Conservation and restoration of marine ecosystems in the context of deep-sea mining

DEEP REST – Third Newsletter

The onsite team in Faial during our first annual meeting, May 2023.

January-May 2023

Editorial – *Dear DEEP REST team, it was great to see you all, either in person or virtually during our annual meeting! We had fun and we've made significant progress over the last year. Hopefully, we will continue to do so. I am pleased to welcome Ricardo Serrao Santos in our advisory board (see his portrait below) and sad that David Billett is leaving us. I wish to thank him for his year with us. Very glad to see that many early career scientists and graduated students are joining the DEEP REST team!*

This Newsletter is yours, it is there to share information, questions and adventures! Do not forget to keep aside whatever you think would be interesting for this community for the next one.

-Jozée

FDmine EuroMarine foresight workshop
Aveiro, 22-24 March 2023
Sofia Ramalho, Ana Hilario, Ana Trovao (UAv), Jozée Sarrazin (Ifremer)
& Lara Macheriotou (UGent)

DEEP REST scientists were able to secure funds from Euromarine to organize a workshop on functional traits entitled FDmine. This workshop was organized around two key objectives: (1) Review of the state-of-the-art and define a common terminology to describe the collection of functional traits that allow an efficient cross-ecosystem comparison of functions in environments rich in mineral deposits and (2) Construct the first ever comprehensive list of functional traits scored for eukaryotic species from all benthic size categories (meio-, macro and megafauna) to be shared in the form of an open-access database, and upgraded over time, as advances in this field progress.

This work will be a major step forward in ensuring the uniformity and consistency of future deep-sea trait-based research as it will provide comparability in observations and data among a wide range of interested parties. The principal outcomes of this workshop will be shared in the form of high-impact synthesis paper describing the current state of knowledge, challenges, methodologies, and applicability of functional trait approaches in the context of deep-sea mining and publication of the new functional trait database in an open repository, which will be validated through various case studies by the working group but also open to the scientific community and mining contractors.

This workshop will generate original knowledge and data on functional aspects of these threatened ecosystems that can be exported to science, industry and policy. Approaches explored during the workshop and the developed framework will be of direct applicability to those involved in baseline and

impact assessment studies in areas potentially targeted for deep-sea mining. Moreover, it will contribute to the development of monitoring protocols and science-based legal frameworks.

Following a pre-workshop meeting in January, 23 DEEP REST scientists met in Aveiro from March 22-24 to test the trait scoring on a list of selected species from the Clarion Clipperton Zone, using a compiled list of functional traits considered relevant to describe functional diversity in environments targeted for deep-sea mining. A presentation of the DEEP REST project and goals of the WP2 was made by Jozée Sarrazin followed by initial discussions of observations and comments provided by those that participate in the trait-scoring exercise.

The participants of FDmine and an enthousiastic working session with our invited expert Dr Amanda Bates (U of Victoria, Canada).

The first key problem identified was the overall difficulty of dealing with certainty scores. The consensus is that certainty scores are important to provide confidence to the scoring results and that these may change over time as new information is gathered while can also help identify (together with the list of unscored traits) gaps in knowledge in the field. The definitions of certainty were adapted to clarify this issue.

Another key problem highlighted (and associated with the one above) was the difficulty to deal with level scoring for higher taxonomic levels (genus for example). It emphasised the fact that if we restrict de FDmine list to species level, both meiofauna and megafauna groups would not be represented as many species are yet to be described while others are separated at morphospecies level only. We also considered if we should restrict the scoring of the database to the information of the areas targeted for mining or if we should considering this as a global database? There were both pros and cons of scoring based on best-known information to date associated with the target environments. In the end, if multiple experts do provide information on the same taxa, we can try to reach a consensus (see Bates et al 2014 doi:10.1016/j.gloenvcha.2014.03.009)

Afterwards, specific comments on each of the traits were shown and discussed. It was clear that for some of the traits (e.g., body size) there is a need to provide supporting information and examples in the modalities to get a consistent score across different experienced experts. Besides the examples, it was suggested to use supporting information such as pictures with examples of what is considered in this database as the maximum body dimension. Overall

suggestions on the trait list, definitions, and modalities made during the 3 days of the workshop led to alterations of the initial list and new traits were added.

