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Deep Sea Mining – Current Status and Future Potential

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Introduction

In one of the most recent editorials on the state of the deep sea mining industry (published on 4 June) the Guardian postulated that "Mining the deep ocean floor for valuable metals is both inevitable and vital, according to the scientists, engineers and industrialists exploring the world's newest mining frontier". Much has been written on the subject ever since the potential for extracting metals from the ocean floor was first identified. However, progress has been somewhat stilted over the years – principally as result of the costs involved as well as environmental concerns. This article seeks to review the progress made to date and the prognosis for further development.

The Available Resources

Deep sea resources come in many different shapes and sizes – from sulphide deposits laid down next to hot springs to polymetallic nodules lying on the sea bed. Rare earth and precious metal modules have been at the forefront of interest but more recently phosphorus nodules are attracting attention in the context of the rush for fertiliser products. While diamond mining on the seabed adjacent to the coast in South West Africa has been active for several years (De Beers has been mining for diamonds in the shallow waters there since the 1960s) the first firms to target deep sea mining were attracted by the discovery of manganese nodules. However those pathfinders immediately encountered the adverse economics involved in the deep sea mining environment. Nevertheless exploration and other prospecting activity has continued and new technologies and (until relatively recently) an upward price curve have offered more positive potential returns to those prepared to invest. In addition grades in deep sea deposits have tended to be higher than with their land based counterparts. For example the copper grade at the Solwara-1 project in Papua New Guinea is estimated to be in excess of 7%. Resource exploration on terra firma involves activity in increasing inhospitable terrain and environments. As a result some analysts have predicted that the deep sea sector could be providing 10% of total mining output by 2030. That, however, is a pin-prick when compared to the estimated available deep sea resource – possibly something in excess of $100 trillion (or more) by some estimates. Against this should be balanced the fact that potential prospectors have been speaking about mining manganese nodules since the 1960s.

Some of the early stage promoters of deep sea mining include UK Seabed Resources, a government-backed British subsidiary of Lockheed Martin. The company has secured a licence to explore a 4,000-metre deep area of the Pacific Ocean which is twice the size of Wales. Possibly the most well known project in the sector though is the Solwara 1 project being developed by Nautilus Minerals in the coastal waters of PNG. Nautilus plans to construct vessels and other infrastructure to exploit a deep-sea gold, copper and silver massive sulphide project. The challenge is illustrated by the fact that the deposit on the ocean floor is 1500 metres below surface. Nautilus hopes to bring the project into production by the first quarter of 2019.

Rare Earths, etc.

Deep sea mining has been frequently mentioned in the context of rare earths and other metals used in new electronic/ technology products. The Pacific ocean floor to the east of Japan (around the island of Minami-Torishima) is known to have particularly rich deposits but the comparable cost to mining on land has so far prevented too much speculative activity. The deposits lie at a depth of more than 5 km. On the plus side the deposits are estimated to contain around 6.8 million tons of rare earths. In addition the geo-politics of the market for rare earths offer compelling motives for a drive to develop resources to compete with the current Chinese virtual monopoly. Other metals needed for new advanced products in the telephonic and electrical industries are to be found in great quantities on the seabed. In April of this year the BBC reported the discovery by British scientists of a deposit some 500km from the Canary Islands which contained tellurium in concentrations 50,000 times higher than in land-based deposits (tellurium is utilised in the manufacture of solar panels – the deposits in question also contained rare earths – used in wind turbines and electronics). The scientists calculated that the deposit – known as Tropic Seamount – potentially contained one-twelfth of total global supply of tellurium. If extracted to make solar panels it could meet 65% of the UK's demand for electricity.

Legal and Licensing Framework

The legal and licensing framework underpinning deep sea mining is often criticised for its uncertainly and inefficiency. This arises in part from the fact that not all countries have signed up to support the regime which has been created (as at July 2016 168 states had signed up – the USA is the most noteable exception; the United Kingdom is a member). The international legal framework stems from Part XI of the 1982 United Nations Convention on the Law of the Sea ("UNCLOS") and the 1994 agreement relating to the implementation of Part XI. UNCLOS provides for coastal states to have exclusive rights to resources contained within the continental shelf to a distance of 200 nautical miles from the coast. This zone is known as the Exclusive Economic Zone ("EEZ"). The seabed beyond the EEZ, and the minerals contained in it, are proclaimed by UNCLOS to constitute the "Common Heritage of Mankind" such that resources in this area must be explored and exploited for the benefit of "mankind as a whole". The regime is subject to regulation by a body known as the International Seabed Authority ("ISA") based in Kingston, Jamaica. States which have ratified UNCLOS are automatically members of the ISA.

Under the UNCLOS regime prospecting, exploration and exploitation (each of which is a carefully defined activity) beyond the EEZ may only be carried out in accordance with the rules and regulations of the ISA. Prospecting requires that the company in question delivers an undertaking to the ISA agreeing to comply with those rules and regulations as well as UNCLOS and also agreeing to accept verification of that compliance by the ISA. Exploration on the other hand may only be carried out subject to the terms and conditions of a contract to be agreed with the ISA. Such contracts may be awarded to either agencies of ISA state members or to private enterprises sponsored by an ISA state member. In each case the ISA state member in question is responsible for compliance with the contract. Each contract is valid for 15 years – although a contract can be extended. To date something in the region of 26 contracts have been awarded.

