

Deep Sea Minerals: A New Development Opportunity for the Pacific?



5th Regional DSM Training Workshop
Rarotonga Cook Islands
13th – 16th May 2014

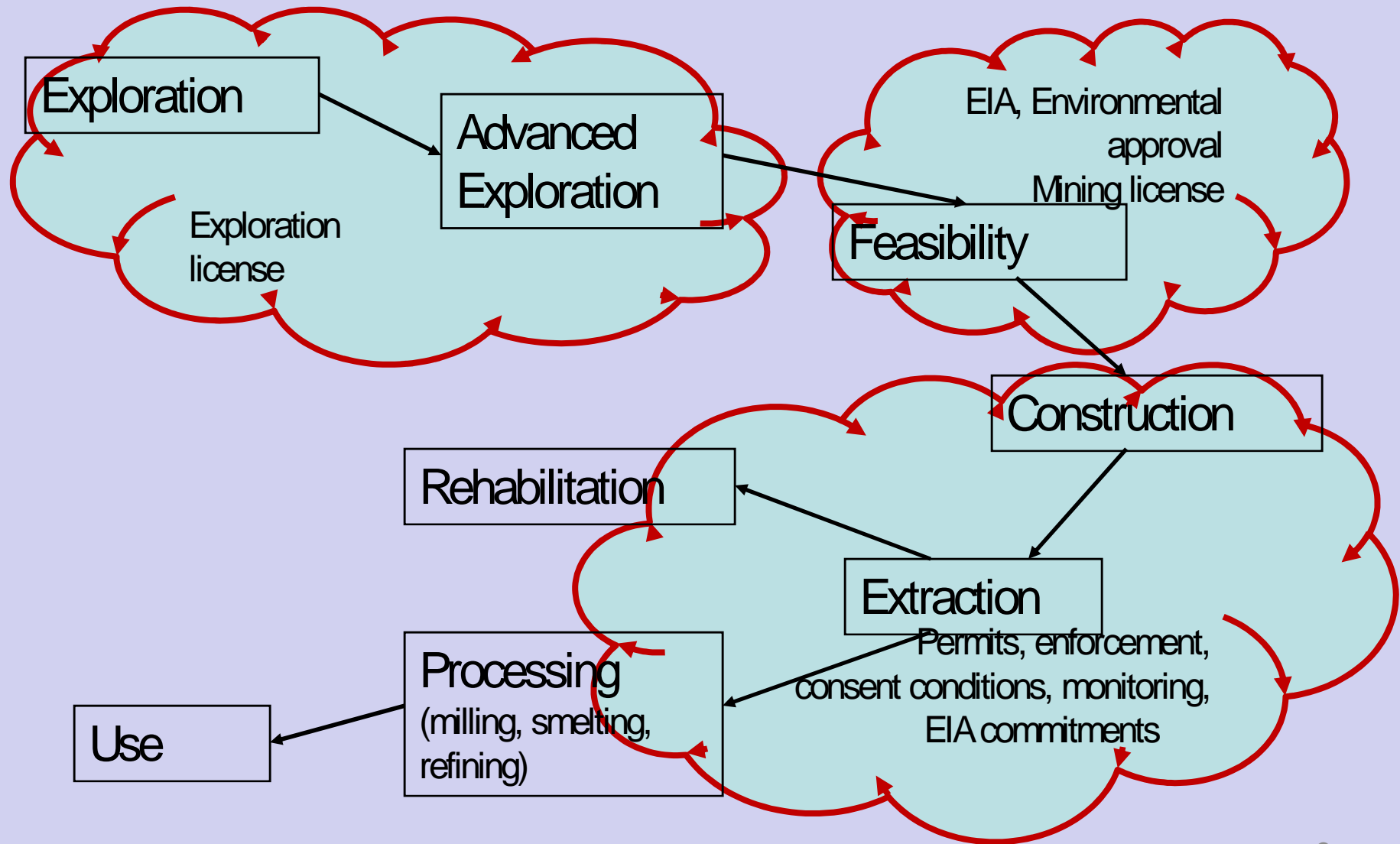
Akuila Tawake
SOPAC Division, SPC

Mining History...

