SCAR's Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments

Background

1. This Scientific Committee on Antarctic Research (SCAR) Code of Conduct (CoC) provides guidance to the scientific community with interests in exploring and conducting research on and in Antarctic subglacial aquatic environments (SAE).
2. The CoC was original prepared by a SCAR Action Group[1] in consultation with SAE specialists from a wide range of disciplines including the Council of Managers of National Antarctic Programs (COMNAP).
3. The CoC was developed in recognition of the value of these environments, the need to exercise environmental stewardship, and the growing scientific interest in subglacial research.
4. The CoC draws on published literature with special attention paid to SCAR Subglacial Antarctic Lake Environments (SALE) Scientific Research Program reports (see http://www.sale.scar.org/) and the U.S. National Academies report on environmental stewardship of SAE[2].
5. The U.S. National Academies report on environmental stewardship of SAE was presented by the U.S. at ATCM XXXI/CEP XI as IP110.
6. This CoC was submitted as an Information Paper (IP33) by SCAR to CEP XIV in 2011. SCAR coordinated a review of this CoC in 2017 through experts and the broader SCAR community, and the revised version was submitted to CEP XX. It will continue to be updated and refined as new scientific results and environmental impact reports become available from planned SAE exploration campaigns. Research developments in this field are summarized in two edited volumes[3],[4].

Introduction

7. Grounded Antarctic ice is widely recognized as a key constituent of the Earth System driving ocean currents and global climate as well as strongly affecting global sea level.
8. Early models for ice flow from the interior of the continent to the ocean assumed considerable friction between the bottom of ice sheets and the underlying rock.
9. The discovery of subglacial Lake Vostok and subsequently more than 400 other lake-like features beneath the ice has changed our view of subglacial environments.
10. Drilling through ice to bedrock often encounters water at the rock/ice interface and changes in ice surface height over lakes suggest that water is actively flowing beneath the ice.
11. From these and other observations, it has been concluded that in most cases the ice/rock interface will have free water present, water will often collect in lakes within watersheds, and

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[2] National research Council, "Exploration of Antarctic Subglacial Aquatic Environments,; Environmental and Scientific Stewardship", National Academies Press ISBN -13: 978-0-309-10635, 152 pp. (2007).

[3] Siegert, M.J., Kennicutt, M, Bindschadler, R. (eds.). Antarctic Subglacial Aquatic Environments. AGU Geophysical Monograph 192, 246 pp. (2011).

[4] Siegert, M.J., Priscu, J. Alekhina, I., Wadham, J. and Lyons, B. (eds.). Antarctic Subglacial Lake Exploration: first results and future plans. Transactions of the Royal Society of London, A. 374, Issue 2059. (2016).

scientific activities that contaminate one area may go on to contaminate subglacial environments downstream.

12. Much scientific attention has been focused on the possibility that subglacial waters will contain active ecosystems including microbial communities that survive and/or thrive in these environments, and research has shown that microbes do exist close to the grounded ice margin and that subglacial lakes can be active microbial ecosystems[5].
13. To safeguard these unique lakes, and the subglacial aquatic environment as a whole, an internationally agreed CoC is essential.
14. In developing and reviewing this CoC, SCAR built on international discussions at SCAR SALE meetings and on the US National Academies recommendations on environmental stewardship of SAE[2].