There are currently no ISA regulations in place for exploitation. A technical study, published in 2013, set out the issues which should be addressed in the regulatory framework for exploitation. These included the procedure for awarding exploitation licences, the fiscal regime and the division of profit and risk in the context of the declaration that deep sea resources are for the benefit of mankind as a whole. A working draft of proposed exploitation regulations was circulated by the ISA in July 2016. By the deadline for submission of comments (25 November) 43 individual sets of comments had been received. On 23 January 2017 the ISA issued a discussion paper designed to advance the discussion over environmental aspects of the exploitation regulations.

Some states (including the USA) have declined to ratify UNCLOS and become a member of the ISA. Reasons for refusal differ but invariably include an object to the requirement, in connection with the award of an exploration contract, to explore two equal sites and transfer the benefit (including exploration results, etc.) of one – over a period of time – to the ISA. The ISA is then left to develop that site for the benefit of those who might not otherwise be able to exploit the deep ocean environment. Non-member states have also objected to the ISA's powers of monitoring as well as a perceived opaque bureaucracy and process.

Exploration contracts signed with the ISA to date include that with UK Seabed Resources referred to earlier – that contract was for the exploration of polymetallic nodules in the Clarion-Clipperton zone in the Pacific Ocean and expires in 2028. Russia has also signed contracts for potential projects in both the Pacific and Atlantic Oceans. China has been very active in attempting to secure contracts. One of the most recent contracts – covering exploration for polymetallic nodules over 72,745 sq km of the Clarion-Clipperton zone – was signed with China Minmetals Corporation on 12 May 2017. India was awarded one of the first exploration contracts by the ISA and, as a result of its exploration activities, has identified an area of around 18,000 sq km in the Central Indian Ocean Basin with an expectation that actual exploitation may commence within the next five years.

In addition to the international regulation contemplated by UNCLOS as administered by the ISA a number of individual countries and groups of countries have established regulatory regimes for deep-sea mining. Nautilus Mining, mentioned earlier, is the beneficiary of a licence awarded by the government of PNG. While that was the subject of proceedings in connection with a dispute the position has been back on track for some years with the government making the required investment in the project. Nautilus is a flagship project being observed by many – if it succeeds others are bound to follow in its footsteps. Several islands in the Pacific have a combined regulatory framework to cover the exploitation of mineral resources in that part of the seabed which is subject to national sovereignty. The Cook Islands passed legislation relating to seabed mining as far back as 2009. In the UK the Deep Sea Mining Act 2014 was passed in order to amend the existing legislation (implemented in 1981) to bring the same into line with UNCLOS.

Environmental Issues

While mining on land presents environmental concerns there are multiple additional potential environmental issues with deep sea mining. Physical disturbance and destruction of habitat and fauna are of principal concern – particularly given the potential for an adverse impact on marine eco-systems more generally. Areas where polymetallic nodules are found seem to be a natural habitat for fauna which are particularly susceptible to damage from mining activity. Modification of natural wave and current regimes is also mentioned as a concern as is the potential for pollutant spills from vessels and other infrastructure involved in the deep sea mining process. The recent Guardian report referred to earlier quoted Verena Tunnicliffe, hydrothermal vent expert at the University of Victoria in Canada, as saying that "Mining will be the greatest assault on deep-sea ecosystems ever inflicted by humans". In the scientific exploration of Tropic Seamount – referred to earlier - an experiment sought to replicate the process of seabed mining with a view to measuring the plume created (the potential size of the plume created by mining activity on the seabed is a prime environmental concern). Early results apparently indicated that the impact of mining operations might possibly not extend beyond 1 km from the mine site. Other studies have not necessarily been so optimistic as to the environmental impact involved. Greenpeace is seeking an international moratorium on seabed mining.

Environmental considerations are particularly high profile in New Zealand (where legislation restricting activity in the EEZ has been in place since 2013). Based on environmental concerns proposals to explore for phosphate nodules by Chatham Rock Phosphate and for iron sands by Trans-Tasman Resources have both been rejected. A decision on a second application by Trans-Tasman is expected this year. New Zealand also recently launched a $3.7 million research programme into environmental concerns.

Technology

The technology for deep sea mining is gradually improving and prices are reducing. Most deep sea deposits will be mined through the use of hydraulic pumps or buckets to bring the raw material to the surface where it can then be either processed or shipped for processing. In addition remotely operated vehicles are now used to collect exploration samples from the target zone. In the one project which is actually heading towards exploitation the remote vehicles employed by Nautilus for actual exploitation are each the size of a small house – the smallest (of three) weighs in the region of 200 tons. The first vehicle is designed to create benches for the passage of a second vehicle which in turn performs the principal cutting process. The third vehicle collects the mined material and pumps the resulting slurry to surface. The vehicles have technology designed to minimise the production of a plume. Launch and recovery systems relating to the vehicles were delivered in May to the shipyard in China where the production support vessel is being constructed.

Conclusion

The extent of the mineral resources on the seabed is without doubt enormous. However the obstacles put deep sea mining at a huge disadvantage to the exploitation of resources in a drier environment. Those obstacles range from cost to technology to environmental issues. Each of these issues is of course present in the land based extractive industries but just not to the same extent. Many in the industry are looking to Nautilus to see whether or not the Solwara 1 project can be successfully brought into profitable production. If it can then it could indeed be a game changer.