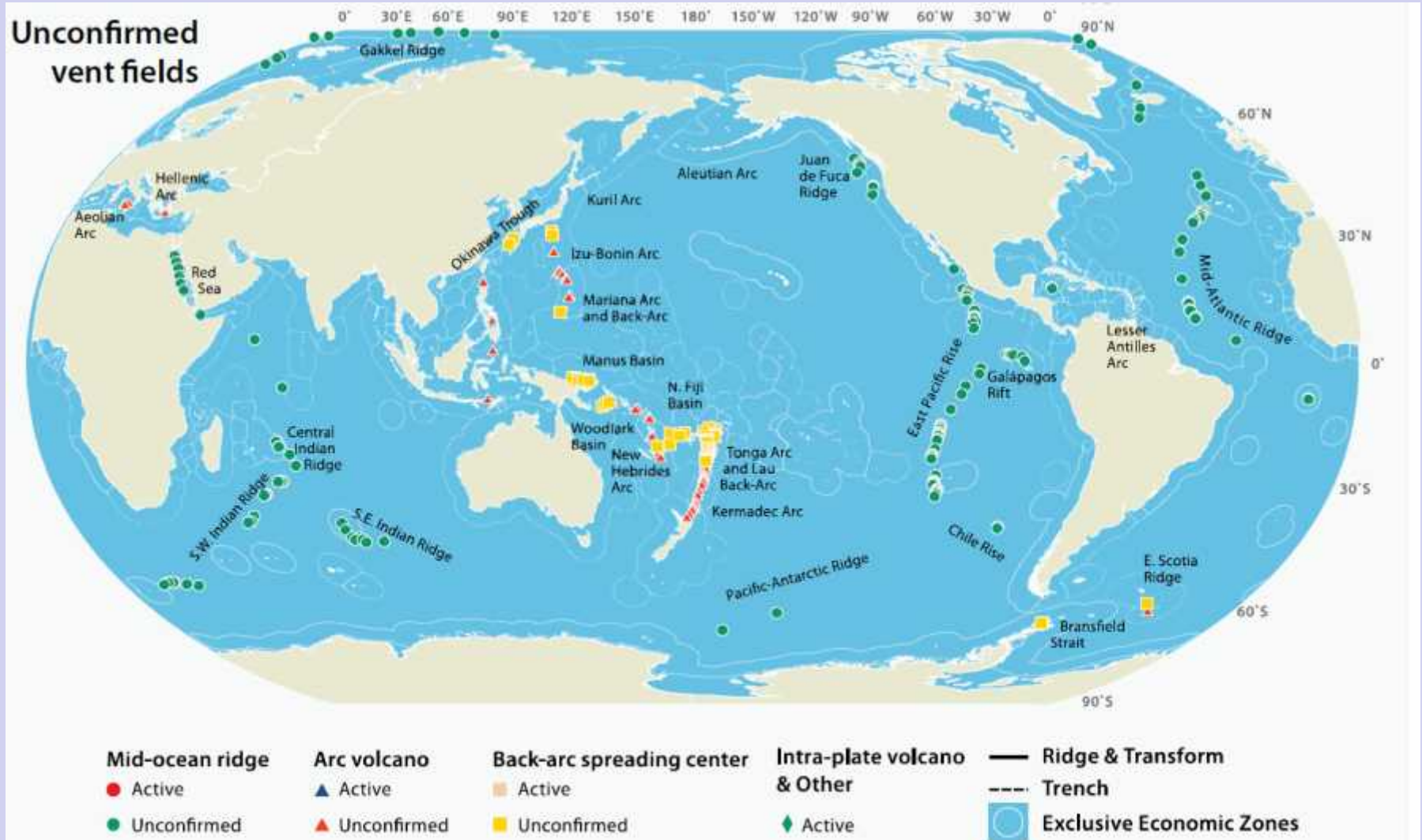


- On-land mining methods:
 - Alluvial Mining: PNG, Solomon Islands
 - Underground mining: e.g. Vatukoula Gold Mine, Fiji
 - Open pit: e.g. Ok Tedi Copper Mine, Lihir Gold Mine, PNG; Gold Ridge, Solomon Islands.
- Deep sea mining is a new frontier in mineral development.

From Exploration to Ore Processing...

