

Moana Minerals – Exploration Application Summary

About Moana Minerals

Moana Minerals (Moana) is a wholly owned, Cook Islands registered limited company and is a subsidiary of Ocean Minerals LLC (OML), a company established under the laws of Texas in the U.S.A. Moana has applied for an Exploration Licence under the Seabed Minerals Act, under the regulations specific to holders of “Reserved Areas”. Moana Minerals’ exploration application area (“Application Area”) contains the 288 blocks of the OML reserved areas, totalling some 23,630 km² or roughly 1.2% of the almost 2 million km² Exclusive Economic Zone (EEZ) of the Cook Islands. The Application Area, located between 500 and 600 km north of Rarotonga, is shown in Figure 1 below.

The resource and the environment

An exploration licence will enable Moana to study the environment within and around the application area as well as the full nature and extent of the polymetallic nodule resource. Proposed activities will gather data and generate information that will allow the company, regulators, and stakeholders including all Cook Islanders to further understand the potential of the nation’s nodule resource, the deep-sea environment of the EEZ and the potential environmental risks and necessary mitigations should future mining of this resource be considered. The proposed work programme should provide new insights into the quantity and distribution of the polymetallic nodules on the seabed in the application area, as well as information on the biodiversity on and in the seabed, the water column above it, the ecological processes within and around the application area, and the size of the economic resource and the contained metals therein.

The exploration activities will be completed in accordance with the Precautionary Principal as set out in the *Marae Moana Act 2017* marine spatial planning framework and the regulatory regimes of the *Seabed Minerals Act (2019, and 2020 Amendment)* and *Environment Act 2003*. The exploration programme will investigate the feasibility of mining options to work towards identification of a preferred mining method that minimises environmental impact while optimising efficiency. Outside the formal regulatory environment, Moana also recognises and understands the inextricable links between the ocean and Cook Islands traditional and modern culture. Throughout the exploration programme, Moana will seek genuine ongoing engagement with multiple sectors and stakeholders.

Overview

The area Moana seeks to explore is outside the marine protected areas set by the *Marae Moana Act 2017*. However, the exploration activities must still be managed in accordance with the provisions of that Act. Our proposed exploration programme is focused not only on verifying the nodule resource and evaluating mining methods, but also on obtaining sufficient scientific information to enable Moana to evaluate and establish the potential impacts of mining activities. This information will allow the Authority to evaluate a future mining licence application and will support evidence-based decision making among all stakeholders.

Moana’s exploration activities will use devices such as echo-sounders, underwater cameras, oceanographic sensors, small scale grab samplers and other seafloor sampling equipment to map and visualise the seabed and water column, assess the nodule resource and identify and

study biological communities. These exploration activities are currently classed as Tier 2 activities in the draft *Environment (Seabed Minerals Activities) Regulations 2021*, meaning that they are unlikely to cause 'serious harm'. If these activities require consent by the National Environment Council pursuant to the *Environment Act 2003* application will be made.

As part of detailed planning for each exploration research campaign, all activities will be assessed for their potential environmental impacts as a part of the project's environmental management programme. Risk mitigation plans will be formalised and reported in campaign work plans in addition to annual reporting as prescribed in the licence and permit(s). Moana recognises the importance of independent oversight and visibility of activities to stakeholders. As such, opportunities to participate in or to observe exploration operations will be made available for representatives of the interested government Ministries and Departments, and possibly academia as well. Moana will continue the practice of capturing video of offshore operations.

If at any time through the exploration programme Moana has cause to undertake activities that are classed as Tier 3 activities as defined in the *Environment (Seabed Minerals Activities) Regulations 2021* when promulgated, this will trigger the requirement for an Environmental Impact Assessment (EIA). Activities that may be classed as Tier 3 activities include in-field tests of components of the mining system.