On the second day, the participants split into 3 break-out groups, one per main key description (Biological, Life-history, and Ecological), while the descriptor "Distribution" was left to discuss as a single group since it was considered the most difficult. These discussions aimed at the identification of functions/ecological relevance of each trait in the context of deep-sea mining. This exercise led to further debate on the trait list and suggestions for changes were made in the worktable mentioned above, including in the modalities section. It also highlighted the need to consider the prioritization of traits depending on the expected impact or mining-related scenarios.

The last day started with an overview of the works from each break-out group and discussion on how to deal with distribution-related traits. The distribution descriptor was adapted, and new traits were included. This was followed by the debate of each trait and defining if it was considered or not a priority for the following scenarios: 1. Habitat loss, 2. Habitat quality decline, 3. Habitat fragmentation and 4. Habitat recovery. After this was completed for all traits, the next steps were stipulated and included two key outputs:

- A conceptual paper on the use of trait-based analyses in the context of seabed mining
- The creation of a DEEP REST/FDmine trait database

Workshop on ecotoxicological impacts of deep-sea mining

April 11-13, Hannover, Germany

Nélia Mestre (UALG), Sophie Paul (GEOMAR), Katja Schmidt (BGR) and Matthias Haeckel (GEOMAR).

The workshop «Ecotoxicological impacts of deep-sea mining - current scientific knowledge and necessary steps towards the definition of environmental thresholds » was held at the Federal Institute for Geosciences and Natural Resources (BGR), in Hannover, Germany. The hybrid workshop involved around 50 international experts from different disciplines such as biology, geochemistry, law, and environmental management. Understanding ecotoxicological risks and impacts caused by deep-sea mining (DSM) activities and transferring this knowledge into appropriate policy advice is a complex challenge that requires expertise and coordination across different fields.

The onsite and online participants of the workshop

Discussions focused on four topics: (1) Sources and routes of toxic exposure; (2) Biological mechanisms of toxicity; (3) Assignment of toxic limits; and (4) Legislative Implementation. It was agreed that the current knowledge is very limited, and that DSM-related threshold values cannot be defined at present with sufficient confidence. Some key research priorities and potential experiments were discussed. In the next few months, a workshop report will be produced and disseminated.

A short report of the DEEP REST annual meeting
Horta, May 3-4 2023
Daphne Cuvelier (UAc) & Jozée Sarrazin (Ifremer)

On site participants. From left to right: Riwan Le Roux (Ifremer), Klaas Willaert (UGent), Marjolaine Matabos (Ifremer), Jozée Sarrazin(Ifremer), Daphne Cuvelier (UAç), Ana Hilario (UAV), Nélia Mestre (UAlg), Ricardo Serrão Santos (UAç), Claudia Viegas (UAç), Laura Trovão (UAV), Neus Campanya I Llovet (UAç) and Manuel Bellanger (UBO/AMURE). Hiding in the back row are Ellen Pape (UGent) and Joëlle Richard (UBO/AMURE)

Part of the online participants. From top left to right: Lara Macheriotou (UGent), Sabine Gollner (NIOZ), Florence Pradillon (Ifremer), Felix Janssen (AWI), Carmen Sousa (UALG), Charlet (mystery man), Massimilano Molari (MPI), Samantha Rob (NIOZ), Alicia Veuillot (Ifremer), Leandro Martinho (UALG), Lise Klunder (NIOZ), Samantha Smith (Advisory board), Livia Brunner (NIOZ), Thomas Van Rensburg (NUI), Denis Bailly (UBO/AMURE), Clara Rodrigues (UAVR)

Earlier this month, the first annual meeting of the DEEP REST meeting took place in the middle of the Atlantic Ocean, in the lovely town of Horta (Faial, Azores). The very busy meeting occurred in a hybrid format: there were 14 participants on site and over 30 participants online. Lead by the WP leaders, each WP showed an overview of ongoing research and progress. A total of 28 individual presentations were given going from biology, ecotoxicology, microbiology, and habitat mapping to policy activities as well as capacity building and engagement with the wider public and stakeholders. Preliminary results about the different planned disturbance experiments and the development of a new particle spreader were presented. Past and future outreach activities were detailed, with the objective to bring the