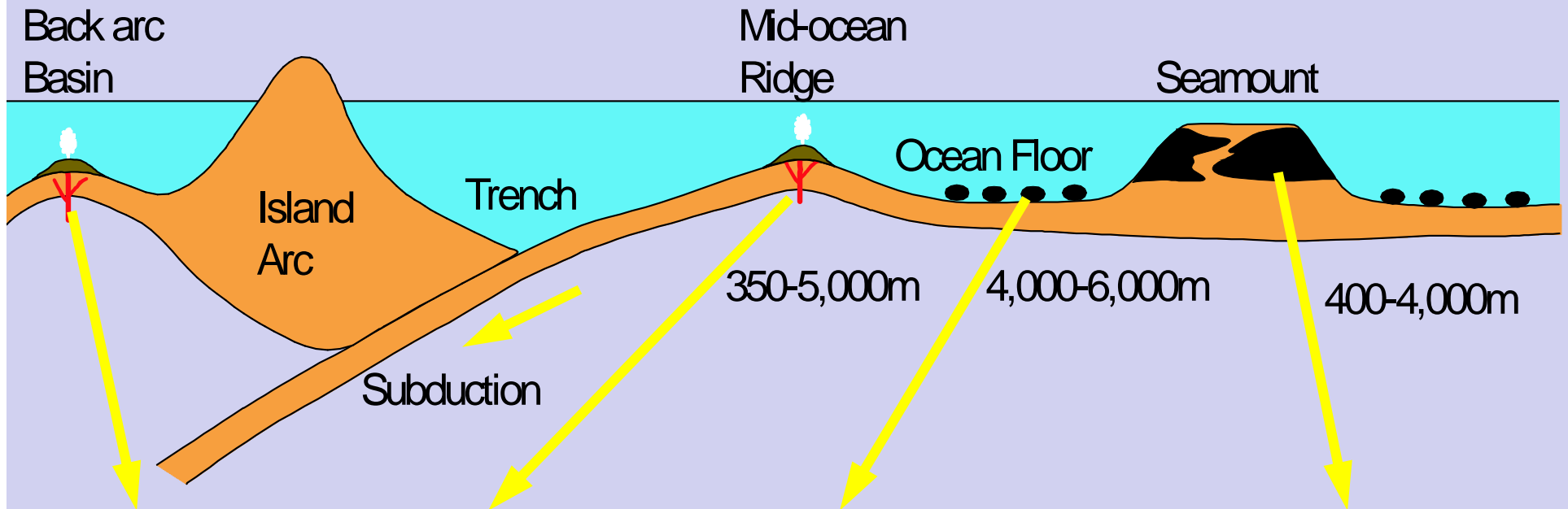


Global Deep Sea Minerals Occurrence



Source: S. Beaulieu, K. Joyce, and S.A. Soule, 2010, Interridge and Woodshole

Deep Sea Minerals Occurrence



SMS Deposit

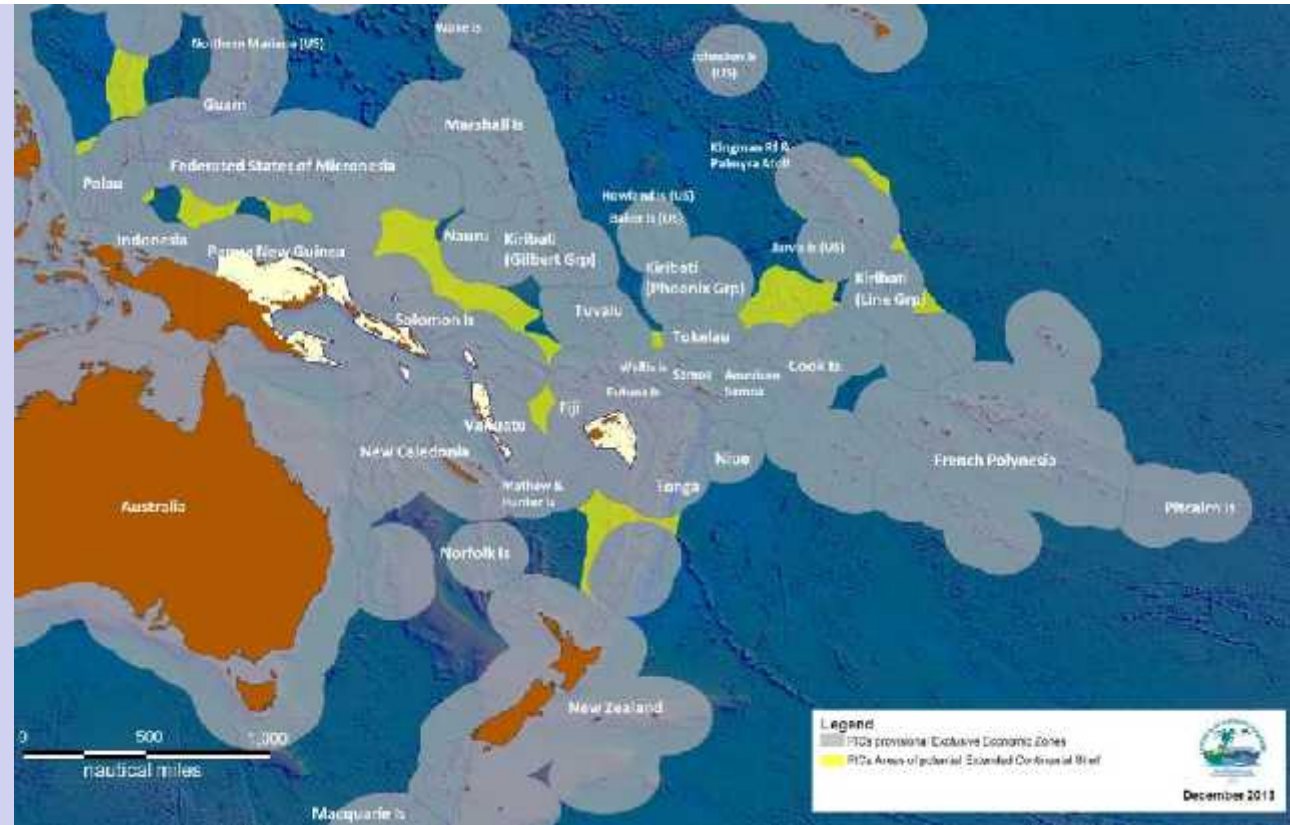


Manganese Nodules



Cobalt-rich Crust

Small Island and Big Ocean Pacific States



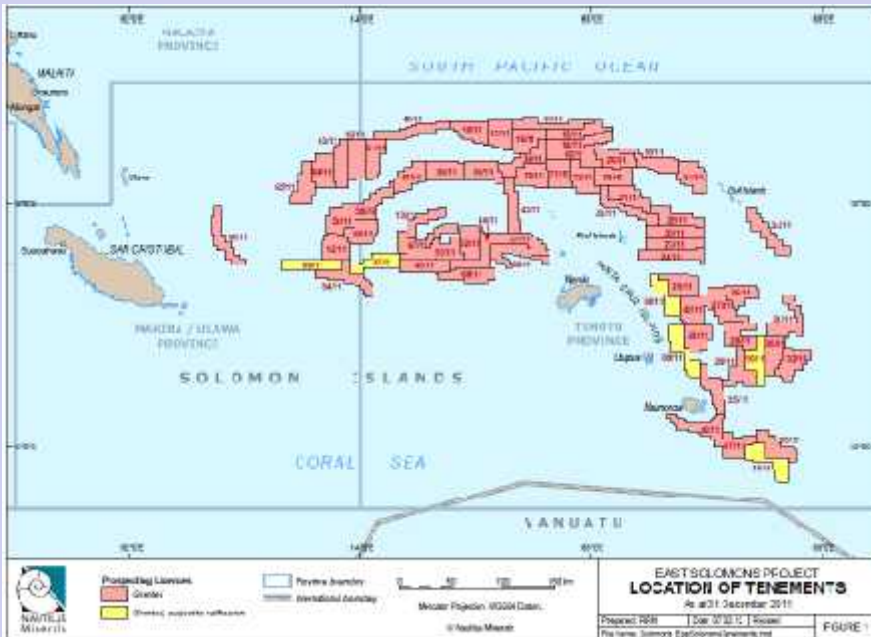
- Pacific Island Countries (PICs) have a total area of 38.5 million km² of EEZ compared to a land area of around 550,000 km² (a ratio of 70:1);
- Additional 2.0 million km² in Extended Continental Shelf;
- In the last 40 years, SOPAC in collaboration with partners, have been involved in DSM activities;
- DSM have been discovered within the EEZ of many PICTs.

