



## **Scientific Community Input on Eureka III Test in BGR Contract Area (CCZ) with BGR Environmental Monitoring**

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 III during a virtual 2-hour discussion held on August 15, 2024. The session was facilitated by Becky Oehler, Sustainability Manager at Impossible Metals, with support from:

- Annemiek Vink, Project Coordinator (polymetallic nodule exploration), BGR
- Adam Kolb, Mechanical Engineering Lead, Impossible Metals
- Ernie Tapanes, Marine Operations Manager, 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](mailto: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:

- Andrew Sweetman - Scottish Association for Marine Sciences, UK
- Erik Cordes - Temple University, USA (*individual meeting post-roundtable*)
- Heidi Dias - Queen's University Belfast, UK
- Jon Copley - University of Southampton, UK
- Kerstin Kröger - Queen's University Belfast, UK
- Tanja Stratmann - Royal Netherlands Institute for Sea Research - Netherlands

Attendee expertise includes biological sciences, 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). This engagement avenue continued with a subsequent roundtable in December 2023 to discuss Eureka II testing plans. The input

gathered during these discussions is summarized in documents posted to the Impossible Metals website at <https://impossiblemetals.com/sustainability/scientific-engagement/>

Impossible Metals is planning to test Eureka III in the BGR contract area of the Clarion Clipperton Zone (CCZ) in early 2026, with environmental monitoring of the test to be carried out by BGR. The purpose of this discussion was to gather feedback from marine scientists on the testing and monitoring plans prior to finalizing the details required for sediment modeling.

## **Presentation**

Impossible Metals and BGR presented slides with the draft testing and monitoring plans, identifying that any aspect of these plans are open for feedback and discussion. The draft testing plan included timing, test duration, and options for a variety of testing “modes” (i.e. differing percentages of nodule pickup). The monitoring plan listed the types of data to be collected and associated equipment.

## **Q&A**

- There are small, very common megafauna (like sponges) that can be found on a large percentage of nodules in an area, would they be avoided or picked up?
  - **IM Answer:** *The AI will be trained not to avoid very common, small megafauna, using information from BGR (they will be picked up).*
- Will speed of the arms/claws be the final speed intended for production? This is important for impact monitoring.
  - **IM Answer:** *Yes - speed of movement over the seafloor and speed of arm/claw movement will be the planned speed for production.*
- Are nodules avoided due to megafauna included in the programmed % avoidance, or in addition?
  - **IM Answer:** *Included in the programmed % avoidance. In some areas, if there is an abundance of avoided megafauna, the % avoidance may be higher than programmed.*
- What is the nodule density in the test area?
  - **BGR Answer:** *It's in a prospective area for which we have detailed geostatistical analyses; ~18kg/m<sup>2</sup> dry weight, mostly medium-large size nodules.*
- Will there be more monitoring longer-term after the test?
  - **BGR Answer:** *Yes, planned return for extended monitoring in 2028.*
- How many of these vehicles would there be working together and how far apart would they be?
  - **IM Answer:** *~20 working together to produce the same amount as a crawler. We haven't done mine planning yet, but we do think they will be operating on parallel lines, moving into the current, and they will be at different stages of ascent/operations/descent to allow for the launch & recovery system to provide support to all of the vehicles.*

## **Feedback on BGR/IM Test Plan**

- Any differences in “modes” will probably need to be quite drastic in order to see differences over time
- Having a variety of “modes” will make it difficult to have adequate data - try to just answer one question rather than all the questions
  - At least 3 replicates are required; so changing modes frequently is not recommended
  - The biggest value here is the comparison between Eureka III and Patania II - make sure we’re answering this question
  - It’s also important to show the capability of the equipment (more than 1 mode, avoiding megafauna)
- ***IM Question to Attendees: When we leave behind nodules, would it be better to have a pattern of nodules that allows for pathways between “islands” of nodules, or left behind at random?***
  - This was also discussed for crawlers, the idea of leaving strips of nodules behind. However, it really depends on the sediment disturbance whether or not this is useful, so find that impact first before considering this aspect.
  - Difficult to answer without knowing what fauna is present; particularly important to this will be larval stages and how they move
  - The test is on a very small scale; answer one key question rather than too many questions (statistically robust answer to one thing)
- Will the monitoring be able to quantify how much sediment is removed from the area (suspension)?
  - ***BGR Answer: Not directly - we will measure sediment concentrations in the water column during plume formation and look at sediment redeposition through photomosaic***
- Sediment washing through Eureka III as the vehicle rises to the surface would be another impact
  - ***IM Response: We have a sealed hopper design during descent/ascent, so the sediment is either removed at the seafloor or it returns to the surface. Any sediment collected during the test will return to shore with us. This will be a key learning for the development team.***
- If there is a plume due to vehicles moving up from the seafloor, consider all vehicles coming up at the same place to localize those impacts
  - Could also consider the vehicle hovering at the seafloor for a set period of time prior to ascent to allow some of the sediment to settle

## ***Environmental Monitoring Plan***

- Make sure that the monitoring is as comparable as possible to Patania II monitoring

- There will be oxygen profilers, will there also be benthic chambers?
  - *BGR Answer: open to discussion about this for this and/or for the other parts of the larger monitoring program.*
- There is a “checkerboard system” that could be deployed within the tracks to collect sediment
  - *BGR Answer: Deployment is done by ROV, which can disturb the sediment, but it will be discussed with the team*
- Consider testing in a “benthic box” to pick nodules and monitor impact.
  - Likely to be quite difficult, but changes in texture/colour and x-ray processes can be used to identify sediment redeposition in box cores or other types of samples (though this is typically qualitative)

### **Other Topics of Discussion**

- If you cannot get an actual sample of CCZ sediment for your development, consider using an artificial alternative. There is a group that hosts a monthly talk by different Dutch companies. During Allseas’ presentation, they indicated that they use artificial particles with the same physical properties as deep sea sediment to test their system.
  - Potential issue - if you don’t have the organics right, could be difficult to get the consistency right
- Potential for fauna (particularly jellies) getting pulled through thrusters, with some species disintegrating when water is blown at them; consider if/how we could avoid this issue.
- Consider what other monitoring equipment could be included on the AUV that’s carrying out the photomosaic (i.e. MBES).

**[Note: This summary was circulated to attendees for comment prior to finalization.]**