SPLUJ theater play to Jamaïca in 2024 for the ISA council meeting (collaboration with DOSI). The protocol for filming the Vox pop video clips was presented to the DEEP REST members for feedbacks and a try-out film, done by the Ifremer team, was shown. An updated protocol was sent at the end of May along with a leaflet that will be handed over to the street participants. Volunteers from the 8 different countries involved in the project stepped forward and a deadline was fixed for September 2023. Everybody onsite and online also participated in a brainstorming exercise for the elaboration of the Deep BLUE DiplomaSEA – a serious game on deep sea mining. We had a lot of great discussions and some initiatives to instigate « across-WP- collaborations ». An important point was raised about the need to increase our interactions with WP5, especially concerning the geopolitical atlas and the assessment of ecosystem services. A virtual meeting on ecosystem services will be organized shortly by WP5.

Feedback from our advisory board (AB) members Samantha Smith and Luciana Génio were very positive. Luciana presented us some opportunities to work hand in hand with the ISA, particularly targeting ISA's six research priorities. Among them, DEEP REST will significantly contribute to increase knowledge about deep-sea species biodiversity and build a functional trait database targeting nodule and SMS areas. She informed us that the ISA will organize three working groups in 2023-2024 where our expertise will be welcomed. Concerning the AB, David Billett was obligated to leave his role due to health issues. We wish him a prompt recovery and thank him for the time he spent with us. Fortunately, a new advisory board member with high-end experience as a policy maker (Ricardo Serrão Santos) joined us, see his portrait below.

The necessity to involve and inform local communities about the resources hosted by deep sea was also emphasised, and the specific example of the hydrothermal vents in the Azores MPA were put forward. Means to address this issue were discussed during an additional meeting on Friday May 5th, during which DEEP REST scientists with various backgrounds met with Gilberto Carreira, Director of Biodiversity and Sea Policy Services of the Government of the Azores (see below). It resulted in some concrete ideas and plans, starting this summer with a conference and photo exhibition taking place in Horta next July.

The meeting program can be found on the web site and the presentations in the partner's area. Thanks to the local team that made this meeting a great success!

May next year: Faro!

RV SONNE Expedition SO295 successfully addressed environmental impacts of nodule mining and potential restoration measures

Patricia Esquete (UAvr), Matthias Haeckel (GEOMAR), Felix Janssen (AWI), Tanja Stratmann (NIOZ), and the shipboard scientific party

The shipboard scientific party of the RV SONNE Expedition SO295

Somewhat exhausted after two full months at sea, 39 members of the SO295 expedition's scientific staff returned to Port Hueneme west of Los Angeles right before Christmas 2023. At the same time, everyone was very happy with the Christmas present brought back to shore: a wealth of samples and data to better understand the benthic ecosystems in nodule provinces of the Clarion Clipperton Fracture Zone, imminent effects of future nodule mining on communities and functions, and potential measures to support post-mining recovery.

Scientific investigations were carried out in two contract areas for nodule exploration held by the German Geological Survey (BGR) and the Belgian company Global Sea Mineral Resources (GSR). In both areas, GSR had carried out tests of the nodule collector pre-Prototype PATANIA II in 2021. Investigations during SO295 followed the independent scientific monitoring of environmental baseline conditions and immediate impacts during the earlier expeditions SO268 and MANGAN 2021 that were carried out as part of the project MiningImpact. Many
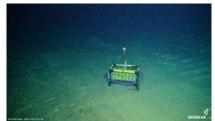
of the people on board already took part in those expeditions in 2019 and 2021 and were hence excited by the opportunity to continue assessing effects of nodule and sediment removal as well as sediment dispersal and redeposition. The second main focus of the expedition was to revisit restoration experiments as a direct contribution to DEEP REST. Sabine Gollner (NIOZ) and colleagues address the question whether the provision of artificial nodules can facilitate recolonization of communities that depend on hard substrates. The Research Group Marine Biology at Ghent University - represented on board by Tania Nara Bezerra - investigated if recovery of infauna communities and their functions could benefit from loosening up of stiffer subsurface sediments exposed by mining.