Mineral Occurrence/Potential in the Region

Country	MN	CRC	SMS
Kiribati			
Cook Islands			
Tuvalu			
Samoa			
Tonga			
PNG			
Solomon Islands			
Vanuatu			
Fiji			
Marshall Islands			
Federated States of Micronesia			
Palau			
Niue			

- No economic potential for Metalliferous Sediment, Precious Coral and Phosphate

Recent Exploration and DSM Interest



- Exploration companies that are active in the region:
 - Nautilus Minerals
 - Bluewater Metals
 - Korea Institute of Ocean Science and Technology (KIOST)
- Exploration licenses are issued in PNG, Tonga, Solomon Islands, Fiji and Vanuatu.
- Nauru and Tonga have sponsored foreign companies to conduct DSM exploration in the International Seabed Area ('the Area');
- Kiribati has established and supported its own company to conduct exploration in 'the Area'.

Economic Issues

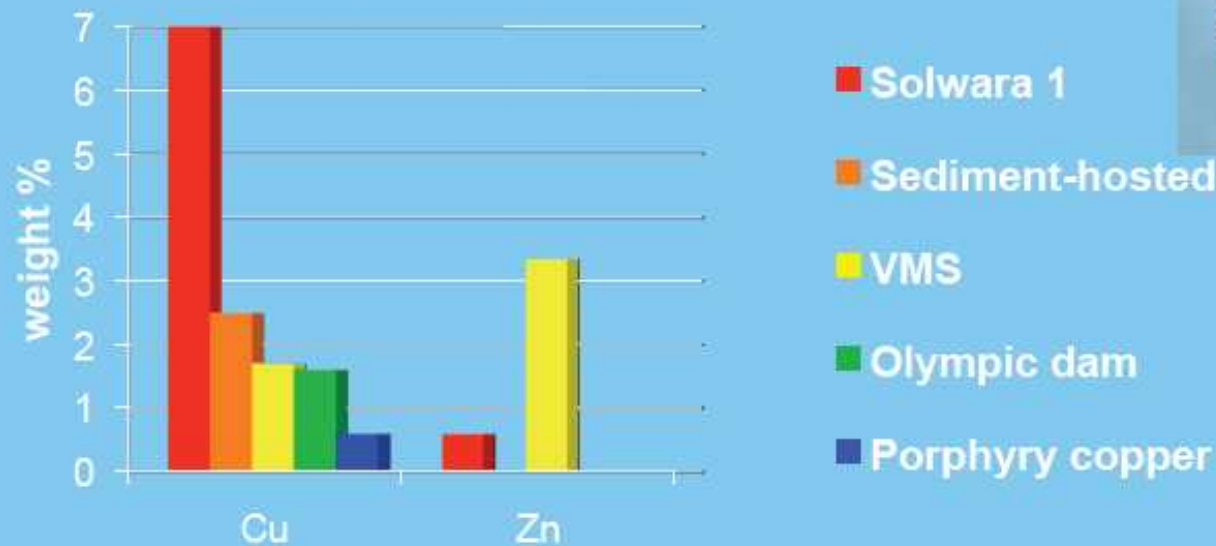
- SMS deposits are higher in mineral content than on-land deposits:

Metal	On-land	SMS
Copper	0.5-2%	5-15%
Gold	0.5-8g/t	2-20g/t
Zinc	5-20%	5-50%
Lead	5-20%	3-23%

- Typical value of a tonne of land based ore: US\$50-180.
- Typical value of a tonne of SMS ore: US\$500-1500.
- One full mining operation could produce export revenues of up to US\$500m pa and taxes/royalties of up to US\$50m pa.

High Grade Copper SMS Deposits

Attractive High Grades for Deep-Ocean Deposits,
e.g. Copper:



Mean composition of Nautilus Solwara 1 marine mine
compared to all major types of land-based copper deposits

Value of Selected Metals in 1 tonne of Cobalt-rich Crusts from the Central Pacific

	Mean Price of Metal (2011 \$/kg)	Mean Content in Crusts (g/tonne)	Value in Tonne of Ore (\$)
Cobalt		6899	\$272.20
Dysprosium	\$2,760.00	60	\$165.60
Cerium	\$81.00	1605	\$130.01
Titanium	\$10.30	12035	\$123.96
Europium	\$5,210.00	13	\$65.13
Nickel	\$20.74	4125	\$42.49
Zirconium	\$64.00	618	\$39.55
Platinum	\$55,299.20	0.5	\$27.65
Tellurium	\$360.00	60	\$21.60
Molybdenum	\$34.90	445	\$15.53
Copper	\$8.91	896	\$7.98
Total	--	--	\$911.70

(USGS, 2011)

