



SCAR Sub-Group

SG

Person

Responsible:

GeoMAP

GS

Simon Cox

SCAR Delegates Report

Geological Mapping Update of Antarctica (GeoMAP) Action Group **2018-2020 Report**

Summary

Report Author(s)

Simon Cox (New Zealand), Paul Morin (USA), Christine Siddoway (USA)

Summary of activities from 2018-20

A GIS dataset describing exposed bedrock and surficial geology of Antarctica has been constructed by the SCAR GeoMAP Action Group. Work started from a continent-scale, low density, attribute-poor dataset in 2015 that was added to and improved through multiple iterations during 2018-2020. It involved capturing existing geological map data, refining its spatial reliability, then improving representation of glacial sequences and geomorphology. GeoMAP depicts 'known geology' of rock exposures rather than 'interpreted' sub-ice features and is aimed towards continent-wide perspectives and cross-discipline interrogation.

A beta version (v.201907) of GeoMAP was made available at XIII ISAES in Korea (July 2019) – primarily for comment and peer review and is still available as a webmap or download via the SCAR website (see www.scar.org/ssg/geosciences/geomap). It has since had 3 iterations of improvement by GNS Science.

Plans to formally release the first version of GeoMAP at the Hobart Open Science Conference were scuppered by Covid-19. The action group now plans to release GeoMAP together with a journal 'data paper' in late 2020. Data will be archived with a doi and delivered from a number of websites – potentially also GeoMAP pages on the SCAR website. The action group can now be wound up due to cancellation of the OSC, and do not need to use funds allocated for 2020. We propose data should continue to be delivered from a dedicated page on SCAR's website, and GeoMAP move to be recognised as a formal SCAR product.

