DEEP FOCUS

GRUPOISA

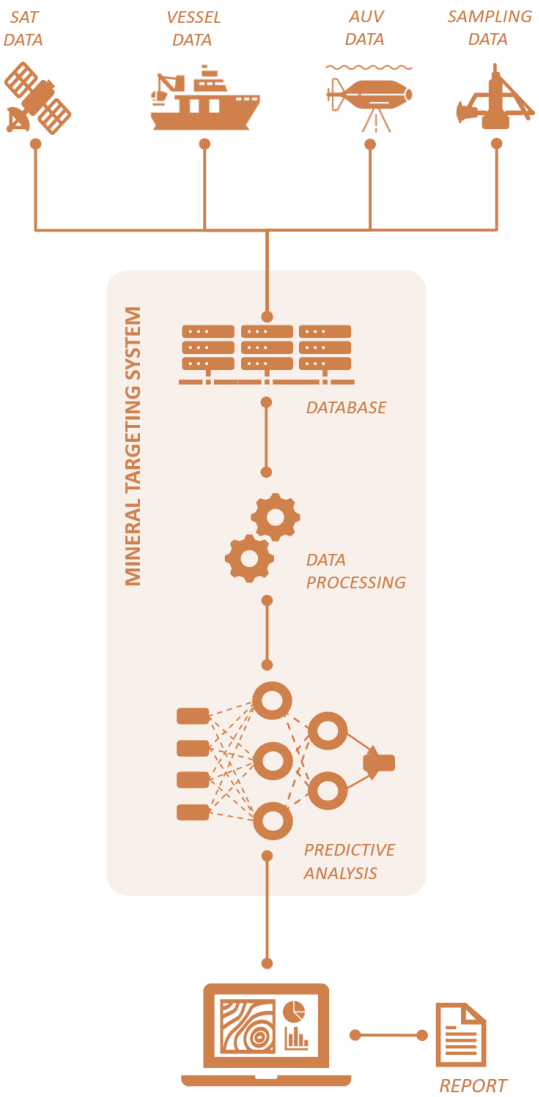
CASE STUDY

CAPABILITIES OF THE AI-POWERED MINERAL TARGETING SYSTEM

Cobalt ferromanganese crusts mineral mapping and resource assessment in Marshall Islands EEZ

AI-POWERED CONSULTING FOR RESPONSIBLE AND SUSTAINABLE DEEP SEA EXPLORATION

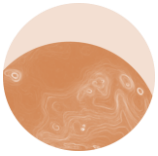
Our concept to fast-track your critical minerals exploration project in the deep sea



CONCEPT

Our innovative AI-powered mineral targeting tools **enable quantitatively assess marine mineral resources across scales and while mapping ecosystem vulnerability**. The predictive models train on several thousand deposit-specific geological and biological examples, creating new knowledge and consistent, high-quality predictive insights to support decision-making.

THE BIG PICTURE



The continually evolving mineral targeting system combines data from multiple sources, including satellite remote sensing, with AI and machine learning to **globally assess deposit-specific multi-commodity predictive maps at regional to camp scale and define possible vulnerable ecosystems** following the FAO International Guidelines for the Management of Deep Sea Fisheries in the High Seas.

A CLOSER LOOK

When further detail is needed, high-resolution data and geological sampling data can be fed into the mineral targeting system pre-trained machine learning models to get more specific information about the area or site of interest. This yields a winning combination to **guide decisions and increase the chances of success at much lower discovery risks and costs**.

THE CHALLENGES

Deep sea exploration is costly, time-consuming, and limited by tight budgets and lack of information. It requires vast areas to explore and even using several survey technologies there's the risk of spending too much time and money only to conclude that an area is not viable or worse, overlooking a potential bonanza.

