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

3rd SPC-EU DSM Project Regional Training Workshop
"Social Impacts of DSM Activities and Stakeholder Participation"
10th – 14th June 2013, Port Vila Vanuatu

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SOPAC Division, SPC

Presentation Outline

- Purpose of the Training Workshop
- Nature of the Mining Industry and Current Issues
- Deep Sea Minerals Occurrence and Potential
- Pacific Island Countries Deep Sea Mineral Interest
- Deep Sea Environment and Associated Biological Communities
- SPC-EU Deep Seabed Minerals Project Update.

Purpose of the Training Workshop

- The objectives of the workshop are to:
- learn lessons from the social impacts of other industries (terrestrial mining, fisheries, logging, etc);
- determine the likely social impacts of DSM activities and develop and implement appropriate improvement measures;
- demonstrate how informed decisions are made through multi-stakeholder engagement; and
- develop a process that ensures meaningful stakeholder participation in decision making relating to DSM activities.

Purpose of the Training Workshop

- At the end of the workshop a participant should be able to:
- Better understand the social impacts of other natural resources extraction and recognise their differences and similarities to the likely social impacts of DSM activities;
- Develop and implement appropriate measures that reduce negative social impacts and enhance social benefits of DSM activities;
- Fully understand how stakeholder engagement is conducted, and recognise that better and informed decisions are made through multi-stakeholder participation including the legal process for redress; and
- Develop and implement, through a participatory decision making process, a management plan for DSM activities in his/her country.

Known Mineral Resources of PNG

Nature of Mining Projects…

- Long exploration history,
- Huge investment – multi-million/billion dollar mining projects,
- Huge infrastructure development,
- Significant physical footprint,
- Generate huge amount of waste materials (waste rocks, tailings, leachates)
- Environmental impacts can be significant,
- Non-renewable resource,
- Can be marginal, profitable or very profitable,
- Support economic development of any country,
- Use significant amount of power (E.g. Lihir power requirement: 75 MW).

