Australian Standfirst

Responsible Deep-Sea Mining:

Resourcing The 2030's, *Polymetallic Nodules* & The Genesis Of The Automation Era

Emerging Supercycle

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With China making significant technological investment strides in recent years, demonstrating a clear aspiration of moving up the value-chain by electrifying its interior economy for the green transition and championing automation initiatives promoted under the, *Made in China 2025* industrial policies, the United States, Britain & the Eurobloc have vivified their efforts and made a stepchange towards remaining at the pointy end of the AI-Automation transformation in a *knee-jerk* response to remain relevant hegemons.

Cite:- Quantum Supremacy: Complicated Technologies Define Realpolitik, Hegemony & Wealth, 22 October 2020

Cite:- Automation, Artificial Intelligence & Bionic Markets, 1 March 2019

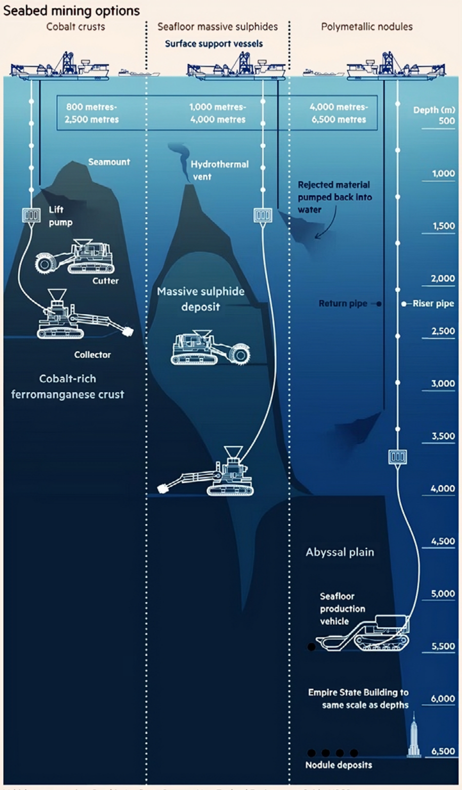
Cite:- Sino Spycraft & Sophisticated Cybersecurity: Cuba, Vanuatu, UAE – Financial Risk Management Concernment Confronting The D10, 5 July 2023

Cite:- The Iron Laws & Oily Rags Of The Commodity Complex, 21 June 2014

Considering current technological capabilities, the near-term commercial use of humanoid robots – the most tangible example of automation we'll notice around us in the coming five years – has visible demand from jobs such as manufacturing, commercial cleaning and food preparation, with the need for robots to handle dangerous jobs already elevated by national policies in China, Israel and no doubt soon, the United States; Humanoid robot demand could reach 1.1-3.5 million units globally before 2030, assuming a 5-15 percent substitution rate for special operations and manufacturing supported by an improved viability of end-to-end AI and multi-modal AI algorithms, which would enable much faster product iterations and better capabilities of achieving by the mid-2030's a general-purpose AI robot, as Elon Musk posited in 2023.

Cite:- The Investment Theme We Like, For A Technology We Hate: Facial Recognition Technology (FRT) and Dual-Use Applications, 13 July 2020

In so doing, China and the incumbent hegemons have come to an immediate realisation that the resource requirements of an AI-Automation ecosystem, powered by renewable energy differs profoundly from a fossil fuel system and that climate change policies may lead to the largest peacetime redeployment of investment and capital since the industrial revolution.



Vehicles not to scale Graphic: Ian Bott Sources: New Zealand Environment Guide; USGS; Frontiers in Marine Science; UNEP; Royal IHC; Nautilus Minerals; FT research

For instance, replacing a coal-fired power plant with offshore wind power generation requires six times the quantum of mineral commodities (copper, zinc, nickel, chromium and rare earths); for a gas plant it's thirteen times more and building solar capacity is less resource intensive but it still consumes three times more minerals than building coal plants. In addition, building new gridlines to connect the world's electricity supply and demand will require significant amounts of copper and aluminium, while replacing fossil-fuelled power generation with clean energy will reduce demand for coal and gas, it fundamentally changes our power generation from a fuel-intensive to a materials-intensive system, stoking a new commodities Supercycle underpinned by a secular shift in the global economy, and an equally seismic rotation in global listed equity markets from growth towards value companies.