Marshals Islands EEZ ferromanganese crusts

The Marshall Islands are located in the northern part of the Central Pacific Basin, within the so-called Pacific Prime Crust Zone – a region identified as being of the greatest economic interest for mining cobalt-rich ferromanganese crusts which extends from the Hawaiian Islands to the Mariana Trench. The Marshall Islands EEZ is some 2,13 million km^2.

A detailed survey for the study of cobalt-rich ferromanganese crusts over 13 seamounts located in the EEZ of the Marshall Islands was conducted in 1996 and 1998(1). As a result, 214 samples were collected. The average thickness found at each seamount ranges from 9 to 46 mm, whereas the average cobalt, nickel and copper grade range from 0,50 to 1,00 %, 0,39 to 0,70 %, and 0,04 to 0,14 %, respectively. The results also showed that crust thickness is higher in the seamounts located in the western sector of the Marshall Islands EEZ area, whereas cobalt content tends to be higher to the east.

Based on these results, 4 years later another survey was conducted for detailed resource assessment on selected areas, namely over seamounts MS1, MS11, and MS12. As a result, the obtained average thickness of the cobalt crust on the 3 seamounts was thicker than the previously obtained. However, the average grade of cobalt of each seamount was lower compared with that of the previous surveys. Nonetheless, the inferred resources at the 3 seamounts were about 55, 173, and 32 million tons, respectively. Also, the total evaluated cobalt, nickel, and copper resources for 12 of the 13 seamounts were 827, 651, and 111 thousand tons, respectively, assuming that thick crusts are generally developed on seamounts summits and slopes above 2500 m deep.

However, only 13 seamounts were listed and sampled from the several hundred seamounts existing in the Marshall Islands EEZ area, solely based on the seamount's depth, shape, and size.

No other criteria were used to select and rank the most promising seamounts. This means that other potential high-value target areas may have been overlooked.

This use case focuses on reviewing high-value ferromanganese crust exploration target areas in the Marshall Islands EEZ seabed area by performing mineral mapping and resource assessment.

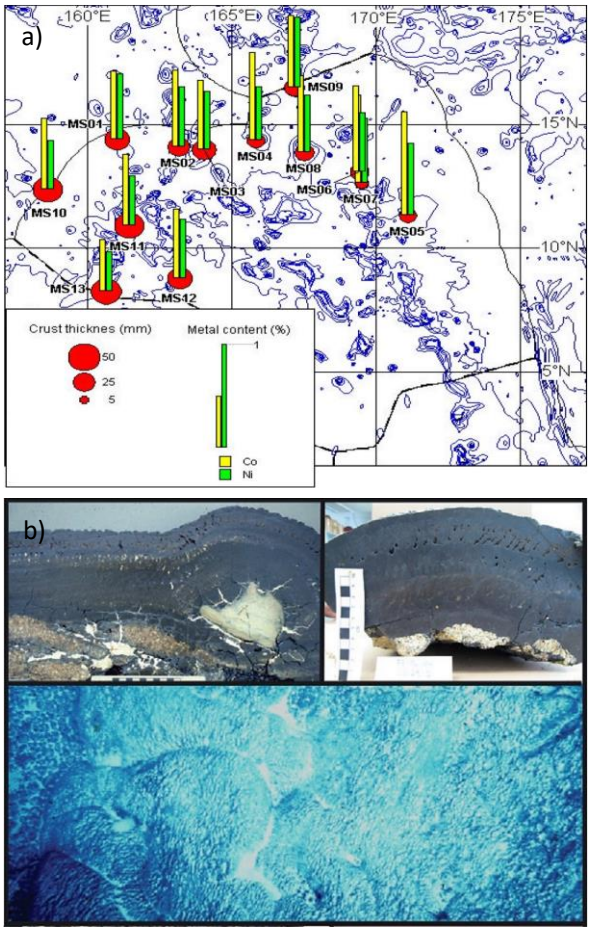


Figure 1 – a) Location of the Marshall Islands EEZ and average crust thickness and cobalt and nickel metal contents in each studied seamount. B) Photographs of ferromanganese crusts found in the Marshall Islands(2).

