

Economic valuation of Cook Islands DSM Deposits

A Cook Islands case study: economics underpinning the Cook Islands DSM project

**SPC (SOPAC Division) Pacific ACP States 5th Regional Training Workshop
Rarotonga May2014**

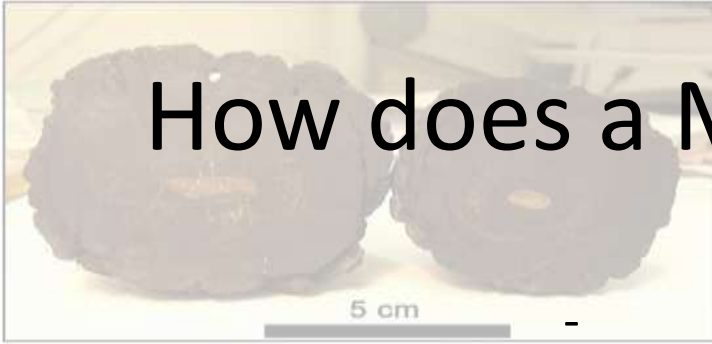
Darryl Thorburn



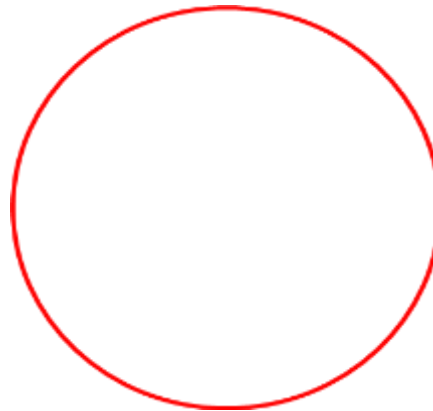
Topics to Cover

- Quick look at mineral owner/resource developer interests 101
- Value chain for Mn nodule recovery
- Understanding the revenue streams – economic modelling –are the economics there: stop/go time 2 years ago?
- Valuing Cook Islands acreage,
 - Understanding your deposit –why resource is where it is and why it is where it is not?
 - where is the value?
 - Where to from here?

How does a Mineral Owner Extract its Wealth



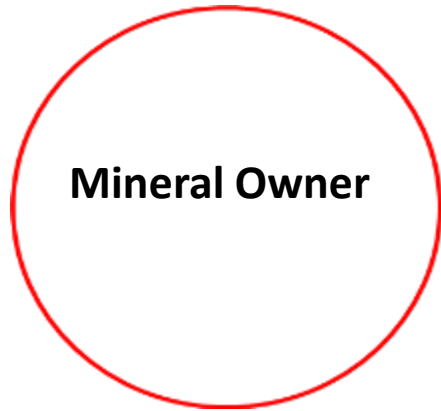
Mineral Owner



Resource Developer

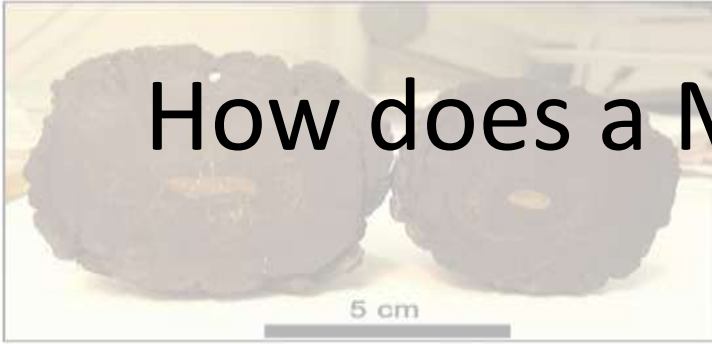


How does a Mineral Owner Extract its Wealth



- **A mineral owner/sovereign nation** for what ever reason wants to monetise its mineral assets. It needs to “market” its mineral assets in a **highly competitive environment**
- Quality, quantity, of resource, number 1. Convince investors that country can offer a stable investment environment - a complete package
- Need to get out there and sell asset, match needs (investor’s) with benefits (country as mineral owner)
- There are more mineral assets being peddled by “sellers” than “buyers”. Need to develop a good business case that is better than the competition.