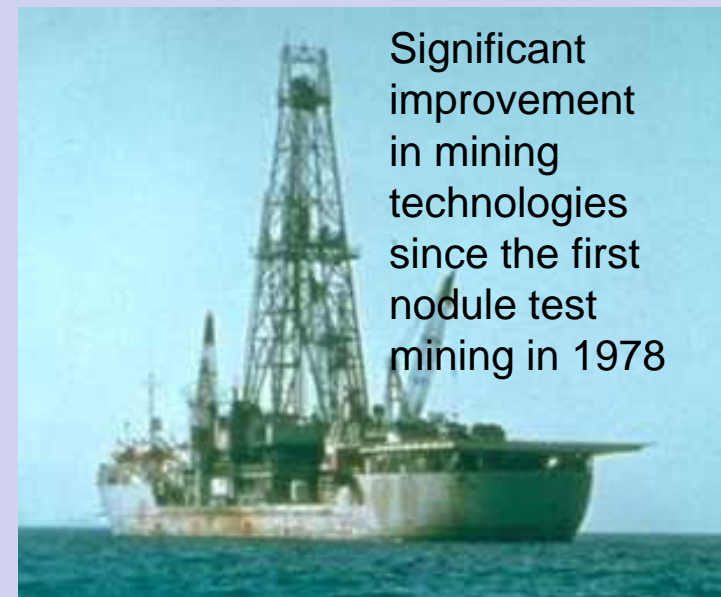
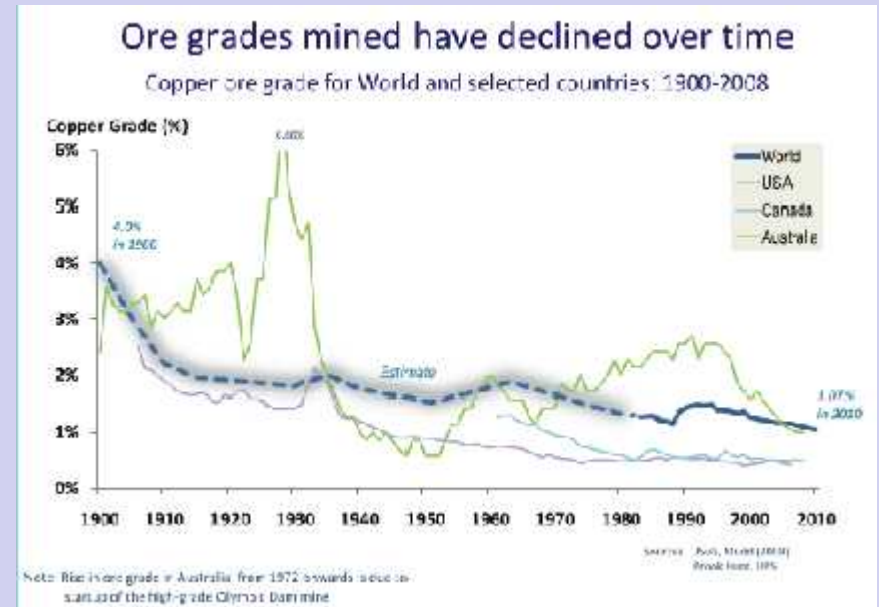
Uses of Metals in Marine Minerals

Metal	Uses
Copper	<u>Generators</u> , fuels cells, electrical appliances, <u>transformers</u> for renewable energy technologies, mobile phones, computers, transportation, etc
Cobalt	<u>Mobile phones</u> , laptops, <u>super alloys</u> , hybrid car batteries, artificial joints, etc
Nickel	<u>Stainless steel</u> , <u>high nickel alloy</u> , Chemicals and Batteries, Catalysts, etc
Manganese	Steel production, <u>rechargeable batteries</u> , animal feed, <u>plant fertilizer</u> , bactericide in waste water treatment, etc
REEs	<u>Smart phones</u> , flat TV screens, advanced military technology, <u>permanent magnets for wind power generation</u> , <u>hybrid vehicles</u> , fuels cells, etc