Mining Process…

Extraction

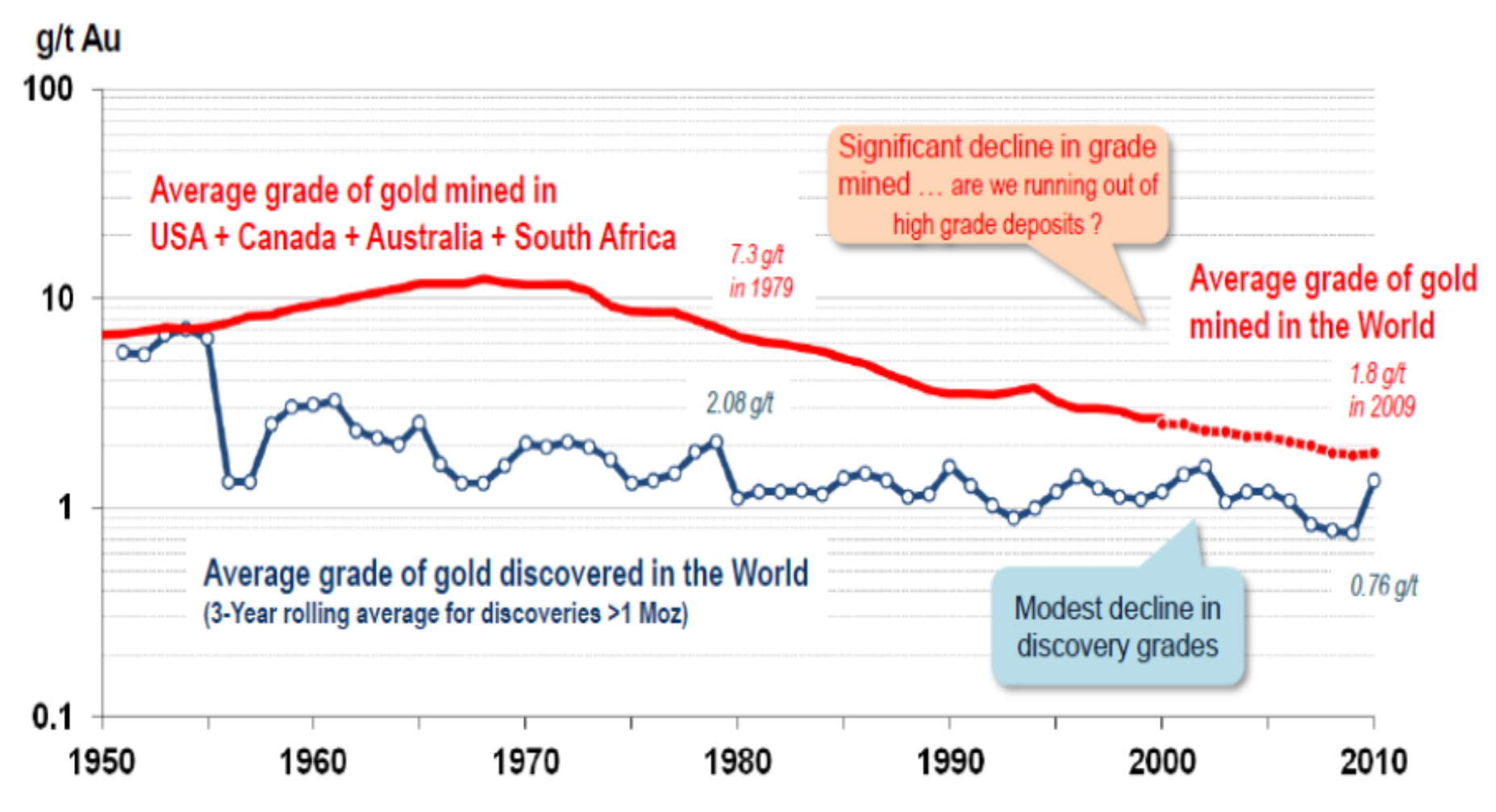
Haulage

Waste Stockpile

Milling

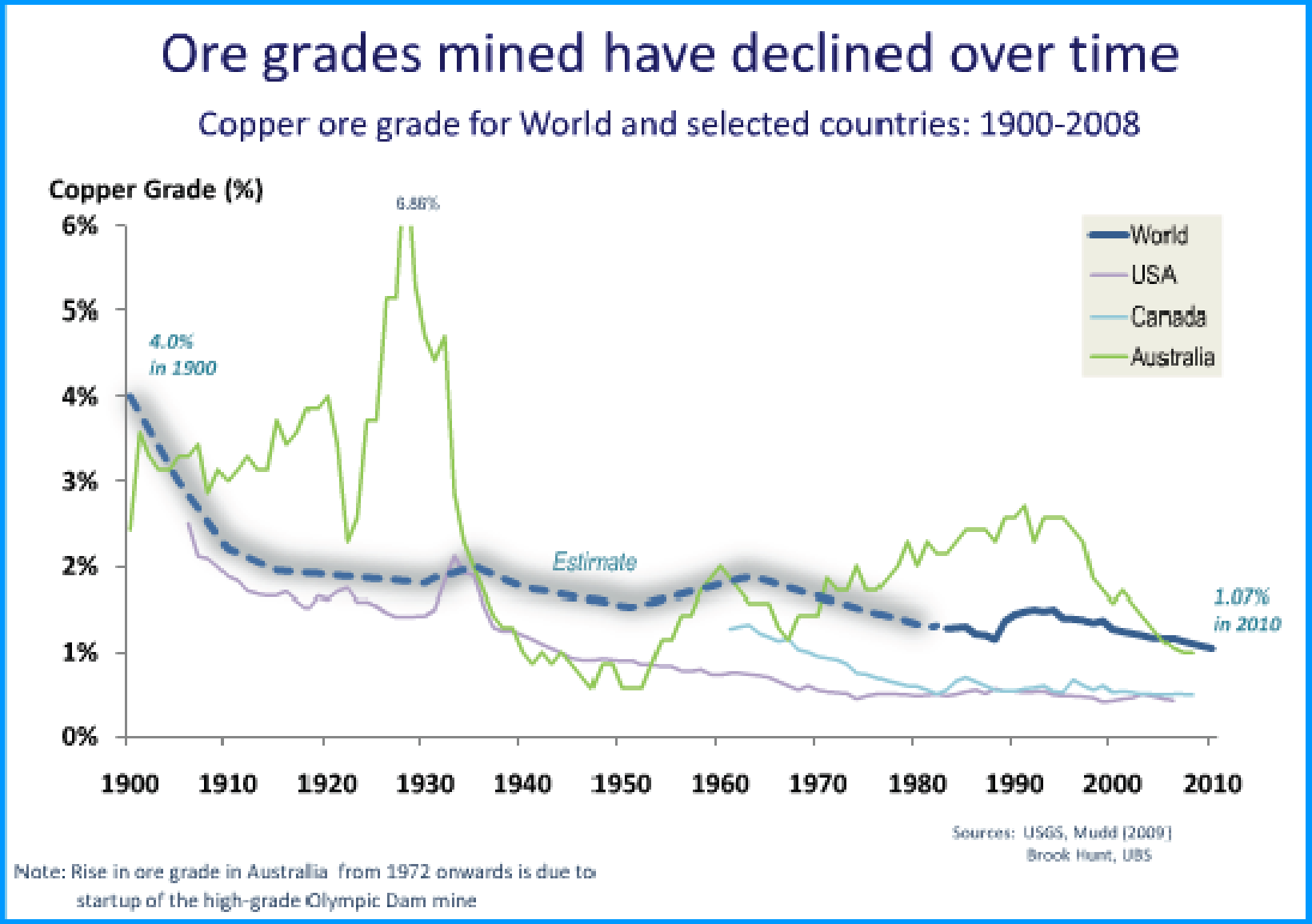
Tailings Disposal

Global Gold Grade and Discovery



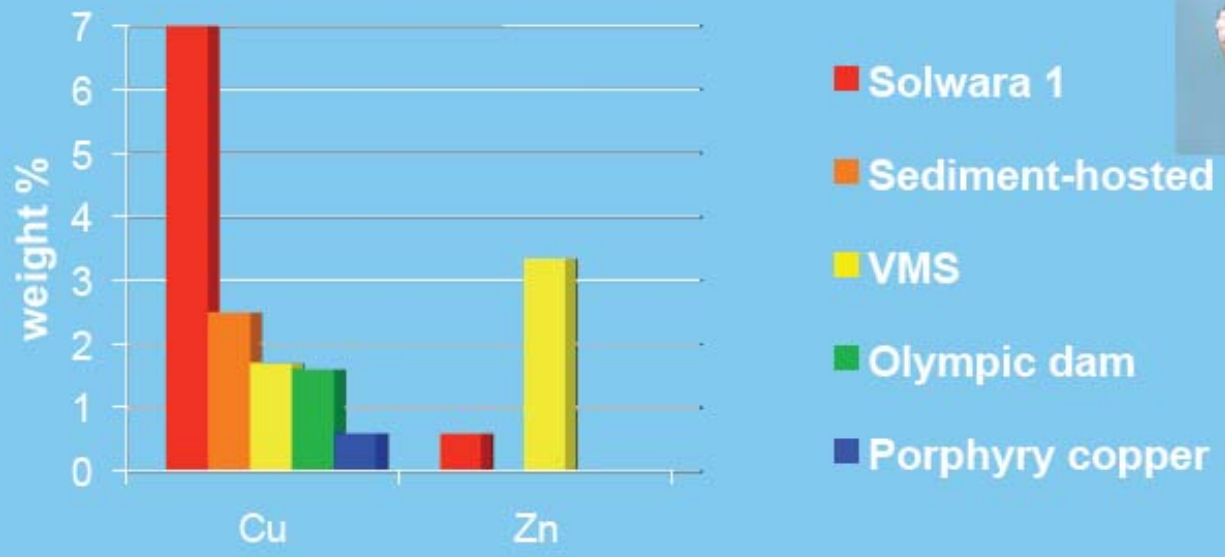
(HD Capital, 2012)

Decrease in Land Based Ore Grades



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

Economics of Mining Projects

- Significant contribution to any country's economy (taxes & royalty);
- Employment;
- Stimulate direct and indirect economic activities;
- Infrastructure Development.
- Enable government to stimulate other economic sectors.
- Positively contribute to local communities' economic activities and living standards (multiplier effect).

- **PNG as an example:**

- A total of K7.9 billion was recorded for the mineral export in PNG in 2007,
- Forecast of K12 – K16 billion per annum worth of mineral export between 2014 and 2018. (Temu, 2008)

Comparison:

- One tonne of ore at Porgera Gold Mine is worth US$150.00

- One tonne of ore at Solwara 1 is worth US$800.00

GDP and Export Earning of Mining

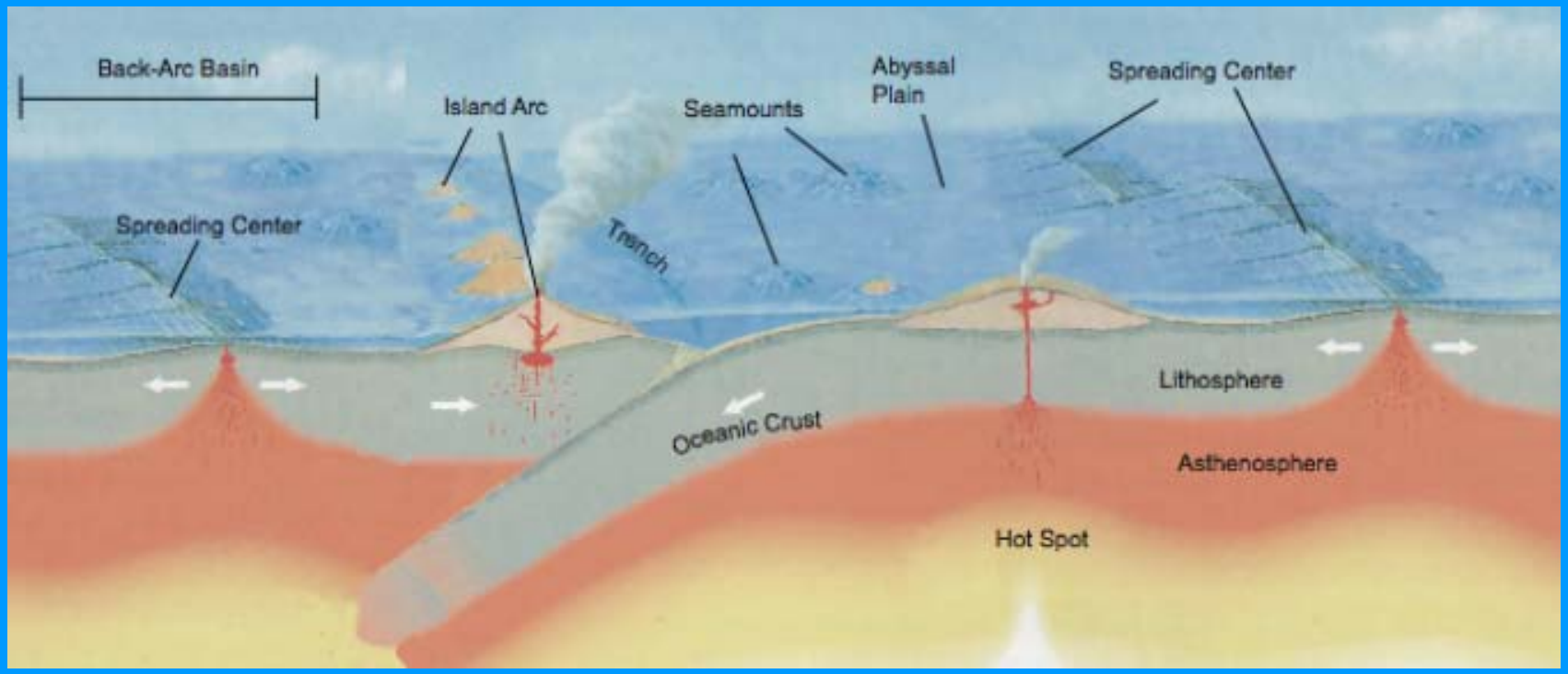
	PNG (2008) *	New Caledonia (2009) *	Fiji (2006) ^	Solomon Islands (2011) ^^
GDP (%)	64	10	1.5	2.5
Export Earning (%)	72	80	7.7	16

* (SMI, 2011)

^ (Ackley, 2008) – these are pre-mine closure figures. Mining was suspended at Vatukoula between December 2006 - April 2008.

