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Agenda Item:

4.1.3

Person Responsible:

B Lyons

**XXXIV SCAR Delegates Meeting
Kuala Lumpur, Malaysia, 29-30 August 2016**

SSG-Geosciences

Executive Summary

Authors: W. Berry Lyons, Jesús Galindo-Zaldivar, Naresh C. Pant

Introduction/ Background: (Summary of SSG)

GS played an active role in SCAR science at the disciplinary and multidisciplinary level. GS scientists from many nations are involved and take leadership roles in of SCAR's ongoing SRPs: Past Antarctic Ice Sheet dynamics (PAIS) and Solid Earth Response and Influence on Cryosphere Evolution (SERCE). Our interdisciplinary activities include in the Expert Group ADMAP (Antarctic Digital Magnetic Anomaly Project), ANTPAS (Antarctic Permafrost and Soils), ANTVOLC (Antarctic Volcanism), GIANT(Geodetic Infrastructure of Antarctica), IBCSO (International Bathymetric Chart of the Southern Ocean) and GRAPE (GNSS Research and Application for Polar Environment, cross-group with SSG-PS). In addition, several action groups are also active including CGG (Connecting Geophysics with Geology), Geological Heritage and Geoconservation, and GEOMAP (Geological Mapping Update of Antarctica) in addition to ANTOS (Antarctic Near-shore and Terrestrial Observing System) cross group. The new Action Group on Geological Heritage and Geoconservation began its activities during the period of present review. Two new groups GEOMAP and ANTVOLC also initiated their activities since last Open Science Conference at Auckland. ANTOS, a cross-disciplinary group (SSG-PS) elected its members at Auckland OSC meeting and initiated activities. Other previous approved groups continue successfully the working plans have presented their results in the business meeting, workshops, oral and poster in the OSC, and many publications of international impact. XII International Symposium on Antarctic Earth Science was held in 2015 at Goa (India) and it attracted a large and wide participation. Proceedings of the symposium are being brought out in four special publications of the Geological Society of London.

Important Issues or Factors:

New Action Groups on Geological Heritage and Geoconservation, GeoMap (Geological Mapping Update of Antarctica) and the expert group AntVOLC (Antarctic Volcanism) have begun activities since the last Delegates Report. A workshop and the inaugural meeting of the Geological Heritage and Geoconservation AG was held on 21 August. During the meeting, SCAR President Lopez-Martinez explained the current protected area system and the tools available for protection of geological and geomorphological features. The group discussed classification protocols. Dr. Chris Carlson (Australia) is serving as the chair of this group. Major activities of all the groups have taken place during XII International Symposium on Antarctic Earth Sciences (ISAES) which was held during 13-17 July 2015 at Goa, India and was well attended by the community.

Recommendations/Actions and Justification:

- 1) Continuation of the SSG GS Expert Groups
 - a. ADMAP, b. ANTPAS, c. ANTVOLC, d. GIANT, e. GRAPE, f. IBCSO
- 2) Continuation of Action Groups
 - a. ANTOS, b. CGG, c. Geological Heritage and Geoconservation, d. GeoMap
- 3) Endorsement of new steering committee
Chief Officer: Prof. Jesús Galindo-Zaldivar
Deputy Chief Officer: Prof. Naresh C. Pant
Secretary & GeoReach Editor: Dr Marcelo Leppe
- 4) Endorsement of SSG GS representative to SCATS - Dr. Marcelo A. Reguero
- 5) It was approved that XIII ISAES 2019 will be held by Kopri at Incheon, South Korea

Expected Benefits/Outcomes:

The activities proposed by the groups for the next period allow to develop common researches in different key field covered by geosciences. Most of the groups provide better maps and a deep knowledge of the geological aspects which are crucial for understanding the behavior of ice sheet in the future. It is remarkable the cross-links between the groups and also with other SSG. The groups also include a wide national representation and are open to facilitate the integration of new members in science conducted by SCAR.

Partners:

SSG GS have linkages with other scientific groups through programs such as ANTPAS and GRAPE. The new group Geological Heritage and Geoconservation will have linkages with Antarctic Conservation and LS conservation groups. In addition Antarctic Volcanism will have possible linkages with a wide variety of groups in LS and PS. In addition several national groups are partners of the SSG-GS to support the proposed activities.