(1) Kojima (1999), https://pacific-data.sprep.org/resource/tr0293
(2) Japan International Cooperation Agency (2003), https://openjicareport.jica.go.jp/pdf/11716859_01.pdf
(3) Hein, J. & Koschinsky, A. (2014). Deep-ocean ferromanganese crusts and nodules. Geochemistry of Mineral Deposits: Treatise of Geochemistry, 2nd Edition. 13. 273-291.

RESULTS

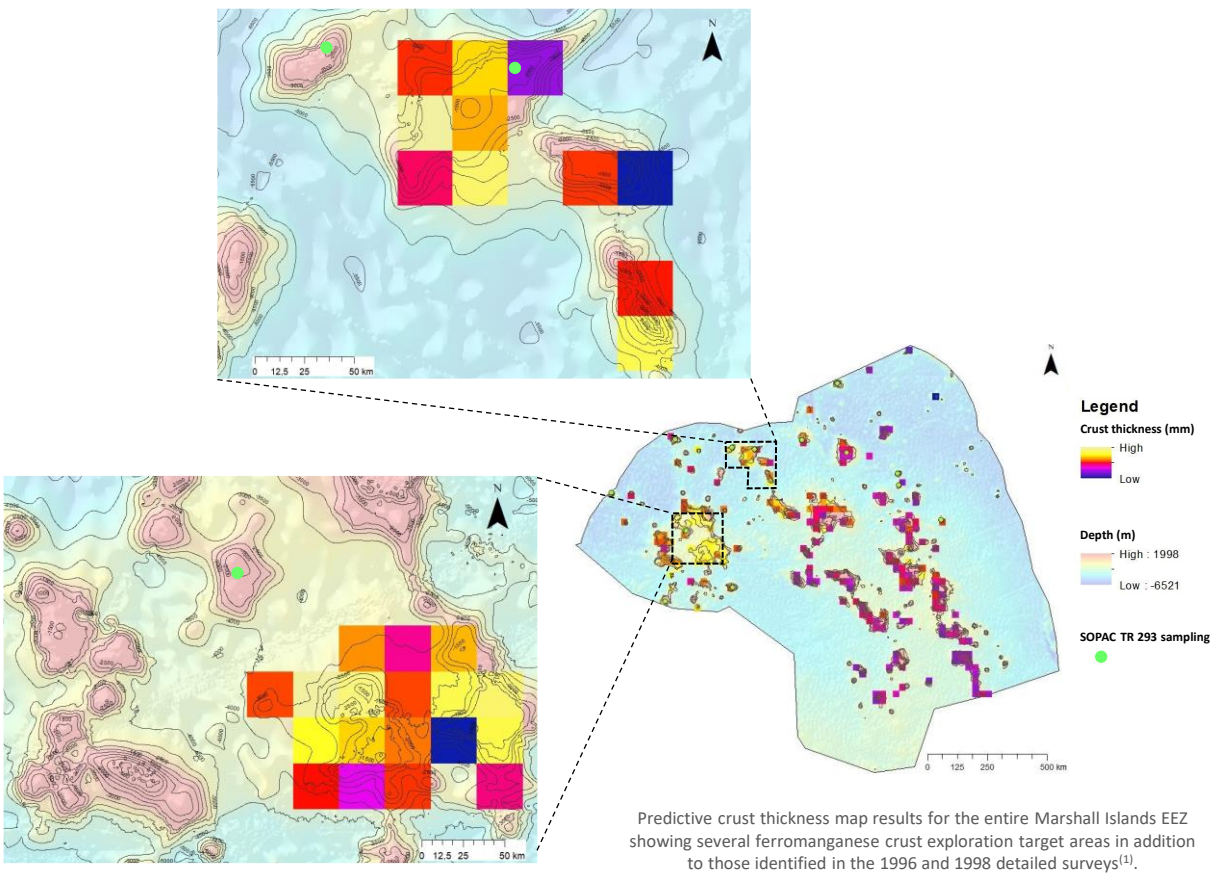
In the analysis performed, we have identified several new target areas showing high crust thickness and cobalt and nickel grades. In addition, our AI-based mineral mapping agrees well with previous studies and assessed crust thickness and metal grades, which demonstrate and validate that our targeting system is an effective way for mapping and assessing high-value cobalt ferromanganese crust areas.