The long transit between Port Hueneme and the working area in the CCZ and between the two contract areas left us with 39 days to achieve all the scientific work that has been planned. With a wonderful group of 38 scientists and technicians, including two teams from GEOMAR running the remotely operated vehicle (ROV) Kiel 6000 and the Autonomous Underwater Vehicle (AUV) Abyss, as well as a journalist (Tim Kalvelage) we had the necessary expertise on board to characterize environmental conditions, study the composition and function of faunal communities across size classes, and to perform experimental work addressing food webs and biogeochemical functions at the seafloor and in the lowermost water column.

At first glance, the sites impacted by the collector or covered with sediments brought into suspension during nodule collection did not show much change from how they appeared right after the PATANIA II test 1.5 years before. To quantitatively map the physical changes and monitor megafauna communities and traces of life ('Lebensspuren') at the sediment surface, extensive optical and acoustical surveys of the seafloor were conducted with SONNE's Ocean Floor Observation System OFOS and with GEOMAR's AUV 'Abyss'. To study infauna communities across size classes and biogeochemical conditions in the sediments, a Box Corer and a video-guided Multicorer were deployed more than 40 times each and surface sediments were sliced, sieved, and subsampled on board. CTDs with Rosette water samplers and in situ pumps as well as a bottom water sampler were deployed to assess microbial communities and biogeochemistry of bottom waters. Most of the observation and sampling gear deployments took place during the night to leave the day for operations of the ROV Kiel 6000. In 23 dives, numerous scientific tasks were carried out at the seafloor. Benthic chambers and microprofilers were deployed to assess sediment respiration and experimental mesocosms were deployed for detailed investigations of benthic food webs. Also targeted sampling was carried out by ROV including the collection of larger organisms and the deployment of dedicated trace metal and pore water samplers. Finally, the ROV was essential to retrieve some of the artificial nodule experiments deployed in 2019 and 2021, and for sampling of the sediments that were loosened up previously to facilitate infauna recovery.

Different operations during the RV SONNE Expedition SO295

All members of the scientific party are very happy with what has been achieved and deeply thankful for the great support by captain Tilo Birnbaum and the entire ship's crew throughout the time at sea. While some time will be needed for sample and data analyses before publishing the findings in scientific journals, some of what has been achieved was already presented during the DEEP REST annual meeting this May. Further information on the expedition is found in the expedition blog, in weekly reports sent from sea and a short cruise report (both linked at the web page of the German Research Fleet Coordination Centre), and in a German article on the expedition by Tim Kalvelage entitled Knollenfieber (nodule fever).

After arriving back in Port Hueneme west of Los Angeles, those who were not needed for post-cruise logistics headed back to see their families for Christmas celebrations. The others enjoyed a superb Christmas lunch on board and realized with excitement that, although the ship's store was largely swept empty towards the end of the cruise, a secret stock of chocolate and cookies still existed.

Deep-sea thoughts

Facing a New Ocean Decade: Geopolitical Change and Challenges in Ocean Governance, Geopolitics

Juan Luis Suarez de Vivero & Juan Carlos Rodríguez-Mateos (US)

The fifty-year period since UNESCO announced its 'Decades' devoted to the oceans has witnessed some deep changes in ocean geopolitics: a new international community made up of a greater number of nation-states that have transformed their territorial bases through the inclusion of large maritime jurisdictions. This, and the decline in the international regulatory ideal, have led to marine governance being addressed very differently from the way it was in the 1970s and presenting a challenge for the future governance of the oceans. This article explores the political change that has occurred during this time and focuses on the State, its maritime territory and the effects of jurisdictional expansion. Methodologically, the geopolitical focus is framed in geographical premises supported with data prepared by the author and premises formulated in the fields of law and political science. The conclusions include some of the effects of unilateral action in marine governance and show that differences and inequalities are the most visible aspects of this new marine territoriality. https://doi.org/10.1080/14650045.2022.2151901

Atlanticism in the South Atlantic. Community of interests and ocean governance

Juan Luis Suarez de Vivero (US)

The geopolitical evolution of the last decades (after the fall of the Berlin Wall in 1989) initiated a process of reorientation of the geopolitical center of gravity towards the south and the east, at the same time as new countries were leading a growth type specific to globalization. Brazil played an important role in this process, as did South Africa at the eastern edge of the South Atlantic basin. At the same time, Brazil projected its jurisdictional rights over a vast maritime area with high potential natural resources. On both sides of the basin, expectations of economic development linked to maritime activities have emerged. Brazil, South Africa and, in general, the Gulf of Guinea began to be configured as economic and political poles in a basin bordering a new ocean (Antarctica) and a new continent (Antarctica) that are the process of appropriation.