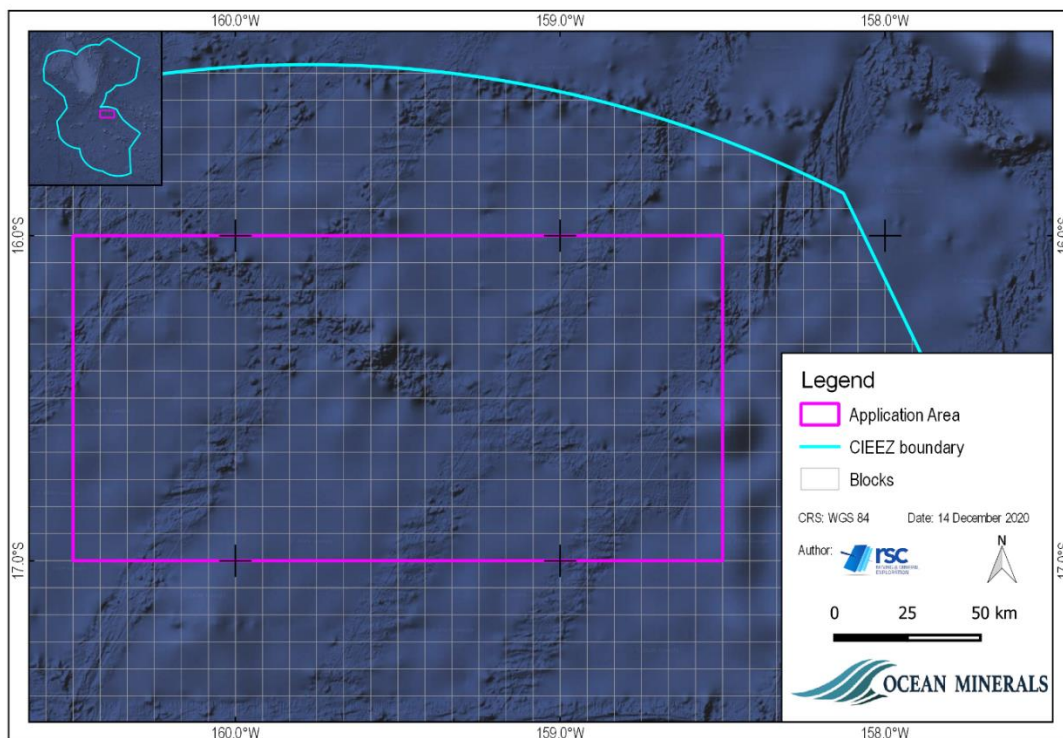


Figure 1 - Exploration License Application Area encompassing OML reserved areas

The team

Moana's experienced team is made up of experts in offshore, deep-water engineering and operations, seabed diamond mining, SMS exploration, deep-water oil and gas drilling, deep-sea ecology, and mining impact assessment. Some members of the team, including our company founder, were active members of research teams exploring the manganese nodule fields of the Clarion Clipperton Zone in the 1970s and 1980s. The Moana team is supported by a large sphere of global partners and service providers in areas of logistics, community consultation, offshore operations, scientific laboratory services, conservation and other specific subject-matter experts

that are drawn upon as required.

Economic viability

In 2017, OML commissioned an independent resource assessment for the Application Area which reported a polymetallic resource containing sufficient quantities of the key metals for modern battery and renewable energy technologies (cobalt, nickel, copper, manganese and rare earth elements (REEs)) as to be economically viable for further development. Of particular importance was the reporting of 1 million tonnes of contained cobalt within the nodules in Moana's Application Area based upon existing data, with the potential based upon resource modelling for up to an additional 1.5 million tonnes of cobalt. Combined, this would make up one of the three biggest cobalt deposits on earth, rivalled only by those in the Democratic Republic of the Congo. Further, OML anticipates that Moana has the potential to be the world's second largest cobalt producer (behind Glencore plc). These projections, paired with the low-cost nature of Moana's polymetallic nodule project, make it a valuable and strategic resource, particularly as the world continues to shift towards more metal-intensive sources of energy such as lithium-ion batteries and other advanced energy technologies.