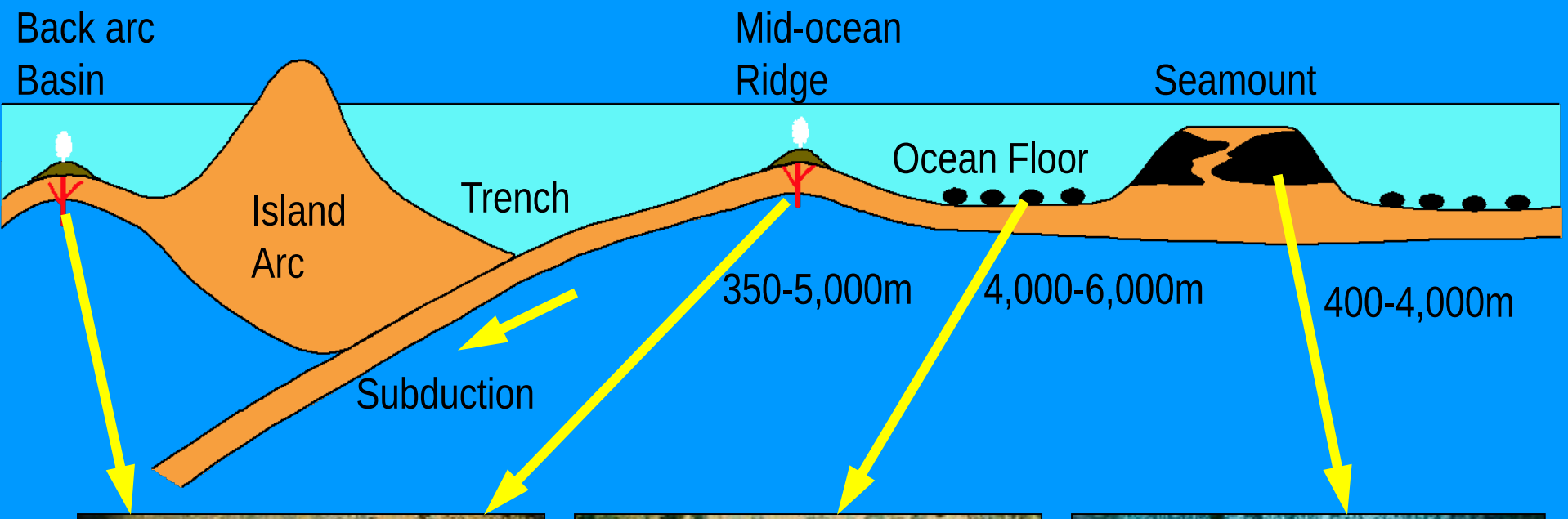
^^ (EITI, 2012) – mining at Gold Ridge was suspended between June 2000 – March 2011.

Plate Tectonics and Marine Mineral Deposits



- Hydrothermal vents / Seafloor Massive Sulphide) are found in tectonically active areas in all the worlds oceans.
- Manganese nodules occur mainly in the Abyssal Plains.
- Cobalt-rich Crusts are found on the side of seamounts and volcanic islands.

Deep Sea Minerals Occurrence



SMS Deposit

Manganese Nodules

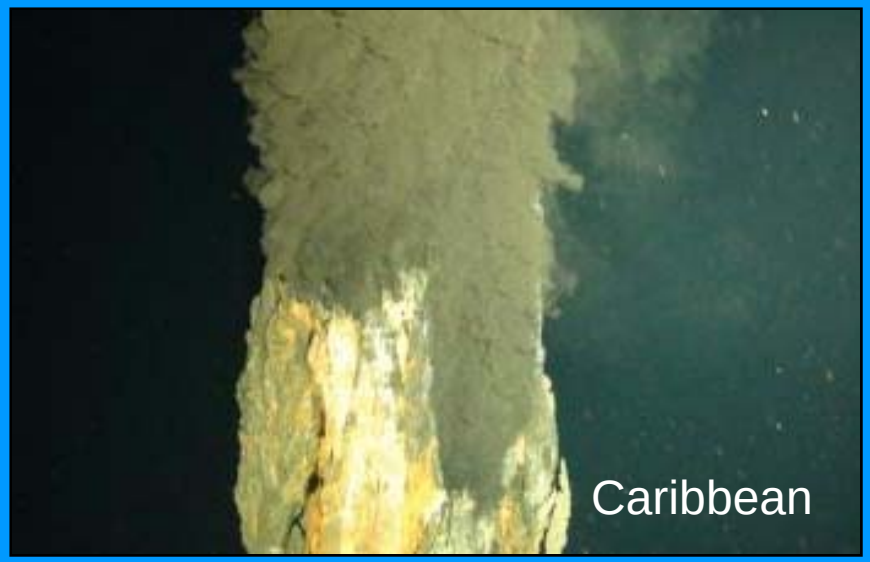
Cobalt-rich Crust

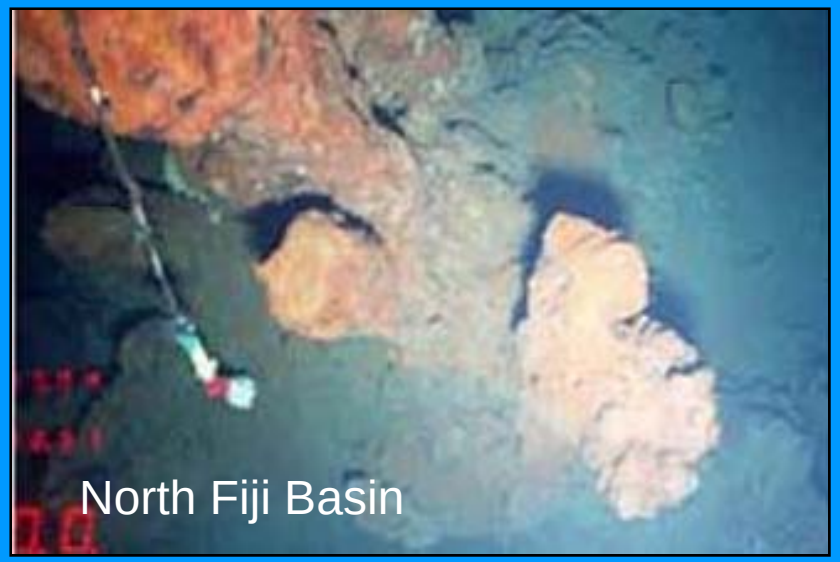
Mineral Occurrence/Potential in the Region