Budget Implications:

SSG-GS include active groups, some of them with special requests related to the generation of products (maps, materials for Antarctic Treaty and critical milestones). We request funds as per following details:

- a. To approve USD 39,000 for the year 2017 and USD 34.000 for the year 2018 for EG and AG activities.
- b. To reallocate unspent amount of SSG GS for the period 2015-16 from EG and AG to 2017 in order to support activities and products of the different groups that will be not possible to be finished before the end of 2016.

STANDING SCIENTIFIC GROUP ON GEOSCIENCES (SSG-GS)

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2. Major Future Initiatives and Actions

Two of the major Scientific Research Programs (SRP's), Past Ice Sheet Dynamics (PAIS) and Solid Earth Response and influence on Cryosphere Evolution (SERCE) are part of the Geosciences Group. The progress of these programs is separately presented in the Plenary Meeting and hence is not repeated here. Progress being presented separately in the plenary meeting on 24/08/2016.

2.1. Past Antarctic Ice Sheet dynamics (PAIS)

Lead proponents: Dr. L. De Santis (Italy)/ Dr. Timothy Nash (Australia)

2.2. Solid Earth Response and influence on Cryosphere Evolution (SERCE)

Lead proponent: Dr. Terry J. Wilson (USA)

2.3 Progress on XIII International Symposium on Antarctic Earth Science (ISAES)

A presentation was made by the Korean National representative for hosting the XIII ISAES 2019 at Incheon, South Korea. This proposal was approved by the SSG-GS.

3. Major Activities and Significant Progress

3.1. Report on XII International Symposium on Antarctic Earth Science (ISEAS), Goa, India.

A total of ~400 participants from 27 countries gathered at Goa during XII International Symposium on Antarctic Earth Science (ISAES) held during 13-17 July 2015. The symposium was organized in 32 sessions on each facet of polar earth sciences. The sessions included Geochronology of Antarctic orogens, Exploring unknown Antarctica, Interactions between cryosphere, atmosphere and oceans in coastal Antarctica, Key drivers of Antarctic biodiversity through Cenozoic, Structure and evolution of the Antarctic continent in light of recent geophysical and geological investigations, The Rodinian orogeny in east Gondwana- implications for supercontinent evolution, Antarctic meteorites and micrometeorites, Past Antarctic ice-sheet behaviour and response to external forcing, The Himalayan Cryosphere- global versus regional climate forcing, Paleoclimate records from Antarctic drilling projects, Southern ocean paleoclimatology and lake sediment records of past changes in sea level and climate during the late Quaternary.

Some of the proceedings of the symposium are being processed for publication Geological Society of London *Special Publication Series*. Titles of these four volumes are:

1. Exploration of Subsurface Antarctica: Uncovering Past Changes and Modern Processes
2. Crustal Evolution of India and Antarctica: the Supercontinent Connection
3. Large Igneous Provinces from Gondwana and adjacent regions
4. The Himalayan Cryosphere: Past and present

3.2 Antarctic Digital Magnetic Anomaly Map Project (ADMAP) Expert Group

The ADMAP-2 group organized splinter meetings at international conferences (e.g. EGU 2014), held 2 workshops (SCAR 2014 & ISAES 2015) and prepared presentations for sessions at international conferences (e.g. AGU 2015). An ADMAP-2 workshop at the SCAR 2016 meeting has been organized and contributions for a session on subglacial geology will be presented.

Major progress has been made in both new regional and continental scale magnetic anomaly compilations and in preparing relevant databases. There have also been several publications about Antarctic magnetic anomaly interpretation in international journals (e.g. Aitken et al., 2014 GRL).

The international ADMAP Expert group has been very productive since its initiation in 1995. Around 200 publications have been published. In two decades this means that we average almost 10 publications per year and our members have several publications in top tier journals including e.g. Nature, GRL, JGR, EPSL, Geology. Two Special Issues of Tectonophysics and one in *Annali di Geofisica* have also been published.

Dr. Graeme Eagles has been elected as the new chairperson.