The next year (2018), OML commissioned an engineering scoping study and cost estimate for a mining system. Then in 2019 an independent third party produced a Preliminary Economic Assessment, which concluded that the development of the proposed nodule project was viable, both technically and economically.

As part of the economic assessment, one of the key risks identified was the process metallurgy (extraction of the metals), which is the step between mined nodule material and usable extracted metals. For this reason, Moana applied for and received a permit to conduct a small-scale research cruise in late 2019 with the primary objectives of collecting nodule material to feed into a research process metallurgy test programme and to begin early environmental data collection (addressed further below).



Figure 2 – OML's Cook Islands 2019 Research Campaign with local crew and participants.

The cruise was completed, with the use of a Cook Islands vessel, Cook Islands locally manufactured sampling equipment, and a mostly Cook Islands-based crew. OML's environmental lead was assisted by Cook Islands student researchers and observers. The resource operations team, headed up by OML CEO and Chief of Operations Hans Smit, was assisted in deck operations for sampling by the vessel crew as well as representatives from the NES, House of Ariki, and a representative from the Seabed Minerals Authority. A video record of the voyage was captured by an independent Cook Islands environmental consultant.

During this 7-day campaign, nodules were collected from within the OML reserved area, but within a region which had seen very little prior sampling by past research cruises. Samples were collected from 50 unique locations and subsamples were sent to the Australian Minerals processing and Metallurgical Laboratory (AMML) in Australia for analysis and comparison against previous scientific cruises. This very limited sample set yielded promising results – comparing well with previous estimates of nodule abundance as well as metal concentrations within the nodules themselves. A portion of the sampled nodules have since been used for a variety of tests, mostly related to understanding the distribution of the metals of interest within the nodules and the implications for extracting those metals. Testing by BGRIMM, a division of Beijing General Research Institute of Mining and Metallurgy as well as by Umwelt-und Ingenieurtechnik GmbH Dresden (UIT), -- two independent world class research facilities for process engineering and test work -- has since confirmed that the metals of interest can be extracted from Cook Islands nodules and recovered using relatively simple hydrometallurgical processes. OML is currently working to expand upon that research to develop detailed process flow sheets and cost estimates. These process flow sheets will be prototyped and pilot tested using a larger quantity of Cook Island nodules early in Moana Minerals' proposed exploration program.

Environment – work done to date

Seabed sediment and nodule rinsate samples were also collected using grab samplers during our 2019 research cruise. Small subsamples were saved for future microscopic and genetic analysis under an exploration licence. A composite bulk sediment sample was created using all recovered sediment from all 50 grabs, and quantities of this material were provided to Cook Islands Investment Corporation for their use in ongoing plume research. Additional small quantities of sediment are being studied as part of an ongoing sediment plume control project being performed by Deep Reach Technology Inc. (DRT) and funded under a US government research grant. (DRT is the engineering company that conducted for another US government agency the original desktop studies related to seabed based rare earth element (REE) deposits, and which eventually led to the spin-off of OML.) DRT's preliminary work in this area has yielded a nodule collector design improvement which ultimately may result in much less sediment suspension and resulting plume.

As part of Moana's exploration programme, environmental studies will be completed from the sea surface to the seafloor and will encompass visual, physical, chemical and biological investigations. These investigations will be conducted within an ecosystem model and will be planned within the framework of an Environmental and Social Impact Assessment (ESIA) Scoping Study. The Scoping Study will ensure that the environmental studies during the exploration programme are suitably scoped to generate the information required by technical experts, regulators and stakeholders to ultimately assess the potential environmental and social impacts of mining. The Scoping Study will be workshopped with regulators and stakeholders and Moana will engage peer reviews of the environmental scope. Indeed, Moana recognises that international technical peer review and independent assessment panels will likely be part of the exploration programme.

Moana will also create opportunities to engage with citizen scientists in the Cook Islands. Moana is a founding sponsor and partner in the Pelagic Observing System (PelagOS), an App-based tool for registering observations of ocean wildlife, vessel activity and debris. In addition to using PelagOS on vessels chartered by Moana, other vessels transiting between islands and marine tourism vessels can use the system to expand the knowledge of the diversity and distribution of oceanic fauna over a much broader area than just the Moana application area.