In geopolitical terms, the tropical Atlantic presents a marked political-territorial dissymmetry between the American and African coasts. The former is characterized by the territorial domination of a single country, Brazil, due to its continental and maritime extension. The Eastern Atlantic, on the other hand, is a large mosaic of countries with little continental extension, with the exception of Angola and Namibia. Insularity is another of the geopolitical characteristics of this region, highlighting three aspects: (1) a block of micro-states to the northwest (Caribbean islands), (2) oceanic islands that project Brazilian sovereignty to the center of the tropical basin and (3) the presence of colonial vestiges, which generate large jurisdictional zones for a non-coastal country in the tropical belt. The maritime economy has enormous potential, with wide margins for development, particularly in the field of energy resources (Brazil & Gulf of Guinea), biological resources - traditionally exploited by exogenous fishing powers - and the development of port infrastructures - currently of little relevance, but which are destined to develop, particularly on the eastern shore, in connection with the strong development potential of the Gulf of Guinea.

Currently, ocean governance is conditioned and limited by the lack of institutional development of coastal states, especially in the Eastern Basin, which is still dominated by the strong presence of fragile states, and in the Western Basin, by the high number of island micro-states with limited ocean management capacity. In this context, it is necessary to highlight the leadership capacity of Brazil, the largest maritime state in the region and the one with the greatest technical and institutional capacity to develop ocean governance. As the expectations and unknowns are numerous and diverse, the objective of this chapter is to analyze to what extent the governance of this part of the Atlantic basin leads to the construction of a transatlantic community in the Southern Hemisphere, starting from the understanding of institutional structures with fragile transatlantic political-cultural (and economic) links. Although a strong network of common interests has not been built in the South Atlantic - in contrast to the North Basin - jurisdictional expansion requires that coastal states adopt maritime policies commensurate with the extent of territorial responsibility acquired. This study focuses on the tropical zone and, therefore, on the maritime space that spans the two Tropics, taking the western part of Brazil and the eastern part of the Gulf of Guinea as a policy reference. As in the case of the North Atlantic, the western margin is occupied by states with large territorial extension compared to the eastern margin, which is mainly composed of

states with small margins, since this space also contains the largest concentration of landlocked states in the world.

This chapter is structured in two main sections: the first devoted to the description and analysis of the geomorphological scenarios that make up the tropical Atlantic and the second to the existing maritime policies in each of the margins of the basin. In both cases, it is possible to draw conclusions both on the importance of maritime development and on the degree of cohesion that can be generated in this part of the Atlantic basin for maritime governance.

Juan Luis Suárez de Vivero, Etiene Villela Marroni, Juan Carlos Rodríguez Mateos, Eurico de Lima Figueiredo et Alexandre Rocha Violante: L'atlantisme dans l'Atlantique Sud. Communauté d'intérêts et gouvernance des oceans. Marie Bonnin et Sophie Lanco Bertrand (eds), Planification *spatial marine en Atlantique tropical. D'une tour the Babel à l'organisation d'une intelligencie collective, IRD Editions, 2023, 266-290.* https://books.openedition.org/irdeditions/44869

Eastern Mediterranean Sea Maritime Spatial Planning and Transboundary Cooperation, 2023
Juan Luis Suarez de Vivero (US)

Political instability, territorial tensions and maritime activities with a global strategic scope are concentrated in the Eastern Mediterranean basin. All of them have a cross-border dimension for whose governance cooperation is essential. This has a strong impact on marine spatial planning, the viability of which is questioned by the scale of the geopolitical challenges. The proposed recommendations aim primarily at capitalizing on existing institutional and policy resources to assist the development of marine spatial planning.