3.3 Antarctic Permafrost and Soils (ANTPAS) Expert Group

The Expert Group on Antarctic Permafrost, Soils and Periglacial Environments (ANTPAS) is a joint SCAR and IPA group aiming at promoting research on the ice-free areas in the Antarctic. The activities in 2015-2016 focused at the organization of a session at the 12th International Symposium on Antarctic Earth Sciences held in Goa (India) and contribution to the consolidation of the Global Terrestrial for Permafrost (GTN-P) through participation in its Steering Committee. Planning for a revision of the ANTPAS Science Strategy started in 2015, with two workshops to be organized at

the International Conference on Permafrost (Potsdam, 18 June 2016) and SCAR OSC (Kuala Lumpur, 27 August 2016). ANTPAS will also organize scientific sessions at both conferences, and as in previous years, continued to allocate part of its funding to travel support to young researchers. The revised Science Strategy will be a key step in strengthening the scientific impact of ANTPAS and is a process that is involving a relevant participation from the Antarctic permafrost and soils community.

3.4 Antarctic Volcanism (ANTVOLC) Expert Group

ANTVOLC started his activities at the end of 2014 and registering the interest of more than 70 persons from more than dozen countries. Two meetings have taken place (July 2015 in Catania, Italy and in Goa, India, during the XII ISAES) and a session on “Antarctic volcanism in space & time – magmatic, tectonic and palaeoenvironmental aspects & linkages” has been organised at the XXXIV Scar Meeting of Kuala Lumpur.

These meetings were dedicated establish the current state of the art of knowledge of Antarctic volcanism and to identify overarching key topics for future Antarctic volcanology. Common activities, possible deliverables and interactions with other communities or institutions (e.g. National Programs, SCAR-SSG, IAATO etc) has been discussed in detail. The organizational structure (e.g. group membership, steering committee) was also briefly discussed. Selection and voting of the new steering committee, including the Deputy Chair are ongoing.

Dr. John Smellie was elected as the new chairperson of the group.

3.5 Geodetic Infrastructure of Antarctica (GIANT) Expert Group

Summary of activities from 2014-2016

- Continuation of geodetic measurements in Antarctica, especially of geodetic GNSS to determine vertical and horizontal deformations of the Earth's crust;
- Relaunch of "SCAR GNSS Database" website and incorporation of new data through coordination with all participating national programs;
- Publication of gridded dataset of gravity anomalies for Antarctica (Scheinert et al., Geophysical Research Letters, 2016);
- Realization of first "SCAR Summer School on Polar Geodesy" in March 2014, this kind of schools should be continued.

3.6 GNSS (Global Navigation Satellite System) Research and Application for Polar Environment (GRAPE) Expert Group

Cross link between SSG PS and GS

After the SCAR OSC 2014 (Auckland, NZ, August 2014) GRAPE (www.grape.scar.org) meetings and scientific sessions have been organized within both URSI AT RASC (Gran Canaria, Spain, 18-22 May 2015) and Beacon Satellite Symposium (Trieste, 27 June -1 July 2016) aiming to disseminate the GRAPE results on the bi-polar neutral and upper atmosphere monitoring, investigations, and data management as well to attract new groups and institutions. A scientific session has been organized within the SCAR OSC 2016 in Kuala Lumpur (Session 16, 10 oral contributions and 6 posters contribution. New groups from Malaysia, not yet involved in GRAPE, submitted papers).

The GRAPE web site (www.grape.scar.org) has been maintained at INGV and updated regularly as well the SCAR web pages (www.scar.org) devoted to GRAPE.

A GRAPE task force has been established during URSI AT RASC to draft a possible new SRP to be discussed with all the communities interested during the SCAR OSC 2016 in Kuala Lumpur.

Thirteen papers published within the group during 2015-2016 period.

3.7 International Bathymetric Chart of the Southern Ocean (IBCSO) Expert Group

At SCAR 2014, Auckland, NZ, an IBCSO side meeting was held to discuss the future plans of the IBCSO project and to keep updated on newly available as well as upcoming bathymetric surveys that could be contributed to a new version of the IBCSO digital bathymetric model. Since IBCSO Version 1.0 was limited to the area south of 60°S. At the meeting, it was agreed that we should envisage to increase the extent of the IBCSO digital bathymetric model to 50° south for a 2nd version. This will include the gateways of the Antarctic Circumpolar Current (ACC). The enlargement will more than double the size of the ocean area included in the model.

A poster on the project status was presented at the ISAES meeting, Goa, India, in 2015.

Additional dedicated IBCSO meetings of the community to further develop the project were the Arctic-Antarctic Mapping Meeting in Monaco (12-13th June 2016) and will be held at the 2016 SCAR Meeting in Kuala Lumpur.