Summary Budget 2018- 2020

2018	2019	2020
Spent	Spent	Allocated
(US\$) \$5956	\$2353	\$2147

Progress to date

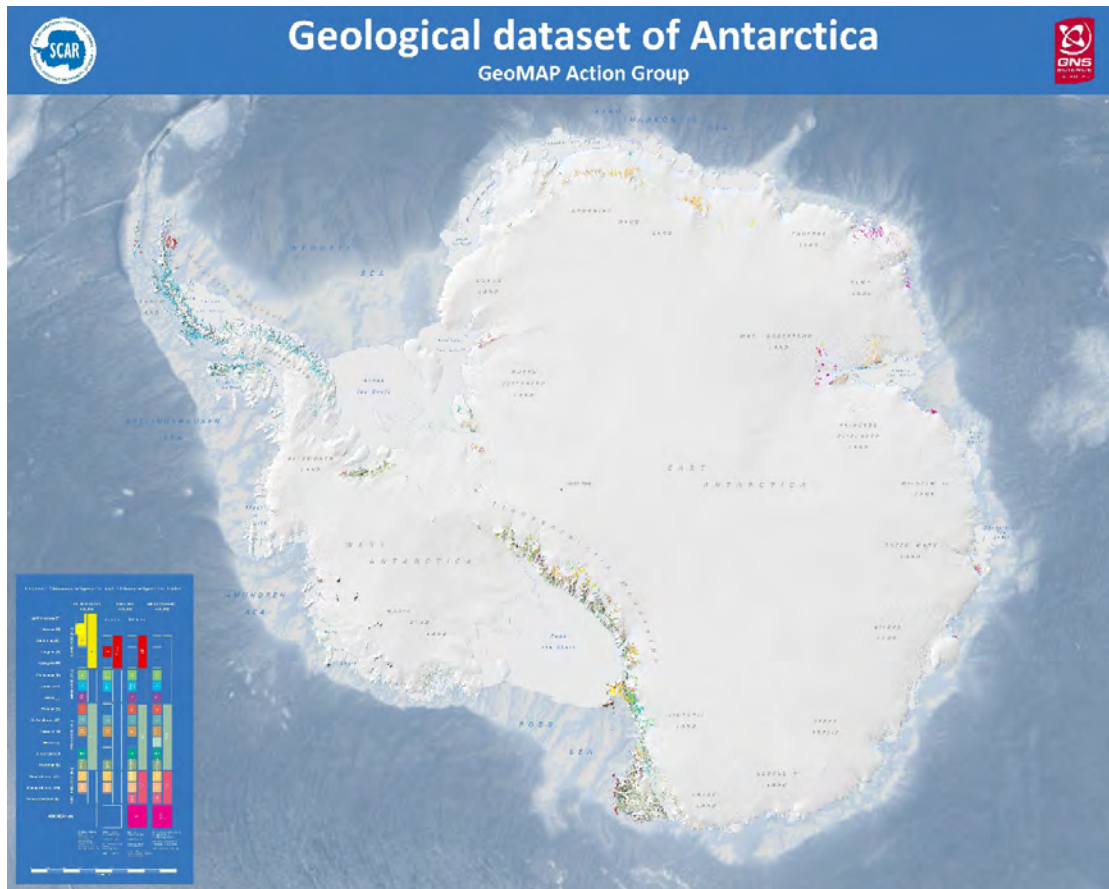
Outcomes/achievements summary table

Sub-group	Outcome/Achievement
GeoMAP	Collaboration: GeoMAP has involved ~18 key collaborators principally from USA, Norway, Italy, UK, Australia, Korea, Russia and New Zealand, but includes contributions from at least 12 nations.
GeoMAP	Capacity Building: Much of the manual work has been completed by 11 student volunteers, who visited NZ on internships (supported by SCAR, their institution, or privately) or worked remotely by video-conferencing in return for GIS-training and learning how to use these data. The mentoring and geospatial data experience contributed to the professional development of the students.
GeoMAP	Adoption of Methodological Framework: The rapid development of a continent-wide dataset was enabled through a clear vision, by adapting a tried and tested methodology from mapping New Zealand (QMAP 1993-2014), and a 'top down' work-stream.
GeoMAP	New Continent-scale Dataset: A dataset of Antarctic geology provides continent-wide perspectives and a framework for cross-discipline use that never before existed. It describes and presents the 'known geology' of rock and bare sediment exposures in a unified framework optimized for use at 1:250,000 scale, with higher spatial precision locally. It provides a continent-wide definition of substrate nature and composition as a contextual layer ideally suited to biological and ecological analysis and investigation of environmental factors that drive diversity of Antarctic communities and their ecology.

Sub-group Cash Flow

Sub-group	Allocation	Amount spent			
		2018	2019	2020	
GeoMAP	\$8473	????	\$5956	\$2147	\$0

Notable Papers



See <https://www.scar.org/science/geomap/resources/> and https://data.gns.cri.nz/ata_geomap/index.html

Statistics from web delivery of the GeoMAP at https://data.gns.cri.nz/ata_geomap/index.html?content=/mapservice/Content/antarctica/www/index.html highlight the impact. Between 1 July 2019 – 24 June 2020, there were:

- **323 downloads** of the dataset (from 363 visits to the download page).
- 2622 visits to the site (2340 from external addresses).

A selection of 3 recent (out of >24) conference papers describing GeoMAP dataset, local mapping for GeoMAP, and/or application of data to other problems:

1. Cox, S.C., & the GeoMAP Action Group 2019. Release of the continent-wide dataset GeoMAP v.201907. abstract A252 IN: ISAES 2019: XIII International Symposium on Antarctic Earth Sciences, 22-26 July 2019, Songdo Convensia, Incheon, South Korea.
2. Cox, S.C.; Roudier, P.; Morgan, F. 2018. Characterising seasonal water and melting in the Ross Sea region of Antarctica. IN: POLAR 2018 : where Poles come together : A SCAR & IASC Conference, Davos, Switzerland, 15-26 June 2018. Davos.
3. Cox, S.C.; Smith Lyttle, B.; Siddoway, C.; Capponi, G.; Elvevold, S.; Burton-Johnson, A.; Halpin, J.; Morin, P.; Elliot, D.; and the GeoMAP Action Group 2018. The GeoMAP dataset of Antarctic rock exposures. IN: POLAR 2018: where Poles

come together : A SCAR & IASC Conference, Davos, Switzerland, 15-26 June 2018. Davos.