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

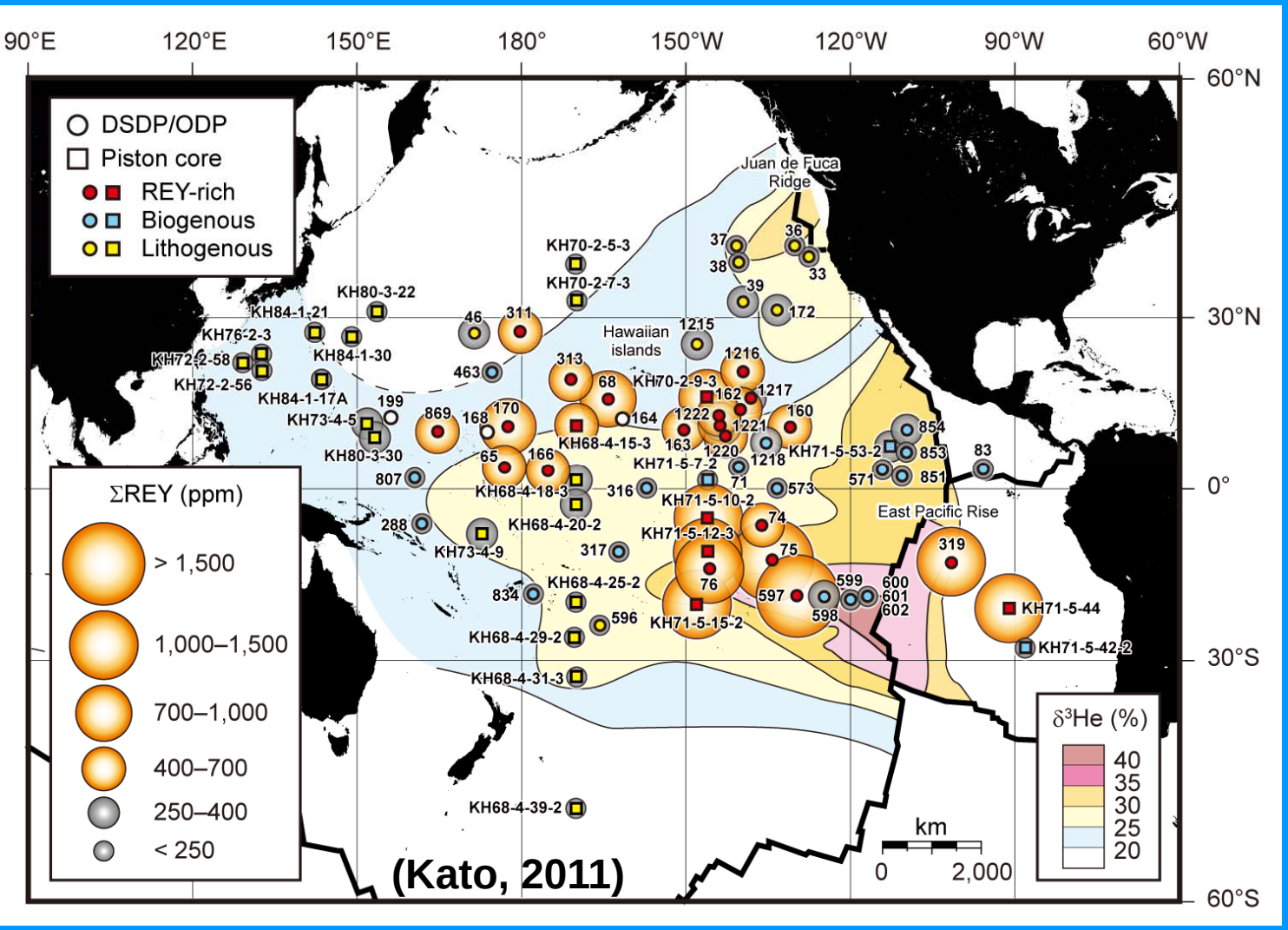
- **No economic potential for Metalliferous Sediment, Precious Coral and Phosphate**

Deep Sea Mineral Samples





Rare Earth Elements



97 % of REE are mined and produced by China

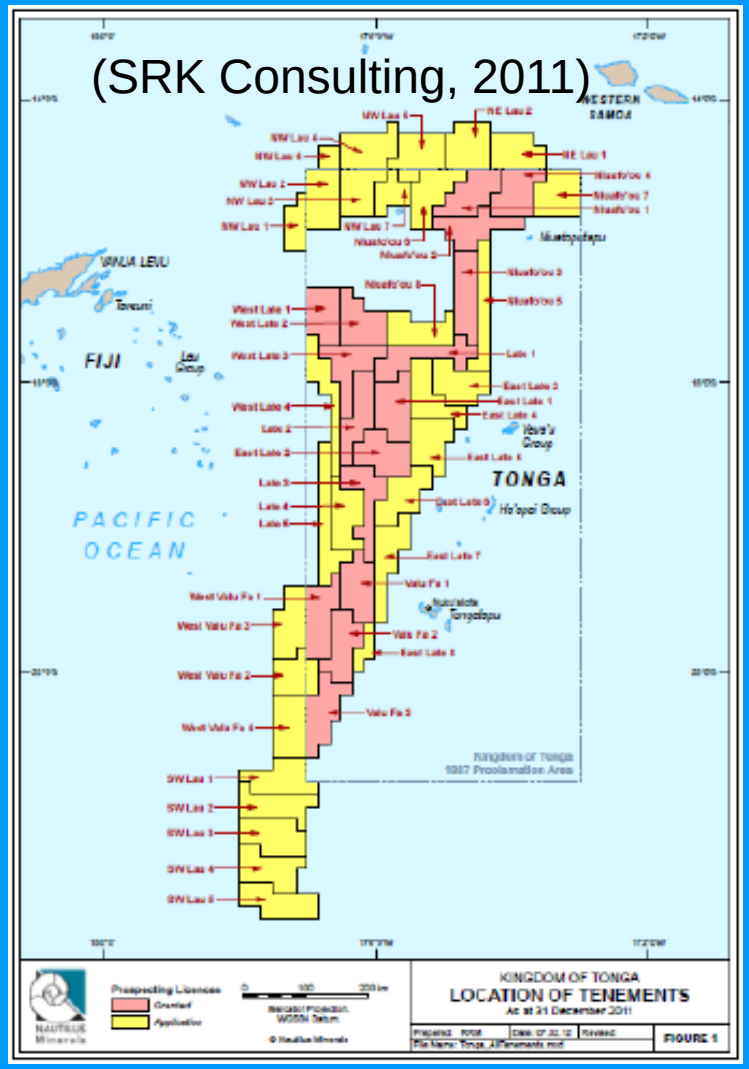
The Co-rich ferromanganese crusts of the Pacific Ocean have 2 to 3 times the REE concentration of the typical CCZ (Clarion Clipperton Zone) nodules

- Distribution of REE rich mud (< 2m in depth)

Uses of Metals in Marine Minerals

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

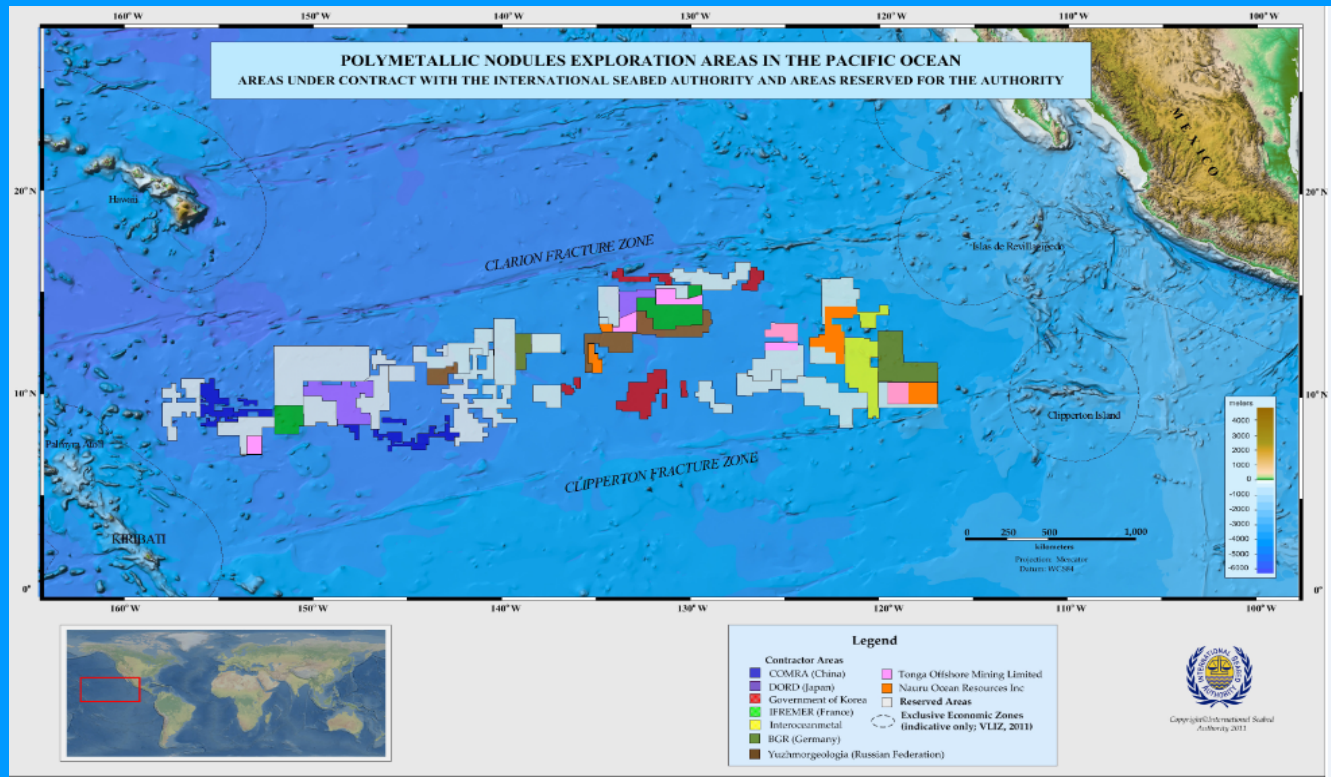
Recent Exploration for SMS in the Region



