

SPACE LIFE SCIENCES SYMPOSIUM (A1)  
Astrobiology and Exploration (5)

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THE CAREX PROJECT AND ROADMAP FOR RESEARCH ON LIFE IN EXTREME  
ENVIRONMENTS

**Abstract**

Life has evolved thousands of strategies to adapt and thrive in harsh conditions. From the arid desert to the pressure of the deep sea, from terrestrial hot springs to the Antarctic plateau, studying life in extreme environments gives insight into some of the most fundamental questions about the origins of life on earth, and the search for potential extraterrestrial life. It is now well accepted that some terrestrial extreme environments can be considered as valuable analogues of planetary bodies.

Studying life in extreme environments, and by extension astrobiology, is a crossroads for scientific communities - it needs to be multidisciplinary in its content, and interdisciplinary in its execution. It also links to many other scientific domains: biodiversity, ecological theory, evolutionary biology and biogeochemical cycles. Mixing different scientific expertise, approaches and cultures is a powerful way to create new knowledge at the highest scientific level.

Evolving from the CAREX project, the CAREX roadmap presents a solid scientific consensus from a community of international experts. It prioritises four high-level research themes, recommending them as the basis for a future international collaborative initiative.

**THEME 1:** Contributions of life in extreme environments to biogeochemical cycles and responses to environmental change

- What was the role of life in extreme environments in defining the biogeochemical characteristics of the Earth? What is the contribution of biogeochemical processes in extreme environments to the modern Earth system? How resilient is life in extreme environments to environmental change?

**THEME 2:** Stressful environments - responses, adaptation and evolution

- How do organisms escape the stresses of extreme environments? Are there unique/common paths for responses to stresses? How have proteins and genomes evolved under extreme conditions? How diverse are the community-level responses to stresses?

**THEME 3:** Biodiversity, bioenergetics and interactions in extreme environments

- What characterises biodiversity in extreme environments? How diverse are bioenergetic processes in extreme environments? What characterises the nature and extent of biotic and abiotic interactions in extreme environments?

**THEME 4:** Life and habitability

- What are the physico-chemical boundary conditions for habitability? Where are the terrestrial analogues for putative extraterrestrial habitats? What bio-signatures facilitate life detection?

Research on life in extreme environments requires specialised methodologies, sophisticated equipment and complex, expensive infrastructure as well as access to remote areas. The Roadmap includes an analysis of the research infrastructure and the enabling technologies required, as well as recommendations for outreach and education.