

TRIDENT – (Technology based impact assessment tool for sustainable, transparent deep sea mining exploration and exploitation) – OVERVIEW OF THE FIRST 18 MONTHS

Pedro Madureira and/on behalf of TRIDENT Partners

INESC TEC, Porto, Portugal

Department of Geosciences of Évora University/CREATE, Évora, Portugal

In its progression towards a transparent and cost-effective system for continuous Environmental Impact Assessment (EIA) and monitoring of exploration and exploitation activities in the deep sea, the TRIDENT project has now reached its 18-month duration. So far, the development of new sensors (Eh, pH, optical dust trap) is well underway, meeting the established goal of presenting novel sensing solutions for deep-sea monitoring.

The visualisation system upon which models for prediction and alert operate – The Traffic Light System – is testing the established models for the test site (each site/operation requires its specific model) and is being fine-tuned to incorporate an ever-growing set of information. These can be obtained dynamically by pinpointing places and situations, changing frequency measurements and adapting, correcting, and validating the model and predictions as operations unfold. Approaching thresholds prompts alarms, thus leading to intervention and mitigation actions. This underlines one of TRIDENT's initial goals: to develop and integrate technological tools and novel solutions to operate autonomously in remote areas under extreme conditions and provide real-time data to permitting and supervising authorities.

Robotic autonomous landers, relocatable platforms and AUVs incorporating innovative communication, positioning systems, and data storage systems with edge-computing, all of which are capable of uniformity between all sensors and components, along with new energy management and charging systems, are ensuring the autonomy and dynamic operation sought for TRIDENT.

The concept of a Black Box proposed to exist in every mining machine paves the way for the effective monitoring and inspection system, compliant with international and national legal frameworks, incorporating as far as possible in terms of scope of activities and data acquisition, the International Seabed Authority's (ISA) recommendations for EIA and baseline acquisition¹ [1]. Environmental sustainability and full transparency in deep-sea mining (DSM) exploitation governance are crucial elements for social acceptance.

TRIDENT is working strongly to guarantee another of its objectives: to present progress beyond the current state-of-the-art by filling technological limitations and data gaps, establishing advanced methodologies for real-time monitoring of environmental impacts and providing mitigation measures in the context of DSM (polymetallic sulphides, ferromanganese crusts and polymetallic nodules)

The final demonstration of the TRIDENT solution will be held on 2027. In terms of data collection, the first mission to the future test site has recently been executed (July). Several measurements of ocean variables were performed, and acoustic data was recorded both from gliders and from a Vertical Sound Array that is being developed for the project. Sediment samples were obtained, and extensive bathymetry was performed.

Upon previously processed historical data from the trial site, a biotope model was established, after which a gap analysis setting the requirements of the first baseline was accomplished, with data from the in-situ mission still requiring in-depth analysis for further robust characterisation.

¹ Legal and Technical Commission - International Seabed Authority, "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the area," 2019.