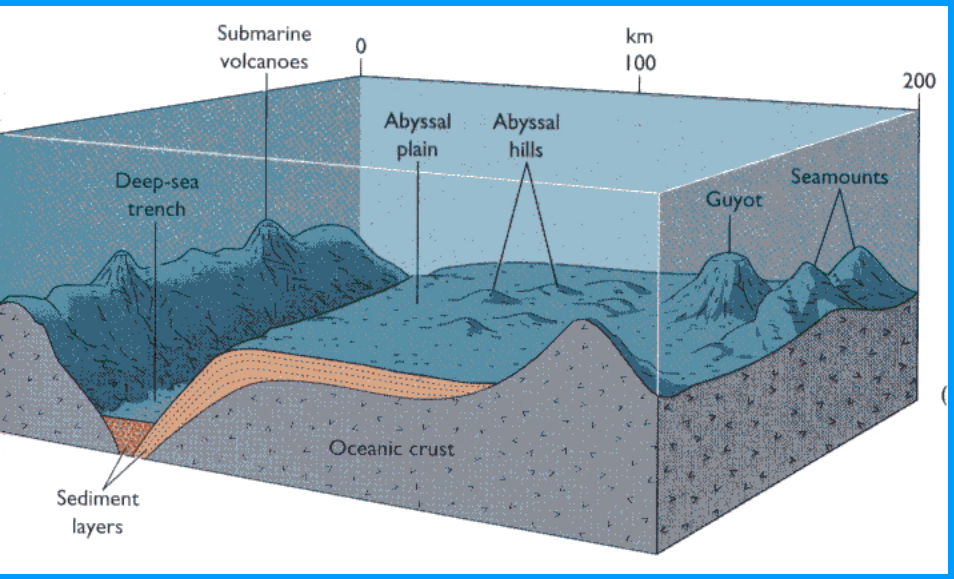
- **Nautilus Minerals:**
  - Mining License granted in PNG,
  - Exploring in PNG, Solomon Islands, and Tonga.
  - Exploration licenses granted in Vanuatu and Fiji
- **Bluewater Metals:**
  - a subsidiary of Neptune Minerals (US), exploring in PNG, Solomon Islands, Vanuatu, and Tonga.
  - Application in Fiji.
- **Korea Institute of Ocean Science and Technology (KIOST):**
  - a semi-state owned organisation.
  - Exploring in Tonga and Fiji.

Exploration Interest in ‘the Area’

- Nauru (NORI), and Tonga (TOML) registered companies have been granted exploration licenses in the “Clarion-Clipperton Fracture Zone (CCFZ) in 2011.
- Marawa Research and Exploration Limited (MREL) of Kiribati has been granted exploration licenses in the CCFZ in 2012.
- PICs such as Fiji and Tuvalu have shown interest to participate in exploring “the Area”.



The Deep Sea Environment and Habitats



The Deep Sea is a Stable Environment:

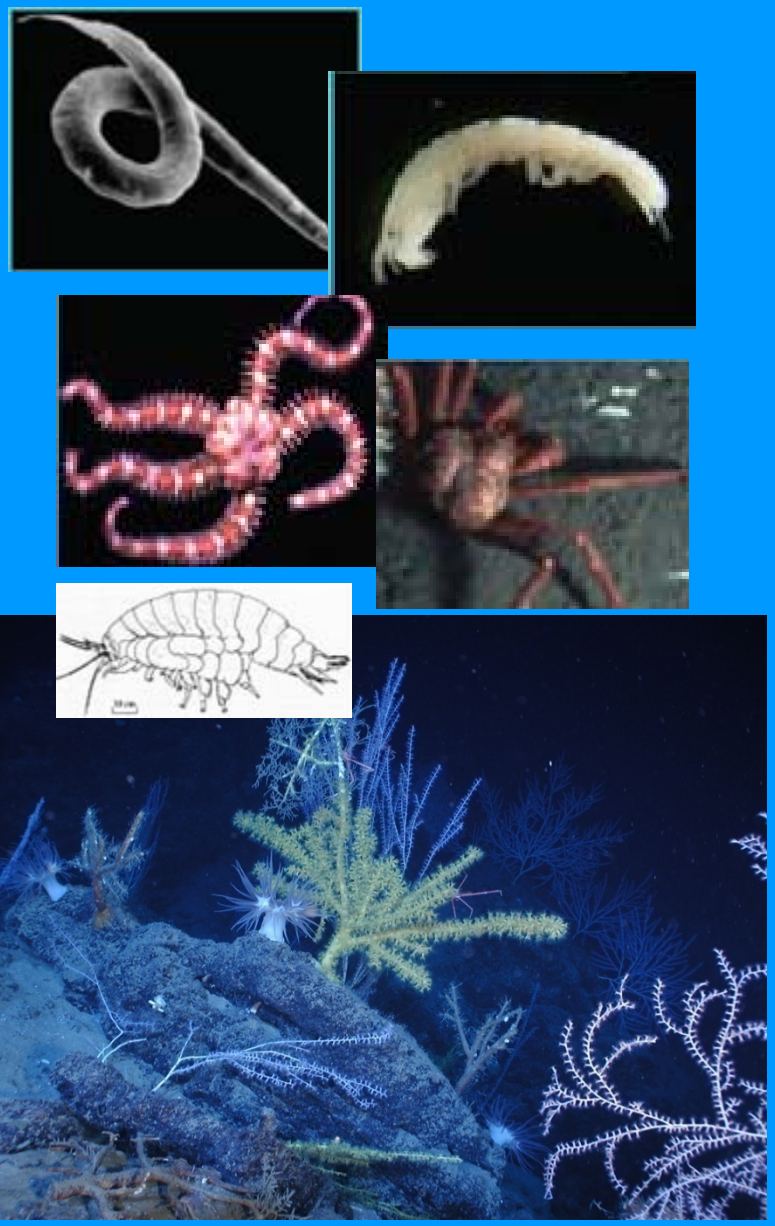
Constant darkness, pressure, temperature, chemistry, and humidity

- Most is sediment
  - Different types of sediment and different sizes of grains host different biology
  - Faunal groups change with depth
  - Fauna changes with food input
- Hard bottom
  - Can be small rocks (Manganese nodules)
  - Mountains (seamounts) and escarpments
  - Hydrothermal vents
  - Cold seeps

Who Lives in the Deep Sea?

- Bacteria/Archaea
- Protozoa
- Meiofauna (42-500 μm)
- Macrofauna (>300 μm)
- Megafauna (visible, >1 cm)
- Giants

Some General Observations

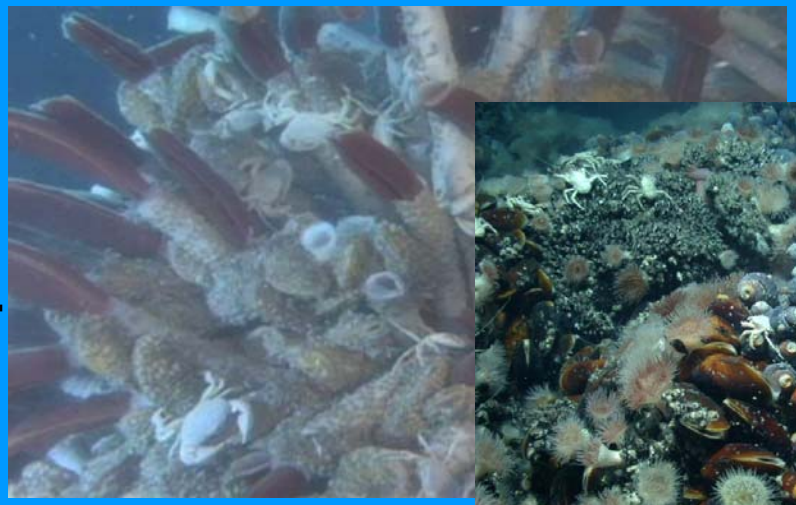


- The fauna of the deep sea is very diverse, but relatively poorly known.
- Different communities are found in different habitats.
- Different communities are found at different depths.
- Different communities are found in different parts of the world's oceans.

