

Conclusion to the Discussion of Copper Shipping, Concentrating, Smelting and Disposal

All copper concentrating and smelting processes have effluents and dangerous by products, such as arsenic. Nautilus has chosen one of the most modern facilities in the world with a greater opportunity to reduce the amount and toxicity of tailings. The TNFM smelter is currently the newest copper smelter in the world, utilizing the latest technology. The Solwara 1 mineralized material has a high concentration of chalcopyrite and has few gangue minerals.¹³⁰ The TNFM smelter is close to associated industries, such as iron, chemical, and concrete production. Thus, most of the pyrite other by-products can be utilized in other industries, greatly reducing waste material. Some end waste materials, including traces of arsenic, will be disposed of as backfill in associated underground copper mines very close to Tongling, TNFM.¹³¹

Though some details regarding the ultimate disposal of tailings and smelting slag remain to be settled, there seems to be both the opportunity and willingness on the part of Nautilus to pursue the most environmentally sound options.

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Other Issues

Finally, several issues likely to be more fully examined in future reports are included here.

Setting Standards

As Solwara 1 is developed, Nautilus and the Government of PNG will manifest the world's first deep seabed mining operation. As such, Nautilus and the PNG Government will play a critical role in defining the standards for deep seabed mining at both the national and international scales. As the first deep seabed mining project, Solwara 1 can set a high sustainability standard for the International Seabed Authority. Setting aside conservation areas such as South Su, investing in baseline data such as a thorough survey of life at the site and beyond the mining impact area, providing information willingly and ensuring close independent monitoring from the life-of-the-mine through reclamation are all ingredients to avoid the dramatic errors made in terrestrial mining.

IFC Standards

International social and environmental standards for investments exist. The most widely accepted standards have been set by the International Finance Corporation (IFC) of the World Bank Group. Although not required to

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meet IFC standards, Solwara 1 should surpass IFC social and environmental standards for mining in many areas. The IFC mining requirements were set in 2007 and should be up-dated. In addition, IFC requirements provide no guidance for deep seabed mining. Nautilus and the PNG Government have an opportunity to dramatically reduce the social and environmental impacts of mining and surpass many elements of the IFC standards. For example, Solwara 1 does not require the relocation of communities and does not impact cultural resources. There is no freshwater contamination, upper watershed tailings, or rock waste. In addition, the Nautilus proposal will have community projects, but not as mitigation for any impact to communities. The mine should only have positive impacts on communities in New Ireland and New Britain. This approach may set a new standard for “best practices” in mining that greatly surpasses the current IFC requirements.

Transforming Mining Processes

Deep seabed mining is a transformational approach to mining. The mine production vessel and three remotely-operated mining vehicles would displace hundreds of vehicles and much heavy equipment common to terrestrial copper mines. Much of the equipment is unnecessary because the mineralized material is on the surface of the seabed, meaning that the removal of millions of tons of overburden is avoided and mine efficiency is improved. Much of what is considered mining would be converted into a shipping activity. A vessel far above the mine site is being designed to enable enormous mining equipment to be easily and directly pulled out of the mine. This is impossible in any underground or open-pit terrestrial copper mine. This advancement alone would save downtime, increase efficiency and save on repair and mining costs. In a typical mine, road building is a gargantuan undertaking, yet this necessity does not exist in this deep seabed proposal. Additionally, weather at the sea floor is consistent, facilitating smooth, continuous operations. In March 2015, all mining stopped at Chuquibambilla (the world’s largest copper mine) and five other large copper mines in Northern Chile due to a heavy rainstorm that washed out the mine roads and flooded open pits. This sort of disturbance would not be a problem in deep seabed mining.¹³² The Bismarck Sea is also protected from typhoons and tropical storms. There is a great deal of opportunity for engineering and efficiency improvements in mining at the deep sea floor that should be addressed in future analyses.

Reduced Mine Employment

Increased efficiency in any industry often results in less employment. As noted by Nautilus staff, there are also social downsides to the mining transformation that seabed mining brings forth. There would be far fewer mining jobs in Solwara 1 as opposed to a traditional mine that removes a similar quantity of copper. Prominent Hill copper mine employs about 1,400 people,¹³³ and Bingham Canyon employs 2,800 people.¹³⁴ There would likely be less than 200 people working on the Solwara 1 mine site on the production vessel.

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Falling employment in mining is nothing new, however. It has been a function of increased technology and mechanization for the past 150 years. The ability to produce more output with less labor is a global phenomenon in every area of commodity and manufacturing production. This certainly deserves greater attention. Increased employment with Nautilus community projects could partially outweigh this net employment loss and could contribute to increased sustainability (coral reef restoration projects, for example). Counterbalancing the loss of employment (which has been a long-standing trend) is the fact that increases in productivity form the basis for rising real wages and a higher quality of life.

Impact on Copper-Exporting Nations

Copper exports provide a significant part of several countries' GDP. For example, copper exports account for 20% of Chile's GDP and 60 % of Chile's exports. At the scale of Solwara 1, the impact would be relatively small, but competition with expanded seabed mining could have a significant impact on the global copper market and particularly copper dependent countries like Chile and Zambia.

Opening the Seabed to Metals Mining

Most of the earth's solid surface resides in the deep seabed. Opening this area to metal mining, and thereby allowing higher concentrations of mineralized material to be mined with dramatically fewer impacts to communities, surface area, and social and natural capital assets, would be a historic achievement for Solwara 1. Copper ore concentrations have been declining dramatically in the last 100 years. Copper is becoming more and more energy-, water-, landscape- and pollution-intensive. "Peak copper", the idea that copper production will become so expensive that world production will decline, has become a mantra in some circles.

Mining selected copper resources at the deep seabed while still carefully conserving biodiversity promises to move copper concentrations back to 6% and open an area far larger than all terrestrial lands to mining. Yet, with higher copper concentrations and virtually no overburden, far less of the ocean floor would need to be disturbed to recover a ton of copper.

Mining selected copper resources at the deep seabed while still carefully conserving biodiversity promises to move copper concentrations back to 6% and open an area far larger than all terrestrial lands to mining. Yet, with higher copper concentrations and virtually no overburden, far less of the ocean floor would need to be disturbed to recover a ton of copper. The physical extent of the proposed Solwara 1 mine is 14 ha, the same area as a typical Walmart parking lot. As is the case for all mining, living systems will be disturbed and destroyed. Some copper mines displace the highest biodiversity ecosystems on the planet. Ok Tedi in PNG is astride a ridge in one of the earth's biodiversity "hot spots" and has impacted ecological systems from cloud forest to coral reef. The deep seabed, especially vent systems, have specialized ecosystems that must be conserved; however, mining high-grade mineralized material allows for less overall disturbance. Mining the deep seabed avoids the inevitable reality of mine waste and tailings eroding, contaminating and flooding the entire length of riparian systems to the continental shelf of the ocean.