Mineral mapping and exploration target generation

Our results for predictive crust thickness and mineral mapping in the Marshall Islands EEZ seabed area show a good agreement with the thickness and metal contents trends reported in SOPAC Technical Report 293[(1)] and Japan International Cooperation Agency Report[(2)].

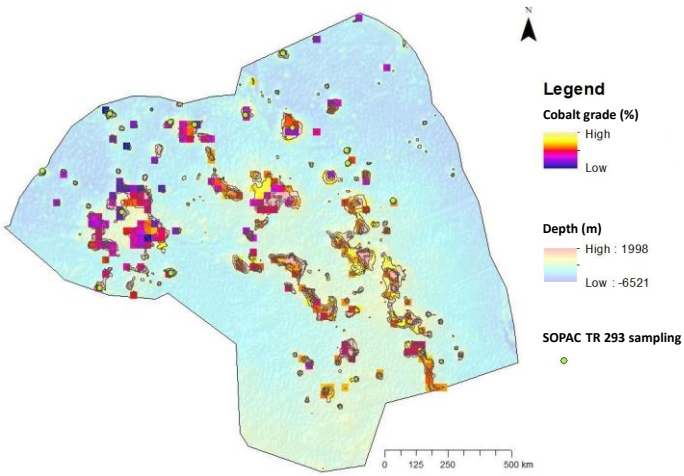
The crust thickness tends to be higher in the seamounts located in the western sector of the EEZ area, whereas metal grades tend to be somewhat lower compared to the results from the 1996 and 1998 surveys, but still slightly higher in the eastern sector of the EEZ area than in the western sector.

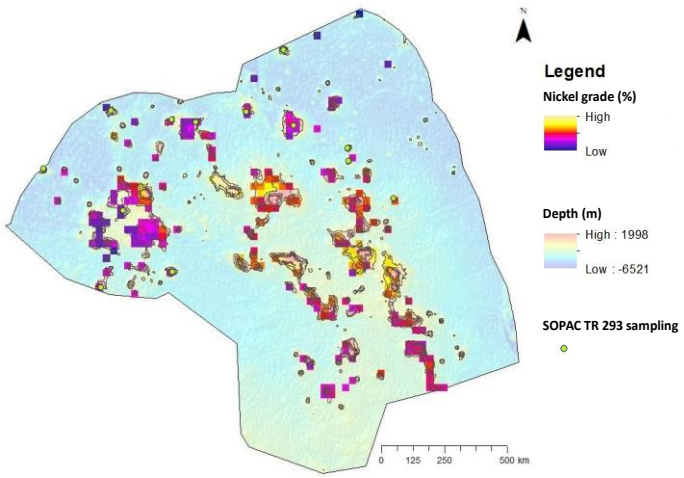
In addition, our results also highlight several unexplored target areas besides those identified in the SOPAC Technical Report 293[(1)] and enable to map areas in each seamount where the thickness of the cobalt crusts is higher. For example, 2 target areas in the western sector of the Marshall Islands EEZ seabed area are of interest and show a predicted average crust thickness above 30 mm. No crust samples were taken from these thicker crust areas to better focus the exploration survey effort and map and assess the resource potential.