In this context, marine spatial planning, a novel tool, must make way for the use of the experience accumulated in recent decades and the resources already available, which have contributed to marine governance in one way or another. There is hardly room for actions with short-term results and unexpected turns. Similarly, the adoption of guidelines for cooperation in the field of MSP applied in regions with a different geopolitical profile is inadvisable.

Policy Paper on EU's Eastern Mediterranean Maritime Space, Energy & Security Policies 611501-EPP-1-2019-1-EL-EPPJMO-PROJECT.

Immersion Science seminar
Ile Tudy, France, March 31st 2023
Jozée Sarrazin, Marjolaine Matabos & Daniela Zeppilli (Ifremer)

As it is the case for the last ten years, we were invited to the Immersion Science seminar. For the 12th edition of Immersion Sciences, the nautical center of Ile Tudy (Brittany, France) welcomed sixty-three students from twenty regional high schools. This immersion program, initiated by the Academy of Rennes, Brittany region and CNRS, allowed the students to meet, exchange and debate with scientists, attend conferences and visit companies and laboratories. Several topics were covered, from astrophysics, mathematics, acoustics and of course, the deep-sea. We did two conferences, one on the functioning of deep-sea ecosystems and the potential exploitation of their resources and the other on meiofauna. We also animated two workshops: the first explaining how to extract biological data on imagery acquired by deep-sea observatories and inviting students to participate to the Deep Sea Spy citizen project (www.deepseaspy.com) and the second, exploring the sea side to find and learn how to observed using different techniques living meiofaunal species. The major objective of this seminar is to arouse student interest and induce vocations by giving them the desire to "do" science!

The deep sea, a source of inspiration and creation
RESSAC symposium, Brest March 30th 2023
Jozée Sarrazin (Ifremer) & Irène Mopin (ENSTA Bretagne)

Since 2021, Jozée Sarrazin has been working with the artists Teatr Piba (a theater company from Brittany) to offer « art & science » workshops on the theme of the deep sea to students from engineer schools and universities in the ISblue network. About twenty students from different specialties (sciences and arts) have already participated in the project which takes place every year on a Breton island (Ouessant in 2021 and 2023, Batz in 2022). During the 3-day workshop, students have the opportunity to discover Jozée Sarrazin's deep-sea research, to work on several artistic disciplines (writing, theater, music & sound...) and to share their knowledge and know-how. In parallel, they work in small groups on the realization of different scenic performances, related to the theme of the workshop. The projects are presented at the end of the weekend and in front of the public once back on land. These restitutions are an opportunity to look back on the creative process and assess the feelings of each participant.

The 2021 workshop was about resilience, especially of deep sea ecosystems. During this workshop, a group of students proposed a sound creation associated with a choreography evoking the fragility of hydrothermal vents. All the sounds used were captured and processed on the Ouessant Island where the workshop took place. The listening was done with headphones during the restitution, for a better immersion in the abyss. Following the workshop, the students (Irène Mopin - ENSTA Bretagne, Angèle Nicolas - IUEM, Noémie Barcat - UBS) decided to continue the adventure together by bringing their sound creation to life in another way. They then joined forces with the Breton illustrator Eor Glas and the animator Manuel Creignou to produce the animated film R.E.S.I.L.I.E.N.C.E. This film retraces the still unknown process of resilience of hydrothermal springs following their destruction, while making the parallel with human resilience following a crisis. Its main objective is to raise awareness of the vulnerability of these ecosystems. It was recently presented at La Cité de la Mer (Cherbourg) to 2000 students of different levels of education.

Radio interviews

Jozée Sarrazin & Pierre-Marie Sarradin (Ifremer), David Wahl (writer)

Two radio interviews (France Inter & RFI) were done during the month of March 2023 by DEEP REST participants. The starting point of these interviews was the recent publication of the book « **La Vie Profonde** » resulting from a collaboration with two scientists of the Deep Sea Lab at Ifremer and the scientific writer David Wahl. The book relates the adventure of David on board the research vessel Pourquoi pas? in 2017. David was cited as the modern Jules Vernes so rich and colourful is his prose.