Because of the work outlined above and completed since 2017, Moana is applying for an Exploration Licence with a high level of confidence that the proposed 4+ year programme will be sufficient to gather all the data and information required to meet the exploration work programme objectives discussed below.

Exploration programme

Exploration objectives as detailed in Moana's Work Plan are summarised below.

Environment

- The environmental baseline studies will encompass the air, sea surface, midwater ecosystems and seabed.
- The environmental programme is described in the Application. The programme will include at least:
 - Mapping of the seafloor and spatial planning of exploration activities in relation to mapped ecosystem features. Mapping will produce at least bathymetry, backscatter and sub-bottom profiles.
 - Bathymetry is essentially a water depth measurement over a grid of the seafloor. A multibeam echosounder will be used to create detailed maps of the seafloor terrain. These maps can be used to identify features such as seamounts, slopes unsuitable for nodule harvesting, hill features, valleys and flats. They can also be used to identify optimal positioning of equipment and planning of work programmes, as well as to provide clues related to location of nodules and to define habitats.
 - Backscatter data is a measurement of the *intensity* of the multi-beam acoustic signal that is *reflected* back off the seabed. It is collected at the same time as water depth and is an indicator of the “hardness” of the seafloor. This in turn can be correlated with the nodule abundance, through seabed imaging and sampling. This data can also be used to help determine/characterise habitats.
 - Sub-bottom profiling (SBP) uses pulses of sound aimed at the seabed in order to penetrate the layers of sediment. Analysis of the reflected and refracted energy gives an understanding of the sediment structure that is important for interpreting nodule distributions and abundance, how effectively the seafloor can be traversed and the general benthic ecosystem.
 - Measurement of water and sediment quality.
 - Studies of water column and sediment biogeochemistry.
 - Oceanography, including the deployment of moored and drifting sensors allowing for collection of long term (multi-seasonal) and continuous data on water quality parameters, productivity, sediment flux, midwater and near-seafloor currents, and baseline noise levels. The requirement for multiple years of such data to establish the environmental baseline is a major driver of the exploration programme

schedule.

- Developing understanding of midwater pelagic biological communities including seabirds, cetaceans, fish and reptiles.
 - Developing understanding of midwater pelagic biological communities and ecosystem processes.
 - Analysing benthic biological communities and ecosystem processes, including studies across the size ranges from megafauna to microfauna.
 - Sampling spatial and temporal scales to understand trends related to the representative seafloor habitats and oceanographic seasons.
 - Engaging with best available local and international scientific knowledge.
 - Multiple collaboration, training, education and information gathering initiatives, to include:
 - Workshopping the ESIA Scoping Study
 - Development of an integrated ecosystem model and tools to communicate what we learn in terms of how the Cook Islands deep water ecosystem functions and its key sensitivities
 - Examination of potential disturbance scenarios
 - Identification of adaptive management opportunities
- The environmental studies will generate several opportunities for collaborative research and community outreach and education about the biodiversity and ecology of Cook Islands' deep-sea environment. These opportunities will be explored fully with the necessary agencies, but examples include:
 - (a) The engagement of a Cook Islander in the position of Community Liaison Officer, to be based at Moana's premises in Avarua
 - (b) The creation of internships within the company in the areas of geology, environment, database management, administration, operations (including safety) etc.
 - (c) The creation of research scholarships in the physical or life sciences
 - (d) The deployment of PelagOS and training packages to engage the marine research and tourism sectors and inter-island shipping industry in collecting valuable environmental data.
 - The Environmental Work Plan will have a strong focus on data accessibility in recognition of the importance of transparency and Moana's contribution to an emerging best practice in seabed minerals exploration in Cook Islands. Moana will maintain an environmental database with online portals for registered users to allow access to real-time information on operations. Moana will also extend invitations to independent observers and videographers.
 - The Environmental Work Programme recognises the considerable body of environmental knowledge now available for nodule habitats in other abyssal basins, most notably the Clarion Clipperton Zone and several of Moana's team members are involved in processes of drafting regulations and establishing best practice by the International Seabed Authority

(ISA). However, we also recognise the uniqueness of the Cook Islands environment and cultural setting. Our work programme therefore seeks to springboard from the applied lessons in other areas to provide the best outcomes for Cook Islands.