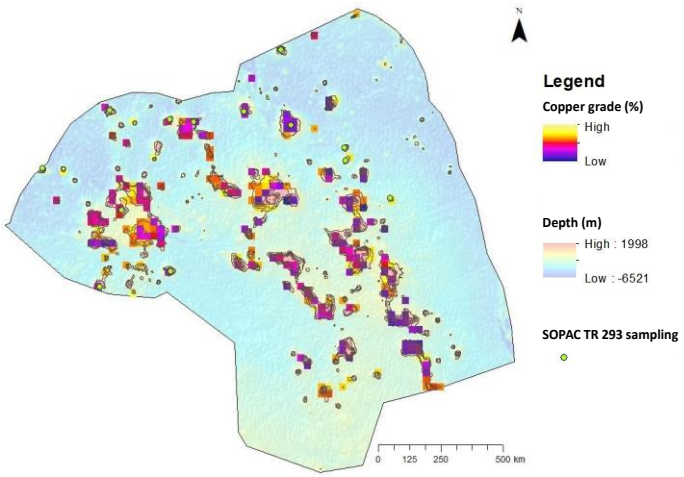


Predictive crust thickness map results for the entire Marshall Islands EEZ showing several ferromanganese crust exploration target areas in addition to those identified in the 1996 and 1998 detailed surveys[(1)].

RESULTS

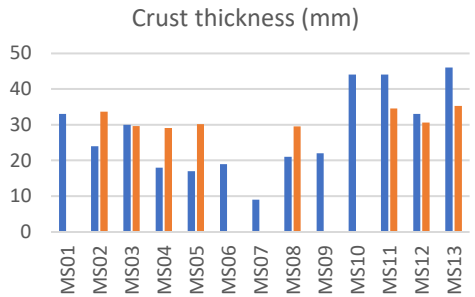


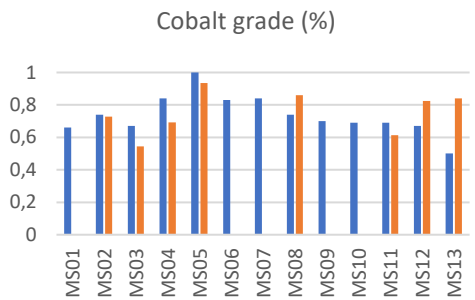


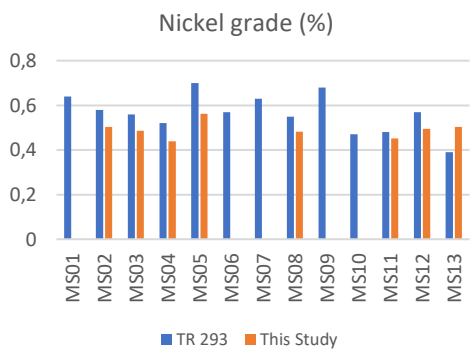


Predictive cobalt, nickel, and copper grades for the Marshall Island EEZ.

When compared with the average crust thickness and nickel and cobalt grades at each seamount, the predictive analysis further confirms the results reported in 2003[2] and allows to identify which seamounts should be the focus of more detailed exploration surveys to confirm the existing economic potential.