David Wahl & Jozée Sarrazin at La Terre au Carré, France Inter (French national radio)

« *On July 8, 2017, the Pourquoi Pas? a vessel in the French oceanographic fleet, set sail on a three-week scientific mission in the middle of the Atlantic Ocean. The aims of this expedition: to observe a hydrothermal field located 1,700 meters deep and to study its extraordinary fauna. Among the seventy-five sailors and scientists on board was David Wahl, on a mission of his own. For three weeks, the writer wrote his logbook. This rare account - which brings together the emerged and the submerged, as well as poetry and science - reveals the existence of a deep-sea universe that is still unknown, mysterious and hostile, but which never ceases to arouse curiosity. Even before they have been fully explored, the abysses are threatened by the risk of human exploitation. As much as an ode to underwater beauty, David Wahl's book is an appeal to reason and to the protection of these ecosystems.* »

Interview on species from potential mining areas

Pierre-Antoine Dessandier (Ifremer)

Brut, the 100% video media with millions of views, interviewed Pierre-Antoine Dessandier, researcher in benthic ecology at Ifremer, about 7 deep-sea species that could be impacted by the potential exploitation of mineral resources. In the context of increasing demand for mineral resources and considering the ongoing discussions of the international seabed authority for the establishment of exploitation regulations in deep-sea systems, the French media BRUT asked Ifremer to introduce how the deep sea biodiversity, threatened by these potential human activities, look like. The video has been designed under the scope of showing 7 type of organisms that we can find in abyssal plains or hydrothermal vents, showing videos and images acquired during scientific expeditions and giving some comments to better understand their life in these extreme environments.

The 5-minute video can be seen on the Brut website, on Instagram or Twitter

Ricardo Serrão Santos, University of the Azores – our new AB member

Ricardo Serrão Santos is a senior scientist at the University of the Azores and a politician actively involved in marine conservation and sustainable development policies. He holds a PhD in Environmental and Evolutionary Biology from the University of Liverpool and has conducted research on marine biodiversity and deep sea environments. He strongly advocates ocean conservation and sustainable development policies and has worked to promote international cooperation on ocean-related issues.

Ricardo has also held political positions, including Member of the European Parliament from 2014 to 2019 and Minister of the Sea in the Portuguese Government from 2019 to 2022. He is a Full Member of the Portuguese Academy of Sciences and an Emeritus Member of the Navy Academy.

Asif Khan, post-doc fellow, University of Galway, Ireland

Dr. Asif Khan is a postdoctoral researcher in economics at the University of Galway, Ireland, where he works with Dr. Thomas Van Rensburg on the DEEP REST project. In this project, he investigates the economic and societal impact of deep-sea mining on relevant stakeholders using stated preference surveys and environmental valuation techniques. He received his PhD in Economics from the University of the Basque Country Spain, where he focused on the Economic Evaluation of Air Pollution in India. During his PhD studies, Dr. Khan gained a solid foundation in environmental valuation techniques such as choice experiments and contingent valuation. He also gained experience in designing the stated preference surveys and conducting them on-site. As a postdoc, he has expanded his skill set to include cutting-edge techniques such as choice experiments. Dr. Khan's current research focuses on the valuation of deep-sea mining. He is particularly interested in examining the economic valuation of ecosystem services and contributing to the development of a socio-ecological system for deep sea ocean governance, conservation and restoration.

Laura Trovão, Master student, University of Aveiro

My name is Laura Trovão and I'm a master's student in Applied Marine Biology at University of Aveiro. This year I had the privilege of becoming part of the DEEP REST project, joining the WP2 team. I have been focusing on studying the functional diversity of the benthic fauna present in mining areas, such as Clarion Clipperton Zone and DISCOL, so that a database with a list of functional traits scored for all eukaryotic species from all benthic size categories may be created.

Also, my dissertation is integrated in this WP, entitled "Functional diversity of benthic fauna from polymetallic nodule areas" under the supervision of Dr. Ana Hilário and Dr. Sofia Ramalho, where I will use the database created in order to functionally compare the species from a contractual area with an APEI, from the CCZ. This opportunity has allowed me to learn a lot, to meet great people, and to have amazing experiences that otherwise I would never had.

