Mining the deep sea

Industrial Mining in the Deep Sea: Social and Environmental Considerations

Duke University Webinar
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Charles Roche

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The Mineral Policy Institute [MPI] is an international civil society organisation, operating from Australia we focus on assisting communities affected by specific mining projects and on achieving mining industry reform through improvements to policy, law and practice.

MPI's role is ...... *"to increase the equitable distribution of the benefits while decreasing the social injustices and environmental impacts of the mining/energy industries"*

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Why are we thinking of mining the sea?

- Metals and minerals for the green economy
- Terrestrial supplies are running low
- Profit/opportunity
- National goals
- Growth
- Development option
- Social and environmental problems with terrestrial mining
- GFC (ie European Union)
- 70% oceans 30% land
- An inquisitive species – because we can

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A deep sea mining meeting

- Mining and exploration proponents
- European Union
- Nation states (China, Korea, Japan, UK)
- International Seabed Authority
- Investment media
- Marine and ecosystem scientists
- Marine, mining and Human rights CSO's
- Host nations (ie Pacific Islands)
- Concerned communities

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Drivers of Pacific DSM 2013-18

	GLOBAL	INDUSTRY	PIC
Primary drivers	Global economic growth: supply and demand, population and consumption, increased industrialization and urbanization	Innovative, frontier field in an industry used to high-risk investment	Alternate development option: alleviate poverty, meet rising aspirations, lack of comparative advantage in other areas
	State actors: securing access to essential resources, capable of vertical integration of resource extraction and processing with product manufacture.	Increasing difficultly and complexity of terrestrial mining: increasing costs, decreasing grades, slowing discovery, environment social and cultural issues	Marine minerals are a 'new' natural resources capable of commercial exploitation in a region with few economic industries/choices
Secondary drivers	Growing societal aspirations for environmental and social sustainability	Technological improvements and scalable applicability	National Independence and Autonomy
	New uses/markets, the green economy		
Restricting forces	Price Volatility	Availability of finance, financial uncertainty	Increasing community concerns about governance of, impact and returns from extractive industries,
	Concern over threats to marine environment, lack of marine science to inform conservation planning	Regulatory uncertainty in EEZ and the Area Significant obligations to share knowledge, proceeds	Lack of Governance, capacity and regulation

Terrestrial and Seabed Reserves

Table 1: Comparison of USGS Reserves and Global Mineral Resources from the Work of Mudd (and colleagues) for Selected Commodities

Commodity	USGS Terrestrial Reserves[a]	Mudd et al Reference	Main Year Assessed	Land Quantity	Land Grade	Deep Sea Quantity	Deep Sea Grade	%DS resources reported to code
Platinum Group Elements (PGEs)	66,000 t PGEs	Mudd (2012)	2010	90,733 t PGEs	3.09 g/t (4E)	0	-	0
Copper[b]	630 Mt Cu	Mudd et al (2013a)	2010	1,861.1 Mt Cu	0.49% Cu	0.22 Mt Cu[b]	7.7% Cu[b]	~0.01%[b]
Cobalt	7,500 kt Co	Mudd et al (2013b)	2011	26,793 kt Co	0.069% Co	793 kt Co	0.24% Co	~3.0%
Nickel	80 Mt Ni	Mudd & Jowitt (2014)	2011	295.9 Mt Ni	0.48% Ni	3.7 Mt Ni	1.2% Ni	~1.2%
Uranium	8,367 kt U_3O_8[c]	Mudd (2014)	2011	11,043 kt U_3O_8	0.033% U_3O_8	0	-	0
Rare Earths	140 Mt REO[d]	Weng et al (In Press)	2013	620 Mt REO[d]	0.74% REO	0	-	0
Lead	89 Mt Pb	Mudd et al (In Prep)	2013	168.3 Mt Pb	0.41% Pb	-	-	0
Zinc	250 Mt Zn	Mudd et al (In Prep)	2013	496.0 Mt Zn	1.20% Zn	0.03 Mt Zn	0.94% Zn	~0.005%
Gold	54,000 t Au	Mudd & Jowitt (In Prep)	2013	187,096.8 t Au	0.40 g/t Au	15.8 t Au	5.66 g/t Au	~0.008%

Notes: [a]Data is shown for the same year as the mineral resources. [b]At the time of the copper research, no formal code-based estimate of any deep sea resource was published, with such a report for the Clarion-Clipperton nodules zone released in September 2012, showing a resource of 3.4 Mt Cu at 1.1% Cu. [c]Data from IAEA's Red Book. [d]REO – rare earth oxides.

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Mineral Resources CCZ

20 March 2013

UPDATED NI 43-101 TECHNICAL REPORT

Clarion-Clipperton Zone Project, Pacific Ocean

NI 43-101 Technical Report

Clarion-Clipperton Zone Project, Pacific Ocean

Qualified Person:

Matthew Nimmo, MAIG, Principal Geologist, Golder Associates Pty Ltd

Effective Date of Technical Report: 20 March 2013.