When deep sea hydrothermal vent communities were discovered in 1977 we expected…….

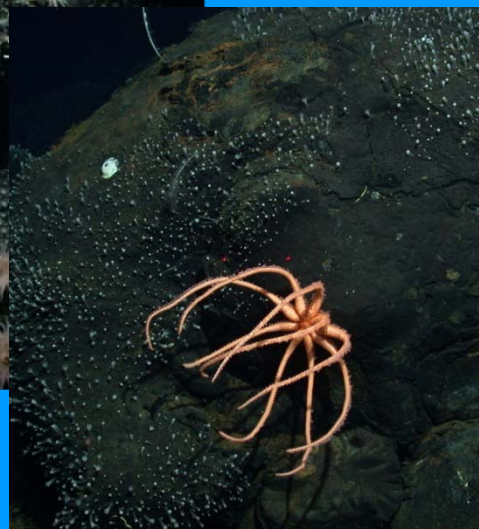
- No sunlight
- New seafloor
- No sediment
- Low biomass (not much food or life)

But, what they found……



Two very different categories of habitat types (and associated fauna):

1) Animals associated with active hydrothermal flow "Vent endemic fauna"
2) Animals associated with inactive structures, either at otherwise active sites or sites with no current hydrothermal activity



Toxicity in the vent environment:

Sulphide is toxic to most animals, and its' presence is tied to the "vent candy" (autotrophy and food)

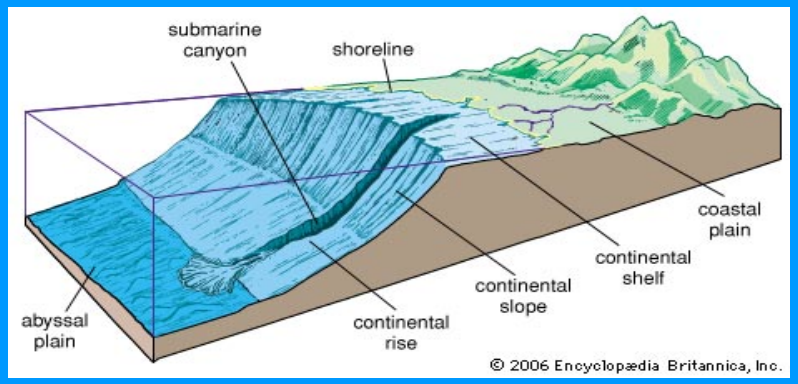
-Sulphide poisons most haemoglobins

- Other stressors that must be overcome or avoided i.e. heavy metals, ph, radioactivity

Vent Endemic Fauna:

- Megafauna are reasonably well known and some species reasonably well studied
- The macrofauna is not well studied and the meiofauna are very poorly known
- The connections to surrounding ecosystems are very poorly constrained.

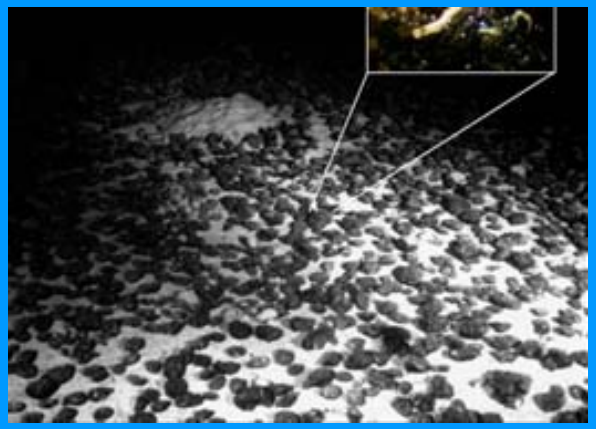
Characteristics of Abyssal Seafloor



- Mostly plains of sediment (sand to clay)
  - typically 2,200 m to 5,500 m
- 40% of the ocean floor is abyssal plain
- Low temperature (-1.0 to 2.0ºC)
- High hydrostatic pressure
- Slow bottom currents (except abyssal storms)
- Much of structure biogenic (fragile) or hard substrates (nodules)
- Absence of sunlight
- Average salinity
- High dissolved oxygen
- Low food supply

4500m Equitorial Pacific

5600m Central North Pacific

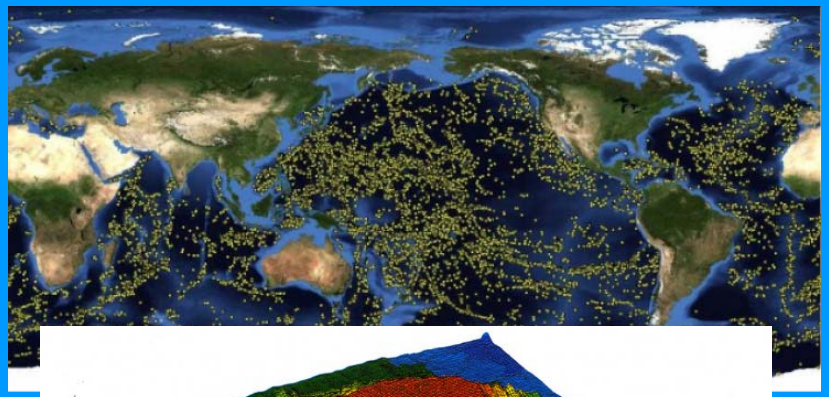


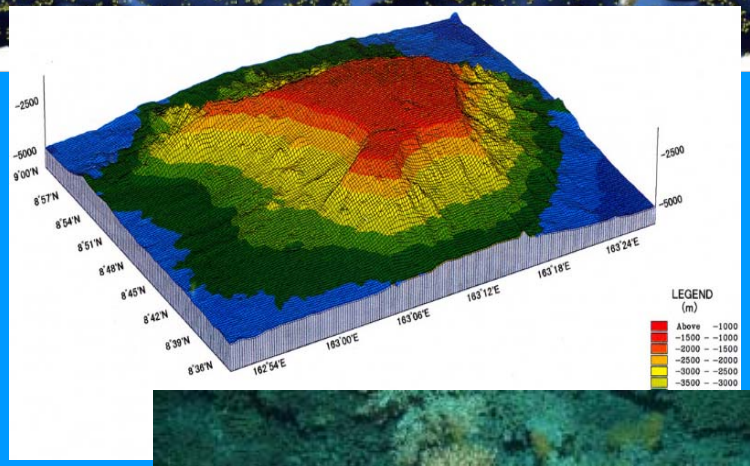
Nodule habitat and fauna

- Most of the biodiversity is in the soft sediment
- High levels of local biodiversity of tiny animals (macrofauna and meiofauna)
- Strong evidence for regional differences within CCFZ
- In general very poorly known (but lots of current work)
- Many new species discovered from almost every collection.