4. In addition, a GeoMAP product will appear as Figure 1 in the second edition of the Elsevier Encyclopedia of Geology, chapter on Antarctica, coming out in 2020.

Linkages

Direct support from outside organisations received for your activities

1. **\$50k In kind support:** GeoMAP has relied heavily on voluntary efforts of students, funded to varying degrees by their home institutions or federal grants. We estimate their co-funding value, in wage-equivalent, to total ~US\$50k for 2018-2020.
2. **US\$162k Co-funding:** GeoMAP has been primarily led by GNS Science in New Zealand. This contribution is based on US\$70k/yr from Direct Core Funding, US \$20k from a Ross Sea Region (RSR) Terrestrial Data Analysis project (Landcare MBIE CO9X1413); \$2k from NZARI.
3. There will be other co-funding from GeoMAP participants, but at the time of writing we do not have full details of these.

Major collaborations your sub-group has with other SCAR groups and with organisations/groups beyond SCAR

Within SCAR

1. An open 'How to use GeoMAP' workshop was delivered at ISAES XIII in Korea. We also held four open meetings on the design and construction of GeoMAP: at ISAES XII in Goa 2015, SCAR OSC in Kuala Lumpur in 2016, Polar2018 in Davos, ISAES XIII in Korea in 2019.
2. GeoMAP knowledge has helped the **Antarctic GeoHeritage and Geconservation** action group.
3. Early release of parts of GeoMAP (bibliography) were incorporated in **Quantarctica 3**.

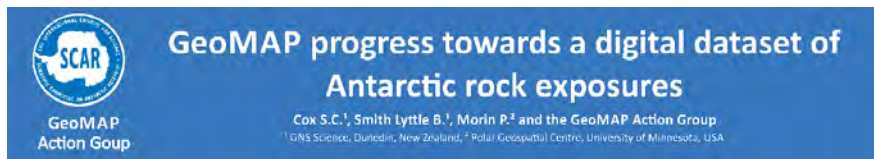
Outside SCAR

1. **OneGeology:** GNS Science have recently been granted 4-star accreditation for their digital geological map web services (on OneGeology). Our aim will eventually be to deliver Antarctic GeoMAP data to OneGeology geological map of the world.
2. **IGCP 628:** Early versions of the GeoMAP were supplied to the IGCP 628 Gondwana map project being coordinated by Renata Schmitt, Brazil.
3. **PGC:** Polar Geospatial Centre web-served imagery, photos and data (eg. REMA)
4. **Other Researchers:** Early versions have been supplied to a number of research teams, including researchers from Victoria University of Wellington who have checked and provided feedback. GeoMAP received multiple requests for data compiled in different areas, before such as time as data were fully checked and verified. The data are already being used for assessing source of dust, sediment supply, heatflow, meltwater, lichen distribution and environmental domains.

Outreach and Capacity Building

Outreach, communication and capacity building activities

1. Communication has generally been by way of group email (~half-yearly) and small skype meetings. GeoMAP mailing list has over 60 recipients representing 15 different nations. Working meetings have been held at all major Antarctic conferences from 2015-2020.
2. Eleven students from USA, NZ, Australia, Italy and UK have been trained in GIS and GeoSciML. All have presented their mapping at conferences and published abstracts and posters; several are continuing with polar research.
3. Presentations and posters have been made for Antarctic conferences, AGU Fall meetings, GSA, Italian and NZ Antarctic conferences. All posters and presentations have been branded with the same banner and logo.



