Priscu Research Group
Land Resources &
Environmental Sciences
Bozeman, MT 59717-0346
Telephone: (406) 994-3250
Fax: (406) 994-5863
Email: jpriscu@montana.edu

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Professor David W H Walton
Environment and Information Division
British Antarctic Survey
High Cross
Madingley Road
Cambridge CB3 0ET
United Kingdom

Dear David,

SUBJECT: SALEGOS comments of the Russian CEE

The Subglacial Antarctic Lake Exploration Group of Specialists (SALEGOS) are aware that the Russian Federation submitted to CEP V a Draft Comprehensive Environmental Evaluation for water sampling of the subglacial Lake Vostok, and undertook to submit a revised draft for consideration at CEP VI. An intersessional contact group was convened by Jean Jacques Reyser of France and has been working on the first draft. We are further aware that the Russian Federation has submitted a revised draft of the document, and Jean Jacques advises that the ICG plans to submit the final report as a WP to ATCM Secretariat by April 23. We realize that the April 8 deadline for official comments has not been met by our Group, but we are hopeful that our comments can be used in the discussion at the ATCM in Madrid.

On behalf of the members of SALEGOS, I submit our comments on the Russian CEE. Please feel free to circulate these comments to interested parties.

Yours sincerely,

John C. Priscu

John C. Priscu
Professor and Convener of SALEGOS

SALEGOS Comment on Russian CEE

The Russian Antarctic Expedition (RAE) has submitted a Revised Draft Comprehensive Environmental Evaluation (CEE) for "Water Sampling of the Subglacial Lake Vostok" to the Treaty for comment. The CEE provides an assessment of the environmental risks associated with a proposed plan to enter Lake Vostok through the existing Vostok ice borehole. The process for comment on CEEs is still evolving but SCAR should take the opportunity to comment on CEEs through the Committee for Environmental Protection (CEP) and its mechanism of Intersessional Contact Groups (ICG). As the SCAR Group of Specialist for Subglacial Lake Exploration, SALEGOS provides the following comments on the RAE CEE for Lake Vostok entry. Please note that two of our colleagues on SALEGOS were involved in the preparation of the CEE (V Lukin and S Bulat) and were offered the opportunity to comment on the SALEGOS assessment. The CEP comment procedure is intended to allow nation's proposing an activity to benefit from the advice and expertise of all Treaty nations to minimize impact and ensure stewardship of Antarctica; it is not an approval process. The SALEGOS comments are provided in this spirit.

SALEGOS compliments the RAE for the extensive and detailed document that has already greatly benefited from review and revision. The CEE document is wide-ranging and generally thorough in its treatment of the topic. However, there are several issues that SALEGOS believes would benefit from a more thorough treatment and analysis to ensure that the conclusions about risk are defensible and sound. SALEGOS recognizes an inherent risk in using untried technologies for the first time to enter what may be a unique and one of a kind subglacial environment. There are also risks associated with the use of the existing borehole that was drilled with technologies that were not intended to be compatible with the objectives of subglacial environment preservation and protection. SALEGOS also recognizes that in other settings, subglacial environments have been penetrated and sampled with little known impact. However, subglacial lake environments, by their nature, experience water residence times of tens of thousands of years and there is a possibility of communication across an extensive subglacial hydrological system. These circumstances present unique challenges in regard to contamination issues that other subglacial environments may not be subject to.

A key issue is the likelihood of chemical and biological contamination of the lake on entry. This issue has several facets including the nature of fluids used for drilling, the technology to isolate the lake entry portion of the process from the overlying column of drilling fluids, the retrievable of uncontaminated samples, the introduction of microbes from the overlying ice and/or the drilling fluids, methods of decontamination and testing of cleanliness, and the introduction of chemicals into the lake. In general SALEGOS found that the discussion of these issues needs to be more rigorous in treatment and assessment. For example, more details are needed on the nature of the "environmentally neutral" fluid to be used during lake entry and what were the criteria (both biological and chemical/toxicological) used to conclude that the fluid is "neutral"? Prior testing of lock-out and deviation drilling techniques in less sensitive locations should be considered.

