of sample repository collections to increase discoverability of these resources for the SCAR science community.
Geodetic Infrastructure in Antarctica (GIANT)	<p>Further observations comprise techniques such as relative and absolute gravimetry, tide gauges as well as the observatory measurements at the Japanese station Syowa (VLBI, SLR, absolute and superconducting gravimetry).</p> <p>Reprocess all available geodetic GNSS data recorded at bedrock sites between mid-1990s and the end of 2021.</p>
IBCSO (International Bathymetric Chart of the Southern Ocean)	<p>IBCSO / Seabed 2030 Regional Centre – Southern Ocean is currently organising the Fifth Arctic-Antarctic and North Pacific Mapping Meeting to be held in Bremen (Germany) from 27 to 29 November 2023.</p> <p>IBCSO will report to the Hydrographic Commission on Antarctica at the 19th HCA Conference in Venice (Italy) in 2024.</p> <p>During 2023-24, the work on IBCSO v3 will be intensified and the search for bathymetric datasets to be included in IBCSO will be continued.</p>
ICEPRO (International Collaboration Effort for Improving Paleoclimate Research)	<p>Define a list of proxies (organic and inorganic markers) of interest for data and model communities.</p> <p>Determine group leaders for each proxy, in close collaboration with complementary expertise (modellers, physical oceanographers, biologists...).</p> <p>Interactions with other working groups.</p> <p>Define common sampling strategy and harmonize analytical work at sea and onshore.</p>
RINGS	A review paper will be submitted to Reviews of Geophysics.

	New survey in the Dronning Maud Land and Enderby Land.
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More details in the individual reports.

Budget

Changes to planned use of funds for 2023 and 2024

We kindly request that the sum of 4500 USD previously allocated to GRAPE be reallocated to the Geosciences Miscellaneous fund, considering the conclusion of this expert group.

Membership

Changes to Sub Group Leadership since 2022 Delegates Meeting report

There are no changes in the main contacts since 2022.

SCAR Fellowship Reviewers

First Name	Last Name	Email	Principal Expertise
Adam	Martin	a.martin@gns.cri.nz	Mantle petrology, Igneous chemistry, Erebus volcanic province
Adelina	Geyer	ageyer@ictja.csic.es	Active volcanism, Deception Island
Alessio	Di Roberto	Alessio.diroberto@ingv.it	Tephrochronology
Andreas	Läufer	andreas.laeufer@bgr.de	Tectonics, Geochronology, Geodynamics
Antonia	Ruppel	antonia.ruppel@bgr.de	Geophysics, Geodynamics
Berry	Lyons	Lyons.142@osu.edu	Ecology Aquatic
Boris	Dorschel	Boris.Dorschel@awi.de	Geology, Habitat mapping
Carlota	Escutia	cescutia@iact.ugr.es	Paleoceanographer, Paleoclimatologist, Cenozoic sedimentology
Detlef	Damaske	d.damaske@t-online.de	Aeromagnetism
Fausto	Ferraccioli	ffe@bas.ac.uk	Potential fields, Tectonophysics, Geodynamics
Graeme	Eagles	Graeme.Eagles@awi.de	Plate Kinematics
Joachim	Jacobs	joachim.jacobs@uib.no	Tectonics, Geodynamics, Geochronology
Johan	Etourneau	johan.etourneau@ubordeaux.fr	Paleoceanographer, Paleoclimatologist, Cenozoic sedimentology
John L.	Smellie	jls55@leicester.ac.uk	Physical volcanology, especially Glaciovolcanism, Eruptive palaeoenvironments
Kenichi	Matsuoka	Kenichi.matsuoka@npolar.no	Glaciology
Kirsty	Tinto	tinto@ldeo.columbia.edu	Geophysics
Koichiro	Doi	doi@nipr.ac.jp	Geodesy, Gravity, Observatories
Kurt	Panter	kpanter@bgsu.edu	Igneous Petrology/Geochemistry/ Mantle geochemistry

Laura	Crispini	andreas.laeufer@bgr.de	Structural geology geodynamics
Matt	King	Matt.King@utas.edu.au	Geodesy, GNSS, GIA
Mauro	Guglielmin	Mauro.guglielmin@uninsubria.it	Permafrost, Climate Change
Max	Maximillian Van Wyk de Vries	vanwy048@umn.edu	Volcano-ice interactions, Glaciology, Volcanic hazard modelling.
Mirko	Scheinert	Mirko.Scheinert@tu- dresden.de	Geodesy, GNSS
Nicoletta	Cannone	Nicoletta.cannone@uninsubria. it	Vegetation, Climate change
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René	Forsberg	rf@space.dtu.dk	Geodesy, Gravity field
Robert	Bingham	r.bingham@ed.ac.uk	Glaciology
Stefano	Ponti	stefano.ponti@uninsubria.it	Remote sensing
Terry	Wilson	wilson.43@osu.edu	Glacial dynamics, Tectonics
Laura	De Santis	ldesantis@ogs.it	Seismic stratigraphy

Additional information

Outreach, communication and capacity-building activities

Most of the groups used their funds to help ERC and student exchange.