Megafauna: Low density, moderate diversity, no current evidence for regional scale endemicity

The Cobalt-rich Crust Habitat





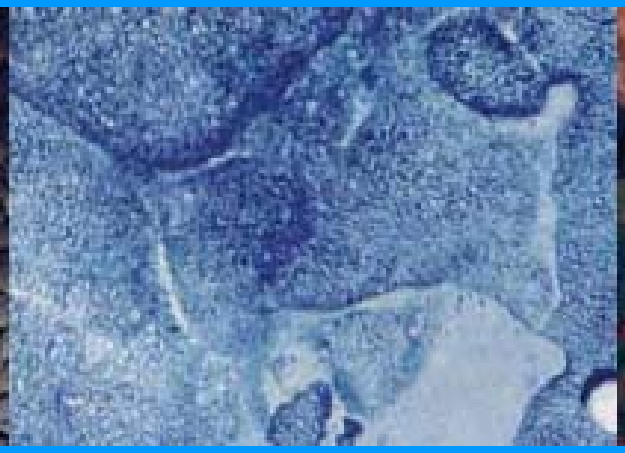
- Primarily on seamounts, and plateaus and volcanic islands 800 – 2500 m depth
- Areas with enhanced currents that remove sediments
- Western and central Pacific region good for crusts
- Deep sea Corals and Sponges can host a diverse, and often productive community including a variety of benthic invertebrates and fishes

Cobalt-rich crust habitat and fauna

• Seamounts can host commercially important fish aggregations. As a result, many are already heavily impacted by commercial fishing operations (e.g. deep sea trawling)

• Although megafauna is rapidly becoming better known, most regions are grossly under sampled
• Macro and meiofauna are very poorly known
• Hard ground communities (like other communities) vary by depth within a region
• More work is needed to determine if there is a fauna endemic to cobalt-rich crusts

Update on the SPC-EU Deep Sea Minerals Project Activities


SPC-EU Deep Sea Minerals Project

Pacific ACP States

Project Objective and Key Result Areas

- **<u>Overall Objective:</u>** to improve the governance and management of Pacific ACP States deep sea mineral resources.

- The Project has four Key Result Areas:

  - Key Result Area 1: Regional Legislative and Regulatory Framework (RLRF) for deep seabed minerals exploration and exploitation;

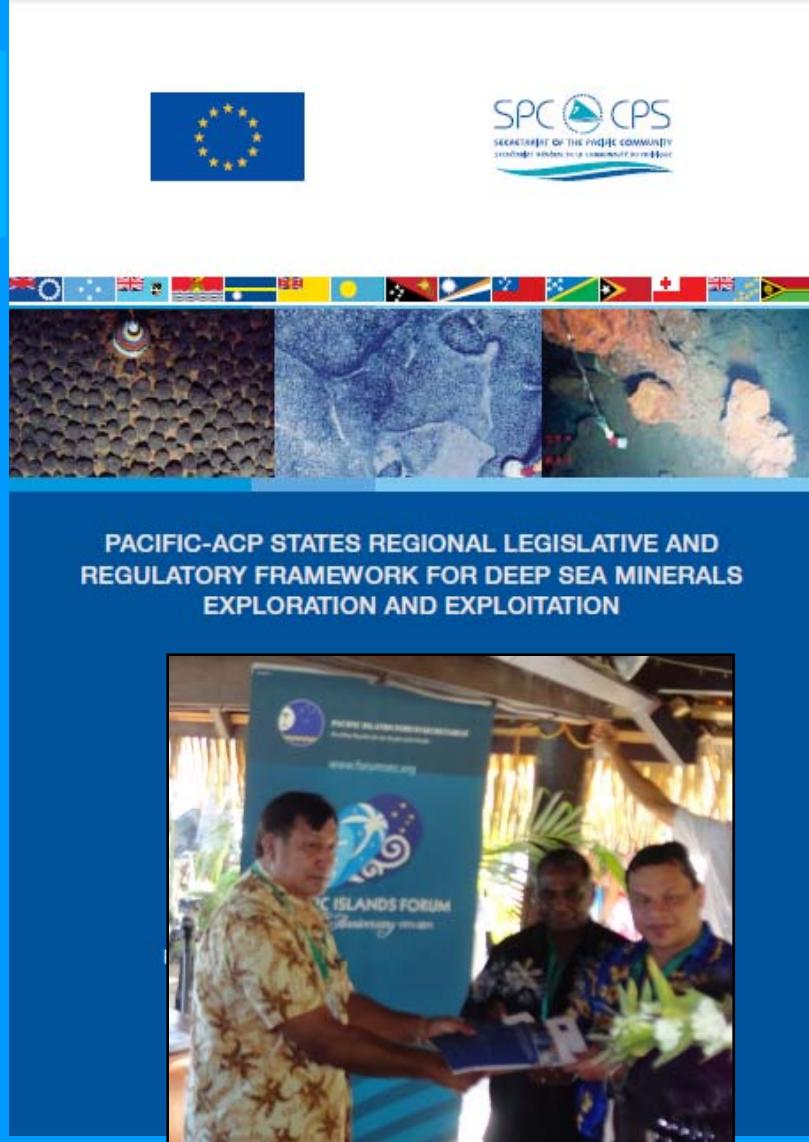
  - Key Result Area 2: National DSM policy, legislation and regulations;

  - Key Result Area 3: Building national capacities – supporting active participation of Pacific ACP States nationals in deep sea mineral activities; and

  - Key Result Area 4: Supporting effective management and monitoring of offshore exploration and mining operations.

Result Area 1 - DSM Regional Framework

- The "*Pacific ACP States Regional Legislative and Regulatory Framework (RLRF) for Deep Sea Minerals Exploration and Exploitation"* has been developed and finalised.
- The RLRF was officially launched during the Pacific Forum Leaders Meeting in Cook Islands in August 2012;
- Pacific-ACP States to use the RLRF to develop their DSM policy, legislation and regulations.

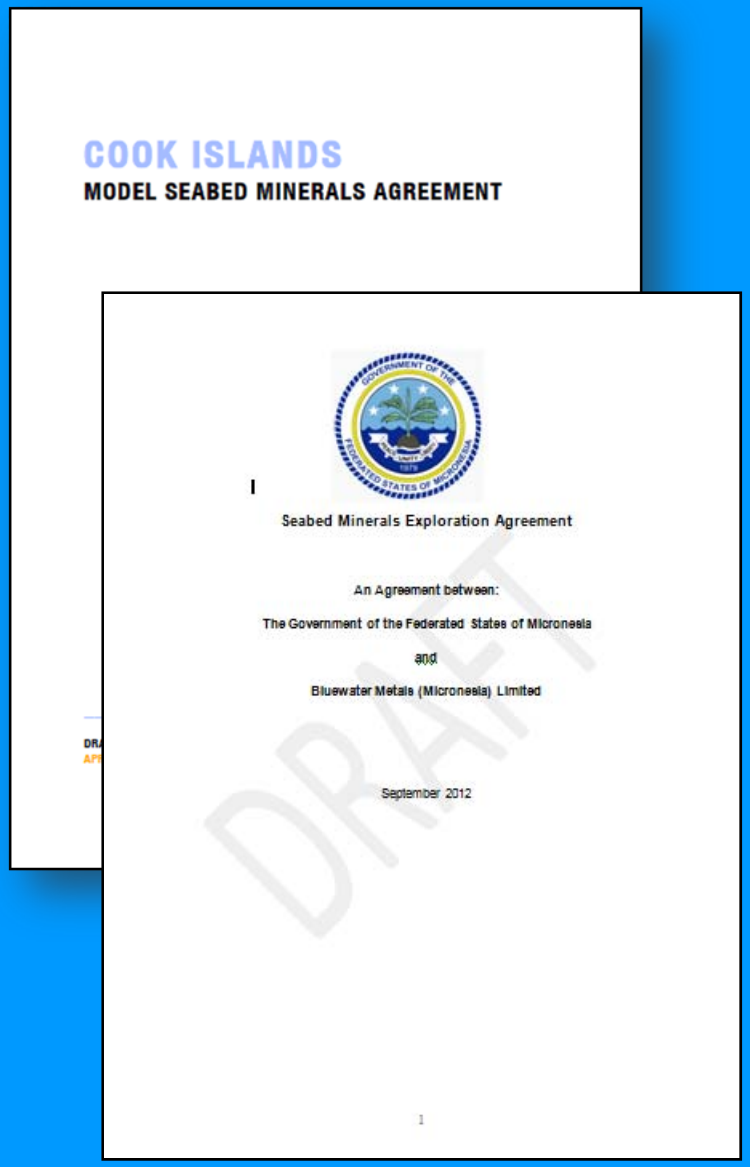


Result Area 2 – National Legislative Instruments

- Convene national stakeholder consultation workshops;
- Establish a multi-stakeholder National Offshore Minerals Committee (NOMC);
- Support NOMC Activities e.g. development / review of policy, consultation and awareness;
- Support policy and legislation review process, submission to cabinet / parliament, and enactment.