- The planned environmental sampling activities are Tier 2 activities, requiring consent, but not a dedicated Environmental Impact Assessment (EIA). The need for Tier 3 exploration activities such as equipment tests, system trials etc., which would require an EIA and permit, will be assessed and determined in year 2 of the Work Plan. Such exploration-level EIAs that arise through the exploration period will be done as required, with specific planning of sites and phased activities.

Mining viability

- As stated above, we have completed significant work using data from research cruises conducted in the EEZ over the last 30 plus years. Within the Application Area, it has been concluded that there is a polymetallic resource containing multiple attractive metals and most notably including 1 million tonnes of contained cobalt with a further 1.5 million tonnes of contained cobalt to be confirmed as part of the exploration programme.
- In order to justify the sizable future investment to develop a commercial nodule recovery capability and bring critical metals to market, Moana needs to both upgrade confidence of the resource from “Inferred” to “Measured and Indicated” (distinct measures of confidence in line with global mineral reserve and resource reporting standards) and confirm the total potential size of the nodule resource with the Application Area, both of which require additional sampling. We propose the use of modified freefall grab samplers (such as were used during our 2019 research cruise), which involves disturbance of very small (± 0.2 sqm per sample) patches of seafloor broadly distributed over the Application Area. In combination with high resolution imaging and other non-invasive seabed survey techniques, coupled with limited box core sampling (also a small disturbance footprint), we should be able to accomplish this upgrade employing very low impact techniques.
- In order to understand the challenges associated with traversing the seabed with any future recovery equipment, we will use sediment samples from the box cores mentioned above and measure the mechanical properties of relatively undisturbed sediment. These same box cores also provide tremendous potential for collecting benthic flora and fauna samples as part of the environmental program.
- In order to definitively determine whether processing of Cook Islands nodules for extraction of the target critical metals can be done economically, pilot scale process testing will need to be completed. This will require the collection of a larger quantity of nodules than can reasonably be accomplished with the small grab samplers. For this material, a small-scale towed dredge will be employed over a limited area.
- At a high level, this work consists of:
 - Broad area survey – bathymetry, backscatter, and sub-bottom profiling.
 - Free fall grab sampling (based on what was used successfully in our 2019 research campaign).
 - Box core sampling
 - Towed dredge basket sampling.

Engineering related research

- This effort piggybacks on the other exploration activities in terms of sample and data

collection. For example, as discussed above, box cores collected primarily for seabed environmental work will also be used to provide relatively undisturbed sediment for soil strength testing in the form of shear strength and compressive strength. In order to be effective, this type of testing must be performed on freshly collected sediment samples (or, ideally, undisturbed sediment samples), and involves the insertion of a small mechanical device and the measurement of resistance to penetration and to being reshaped. This is important information for the design of any future nodule collector system, with the goal of moving easily over the seabed while minimising sediment disturbance.

- During later years of exploration there may be at-sea testing of prototype mining equipment but this will require an EIA and associated NES permitting. This testing should provide critical engineering data and give an opportunity to observe and measure the likely impacts of various mining equipment on the marine environment. The objective of these activities is all about further reducing technical risk and environmental risk.