They also provided new material for education and outreach and maintained web sites and twitter accounts to inform about ongoing activities.

The ADMAP-2 compilation was showcased as part of the prize-winning Antarctic Resolution book project (<https://www.lars-mueller-publishers.com/antarctic-resolution>) which went online and open-access in April 2023 : <https://antarctic-resolution.org/openaccess/>.

The Ant-Volc digital outreach book published in June 2022 has reached over 4100 downloads. Also it has been translated into Spanish and Italian during this reporting period: Geyer, Adelina, Van Wyk de Vries, Max, Smellie, John L., Cooper, Jennifer, Di Roberto, Alessio, Panter, Kurt S., Martin, Adam P., Pompilio, Massimo, Dunbar, Nelia, & Blankenship, Donald D. (2023). Vulcanismo antártico: ¡Explora los volcanes más remotos del planeta! Zenodo.

<https://doi.org/10.5281/zenodo.7699900>

<https://doi.org/10.5281/zenodo.7704405>

In parallel, the printing version of the outreach book has been prepared in all three languages and distributed (100 printed copies in English and 25 in Spanish among educational centres, libraries, etc. During Summer 2023, the Italian version of the book will be also printed and distributed from September 2023 onwards).

Notable Papers

Bodart, J.A., R.G. Bingham, D.A. Young, J.A. MacGregor, D.W. Ashmore, E. Quartini, A.S. Hein, D.G. Vaughan and D.D. Blankenship (2023) High mid-Holocene accumulation rates over West Antarctica inferred from a pervasive ice-penetrating radar reflector. *The Cryosphere*, 17 (4), 1497-1512. <https://doi.org/10.5194/tc-17-1497-2023>. *This paper shows that a clear radar-sounded internal layer widely traced across the West Antarctic Ice Sheet and dated to 4.7 ka by intersection with WAIS Divide Ice Core can be used to compare past and present accumulation and shows that accumulation rates were ~18% higher than present during the mid Holocene.*

Cox, S.C., Smith Lyttle, B., Elkind, S., Smith Siddoway, C., Morin, P., Capponi, G., Abu-Alam, T., Ballinger, M., Bamber, L., Kitchener, B., Lelli, L., Mawson, J., Millikin, A., Dal Seno, N., Whitburn, L., White, T., Burton-Johnson, A., Crispini, L., Elliot, D., Elvevold, S., Goodge, J., Halpin, J., Jacobs, J., Martin, A.P., Mikhalsky, E., Morgan, F., Scadden, P., Smellie, J. & Wilson, G. (2023): A continent-wide detailed geological map dataset of Antarctica.- *Nature Scientific Data*, <https://doi.org/10.1038/s41597-023-02152-9>. *This work is a major contribution to this SCAR group, from a wide region of Antarctica by many CGG members.*

Dorschel Boris, Hehemann Laura, Viquerat Sacha. *et al.* Warnke Fynn, Dreutter Simon, Tenberge Yvonne Schulze, Accettella Daniela, An Lu, Barrios Felipe, Bazhenova Evgenia, Black Jenny, Bohoyo Fernando, Davey Craig, De Santis Laura, Dotti Carlota Escutia, Fremant Alice C., Fretwell Peter T., Gales, Jenny A., Gao Jinyao, Gasperini Luca, Greenbaum Jamin, Jencks Jennifer Henderson, Hogan Kelly, Hong Jong Kuk, Jakobsson Martin, Jensen Laura, Kool Johnathan, Larin Sergei, Larter Robert D., Leitchenkov German, Loubrieu Benoît, Mackay Kevin, Mayer Larry, Millan Romain, Morlighem Mathieu, Navidad Francisco, Nitsche Frank O., Nogi Yoshifumi, Pertuisot Cécile, Post Alexandra L., Pritchard, Hamish D., Purser Autun, Rebesco Michele, Rignot Eric, Roberts Jason L., Rovere Marzia, Ryzhov Ivan, Sauli Chiara, Schmitt Thierry, Silvano Alessandro, Smith Jodie, Snaith Helen, Tate Alex J., Tinto Kirsty, Vandenbossche Philippe, Weatherall Pauline, Wintersteller Paul, Yang Chunguo, Zhang Tao, Arndt, Jan Erik. (2022). The International Bathymetric Chart of the Southern Ocean Version 2. *Sci Data* 9, 275. <https://doi.org/10.1038/s41597-022-01366-7> *This paper freely released the last most updated version of the Southern Ocean Bathymetric map IBCSOv2. It carefully presents the method used for interpolating all the data and includes all available single beam and multibeam data. It is one of the best examples of international collaboration for a common benefit.*

