Saving the world – or destroying the deep?

Anja Hazekamp:
The deep sea is the most extensive habitat on our planet and it supports high biodiversity. And scientists believe that as many as 10 million species inhabit the deep sea and ecosystem that may be as rich as the tropical rainforests. The majority of species are yet to be discovered.

Nancy: That's Anja Hazekamp, a Dutch member of the European Parliament, on January 17, protesting the Norwegian Parliament's first in-the-world decision to open its seabed to exploration and mining.

Anja*: The deep sea is also critical for other environmental services, such as long-term carbon sequestration. This kind of activity could quite literally start a global race to the bottom. A race to mine the ocean floor. The position of the EU is clear. The precautionary principle must be applied, and we need an international moratorium on the seabed mining. We need to send a clear message to the Norwegian parliament to withdraw the decision.*

Nancy: While the Norwegian Parliament, the Storting, approved the plan on January 9 with an 80 per cent majority, the EU's parliament, as you can hear, isn't as enamored with it.

Neither are Norway's own Environment Agency and Institute for Marine Research, which both said the country doesn't know nearly enough about the environment in the area to take this step.

As far as the EU goes, even though Norway isn't an EU member, a vote by the EU's Parliament to condemn Norway's decision sends a strong message.

I'm Nancy Bazilchuk, and you're listening to 63 Degrees North, an original podcast from NTNU, the Norwegian University of Science and Technology.

Today, I'm going to take a closer look at Norway's landmark decision to open an area the size of Italy, most of it in the Arctic, to exploration and mining. (more of a teaser here??)

I'll be talking to experts from all sides of this debate, to find out why some believe it to be a responsible move and the only way forward if we are going to transition away from fossil fuels, and others who think it's a terrible idea.

But before I get into today's debate, I think it's useful to take a quick look at the evolution of our understanding of what riches lie on the seafloor. We've known about seabed minerals for more than a century, as it happens. The story starts with the British Challenger Expedition, which circumnavigated the globe from 1873-1876 .

Mats: So, the Challenger expedition is often thought of as the birth of modern oceanography, and it was also they who first discovered the manganese nodules. They did a haul to the west of the Canary Islands in February, 1873, where they first got a small piece of what turned out to be a manganese nodule.

Nancy: That's right! We've known about seabed minerals for more than a century, as it happens. The story starts with the British Challenger Expedition, which circumnavigated the globe from 1873-1876 .

Nancy: And that's Mats Ingulstad, a professor at NTNU's Department of Modern History and Society. In addition to his research on the history and development of strategic minerals, he also heads an interdisciplinary program called Triple Deep, which is looking at the many cross-cutting issues surrounding deep sea mining.

Those manganese nodules that the British Challenger Expedition found on the seafloor are *not* the kinds of minerals that are found in the area that Norway has opened to mining. But the discovery awoke the collective consciousness that there could be something more than fish of value in the seas.

Mats: It really opened up a new idea of the deep seabed as a place where you could find vast mineral riches. *And this is in the 1870s? Yeah*. And then the thing is that for most of human history, the deep seas have been sort of off limits, and they haven't really been of interest. So when ships sailed, they weren't interested in how deep the ocean was. They were interested in knowing how shallow it was, so they could avoid running aground or they could locate fisheries that were quite rich in shallow areas. So they seldom carried more than a hundred or 200 fathoms of sounding line.

Nancy: For roughly 100 years, these manganese nodules were more or less the main hint of what lay in the ocean's depths. But things began to change as Western societies became more prosperous and began to need more and more minerals.

For Norway, the real shift began in 2008, when a multinational expedition led by a geologist from the University of Bergen discovered a series of hydrothermal vents in the Arctic. These were much farther north than other similar seafloor deposits. The researchers had a remotely operated vehicle and found these vents, or black smokers, in water that was more than 2000 metres deep.

They called the area Loki's Castle, because the vents took the form of chimneys, like fantastical lumpy castles built by kids. A University of Bergen press release from that

time said the name was chosen with reference to the ancient Norse god of trickery, Loki, which the researchers thought was "an appropriate name for a field that was so difficult to locate".

Nancy: The area that the Norwegian government has opened to seabed exploration and mining covers part of the Arctic Mid Ocean Ridge. Loki's Castle is a part of the ridge, but the government plan excludes it and other active hydrothermal vents from mining because active vents are thought to be more biologically rich and important.