As a consequence, Sustainable Investors looking to own *Greenablers*, have begun turning their focus towards mining new sources of hard-commodity supplies from frontier areas such as the moon, nearby asteroids and most recently the deep-sea.

Cite:- Mining The Moon: Spacefaring Silicon Carbide, Helium-3 For Nuclear Fusion & The New Astro-Metallurgical Frontier, 2 May 2023

Cite:- Space Investing Faces Obstacle In China-Taiwan Stoush, 26 August 2019

Cite:- Opportunities In Aerospace & Defence, 3 July 2018

One report by the US Geological Survey estimated that if deep-sea mining were to follow the path of fossil-fuel extraction at sea, then by 2065 the **deep oceans could supply as much as 35-45 percent of global demand for critical metals**.

While there are no commercial deep-sea mining activities taking place today, a number of companies and countries have begun exploring potential opportunities, with Norway most recently announcing intentions to begin mining their waters for metals they view as vital to the green transition, with deep-sea reserves potentially equating to US$16 trillion in materials across the global seaboard.

Asia and Europe make up nearly all current deep-sea exploration contracts, with China and India supporting technology development for eventual commercial operations and whilst most of the players working on exploration of the deep sea for potential future mining operations are state-owned, there are a limited number of public companies with exposure to the theme, including The Metals Company [TMC:US], DEME Group [DEME:BB], Seatrium [S51:SP] and Transocean Ltd [RIG:US].

Deep-sea mining is a process that collects metals and mineral deposits off the seafloor and transports them up to a ship or mining platform where the desired materials are extracted. Tailings are then returned to the ocean either into the water column or at the seabed, creating plumes of sediment at both the collection point and the point of discharge.

In the oldest parts of the seafloor, resource deposits are estimated to have been forming for the last Seventy million years. Deep-sea metals were first discovered in the late Nineteenth Century and brought to the public's attention in the 1965 book, *The Mineral Resources of the Sea*, in which John Mero argued that the seabed could be a significant source of minerals to meet the world's needs.

The *Clarion-Clipperton zone* alone – an area of the deep-sea in the Pacific ocean with active exploration contracts for deep-sea mining – is estimated to contain more than forty million tons of cobalt and 270 million tons of nickel in 21.1 billion dry tons of polymetallic nodules. This one zone amounts to over five times the amount of cobalt found in estimated land-based reserves and over three times the amount of nickel. Other metals with higher estimated amounts in the Clarion-Clipperton

continue over

zone compared to land-based reserves include manganese, molybdenum, yttrium and tellurium, which are used in EV batteries, CIGS solar cells, LEDs and photovoltaic solar cells, respectively.

Deep-sea mining exploratory operations have found a number of metals and minerals on the ocean floor from three different sources:

Polymetallic nodules: These are golfball to cricketball-sized nodules rich in manganese, cobalt, nickel, copper, iron and more, which form at a rate of only a few millimetres every million years. They are currently found scattered on extensive fields around 4,000-6,500 metres beneath the surface, with four areas of economic interest (north-central Pacific Ocean, south-central Pacific Ocean, south-east Pacific, and center of north Indian Ocean).

Polymetallic seafloor massive sulfides: These are mineral deposits that exist near volcanic and tectonic vent sites on the seafloor, both active and dormant. Copper, lead, zinc and gold can be found in these bodies of metallic sulfides at between 1,400-3,700 metres depth, with most potential currently in the central equatorial Pacific Ocean.