Hrbáček, F., Oliva, M., Hansen, C. Balks, M., O'Neill, T. A., Angel de Pablo, M., Ponti, S. Ramos, M. Vieira, G. Abramov, A. Kaplan Pastirikova, L. Guglielmin, M. Goaynes, G. Rocha Francellino, M. Schaefer, C. Lacelle D. (2023) Active layer and permafrost thermal regimes in Antarctica. *Earth Science Reviews*, 242, 104458. *This contribution is a main review paper relevant for permafrost studies.*

Kim, H.R., Golynsky, A.V., Golynsky, D.A., Yu, H., von Frese, R.R.B, Hong, J.K., (2022) New magnetic anomaly constraints on the Antarctic crust. *Journal of*

Geophysical Research: Solid Earth. e2021JB023329. *This work provides a presentation of a major new ADMAP compilation version using satellite data.*

King, M. A., Watson, C. S., White, D. (2022). GPS Rates of Vertical Bedrock Motion Suggest Late Holocene Ice-Sheet Readvance in a Critical Sector of East Antarctica. *Geophysical Research Letters*, 49. <https://doi.org/10.1029/2021GL097232> *This paper shows: an assessment of correlated noise in GNSS time series analyzed by precise point positioning (PPP) adopting common-mode error analysis (CME), a comparison with GIA model predictions for East Antarctica, Holocene readvance of the Antarctic ice sheet.*

Li, W., Li, F., Shum, C., Shu, C., Ming, F., Zhang, S., Zhang, Q., Chen, W. Assessment of Contemporary Antarctic GIA Models Using High-Precision GPS Time Series. *Remote Sens.* 2022, 14, 1070. <https://doi.org/10.3390/rs14051070> *This paper is an assessment and review of current GIA models in Antarctica utilizing GNSS time series results and considerable underestimation by GIA models in West Antarctica (esp. Amundsen Sea Embayment).*

Martin, A.P., van der Wal, W. Review volume titled 'The Geochemistry and Geophysics of the Antarctic Mantle' (<https://mem.lyellcollection.org/online-first/56>), editors Adam P. Martin and Wouter van der Wal, to be published as a Geological Society of London -GSLMemoir. All chapters have been accepted for publication and are currently in press. The GSL has now begun the editing & proofing tasks and publication in paper is theoretically guaranteed by 2023.

Matsuoka, K., R. Forsberg, F. Ferraccioli, G. Moholdt, and M. Morlighem (2022), Circling Antarctica unveil the bed below its icy edge, *Eos*, 103, <https://doi.org/10.1029/2022EO220276>. Published on 15 June 2022. *This paper describes the scientific rationale of the RINGS concept for a wide earth science community.*

Riley, Teal R., Burton-Johnson, A, Hogan, Kelly A., Carter, A., Leat, Philip T.. (2023) Cretaceous – Paleogene tectonic reconstructions of the South Scotia Ridge and implications for the initiation of subduction in the Scotia Sea. *Journal of the Geological Society*, 180. 10 pp. 10.1144/jgs2023-013. *This paper provides a tectonic reconstruction of the Scotia Sea.*

Direct support from outside organisations received for your activities

A royalty payment from the Geological Society of London of £1,250 to be credited to the Geosciences Miscellaneous budget line.

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

(Numbered list of substantive collaborations)

Within SCAR

1. Links crossing geosciences groups.
2. AntArchitecture
3. Antos
4. Rings
5. INSTANT

6. AGATA
7. Quantarctica.
8. SCATS
9. Standing Committee on Antarctic Geographic Information (SCAGI)
10. Standing Committee on Antarctic Data Management (SCADM)

Outside SCAR

- 1.IAVCEI
- 2.IGCP-628: Geological map of Gondwana
- 3.IGCP 648: Supercontinent cycles & global geodynamics
- 4.ESA & 3D Earth
- 5.4D Antarctica
- 6.IUGG
- 7.International Lithosphere Programme (upcoming focus on East Antarctica)
- 8.Antarctic Resolution
- 9.One Geology
10. PGC: Polar Geospatial Centre webserver imagery, photos and data (eg. REMA)
11. IPA (International Permafrost Association)
12. LTER Long Term Ecological Research
13. ITEX (international Tundra Experiment)
14. IAG (International Geomorphology Association)
15. Nippon Foundation – GEBCO Seabed 2030 Project
16. General Bathymetric Chart of the Oceans
17. International Association of Geodesy (IAG) Subcommittee 1.3f: Regional reference frame in Antarctica, International Association of Geodesy (IAG) Subcommittee 2.4: Gravity and Geoid in Antarctica