Sterilization and cleaning techniques and methodologies to minimize biological and chemical contamination should be more rigorously evaluated and incorporated as appropriate into the plan (see SALEGOS Reports 1-3). Contingency and emergency plans for action if the procedures do not proceed as predicted should be developed. Other alternative drilling procedures should be evaluated and the benefits and drawbacks of each approach assessed. Many of the details of the proposed drilling technologies are insufficient to judge their efficacy and likelihood of success under these extreme conditions. Finally, the conditions within the lake are at present unknown. The *in situ* pressure, temperature, salinity, and gas content are unknown and thus the likelihood of over or under pressure cannot be unequivocally determined. The pressure and gas conditions in the lake are critical to the success or failure of the proposed procedure. Some current models indicate that gases are supersaturated in Lake Vostok and may "blow-out" during lake penetration unless preventative measures are taken. A precautionary approach, such as controlled entry into the lake (possibly with a "freeze behind" sealing entry of sensors arrays) to establish the lake's chemical and physical conditions, may be needed before attempting open hole, lake entry.

SALEGOS members raised several specific suggestions and/or concerns. It is recommended that a geophysical ice core scientist be present during the final phases of drilling to provide on-site assessment of ice conditions for real-time modification of drilling procedures if ice conditions change. Uncertainty is introduced into the operations because the ice conditions (accreted ice) as one approaches the lake have not been sampled and analogous situations are unknown. Others have proposed the types of measurements that should be made on site to judge ice condition. It is suggested that the inclusion of a back-up system be considered to allow rapid removal of fluid from the hole if changing pressure conditions necessitate action to prevent loss of fluids into the lake. The low pressure at the base of the hole would allow the hole to close and limit forward contamination assuming the lake is not greatly over pressured. Special attention must be paid to the integrity of the ice borehole, which may not have the strength to sustain pressure fluctuations that could lead to hydro-fracturing. The integrity of the borehole may be compromised if significant under or overpressure is encountered in the lake potentially leading to an uncontrolled blowout situation in the overpressure case. The thermal probe and the ability to seal off various portions of the borehole need to be tested under realistic conditions to determine if these procedures perform as described. It is pointed out that the proposed infusion of lake water into the borehole followed by freezing will be accompanied by significant expansion of the lake water plug in the borehole. This may compromise the integrity of the borehole at its edges and instigate fracturing of the surrounding ice massif. Concerns were also raised that the proposed water sampling technique does not guarantee an uncontaminated sample of lake water will be retrieved. The same types of ambiguities related to the accreted ice studies will more than likely compromise the results obtained on lake water obtained in the proposed manner unless clean drilling, entry, and sample return can be verified. In addition, the fractionation that occurs during freezing is still not fully understood rendering results based on frozen subsamples difficult to interpolate to actually lake water properties.

The number and detail of the comments provided on the Revised Draft CEE reflect the complexity of the proposed activity. While, SALEGOS raises many issues, the GoS believes that these issues can be addressed in a manner that will minimize impact and yet allow for the accomplishment of important scientific objectives. In its planning, SALEGOS has indicated that Lake Vostok is a key exploration target for subglacial environment exploration. Due to the high interest of the public and the importance of the long-term science goals for subglacial environment exploration, it is important that initial entry into these environments be approached with caution and that state-of-the art techniques are used to ensure that the resultant impact is acceptable. SALEGOS applauds the Russian efforts to move this important program forward and believes that careful attention to the many comments and advice provided will improve the proposed procedures and ensure the greatest scientific return while preserving and protecting these unique environments.

As mentioned above, two of the SALEGOS members (V Lukin and S Bulat) were involved in developing the Russian CEE. These colleagues were asked specifically to provide a response to the SALEGOS comments. The opinion of RAE, the main official body dealing with coordination of the Lake Vostok sampling program, follows:

The CEE was promulgated according to the requirements of the Antarctic Treaty, the Protocols for Environmental Protection, and Russian national procedures. Under these procedures, the Russian Federation's Joint Commission of Ministry representatives are responsible for review and approval or denial of applications to conduct activities in Antarctica. An EIA must also be submitted. As part of the process, additional details can be requested and input from other entities, such as the expert opinion of the Antarctic Treaty member nations provided through the CEP comment process, will be considered. The Joint Commission will request a response by the applicants to any issues raised by other official bodies and experts. Based on a careful and complete consideration of all of the materials provided by the applicants, the Joint Commission will make a decision to grant or not to grant a permit to conduct the described activity. The RAE is using this opportunity to receive wide comment on its proposed activities and will proceed with this important project in strict compliance with international and Russian internal procedures. All comments will be carefully considered as the plan for lake penetration evolves. The RAE thanks SALEGOS for its thoughtful comments on the CEE and these opinions will be helpful in further revising and improving the CEE.