Guiding Principles

15. Responsible stewardship during the exploration of subglacial aquatic environments should proceed in a manner that is consistent with the Protocol on Environmental Protection to the Antarctic Treaty, that minimizes their possible damage and contamination, and that protects their value for future generations, not only in terms of their scientific value but also in terms of conserving and protecting these pristine environments.
16. In accordance with the Protocol on Environmental Protection to the Antarctic Treaty, all proposed activities must undergo environmental impact assessment prior to an activity commencing.
17. Projects aiming to penetrate into subglacial aquatic environments are very likely to require an Initial Environmental Evaluation (IEE), and a subsequent Comprehensive Environmental Evaluation (CEE) may be the appropriate level of assessment given the potential impacts expected from such an activity.
18. The CEE will ensure that all relevant information is available internationally, that proposals are exposed to a wide range of expert comment and that the scientific community uses best-available practices.
19. In accordance with the principle of scientific cooperation found in the Antarctic Treaty, multinational participation in SAE exploration is encouraged.
20. Exploration should take a conservative, stepwise approach in which the data and lessons learned at each step are archived and used to guide future environmental stewardship, scientific investigations and technology development. This information should be freely disseminated in the public domain, including, via national authorities, to the Committee for Environmental Protection.
21. It is recommended that each potential exploration site is evaluated within the context of geophysical datasets that identify lakes and other regions where there is basal melting. This would assist in characterizing the unique character of each site and selecting drilling locations. Additional considerations related to location include water depth, accessibility, logistic constraints, cost and potential environmental impacts of the surface camp.
22. Accurate records should be collected, maintained and made freely available, to benefit all future subglacial sampling efforts.
23. Annex V of the Protocol allows areas to be designated as Antarctic Specially Protected Areas (ASPAs), either to manage areas for research purposes or to conserve them as pristine exemplars for future generations. Once sufficient information is available about the characteristics of subglacial lakes, attention should also be given to selecting and designating

[5] Christner, B.C., Priscu, J.C., Achberger, A.M., Barbante, C., Carter, S.P., Christianson, K., Michaud, A.B., Mikucki, J.A., Mitchell, A.C., Skidmore, M.L.,Vick-Majors, T.J.. A microbial ecosystem beneath the West Antarctic ice sheet. Nature, 512 Issue 7514, pp 310-313 (2014).

exemplar subglacial aquatic environments as ASPAs for long-term conservation, in accordance with Article 3 of Annex V to the Protocol.

Drilling and SAE-entry

24. Unless there is site-specific evidence to the contrary, drilling to the base of Antarctic ice sheets should assume that the basal ice is underlain by liquid water, and that this water forms part of a subglacial drainage network requiring a high level of environmental protection. In general, downstream sites, particularly those closest to the sea, can be viewed to have lower environmental risk than upstream sites.
25. Exploration protocols should also assume that the subglacial aquatic environments contain living organisms, and precautions should be adopted to prevent any permanent alteration of the biology (including introduction of non-native species) or habitat properties of these environments.
26. Drilling fluids and equipment that will enter the subglacial aquatic environment should be cleaned to the maximum extent practicable, and records should be maintained of sterility tests (e.g., bacterial counts by fluorescence microscopy at the drilling site). As a provisional guideline for general cleanliness, these objects should not contain more microorganisms than are present in an equivalent volume of the ice that is being drilled through to reach the subglacial environment. This standard should be re-evaluated when new data on subglacial aquatic microbial populations become available.
27. The concentrations of chemical contaminants introduced by drill fluids and sampling equipment should be documented, and clean drilling technologies (e.g. hot water) should be used to the full extent practicable.
28. The total amount of any contaminant added to these aquatic environments should not be expected to change the measurable chemical properties of the environment.
29. Water pressures and partial pressures of gases in lakes should be estimated prior to drilling in order to avoid down flow contamination or destabilisation of gas hydrates, respectively. Preparatory steps should also be taken for potential blow-out situations.

Sampling and instrument deployment

30. Sampling plans and protocols should be optimized to ensure that one type of investigation does not accidentally impact other investigations adversely, that sampling regimes plan for the maximum interdisciplinary use of samples, and that all information is shared to promote greater understanding.
31. Protocols should be designed to minimize disrupting the chemical and physical structure and properties of subglacial aquatic environments during the exploration and sampling of water and sediments.
32. Sampling systems and other instruments lowered into subglacial aquatic environments should be meticulously cleaned to ensure minimal chemical and microbiological contamination, following recommendations under point 26.
33. Certain objects and materials may need to be placed into subglacial aquatic environments for monitoring purposes. This may be to measure the long-term impacts of human activities on the subglacial environment and would be defined in the project's environmental impact assessment, or it may be for scientific purposes, e.g., long term monitoring of geophysical or biogeochemical processes. These additions should follow the microbiological constraints outlined in point 26, and for scientific uses should include an analysis of environmental risks (e.g., likelihood and implications of lack of retrieval) versus scientific benefits outlined in the environmental assessment documents.

Wherever possible, objects and materials put into subglacial aquatic environments should be recovered once the intended objectives have been achieved.