E.g. of REEs: Cerium, Neodymium, Samarium, Europium, Terbium

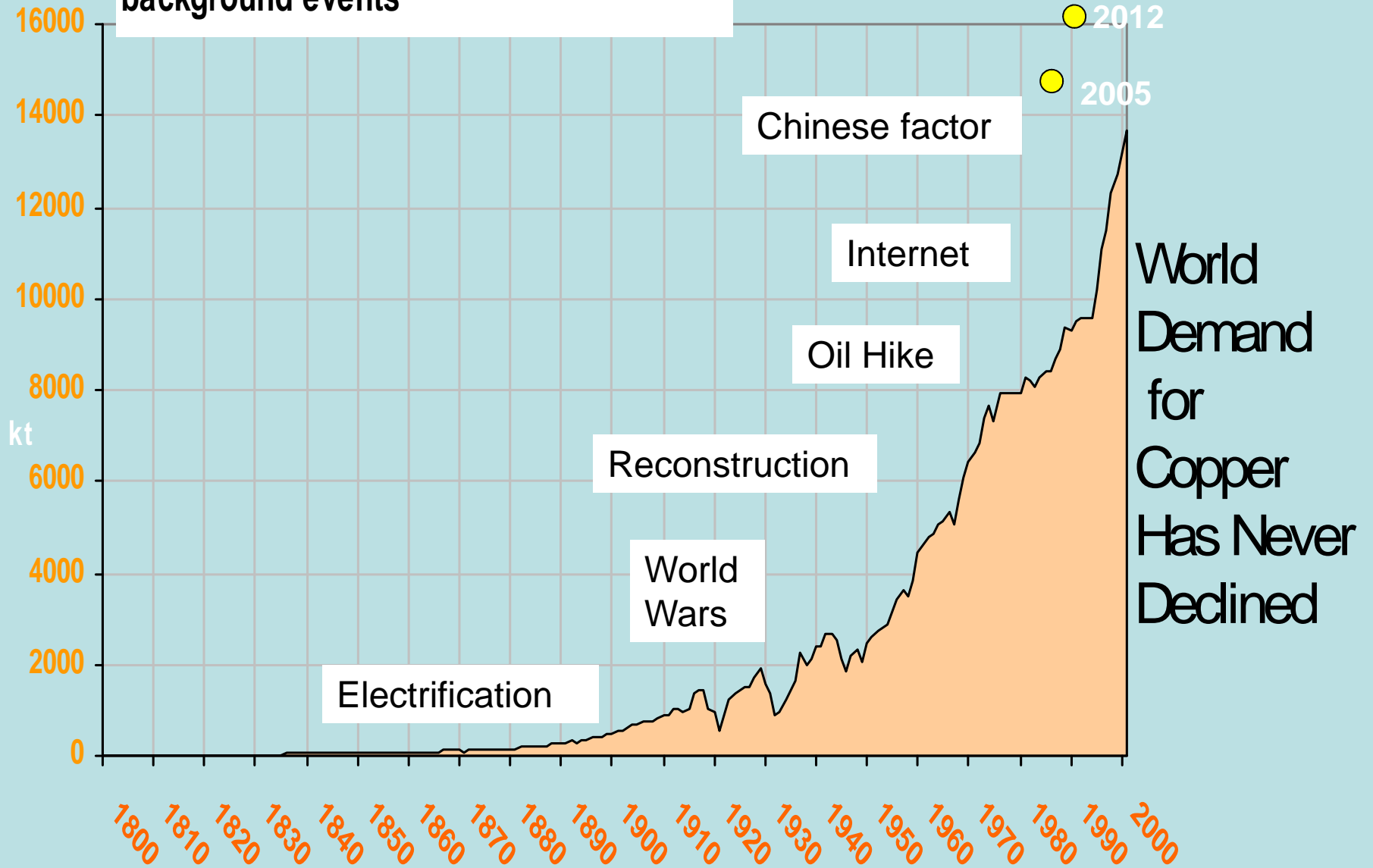
Drivers of Marine Minerals Development

- Increasing global demand for metals;
- High metal prices;
- Decreasing metal concentration in terrestrial mineral deposits;
- High concentration of certain metals in offshore mineral deposits;
- Significant improvement in marine mining technologies;
- Increasing demand for non-traditional metals such as REE.

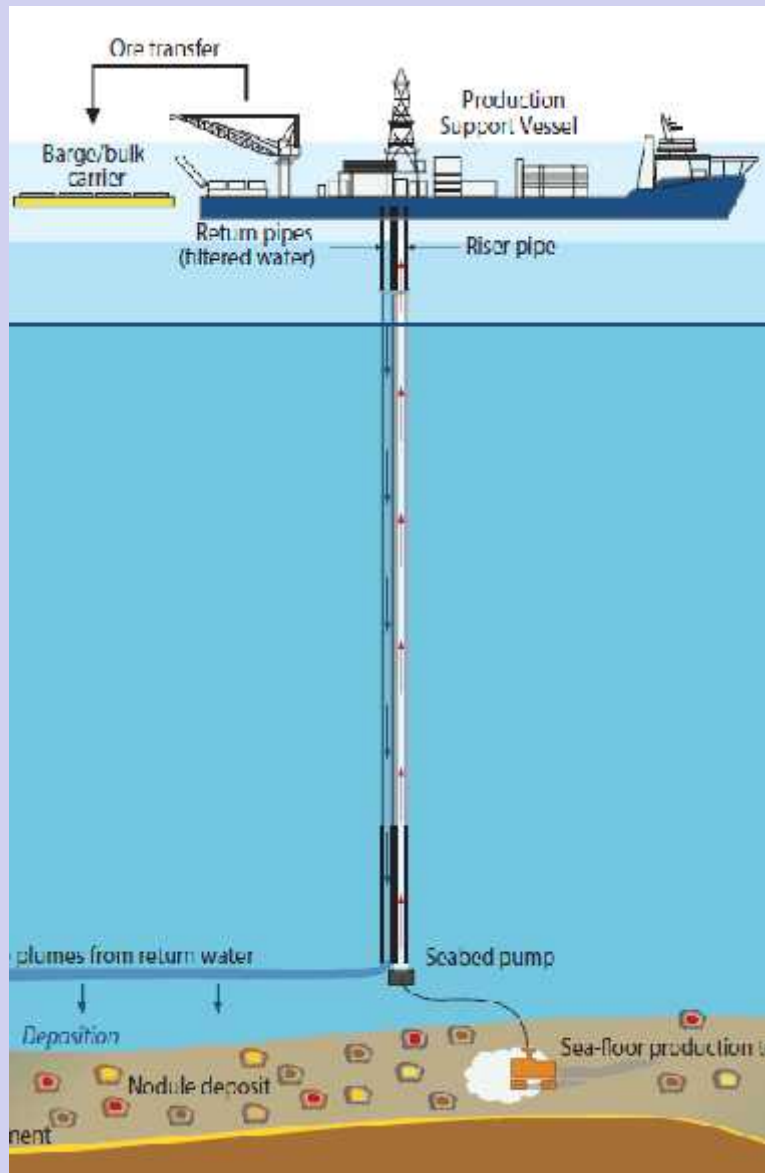


Copper: mine production 1800 - 2000
showing average output growth rates and
background events

Data: BGS



How PICTs will Benefit from Offshore Mining?