In 2014/2015 the IBCSO V1.0 digital bathymetric model was incorporated in the GEBCO_14 global bathymetric model (Weatherall et al., Earth and Space Science, 2015) of the General Bathymetric Chart of the Oceans (GEBCO).

3.8 Antarctic Near shore and Terrestrial Observation System (ANTOS) Action Group

August 2014: A committee was elected at a workshop held at the SCAR OSC (Auckland); this was attended by 43 people from 10 nations. Following this meeting we proposed and were granted permission to establish an SCAR Action Group to further develop the idea of ANTOS.

ANTOS sits primarily within the SSG-LS, but is a cross-disciplinary project involving SSG-PS and SSG-GS. The Chairs are Craig Cary, New Zealand (primary) and Vonda Cummings, New Zealand (co-chair). Committee members include Dana Bergstrom, Australia; Megumu Tsujimoto, Japan (Secretary); Emmanuelle Sultan, France; Soon-Gyu Hong, Korea (Data management advisor); Charles Lee, NZ (Technical); and Elie Verleyen, Belgium.

August 2015: A workshop was held to develop an implementation plan for ANTOS. The workshop was attended by 25 researchers from 12 countries (Australia, Belgium, Chile, France, Germany, Italy, Japan, Korea, NZ, Sweden, UK, USA) and was supported through funds from the New Zealand Antarctic Research Institute (NZARI), AntEco, and the University of Waikato, New Zealand where the meeting was hosted.

A full report summarising the activities and outcomes of the meeting was produced, and is available on the ANTOS website (<http://www.scar.org/antos/antos-publications>).

3.9 Connecting Geophysics with Geology (CGG) Action Group

The connection of the exposed geology and the geophysics is often loose, specifically in mountain/nunatak areas that have only sketchily been studied. Key areas need to be identified where detailed geological field studies and focused geophysics should be carried out in order to understand the significance of major geophysical lineaments and the boundaries of tectonics blocks. There are still unmapped areas. The systematic aerogeophysical surveying starts to reveal the sub-ice geology of the continent.

This group has started the activities in the last period and has cross-link interest with ADMAP expert group that may provide suitable magnetic anomaly data to improve the geological knowledge of Antarctica.

3.10 Geological Heritage and Geoconservation Action Group

The Terms of Reference for an Action Group on *Geological Heritage and Geoconservation* was approved by SCAR EXCOM in September 2015 following a number of preliminary discussions at XXXIII SCAR (2014) and ISAES XII (2015).

The Action Group, which is to hold its first formal meeting at XXXIV SCAR in Kuala Lumpur, will address the emerging issue of geological heritage and geo-conservation in Antarctica, and in considering the diversity of geological, paleontological and geomorphological features of the Antarctic, developing a set of principles and criteria for identifying, classifying, protecting, managing and promoting geo-heritage sites in the Antarctic.

The Action Group submitted an Information paper, entitled '*Antarctic geoconservation: a review of current systems and practices*' to SCATS which was presented at the XXXIX ATCM in Santiago in June 2016 (ATCM XXXIX IP31).

3.11 Geological Mapping Update of Antarctica (GEOMAP) Action Group

The SCAR GeoMap (Geological Mapping Update of Antarctica) action group aims to capture existing geological map data, update its spatial reliability, improve representation of glacial sequences and geomorphology, and enable data delivery via web-feature services. In the first instance the GeoMap focus is to provide a dataset describing the exposed geosphere aimed at cross-discipline use, or for continent-wide perspectives, using a mixed chronostratigraphic- and lithostratigraphic-based classification.

The action group was first proposed in late 2014, held its first its first meeting in 2015 at the ISAES conference, and has had some staff visits and virtual meetings during 2015-2016. There has been significant progress in the capture of digital geology covering western Marie Byrd Land, Dronning Maud Land, northern and southern Victoria Land and the Antarctic Peninsula. About 20% of Antarctic rock outcrops now have some form of geological representation assigned to them suitable for use at 1:250,000 (or more-regional) scale. Work continues to translate data attributes into a standard format. In addition, a high-resolution DEM of the continent is expected to be produced and delivered in the next 2 years. The GeoMap group welcomes anyone interested in capturing their geological and geomorphological data, or historic data from a particular region.