The key here is that these underwater vents spew mineral rich water out into the ocean, where the minerals can precipitate and collect around the vents.

Until this discovery, researchers didn't think these kinds of deposits were found off of Norway.

But they are.

Kurt: This area is extremely interesting because it's an active tectonic area where you have a spreading ridge, making the Greenland side and Norwegian side move apart from each other. Related to this spreading, you have volcanic activity. So you form new oceanic crust, and with that you also have hot fluids that circulates in the oceanic and crust comes up through what we know as black chimneys or hydrothermal chimneys.

Nancy: That's Kurt Aasly, a professor of process mineralogy at NTNU's Department of Geoscience and Petroleum. Those first deposits he described are called seafloor massive sulfide deposits, which mainly contain copper and zinc.

Kurt: You also have sea mounts. Some of them are covered with a thin layer of what we call cobalt rich manganese crust. This crust can be typically up to eight centimeters thick on the original rock. It contains metals like manganese, copper, nickel, and cobalt of course. And then potentially also some rare earth minerals or metals.

Nancy: When researchers have explored these hydrothermal vents, they found much more than this treasure trove of minerals. They began to find all kinds of weird creatures living around them that no one had ever seen before. A whole ecosystem, evolved to survive in the deep, under incredible water pressure, and right next to waters that are so hot that they can melt plastic.

Mats: There are two issues that are raised immediately. One is that this is a vast treasure of mineral riches, and also this is a biological hotspot potentially for lots of unknown species.

Nancy: And that's more or less where things still stand today. On the one hand – the potential for great wealth, new jobs – especially for Norway's oil and gas industry, which has expertise working offshore – and on the other, this unknown kingdom of organisms that we know almost nothing about. But before we talk about the biological hotspots (pun intended), let's dive a little more deeply into what the Norwegian Parliament actually did when it acted on January 9.

Egil: Norway actually granted the start of deep sea mining on a part of the Norwegian exclusive economic zone of about 280,000 square kilometers.
So they actually opened up the process after about four years of public hearings, and reporting and discussions and so on.

There was a four-fifth majority of the Norwegian parliament for opening up this sector or this area.

My name is Egil Tjåland. And I'm an associate professor at the Department of Geoscience and Petroleum at NTNU. So that is my main job. And then I have another title, which is Secretary General of the Norwegian Forum for Marine Minerals.

Nancy: Needless to say, as secretary general of the Norwegian Forum for Marine Minerals, Egil thinks the government's decision is a good idea.

Egil: If you look at the reason for the Parliament to do this, that is to obtain security for metal minerals. That is the main objective. ...We are moving into this energy transition with the need of metals for all these types of new energy sources like windmills and solar panels, and we need to make batteries and all that stuff. And if you look at the demand for materials to drive this in transition, you need to secure those ingredients inside those things. And right now, Europe has almost nothing. I think we are talking about maybe 2 to 3% of all the materials that we have come from mining in Europe: It used to be 50, 60, 70% just a hundred years ago.

Nancy: Kurt Aasly agrees about the need for new metal mineral sources, but has concerns about the government's approach.

Kurt: I think that opening for exploration in the extended Norwegian continental shelf is important because we know there are potential for mineral resources down there. I think that part of the decision is good. And when government says that, okay, if the commercial companies, they will be responsible or be given the responsibility to collect data about the potential resources, then the government will have the responsibility for collecting data about the environment, biology and all the other things that you need to know before you make decisions for potential mining. If that comes together, that's very good.

What I personally or professionally think can be a bit difficult is that they have opened for mining. So the license is a mining license.

Nancy: (34) Kurt says people who look at the worst-case scenario assume that the government will immediately allow companies that have been given licenses to mine once they have finished their exploration, but that's not correct.

Kurt: The actual license gives you the exclusive rights to an area to explore for potential mineral resources. And then if the company finds something that shows that this can be actually be mined with a profit, then they have to do a new environmental impact assessment for this area, provide a mining plan and an application to the Storting. And then the Storting has to decide if this is okay or not.

Kurt: I agree that we need the exploration, but I think it's premature to include mining in that permit.

Nancy: Biologists are particularly concerned about how little we know about this giant area and its strange, otherworldly biology.

Torkild : The general concern is that the knowledge we have about these areas is so tiny, considering the area – it's almost as big as mainland Norway. It's 280,000 square kilometers approximately, and mainland Norway is 330. So it's huge. It's massive.