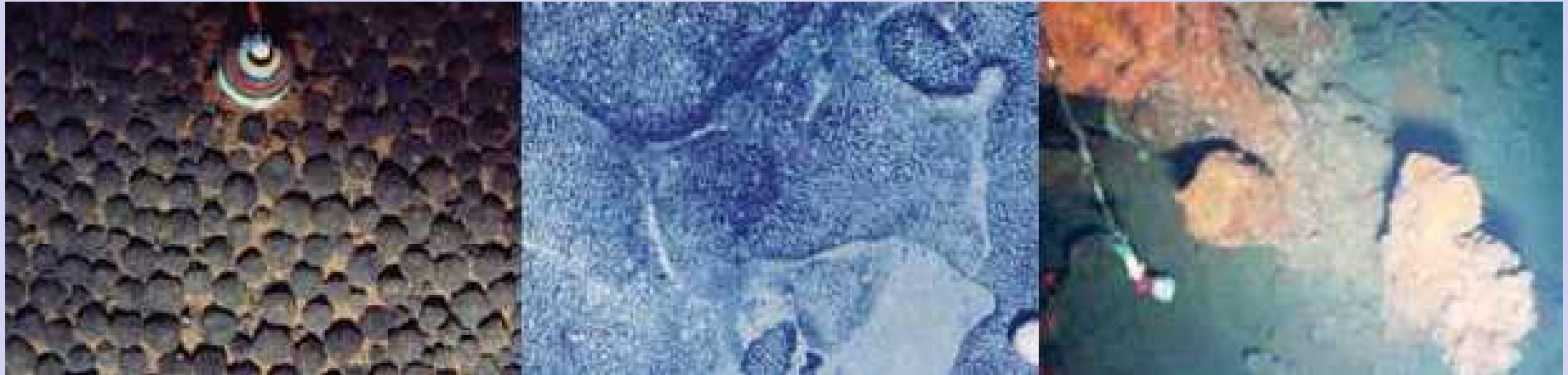


- Opportunity to participate in a new economic sector;
- Revenue generation;
- Employment;
- Opportunity for revenue saving scheme (sustainability opportunity);
- Stimulation of other economic sectors;
- DSM can contribute to poverty alleviation.

Comparison of Terrestrial and Offshore Mining

Terrestrial	Marine
Significant overburden	Huge water body (ocean) that needs to be dealt with
Generate significant amount of waste (overburden, tailings, leachates)	Reasonably less amount of waste generated
Huge footprint	Small footprint (SMS) Reasonable footprint (MN & CRC)
Often isolated and difficult to access	Located with national EEZ
Huge infrastructure development	Far less infrastructure to be built
Acid Rock Drainage	Sulphuric acid cannot form in ocean (seawater being "alkaline")
Complex resource ownership system	Common heritage of the nation
Reasonable knowledge of environment	Limited knowledge of environment

SPC-EU Deep Sea Minerals Project



SPC-EU DSM Project Objective and KRAs

Objective: to strengthen the system of governance and capacity of Pacific ACP States in the management of deep-sea minerals through:

- (i) development and implementation of sound and regionally integrated legal frameworks;
- (ii) improved human and technical capacity, and
- (iii) effective monitoring systems.

Four Key Result Areas of the Project:

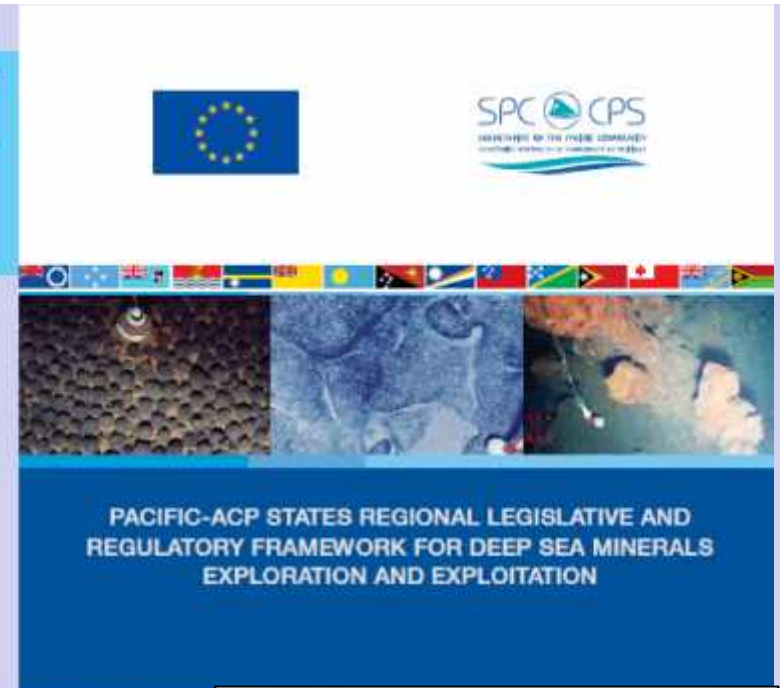
- (1) Regional Legislative and Regulatory Framework (RLRF) for offshore minerals exploration and exploitation;
- (2) National DSM policy, legislation and regulations;
- (3) Building national capacities – supporting active participation of PICs nationals in deep sea mineral activities; and
- (4) Effective management and monitoring of offshore exploration and mining operations.

Development of Regional and National DSM Framework

Pacific ACP States Regional Legislative and Regulatory Framework (RLRF) for Deep Sea Minerals Exploration and Exploitation

In the 2012 Forum Communiqué, Leaders expressed their appreciation to the SPC and the EU for the work carried out under the DSM Project.

Development of National DSM Policy, Legislation and Regulations



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 FIJI MINERAL RESOURCES MINERAL MANAGEMENT (DEEPLY SEA)
 (Section 101 of 2012)

SECTION 1
 PART 1 – PRELIMINARY

1. Short title and commencement
2. Interpretation
3. Objective
4. Jurisdiction

PART 2 – REGULATION AND ADMINISTRATION OF DEEP SEA MINERAL ACTIVITIES

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6. Establishment of the Deep Seabed Mineral Authority
7. Use powers of the Authority
8. Objectives of the Authority
9. Functions of the Authority
10. Powers of the Authority
11. Delegation of powers
12. Non-approval proceedings of the Authority
13. Authority may move orders to workings
14. Declaration of interest
15. Contributions
16. Funds of the Authority
17. Annual reports
18. Audit
19. Fiji (International Seabed Minerals Working Group)
20. High Level Forum
21. High Level Mineral Resource Dialogue