Submitted to:
John Parianos
Tonga Offshore Mining Limited

REPORT

Report Number. 127631013-003-R-Rev1

Golder Associates

16 Mineral Resources and Mineral Reserve Estimates

No mineral resources and minerals reserve estimates have been completed on any properties outside of the Bismarck Sea, Papua New Guinea. (p.85)

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Mineral Resources Solwara

23 March 2012

MINERAL RESOURCE ESTIMATE

Solwara Project, Bismarck Sea, PNG

Technical Report compiled under NI43-101

Qualified Person:

Ian Lipton, Principal, Golder Associates Pty Ltd, FAusIMM

Effective Date of Technical Report: 23 March 2012

Submitted to:
Nautilus Minerals Nuigini Limited

as SL01-NSG-RPT-7020-001 Rev 1 – Golder Resource Report

Report Number. 107631040-003-R-Rev 1

REPORT

Golder Associates

16.0 MINING METHODS

There are no Mineral Reserve estimates for Solwara 1 and Solwara 12 and the potential viability of the Mineral Resources has not yet been supported by a preliminary economic assessment, a pre-feasibility study or a feasibility study. (p.182)

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Last word - Hein

"The resource potential of Fe–Mn crusts, nodules, and SMS in the global ocean is not well known… However, it is **essential that marine mineral deposits be evaluated using methods applied to land-based deposits** so that their relative importance can be understood as potential sources of many rare, strategic, and critical metals. **Comparative evaluations should include the entire life cycle of the commodities of interest and the environmental** *[and social]* **justifications for each".** (Hein et.al, 2013, p. 13)

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Social Impacts - Mining

- **Political, cultural and social change** – demographics, migration, social order, cultural identity, health, employment, self-determination, resettlement, conflict
- **Economic change** – distribution of taxes, incomes and benefits, infrastructure, resource curse/dutch disease
- **Socio-environmental change** – on/offsite environmental impact, pollution, social disturbance
- **Process of change** – consent processes, grievance, community development, planning, respect for customs

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Environmental Impacts - Mining

- Acid mine drainage
- Perpetual management ie tailings dams
- Air, water, land pollution (emissions)
- Biodiversity, endangered species
- Clearing, subsidence
- Changes in hydrology
- Mining legacies
- Ore to waste ratios

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Land vs Sea Comparison

Parameters	Land based mines	Marine mines
Energy use and GHG emissions	GHG emission via transport and cement production, air pollution, high energy use (depending on the extraction technique energy costs can account for 10-12% of all costs)	Off-shore processing of the minerals and transportation by air or water while undoubtedly contributing to GHG emissions could reduce the environmental and social impacts caused by the infrastructural developments linked to road transportations and building of on-shore processing plants.
	Manganese	Manganese nodules
Land disturbance	Large area of disturbance both at the mine (open cut and underground). Some disturbance associated with infrastructure such as roads, concentrator, smelter. Mine life can be measured in decades.	Very large areas of disturbance of benthic layer at mined areas and potentially areas adjacent. Potentially short mine life.
Waste generation	Large amounts of waste including waste rock, tailings, effluent, air pollution, potential oil/chemical spills.	No overburden, limited tailings (in comparison to land based deposits) due to near seabed surface nature of the deposit type and also because the ores will be shipped intact, some waste-water discharged as a plume which may disperse considerable distance, limited air pollution, potential oil/chemical spills.
Biodiversity loss	Total biodiversity loss over a large spatial scale at open cut mines.	Total biodiversity loss at sites of extraction and potentially adjacent areas due to plume spread and smothering. Loss of nodules substrate for attached fauna.
Rehabilitation potential	Major changes to landscape and hydrological regime, but good potential for general rehabilitation over decades to centuries.	Although changes to the seafloor morphology may be limited, current scientific evidence indicates that there is likely to be very poor rehabilitation potential within human time scales.
Energy use and GHG emissions	GHG emission via transport and cement production, air pollution	Off-shore processing of the minerals and transportation by air or water while undoubtedly contributing to GHG emissions could reduce the environmental and social impacts caused by the infrastructural developments linked to road transportations and building of on-shore processing plants.

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Community concerns

- Bismarck-Solomon Sea Indigenous Peoples Council (BSSIPC) , Te Ipukarea Society Cook islands -IUCN, PIANGO, Makata, Act Now PNG, PANG
- International - Deep Sea Mining Campaign, Greenpeace, Universities/Research Institutions
- Evangelical Lutheran Church PNG
- ACP-EU Joint Parliamentary Assembly
- Center for Biological Diversity legal challenge

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Experimental seabed mining

CBD legal challenge

9. The Center for Biological Diversity challenges NOAA's June 1, 2012, extension of Lockheed's USA-1 and USA-4 exploration licenses. Defendants violated the Deep Seabed Act, and the Administrative Procedure, by failing to respond to Plaintiff's comments on the licenses, extending the licenses despite significant environmental impacts, and approving the license extensions' amended exploration plan without complying with the statute's requirement to conduct environmental analysis.

NOAA's approval of Lockheed's extensions without environmental review, considering the existence of significant new information about the environmental impacts of deep sea mining, and the ecology of benthic ecosystems, is unlawful. (edited p. 4)

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Future Directions

- Transparent and inclusive process - not based on a pre-determined outcome (capacity)
- Strategic, regional and conservation planning
- Development agenda - not colonial extractivism
- Learn from rather than ignore the lessons from fishing, oil/gas and terrestrial mining
- Knowledge gaps and next steps – multidisciplinary: marine, mining, development, socio-economic, cultural, ethics, medicine, conservation.