

OOS2025-176, updated on 23 Apr 2025 https://doi.org/10.5194/oos2025-176 One Ocean Science Congress 2025 © Author(s) 2025. This work is distributed under the Creative Commons Attribution 4.0 License.



The LIFEDEEPER Project : LIving together in the Future: vulnErability of DEEP sea Ecosystems facing potential mineral Resources exploitation

Marie-Anne Cambon-Bonavita¹, Ewan Pelleter², and the Marie Anne CAMBON^{*} ¹Ifremer, Ifremer Brest, REM-BEEP-LM2E, Plouzane, France (macambon@ifremer.fr) ²Ifremer, Ifremer Brest, REM-GeoOcean-CYBER, Plouzane, France (epelleter@ifremer.fr) *A full list of author appears at the end of the abstract

Protection of deep seabed, the largest biome on the planet, is a major challenge for future generations. Covering more than 70% of the Earth's surface, the ocean encompasses $\approx 80\%$ of the seawater volume, produces at least 50% of the atmospheric oxygen and absorbs $\approx 25\%$ of anthropogenic CO₂. Hidden from our eyes, the deep ocean has long been considered as a vast desert of darkness, populated by sea monsters. Today it is the covetousness of developed and emerging countries for its resources in terms of biodiversity and minerals. It becomes then urgent to acquire, through holistic approaches, solid knowledge baselines with regard to the diversity of geological systems, habitats, taxonomic and functional biodiversity, at open and interconnected ocean scales.

Our consortium led a five cruises series (2014- 2023) in the framework of the French contract for exploration of Atlantic polymetallic sulphides resources (ISA). At 3600 meters depth, the TAG hydrothermal field is an area of choice for studying the geo-biodiversity of so-called inactive SMS deposits, and is, with the young and volcanic Snake Pit hydrothermal field, at the heart of our studies. Exploration of the area revealed geochemical evidences for new active vent sites, some visited such as HYDRA, a new ones to be found. These sites constitute potential relays for the organism dispersal, a key point in the overall understanding of ecosystems and their relationships along ridge segments.

LIFEDEEPER intend to develop new approaches, combining *in situ, in vivo*, and lab experimentations, modeling and qualitative research in social sciences to disentangle the geological, geochemical and biological natural functioning of deep ocean ecosystems. In addition to the coordination work package (**WP1**), 4 multidisciplinary, complementary scientific WPs and one communication WP are proposed:

WP2: Exploration and description of ecosystems associated with inactive and active massive sulphide deposits : toward integrated definitions of active and inactive vents.

WP3: Integrated 3D study coupling hydrodynamics, distribution of trace metals and numerical modeling to assess the biogeochemical impact of the hydrothermal plume to the deep ocean.

WP4: Study the connectivity and life cycle of holobiont models, capacity of adaptation and acclimation allowing the resilience of communities.

WP5: Legal and political analysis of international regulatory regimes, sociological analysis of science-

technology-society, capacity building.

A last WP6 will then aim to produce effective educational and public outreach activities targeting citizens, students, scholars, organizations and various stakeholders, through participative science, educational science and art.

Ultimately, we want to establish a precise map of contrasting sites along the 600 km ridge segment, to provide key parameters to understand the natural functioning of these environments, both from a geological and biological point of view. Key components of the functioning of these ecosystems and associated services, along activity gradients, will permit establishing global-scale inter-comparison protocols. In a holistic and multidisciplinary approach, *LIFEDEEPER* aims to acquire definitions of reference ecological profiles and preservation strategies in the context of the growing interest in deep mineral resources for the carbon-free and digitized world economy. *LIFEDEEPER* will propose solutions to allow future informed guidelines and decision-making.

Marie Anne CAMBON: The LIFEDEEPER consortium including Ifremer teams, UBO, Sorbonne University, CNRS, IRD, MNHN