Torkild : My name is Torkild Bakken, an associate professor at NTNU University Museum. I'm a marine biologist and have been working on biological diversity.

Nancy: I should note that Torkild recently co-authored a paper about the creatures found around Loki's Castle vent field. At least 10 of the species he and his colleagues found have yet to be named.

Torkild : We have been down at the seabed very, very few times, and when we have been there, or someone has been there, the areas that have been studied or sampled, it's only a few square meters at a time. And that's just a pinpoint within this huge area. So we have very little and very fragmented knowledge.

Nancy: Torkild says the challenge with seabed mining, especially the kind that would be done in Norwegian waters, is that it is destructive. Mining would involve dredging up or scraping these layers of minerals off the seabed. So that habitat disappears. But there is also the issue of the fine sediments that will be kicked up by the mining. And, sound. How noisy will it be, both during exploration and mining itself? We know whales are vulnerable to underwater noise. How will this effect them?

And what about ocean bottom currents, about which we know virtually nothing?

Torkild :So what happens when there's an impact, you see it from the bottom trolling as well in the sediment plumes. So they choke and bury the life that lives on the bottom or in the seabed, in the sediment in that area. So that's a concern. That's why I would say that we can't do deep sea mining sustainably at all. Not at all in the biological meaning of sustainability, because it's total destruction of that exact area that you're mining or trawling, for that matter, where the impact is.

Nancy: So why do this at all? Egil Tjåland, who we heard from earlier, argues that if we want to make the transition to a greener economy, we will need seabed metals to build more electric cars, build windmills and improve transmission grids. And he says we can't recycle our way out of this problem.

Egil: Copper is a material that we can recycle quite easily. Aluminum, of course, we know that. But when it comes to the demand for the energy transition, we need of the order of five to six times more copper production than we have today. So we cannot recycle what we have. We cannot take out the copper wires in the walls to recycle it. It's not logical. It doesn't make sense. So to get enough material, you need to have an additional source.

Nancy: So where do we get these minerals?

Egil: Well, you can of course increase the production on terrestrial mining, but that has also an environmental impact. Take an example of nickel, the biggest producer is Indonesia. They have one of the biggest rainforests in the world. So when you produce a new nickel mine in Indonesia, you also disturb the environment. We would like the materials, and we cannot get enough by recycling alone. We need to do something. And by just sitting there and hoping that it comes from somewhere, that is to me a very dangerous approach.

Nancy: I will note here that not everyone agrees that recycling won't help. The European Academies' Science Advisory Council published an assessment of deep-sea mining with an eye to future metals demand and environmental impacts in June 2023. In sum, they concluded that for Europe, anyway, recycling could meet as much as 40-77 per cent of the region's clean energy metals needs by 2050**.** In fairness, though, that number has been disputed by some. Regardless of the actual numbers, the council has called for a moratorium on deep-sea mining because its environmental impacts are so poorly understood.

But Egil makes two other arguments. The first is the potential value of minerals and metals in the zone that Norway has opened for exploration and mining. This estimate

comes from the former Norwegian Petroleum Directorate, which has now been renamed the Norwegian Offshore Directorate.

Egil: (The former Norwegian Petroleum Directorate,) they have an estimate, which is based on samples they have done over the last four or five, six years. And the resource estimate they have is enormous.

Nancy: And how much money are we talking about?

Egil: I calculate on back of the envelope, without taking in the rare earth elements, it's $1.5 trillion.

Nancy: Yup, that's a lot of cash. But Mats Ingulstad, who's head of the interdisciplinary deep sea mining project, Triple Deep, has a different take on the estimates. He says the government White Paper that formed the basis of the Storting's decision is...

Mats: ...very enthusiastic about the possibilities, suggesting the presence of large mineral riches. But the fact of the matter is that we know very little about these potential deposits. So you could not maybe even classify them as resources in layman's terms, because you don't have the data to describe them or the extent of them scientifically. So it's a huge gamble, for rather uncertain gains.

Nancy: The second argument Egil makes is that Norway can show the way to do this responsibly.

Egil: If you look at the oil and gas industry, you cannot spill a drop of unwanted chemical in the water, it will be penalized heavily. So by using this same kind of kind of technology and attitude towards this new fledgling industry, Norway will be able to maybe point towards how to do this for other countries. I think we could be a role model for this.

Nancy: Torkild, our biologist, acknowledges that Norway has been careful to monitor its petroleum sites.