Gayathra Bandara, Ghent University, Belgium

Gayathra Bandara is a Sri-Lankan student within the MSc programme IMBRSea (International Master of Science in Marine Biological Resources), which is coordinated by Ghent University in Belgium. In January 2023, he will start processing sediment meiofauna samples for his MSc thesis project entitled «*Impact on meiofaunal assemblages by the pre-prototype nodule collector "Patania II" in the Pacific Clarion Clipperton Fracture Zone (CCFZ)* » under the supervision of Dr. Ellen Pape.

The samples for this MSc thesis were collected during a two-month sampling campaign to the CCFZ (November-December 2022) aboard the German research vessel Sonne. During this campaign, the sites of nodule collector tests conducted 1.5 years before, were revisited and sampled to evaluate environmental impacts. Using microscopy, Gayathra will analyze sediment samples for meiofaunal higher taxonomic abundances from the collector track area and from areas with varying levels of sediment deposition sampled within the GSR (Global Sea Mineral Resources) exploration contract area. Meiofaunal data will be linked to abiotic sediment data such as sediment grain size, pigment levels and carbon and nitrogen content.

This dataset will be compared to previously collected meiofauna and abiotic data from the area before and shortly (1 month) after the tests. The complete dataset will provide insights into the impacts of the nodule collector test on the benthic environment. Gayathra and Ellen are very much looking forward to see the results!

Thesis student Gayathra studying CCFZ meiofauna with the stereomicroscope. © Ellen Pape, Marine Biology Research Group, Ghent University

Related projects

Meeting with Gilberto Carreira, Director of Biodiversity and Sea Policy Services of the Government of the Azores

Riwan Leroux, Jozée Sarrazin, Marjolaine Matabos (Ifremer), Joelle Richard, Manuel Bellanger (UBO/AMURE), Daphne Cuvelier (UAc)

During the meeting with the director of biodiversity and sea policy services of the government of the Azores, we offered to collaborate in science dissemination events in the Azores and in Marine Protected Areas management. In order to raise awareness about the deep sea and EMSO observatory, we offered conferences, exhibitions and/or vessel visits at the beginning

or end of MOMARSAT cruise in addition to the translation of already existing materials (booklets, theater play …).

For MPA management, Azores government is redefining its MPA network and wish to provide regulation rules by the end of this year. The piece of legislation will include management rules (for research as well), monitoring prospects and outreach goals. We accept to provide maps of research activities from the Lucky Strike vent field as part of the PROTECT project. We also agree to have a consultative role for the establishment of MPA zonation for research activities and establish respective responsibilities for MPA activities.

Infos & reminders...

Conferences and symposium

- ❖ 7th International Symposium on Chemosynthesis-Based Ecosystems (CBE). 14-18 August 2023 – Sao Paulo, Brazil. CBE is the premier meeting of researchers, specialists, explorers, managers, policy makers and students to exchange ideas and share knowledge about advances in chemosynthesis-based ecosystems. This 7th edition will take place in South America for the first time. Do not forget to cite DEEP REST at the end of your presentation!

- ❖ Symposium at the University of Edinburgh "The High Seas Treaty – from negotiations to implementation" 6-7 October 2023. The symposium will include keynotes from leading authorities in each of the four pillars of the agreement: (1) marine genetic resources, including questions on the sharing of benefits; (2) measures such as area-based management tools (ABMTs), including marine protected areas (MPAs); (3) environmental impact assessments (EIAs) and (4) capacity-building and the transfer of marine technology.

The final version of the **consortium agreement** has been sent to all DEEP REST partners, please make sure that it is signed promptly! There are still missing signatures.

The **data management plan** also needs your inputs. Please take a few minutes to identify the data you will be using during this project.

Communication tools
Web site: https://deep-rest.ifremer.fr/
Mailing to deep-rest organization team (WP1): deeprest2022@gmail.com
General DEEP REST mailing list: deeprestall@listes.ifremer.fr
WP leader list: deeprestwpleader@listes.ifremer.fr

Our advisory board is composed of: Samantha Smith, Luciana Genio, Ricardo Serrao Santos and Claire Armstrong. You can see their profiles on the web site and contact them directly by using their mailing list: advisory_board_deep-rest@listes.ifremer.fr. Thanks to all of them to be part of our great project!

-The end-