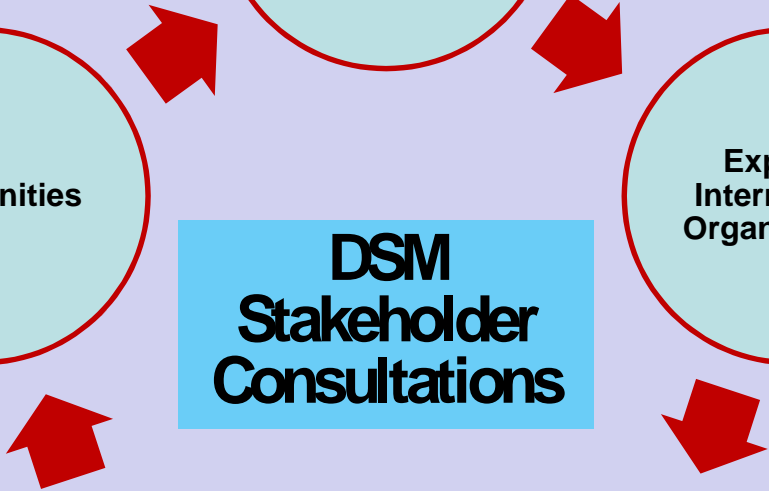
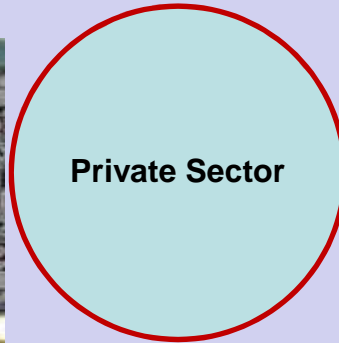
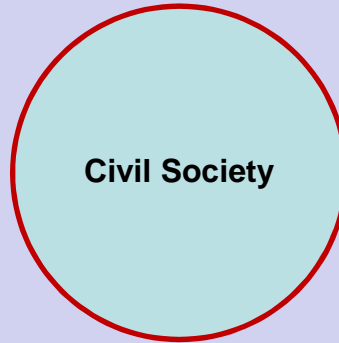
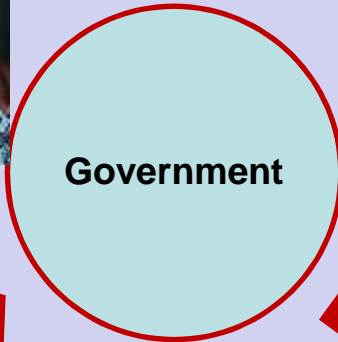
PART 3 – SPM JOINDER APPLICATION AND APPLICATION TO THE ISM

22. Eligibility to perform Seabed Mineral Activities
23. Eligibility for Sponsorship Applications
24. Sponsorship Applications
25. The processing of Sponsorship Applications
26. Powers of Sponsorship Applications
27. Information to be provided on a Sponsorship Certificate
28. Issuance of Sponsorship Certificate
29. Revocation of Sponsorship Certificate
30. Application by Sponsored Party to ISM
31. Sponsorship Agreements

Capacity Building Initiatives

- Regional Training Workshops
- Legal Internship
- Short-term training attachments
- Data and database management training
- Participation in international DSM seminars / conferences
- Multi-stakeholder training



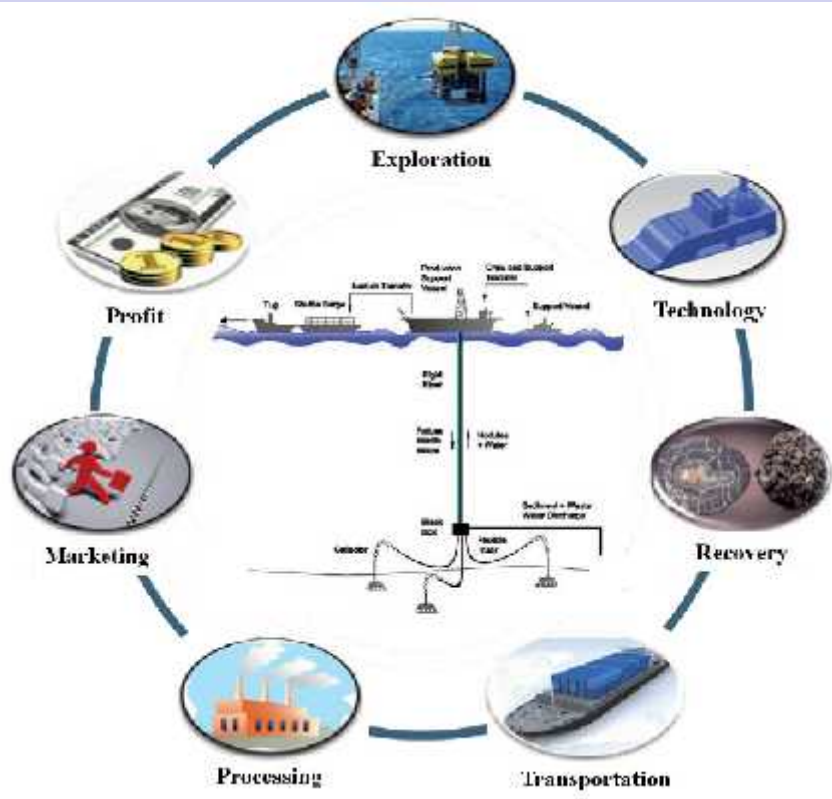


DSM Project Communication and Information Sharing

- Regional and national stakeholder consultation workshops;
- Project reports;
- Information brochures;
- Newsletters and media releases;
- DSM documentaries.
- Community awareness
- DSM Project webpage
<http://www.sopac.org/dsm>



Proposed Way Forward for the Region



- A regional collaborative approach is considered the best way forward;
- Consider the whole cycle of DSM activities;
- Address regional / national issues highlighted in stakeholder consultations;
- SPC is well placed to continue to take a lead role in the DSM Sector;
- SPC to collaborate with international organisations: USP, SPREP, ISA, USGS, NIWA, UNEP/GRID, etc;
- DSM Project Phase 2 to be funded through EDF11, GIZ, etc