Torkild: So if there are areas that are well known, we know that we can monitor the impact along the way. We see that in the petroleum sites, off the coast now, there's has been a monitoring system for decades. So you can see that are there changes going on or not. We know what the harm is, and we know what the impact is, and can we take that risk. So if you have the knowledge you need, then you can do a qualified decision or mitigations can come in, for example.

But in this area, we don't know.

We haven't been there.

Nancy: While acknowledging that society needs minerals, Torkild points out that there's a big difference between the Norwegian continental shelf, where Norway's oil installations are located, and the deep sea.

Torkild :We know that we need minerals. So there's a real dilemma. But if we're going into a pristine, completely unknown area, what the impact will be and what we will destroy?

Torkild :We risk losing species that we didn't know we had, species that are still unknown to us. That's one thing. There's also their habitats and parts of the ecosystems. We need more knowledge, simply.

Nancy: Egil sees other risks – but not the kind you might think.

Egil: Well, the risk is that there is not enough materials down there to make any business.

Nancy: Kurt Aasly, our geologist, agrees not enough is known to mine. But he also points out that any mining proposal can take years or even decades, for the journey from discovering a viable mineral deposit to actually mining it.

Kurt: Okay. So, we know from experience, not only in Norway, but most of, at least most of the western world, that when you find a potential mineral deposit, it takes at least 20 years before that deposit can be mined. It includes many years of work, many investments to explore and develop the deposit. Then you have to start applying for permits to do the mining.

Nancy: Among those are environmental impact statements.

Kurt: Then you can in the end, apply and have a license to operate. This will take years. We know today what we need for the current technology to be viable in the future. We need copper, we need cobalt. We need nickel. We don't know what technology will bring in five years, 10 years. But if we don't make sure to know where we can find what we need today, it'll take even longer to secure these resources. So we need to work on what we need, define resources, and then start mining if we need them. Doesn't matter if it's onshore or offshore.

Nancy: I'm going to give the last word to Mats, our historian. The Triple Deep researchers worked together on an opinion piece after the Norwegian government made its decision saying what you've heard already – that we don't know enough. Mats explains.

Mats: What we are criticizing is that there's not an apparent will to recognize the limits of what we know and of what the potential side effects might be. And also that the actual gains from this might turn out to be rather limited. So let's say the technological demand for minerals is not as great, or it's not for the specific minerals that are most accessible in the Norwegian area. Then you've made quite a gamble and invested a lot of time, a lots of resources, a lots of prestige into something that's ultimately not worthwhile or helpful in driving the transition. So it's highlighting the uncertainty. That's what was our ambition. And from the political signals that we see from the debate in Parliament, they've taken some of this to heart.

Nancy: There remains, however, an addition problem that the Triple Deep group identified. It involves something called ecosystem services. This is a fancy way of saying that all the things that are provided by the Earth's ecosystems — from wetlands that protect coastlines from wave erosion, or bees that willingly pollinate our food crops – we don't pay for those, so we don't put a monetary value on them. For something like deep sea mining, it can be hard to calculate the financial loses we incur if we alter the ecosystem there, even though, in the end, it may be critical to our survival.

Mats: How can you calculate the value of the ecosystem services? As the biologists like to point out, the production of plankton in the (CUT DEEP) sea is really crucial for the production of oxygen. If you disturb the oceanic currents or even conditions in these areas, you could have very substantial knock-on effects through the food webs. But we don't know what they are, because we don't know what the food webs look like.

So, we concluded that, if you insist that these minerals can be Norway's contribution to the deep transition away from fossil fuels, and also that it's phenomenal riches that will amount to thousands of jobs and billions of income, then you should at least invest in having the necessary research done to map in geological and biological terms, what are the conditions in the deep sea in in this territory.

Nancy: I'm Nancy Bazilchuk, and you've been listening to 63 Degrees North, an original podcast from NTNU, the Norwegian University of Science and Technology. My guests on today's show are Mats Ingulstad, Kurt Aasly, Egil Tjåland and Torkild Bakken.

You can read more about Norway's proposal and find links to some of the documents we've talked about here in the show notes. And if you're curious, like me, about the history of deep sea mining and want to hear some cool stuff that I couldn't fit into today's show – including, yes, a CIA plot and Howard Hughes – watch your feed! I'm working on a little podcast extra on that. Shout out to Per Jynge for his help.

Writing, editing, sound design and production by me, Nancy Bazilchuk. Thanks for listening.