Maximising the return for Cook Islanders

- There is significant potential to do all the survey work using local Cook Islands vessels and crews, augmented by specialised survey vessels and experts.
- All work will be done in close consultation with Cook Islands' stakeholders, maximising use of local resources, services, supplies, and personnel. Moana's lead for local engagement and office operations in the Cook Islands will be a local Cook Island national. Moana's office, on which the company has held a lease for the last two years, and from which we staged the 2019 research campaign, is in downtown Avarua. The Moana team looks forward to working with the Cook Islands community to further develop the company's comprehensive Local Engagement, Training and Business Development strategy.
- As evidenced from the 2019 research campaign, our approach to exploration is to maximise use of local assets, rather than mobilising expensive, foreign flagged ships. This is beneficial for all stakeholders – increasing local expertise and creating jobs, optimizing costs, providing opportunities for training and workforce development, reducing carbon footprint, keeping exploration funds in the local economy, and providing more local control in terms of scheduling and allocation of resources.
- Some or all of the above activities will require prior approval from the Business Trade and Investment Board under the *Development Investment Act 1995-96*. OML registered with the BTIB on 28th of June 2018, and Moana shall also register.
- Moana has a comprehensive Integrated Safety, Health and Environmental (SHE) Management Plan in place, which will guide our approach to ensuring world class SHE standards are applied during the work programme. This Plan is supported by an Incident Response Management Plan that identifies potential risks and mitigation activities.
- Moana will ensure that the company sends its liaison officer to at least two islands in the pa enua (outer islands) each year and offer in-service training or a scholarship to a person from the islands visited.

Financing

Ocean Minerals has a proven track record of progressively funding the Cook Islands operations and so far, has made significant advancements in developing the project. Granting of an Exploration Licence will be the next key milestone in Moana's Business Development Plan. Award of an Exploration Licence triggers current agreements with Moana has concluded with

investors and partners that fund the remainder of the exploration programme. Further, should the efforts of the proposed 5-year exploration programme convince the collective stakeholders that seabed mining of nodules in the Cook Islands can be done with minimal environmental impact and produce critical metals at an attractive cost for the global metal markets, implementation funding should be readily available from partners, institutional investors and lenders and large investment funds. Although an important future consideration, the company has much work to do first, and this will become relevant when all of the other objectives of the exploration programme are completed.

Markets

Finally, it is important to continue our engagement with end users (the “market”) for the critical metals abundant in the Cook Islands’ nodules. This includes auto makers and lithium-ion battery makers, towards development of the products to advance global objectives for electrification of transportation and other carbon-reduction initiatives. This also includes rare earth element “green energy” applications such as permanent magnets used in wind turbines and specialty alloys and other materials used in high efficiency solar cells and other applications. The overall goal is to help to ensure the Cook Island’s nodule resource is recognised as the largest primary cobalt resource in the world and prove that it can be brought to market more cleanly, more responsibly, and more affordably than any other major sources presently supplying these metals. OML is an affiliate of the Cobalt Institute, ensuring the company keeps abreast of current market regulations, conditions and developments. Our engagement with the Critical Materials Institute within the U.S. Department of Energy to understand the cutting-edge research around materials and metal replacement and recycling strategies will also continue. This includes staying current on the somewhat fluid field of battery (especially cathode) chemistry research and investment. The exact amount of cobalt that is going to be needed is a moving target, but there is general consensus that the demand is going to significantly exceed the anticipated supply unless new sources of cobalt can be brought into production. Much of the world’s current supply is under the control of a very limited number of mining and processing interests and much of these supplies have considerable community and environmental challenges that have only recently begun to be addressed.

Conclusion

There is much to be done before mining of seabed nodules becomes a reality. Moana believes that with the necessary legal and ethical guidelines in place, the potential the Cook Islands’ nodule resource represents is tremendous. For Cook Islands the project represents a generational opportunity to provide long-term financial security, robust economic growth and a dynamic future, particularly for the youth, without compromising the local culture and traditions inextricably linked to the ocean. For Moana and its owners, the attraction is being involved in a long-term economic project that is a true “game changer” for some of the most critical technology metals needed for the world to meet carbon reduction goals. Moana believes the exploration work plan and environmental management plan and the plan of operations as proposed in our application will provide the necessary crucial information to help all seabed mining stakeholders understand the opportunities and risks with moving forward in a reasonable timeframe towards cautious development of this resource, with significant benefit to the Cook Islands.