Result Area 2 – Activities Achieved to Date

- Tonga Seabed Minerals Legal Instruments prepared:
  - Seabed Minerals Policy, Legislation and Regulations;
- Drafting instructions for Nauru Seabed Minerals Legislation prepared;
- Fiji International Seabed Minerals Decree drafted;
- Government-Company contract agreement for FSM prepared;
- Cook Islands DSM Policy reviewed and drafting notes for the seabed mining environmental regulations provided;
- Cabinet paper for the formal establishment of NOMC in Vanuatu and RMI prepared.
- Drafting of Tuvalu Seabed Minerals Legislation in progress
- Legislative review of Niue's existing legislation completed.


COOK ISLANDS
MODEL SEABED MINERALS AGREEMENT

Seabed Minerals Exploration Agreement

An Agreement between:

The Government of the Federated States of Micronesia

and

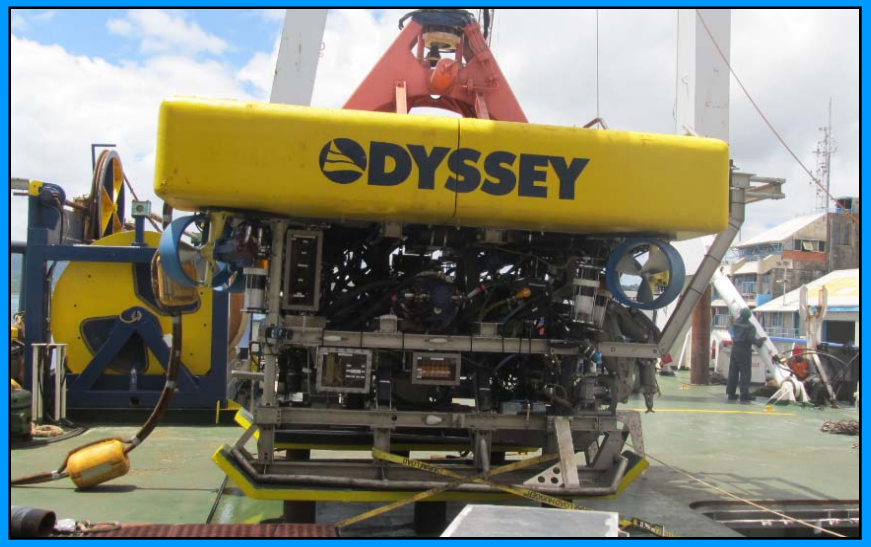
Bluewater Metals (Micronesia) Limited

September 2012

DRAFT

Result Area 3 – Capacity Building

- Establish a process for assessing MSR, offshore mineral / mining contracts, and EIAs;
- Support short-term training of relevant technical and legal professionals;
- Capacity building / supplementation through training workshops, e.g. Geological, environmental, legal and fiscal aspects of DSM;
- Establishment of an open source Regional Marine Minerals Database;



Result Area 3 - Capacity Building Initiatives

- Supporting representatives of Pacific ACP States to participate in regional and international workshops/conferences e.g. the 2011 Pacific Mining Conference.
- Support selected candidates to participate in marine safety and shipboard training, and post-survey data analysis.
- Legal Internship – has been ongoing since January 2012, to assist the Legal Advisor and be trained on legal issues relating to DSM;
- Dr Duane Malcolm from the Cook Islands was supported to undertake manganese nodules chemical analysis and data interpretation at the USGS in Feb-Mar 2013;
- Data collation is ongoing to establish a Regional Marine Minerals Database by 2014.

Result Area 3 – Regional Training Workshops

- *"1st Regional Training Workshop on Geological, Technological, Biological and Environmental Aspects of Deep Sea Minerals"* was held in August 2012 in Nadi Fiji;

- *"2nd Regional Training Workshop on Deep Sea Minerals Law and Contract Negotiations"* was held in March 2013 in Nukua'lofa Tonga;

- **Three additional regional training workshops:**

  - June 2013 – Stakeholder Participation and Social Impacts of DSM Activities;

  - September 2013 – Environmental Perspectives of Deep Sea Mineral Activities in the Pacific;

  - March 2014 – Fiscal Regime and Revenue Management of Deep Sea Mining.

Result Area 4 – Environmental Management

- Develop regional MSR, and DSM environmental management guidelines;

- Capacity building on developing EIA template, conducting EIA, and review of EIA report;

- Support environmental monitoring of offshore mining operations, and encourage the participation of potentially impacted local communities;

- Support government and CSO in conducting awareness programmes to potentially impacted local communities;

- Carry out a Benefit-Cost Analysis (BCA) of deep sea mining:

High costs of deep sea mining and the potential impacts on the marine living resources	against	Profit derive from any mining operation due to high commodity prices and the decrease in land metal reserves

Result Area 4 – Environmental Management Guidelines

- An international workshop on *"Environmental management needs for deep seabed minerals exploration and exploitation"* was jointly organised by the ISA, Fiji and SPC through the DSM Project;

- An EIA template for DSM was prepared by experts during the ISA-SPC-Fiji November 2011 Workshop that can be applied both with national jurisdiction and in the Area;

- Pacific Marine Minerals Assessment Report (under SPC-UNEP/GRID-Arendal Agreement) contains two chapters on environment management;

- 2013-2014: Regional Deep Sea Minerals Environmental Management Guidelines to be developed.

DSM Project Beneficiaries

- **Two main beneficiaries:**
- **(1) National governments:** relevant government agencies particularly those that are responsible for mining, fisheries, environment, law, and fiscal matters;
- **(2) Local Communities:** particularly those that are most likely to be impacted by activities relating to offshore exploration and mining;
- **Other beneficiaries:** Private Sector, CSO, and regional and international agencies.

Implementing Partners

- **Relevant government agencies of the 15 Participating Countries:**

  - Mining; - Fisheries;

  - Environment; - Finance,

  - Office of the Attorney General

- **Regional Organizations:**

  - Other Divisions of the SPC,

  - Pacific Islands Forum Secretariat (PIFS),

  - PNA Secretariat,

  - Secretariat of the Pacific Regional Environment Programme (SPREP);

- **Other Organisations:**

  - UNEP/GRID-Arendal,

  - Commonwealth Secretariat,

  - Geoscience Australia,

  - International Seabed Authority,

  - World Bank, etc;

- **Local Communities**;

- **Non-State Actors:**

  - IUCN; WWF; PIANGO;

  - Minerals Policy Institute (MPI);

  - Other CSO

Information Sharing

- Host regional and national stakeholder consultation workshops / meetings;
- Workshop reports have been prepared and disseminated;
- SPC-UNEP/GRID-Arendal report on the state of knowledge of marine minerals in the Pacific;
- 12 DSM Project information brochures prepared and disseminated to stakeholders;
- The production of a DSM Documentary is near completion.

The Prospect

Issue 1, May 2013 NEWS FROM THE PACIFIC DEEP SEA MINERALS PROJECT

Welcome to the first newsletter of the SPC-EU Pacific Deep Sea Minerals Project

The SPC-EU Pacific Deep Sea Minerals Project is helping Pacific Island countries to improve the governance and management their deep-sea minerals resources. The Project is helping the countries to improve legal frameworks, increase technical capacity and to develop effective monitoring systems.

The Pacific Deep Sea Minerals Project is funded by the European Union and managed by SOPAC, the Applied Geoscience & Technology Division of the Secretariat of the Pacific Community, on behalf of 15 Pacific Island Countries: the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor Leste, Tonga, Tuvalu and Vanuatu.

The 4-year (2011-2014) SPC-EU Pacific Deep Sea Minerals Project is the first major initiative designed to regulate this new activity in a coordinated way within the Pacific Region. The €4.4 million EU-funded project is designed to help national governments develop the legal, fiscal and environment management frameworks needed to ensure that any exploitation of deep sea minerals will directly support national economic development while also minimizing any negative impacts on the environment and local communities.

Tonga Workshop Builds Vital Contract Negotiation Skills

Figure 6. A sample each of the first four DSM Project Information Brochures.

Project Communication and Visibility

- Excellent media coverage through news release, TV and radio interviews;
- Project activities and updates are published in other websites (e.g. MPI, UNEP/GRID-Arendal, InterRidge, N-S Environmental Law)
- A mini-website for the DSM Project has been established: **www.sopac.org/dsm**
- A Communication Specialist is contracted to prepare a communication strategy and assist the Project to implement the strategy