Cobalt-rich ferromanganese crusts: These are mineral deposits found on hard rock surfaces on seamount flanks, ridges and plateaus. They are found at depths between 400-2,400 metres, contain cobalt, nickel, tellurium and rare earth elements, and they grow at several millimetres per million years.
Cite:- Relative Magnetism Of Rare Earths For Real-Money Investors: Green Capex, The Great Pacific War & Digital Revolution, 14 October 2021
Cite:- Concrete, 29 September 2019

The *International Seabed Authority, or ISA*, has oversight of the deep-sea, with obligations bestowed by the 1982 UN Convention on the Law of Sea to protect the marine environment in international waters and ensure equitable distribution of revenue associated with the deep-sea for the "*common heritage of mankind*". This covers forty percent of the planet's surface and includes all ocean beyond 200 nautical miles off coastlines. As part of this oversight, the ISA is tasked with creating regulations for deep-sea mining, and so far, has granted 31 exploration contracts with 22 different contractors.

The ISA's oversight, however, does not cover countries' economic exclusive zones (EEZ) and continental shelves in the ocean, which are governed by respective federal governments. Brazil voluntarily terminated its contract early in 2022 and rezoned it's EEZ thresholds in 2023, whilst other countries, including Canada and New Zealand, have allowed for exploratory efforts of their EEZ for mining, though it was ruled unconstitutional in New Zealand before any commercial mining began. China and India are in favour of deep-sea extraction, and the US has noted, in the *National Defense Authorization Act for FY2024*, that it is essential that the US secures its supply of critical and strategic minerals and materials, including polymetallic nodules from the deep-sea.

China is the biggest ISA member state to be explicitly betting that the seabed could help it prolong its sway over critical mineral supply chains, as the productivity of terrestrial mines continues to decline.

China holds five out of 31 exploration licences, including in a particularly fertile zone for metals in the Pacific Ocean and the US holds exploration licences in the Pacific but is not a member of the ISA. US defence group Lockheed Martin [LMT:US], recently sold off two exploration contracts it held on behalf of Britain.

The ocean is the least-discovered and least-understood ecosystem on the planet and techniques to obtain the nodules vary; Some involve using machines likened to huge combine harvesters, disturbing a layer of sediment as the nodules are collected. The plumes of sediment released by this activity could stretch for hundreds of kilometres and risk smothering animals, harm filter-feeding species and obscuring animals' vision, according to the IUCN.

Species including delicate corals and white octopuses, which have evolved over millions of years, will take only minutes for machinery to destroy and there's the spectre of sound pollution disrupting whale life as well as the potential spread of radioactive particles on the seabed.

For species living higher up in the water column, such as cetaceans, the impacts of mining are less well understood, however, considering the myriad threats faced by marine ecosystem in general, regulation of human activities is vital to ensure biodiversity conservation and to preserve ecosystem functioning.

There is also an **immense quantity of carbon thought to be locked up** in deep-sea sediments. When tiny organisms and bits of organic matter, from dead seaweed to whale faeces, fall to the ocean floor, some of the carbon that makes up that detritus, known as "*marine snow*", falls out of the carbon cycle and rests in sediments for millions of years. That is, if it is left undisturbed.

Deep-sea mining faces other unresolved questions. For example, if a miner released waste water too close to the surface or severely damaged the seabed, it remains unclear who would be liable for compensation.

Supply for these metals has come into increased focus as net zero commitments lead to discussion around materials required for the green transition. The World Bank found that in order to be on track to keep global warming below two degrees Celsius by 2050, the annual production of graphite, cobalt and lithium will have to be five times higher by 2050 than today. In addition, as metal grades decline on land over time, alternative solutions to meet these requirements will come into focus, bringing frontier areas such as the moon, nearby asteroids and the deep-sea into the mainstream narrative.

Given deep-sea mining has not taken place on a commercial scale to date, considerable uncertainty remains regarding the cost-effectiveness and reliability of mining technology for deep-sea applications, though multiple studies have found opportunities for future profitability. A study by MIT estimated operating costs of deep-sea mining in the Clarion-Clipperton Zone (collection and refining of three million dry tons of nodules) at between US$600 million and US$1.1 billion per year, initial CAPEX at between US$3 and US$4 billion and associated gross revenue from the operation at around US$2.3 billion per annum: this would indicate a breakeven point between two-four years into operating, though estimating future revenues has downside risk as new mines add to the supply curve of mined metals, which could thus meet demand at a lower price.

Building the AI-Automation transformation is as much a question of materiality as it is technology. ■

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