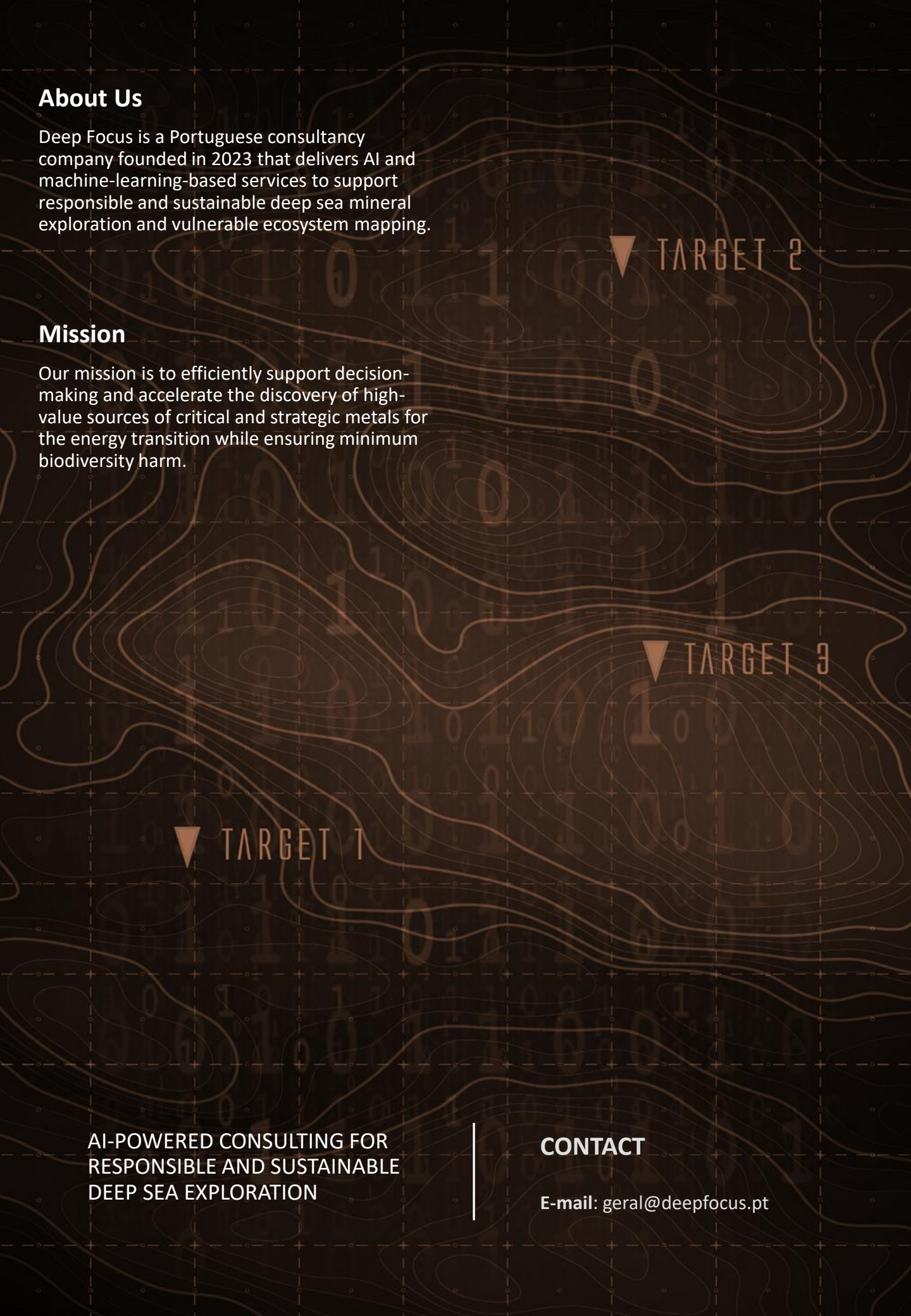
Overall, the appraised mineral resources in the Marshall Islands EEZ assuming a 30% crust exposed surface coverage exceeds 2 billion dry tons of crust @ 0,75% cobalt, 0,49% nickel, and 0,07% copper. This accounts for about 50 million dry tons of contained cobalt metal, 32 million tons of nickel, and 5 million tons of copper.

About Us

Deep Focus is a Portuguese consultancy company founded in 2023 that delivers AI and machine-learning-based services to support responsible and sustainable deep sea mineral exploration and vulnerable ecosystem mapping.

Mission

Our mission is to efficiently support decision-making and accelerate the discovery of high-value sources of critical and strategic metals for the energy transition while ensuring minimum biodiversity harm.



AI-POWERED CONSULTING FOR RESPONSIBLE AND SUSTAINABLE DEEP SEA EXPLORATION

CONTACT

E-mail: geral@deepfocus.pt