4. GeoMAP has been profiled in SCAR Newsletters (e.g. <https://scar.org/scar-news/geomap-news/world-first-digital-database-of-antarctic-geology/>)
5. GeoMAP pages on the SCAR website are well populated and informative. They have links to webmaps and data download sites, and are reasonably up to date (see <https://www.scar.org/science/geomap/home/>)

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started
Chair	Simon	Cox	GNS Science	NZ	s.cox@gns.cri.nz	2015
Chair	Paul	Morin	PGC	USA	lpaul@umn.edu	2015
Deputy Chair	Christine	Siddoway	Colorado College	USA	CSiddoway@Colorado College.edu	2018

Please identify early-career researchers with * in first column

Other members

First Name	Last Name	Affiliation	Country	Email
Laura	Crispini	University of Genova	Italy	crispini@dipteris.unige.it
Gianni	Capponi	University of Genova	Italy	capponi@dipteris.unige.it
*Burton-Johnson	Alex	British Antarctic Survey	UK	alerto@bas.ac.uk
Elliot	David	Ohio State University	USA	elliott.1@osu.edu
Synnøve	Elvevold	Norwegian Polar Institute	Norway	elvevold@npolar.no
*Tamer	Abu-Alam	Norwegian Polar Institute	Norway	Tamer.Abu-Alam@npolar.no
*Adam	Martin	GNS Science	NZ	a.martin@gns.cri.nz
Jacqueline	Halpin	University Tasmania	Australia	jahalpin@utas.edu.au
John	Goodge		USA	
Eugene	Mikhalsky	VNIIOkeangeologia	Russia	emikhalsky@mail.ru
Andreas	Läufer	BGR	Germany	andreas.laeufer@bgr.de
Fraser	Morgan	Landcare	NZ	morganf@landcareresearch.co.nz

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

*Note that since GeoMAP held its first formal meeting at the ISAES XII conference Goa there have been many people involved. The mailing list has ~60 people, representing 15 different nations. The people listed above are just a selection of those who have been more extensively involved in the design and compilation work.

Final recommendations to Delegates

Final future research recommendations

What should SCAR's priorities be for future research in this area? Note that this section should not be used to propose new groups, for which a separate process should be followed with advice from your Science Group leader(s)

1. Functionality of Antarctic digital geological data and GeoMAP would be improved substantially by **developing a high-level stratigraphic/structural classification scheme for Antarctic Geology**, similar to that developed for New Zealand (Mortimer et al. 2014 NZJGG 57:402-419, doi:10.1080/00288306.2014.946062).
2. Precision of GeoMAP can and should be improved iteratively. The next logical step for geological mapping in Antarctica is to use GeoMAP to classify high-resolution satellite imagery and multispectral data, then generate geological maps at metre-scale resolution.
3. There are many other potential cross-discipline applications where GeoMAP definition of substrate composition can inform ecological, environmental, biological and meltwater modelling. GeoMAP needs to be distributed and promoted widely.

Final procedural recommendations

Following publication of a South Victoria Land geological map in 2012, GNS Science launched an ambitious project to build a similar high-quality digital geological dataset covering the entire Antarctic continent. With minimal local funding available in NZ, they sought support and enthusiasm internationally through formation of a SCAR Action Group. Five-years later, the first version of GeoMAP (v.201907) was released at the ISAES XIII meeting in July 2019. Such rapid work was enabled through a clear vision, a tried and tested methodology from mapping New Zealand (QMAP 1993-2014), and a 'top down' work-stream. SCAR provided structure, connections and validation of concept – without which the project would not have happened.

Thank you, SCAR!

We recommend that:

1. The GeoMAP Action Group now be wound up.
2. The final GeoMAP dataset, once formally released in late 2020, becomes adopted as an official SCAR Product.
3. GeoMAP maintains a presence on the SCAR website, moving its pages from within <https://www.scar.org/science/gsg/home/> to somewhere like <https://www.scar.org/data-products/products-overview/>