GeoMAP's challenge is to collaboratively build a modern geological dataset that classifies and describes the bedrock and surficial geology of Antarctica's rock exposures – in practice this means classifying and describing around 72,000 distinct polygons that cover 51,000 km². We aim to use the international GeoSciML data format standard to turning available hard-copy maps into an easily accessible dataset that describes the exposed geosphere.

Progress during our first period includes capture of:

- Western Marie Byrd Land captured and glacial geology updated
- Northern Victoria Land bedrock captured, glacial geology WIP
- Southern Victoria Land converted to GeoSciML
- First Antarctic Peninsula dataset created
- Dronning Maud Land mapping progresses
- Australian maps of east Antarctica scanned & georeferenced
- Funding, stereo imagery and computer time required to produce a DEM production of all geologic outcrops has been secured
- Meeting held at Goa. 2 x newsletters produced. Website updated.

In conclusion: Around 20% of the continent's rock outcrops have now been classified with some form of digital representation of geology, much of it converted into GeoSciML format, during the first 12 months of 'Action'. A fantastic start, but perhaps including some of the more easily completed regions where surficial geology is relatively straightforward. There are still many issues to decide with regard to precision of polygons and final data format, let alone how to present and share these data.

4. Budgetary Implications

4.1. The expert and action groups have demonstrated an intense scientific activity and need support to reach the proposed plans for the next two years. There are more and new active groups in SSG-GS. Several groups have special needs: Geological Heritage and Geoconservation action group needs support to provide advice to the Antarctic Treaty; groups that generate new products (ADMAP, GEOMAP, IBCSO), in addition to new groups that started recently their activities (ANTVOLC). In addition all of them provide critical milestones on Geosciences.

SSG Expert and action groups

GROUP	Year 2017	Year 2018
ADMAP	6000	6000
ANTOS	2000	2000
ANTPAS	3000	3000
ANTVOLC	4000	3000
CGG	3000	3000
Geological Heritage	3000	3000
GEOMAP	6000	4000
GIANT	3000	3000
GRAPE	3000	3000
IBCSO	4000	4000
Mapping Antarctica <i>BatDrake (map)</i>	2000	
TOTAL	39000\$	34000\$

4.2. To reallocate unspent amount of SSG GS for the period 2015-16 from EG and AG to 2017 in order to support activities, tasks and products of the different groups that will be not possible to be finished before the end of 2016.

5. Recommendations that Delegates and Chief Officers should consider

1) Continuation of the SSG GS Expert Groups

- a. ADMAP, b. ANTPAS, c. ANTVOLC, d. GIANT, e. GRAPE, f. IBCSO

ADMAP-

The group needs to be continued firstly to produce the final ADMAP-2 magnetic anomaly map for Antarctica including the relevant digital databases. Also a much improved web-based data release portal and an international geomagnetic-community-based paper summarizing the new compilation needs to be prepared.

A variety of new aeromagnetic surveys have been flown in 2015 and 2016 and others are already planned for the next 2 Antarctic field seasons (e.g. over Princess Elizabeth Land, South Pole, Ross Ice Shelf and interior East Antarctica). These efforts will need to be included into updates to the ADMAP-2 compilation.

IBCSO-

At the moment there is no person funded to work on the IBCSO project. Based on our experience from IBCSO Version 1.0 funding for one person for at least 2 years is necessary to compile a bathymetric data for a project of this size. We work on acquiring designated funding but getting science funding for mapping/compiling bathymetry is difficult despite its unquestionable merit of the product for the scientific community. Funding options are assessed in cooperation with the International Hydrographic Office (IHO) and General Bathymetric Chart of the Ocean (GEBCO).

2) Continuation of Action Groups

- a. ANTOS, b. CGG, c. Geological Heritage and Geoconservation, d. GeoMap

ANTOS- We recommend that become becomes an Expert (or new 'Task Group') with an extended life span (>4 years).

GEOMAP- Note significant progress to date. We request funds for student GIS training and to help capture of digital datasets.

3) Endorsement of new steering committee

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4) Endorsement of SSG GS representative to SCATS

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5) XIII ISAES

It was approved by delegates of GS-SSG that XIII ISAES 2019 will be held by Kopri at Incheon, South Korea. We propose the SCAR delegates to accept it as well.