Scientific Community Input on
Eureka II Blake Plateau Testing & Potential for Use as Scientific Equipment

This document is a summary of the issues and considerations discussed by scientists in relation to the testing plans for Impossible Metals selective harvesting AUV called Eureka II (previously referred to as v4), during two discussions held on December 5 and 8, 2023. The session was facilitated by Becky Oehler, Sustainability Manager at Impossible Metals.

Contributors

Scientists involved in these preliminary studies, as well as other scientists with expertise in the field of benthic ecology and abyssal ecosystems, are encouraged to contact Becky Oehler (becky.oehler@impossiblemetals.com) if they would like to be involved in further scoping and subsequent environmental studies related to the selective harvesting methodology proposed by Impossible Metals.

The scientists who contributed to the discussions summarized in this document are as follows:

- Elisabetta Menini - Duke University, USA
- Erik Cordes - Temple University, USA
- Kerstin Kröger - Queen's University Belfast, UK
- Patrick Collins - Queen's University Belfast, UK
- Rudy Helmons - Delft University of Technology, Netherlands
- Sandra Brooke - Florida State University, USA
- Steinar Løve Ellefmo - Norwegian University of Science and Technology, Norway
- Tanja Stratmann - Royal Netherlands Institute for Sea Research - Netherlands

Attendee expertise includes biological sciences, engineering, geology/mineral resources, deep sea mining exploration/environmental impact assessment, and policy.

Introduction

In 2022, Impossible Metals consulted with scientists via roundtable discussion in May and October, to gather initial feedback about the concept of selective harvesting and to discuss more detailed testing plans for AUV v3 and v4 (Eureka I and II). The input gathered during these discussions is summarized in documents posted to the Impossible Metals website at https://impossiblemetals.com/sustainability/scientific-engagement/

As Impossible Metals begins testing of Eureka II, there were two key topics to discuss with scientists, Blake Plateau testing of Eureka II and the potential for Eureka II technology to be used for scientific equipment (i.e. sampling)

Presentation & Key Questions

Impossible Metals presented key information for the discussion, including an overview of the selective harvesting concept, progress on development since the last roundtable in October 2022, and plans for testing at the Blake Plateau. Two questions were then discussed with participants:

1) Impossible Metals is carrying out initial ocean testing on the Blake Plateau off the Southeastern US coast, where there are nodules at approximately 800 metres depth.
    - Where can the monitoring data and video feeds be published so it is most useful? (i.e. data repositories)
    - What format should the data have to be most useful? (i.e. data format, time standards, location)
    - Do you anticipate any immediate interest in this data?
    - Regarding samples, what kind of information are you interested in learning, or you think may be of interest?

2) The potential for Eureka II technology as scientific equipment? (as is and modified versions)
    - Features that may be of interest:
        - Efficiently travels up and down in the water column
        - Does not land on seafloor
        - Hovers over the seafloor as it travels and collects
        - Uses AI to do it's work (no pilot)
        - 50 kg sample payload
        - Potential for seek and sample (i.e. select particular visible fauna)

Feedback on Blake Plateau Testing

Data Repositories & Format

- There are several data repositories where the monitoring data can be stored (NOAA database NCEI; OBIS).
- Video data can be stored in NCEI and Ifremer
- OBIS-SEAMAP is primarily for migratory species data, but it also has static datasets for fauna
- Any data should include time/date and location, as well as metadata to explain the context of the data (who, where, when, how); generally, more information is better, the dataset can always be downsized by those using it
- It may also be prudent to create our own data storage repository if Impossible Metals anticipates having more data in the future that will need to be organized and accessible

Interest in Data

[Impossible Metals noted plans to identify bacteria species hosted in the nodules for potential use in development of a mineral processing technique that uses bacterial respiration to dissolve ore into solution.]

- Background data is useful for later modeling if/when someone is carrying out a study on the area or region.
- One participant is interested in video footage for fauna identification.
- One participant is interested in combining assay data from any samples with the vision system data for resource estimation. The purpose of this would not be to estimate the potential for the Blake Plateau (which is not considered economic, and the testing is limited to a small area), but to start developing a methodology for using vision system data, combined with assay data, to estimate a resource.
- There is academic interest in the community of meiofauna living in the pore space of the nodules. Could be interesting to compare the meiofauna community of the Blake Plateau nodules to nodules from other areas.
- There is interest in the size of fauna the AI will be able to detect (useful information from Blake test and future tests).

Feedback on the Potential for the use of Eureka II technology as scientific equipment

- Participants agreed that an AUV using Eureka II technology is most likely to be used for regular monitoring at the same location with the same type of samples. On exploratory cruises, the scientists are determining what/how to sample based on what is found at the time. However, if regular monitoring is occurring (i.e. monitoring of mining operations), the autonomous nature of the vehicle may be beneficial to gather the same types of samples/data at the same locations (i.e. water, sediment, video, temperature, pH, etc.)
- Recommendation to concentrate on making regular monitoring sampling more efficient than what is currently available (more samples per dive, faster, etc.).
- At depths/locations where tethering is possible and a scientist could identify what should be sampled, the autonomous sample collection could be useful for exploratory cruises, particularly if the sampling mechanism can remove human error from delicate sampling work.
- Core samples seem unlikely because of the hovering mechanism - pushing/drilling into the seafloor would likely push the vehicle away. However, soft sediment sampling could be possible.
- One participant noted that they are working on a project regarding critically endangered shark eggs that are approximately the same size/shape as nodules. There could be potential to collaborate.

Other Topics of Discussion

- Recommendation to consider an on-board geochemical analyzer that could be used at the seafloor to sample sediments for regional metals studies (i.e. trace ore-containing sediment back to the source using regional geochemistry; more useful for non-nodule deposits).
- Vision data & footage could contribute to the body of data that can go into procedures for developing deep sea mining plans.
- Recommendation to consider the technology for use in nodule replacement. Could the vehicle place replacement "nodules" as it picks nodules (picks in the front, replaces in the back)? *[It was noted that the effectiveness of nodule replacement is unknown (how is it accepted by the fauna?) and studies need to be carried out. There is interest in this type of study.]*
- There was a discussion about how the vehicle will stay ahead of any potential sediment disturbance, however minimal.
    - Participants noted that in some places of the deep ocean, currents can change direction with tidal cycles.
    - Participants discussed other potential imagery spectrums if visual light doesn't work due to sediment disturbance. One participant noted hyperspectral imager as a potential solution.
- Potential for Eureka II technology to be used as a support vehicle for other types of deep ocean mineral exploration and exploitation.
- Consider real-time plume monitoring on the next and final version of the AUV, that could have an on-board "traffic light" system (can stop mining at a certain amount of sediment disturbance)
- There is interest in further discussion with the Impossible Metals mineral processing team, who are developing techniques using bacterial respiration to put ore minerals into solution.

Further Work

At the conclusion of the session, Impossible Metals noted that the next roundtable will be held when Impossible Metals has firm plans to test at a nodule site in deeper water with sediment more characteristic of economic nodule deposits. At that time, there will be discussion about how the test will be studied.