How does a Mineral Owner Extract its Wealth



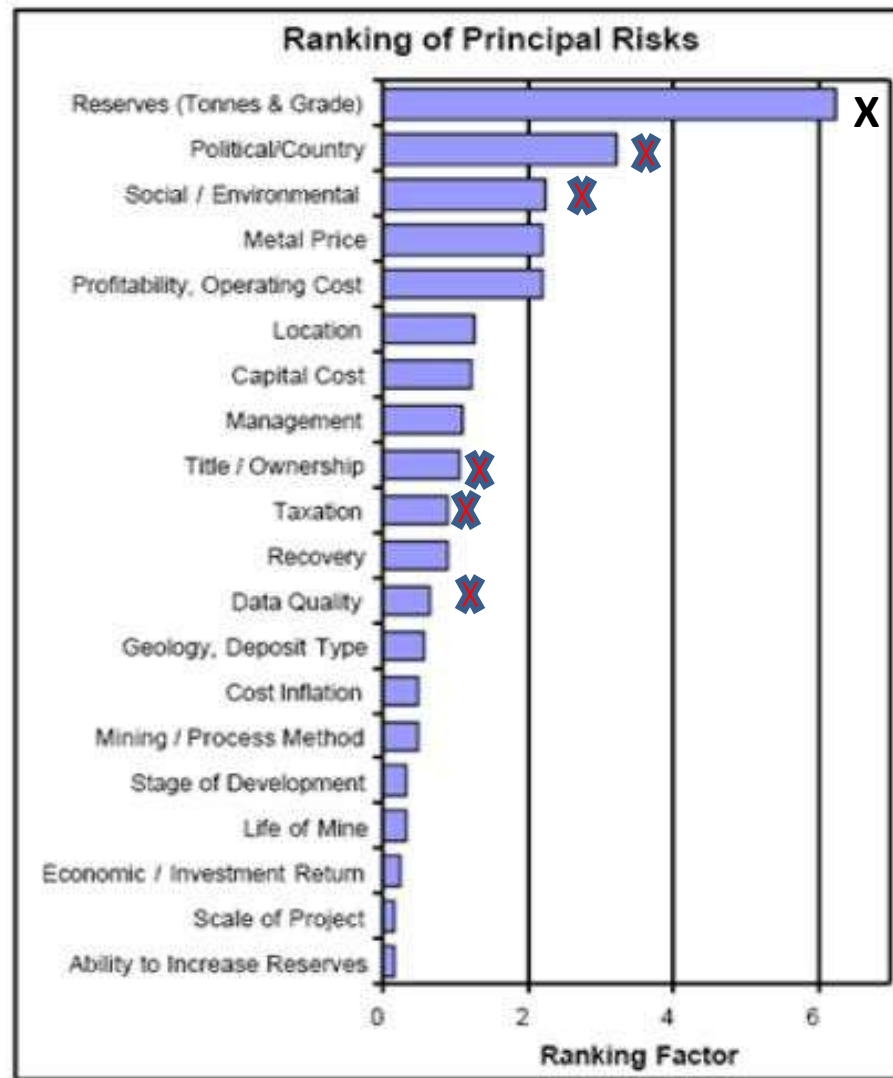
- **A resource developer /investor** is looking for superior mineral assets, to invest and develop and generate a suitable return to meet its risk weighted return on capital and live another decade.
- There are many such prospects that it will look at in making its choice.
- It brings capital, risk management and technical skills to the table
- Investors will consider the following risks involved on a case by case basis.



How does a Mineral Owner Extract its Wealth

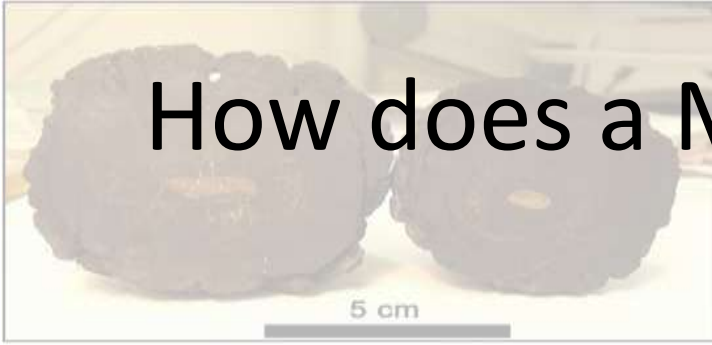
Mineral Owner

Resource Developer

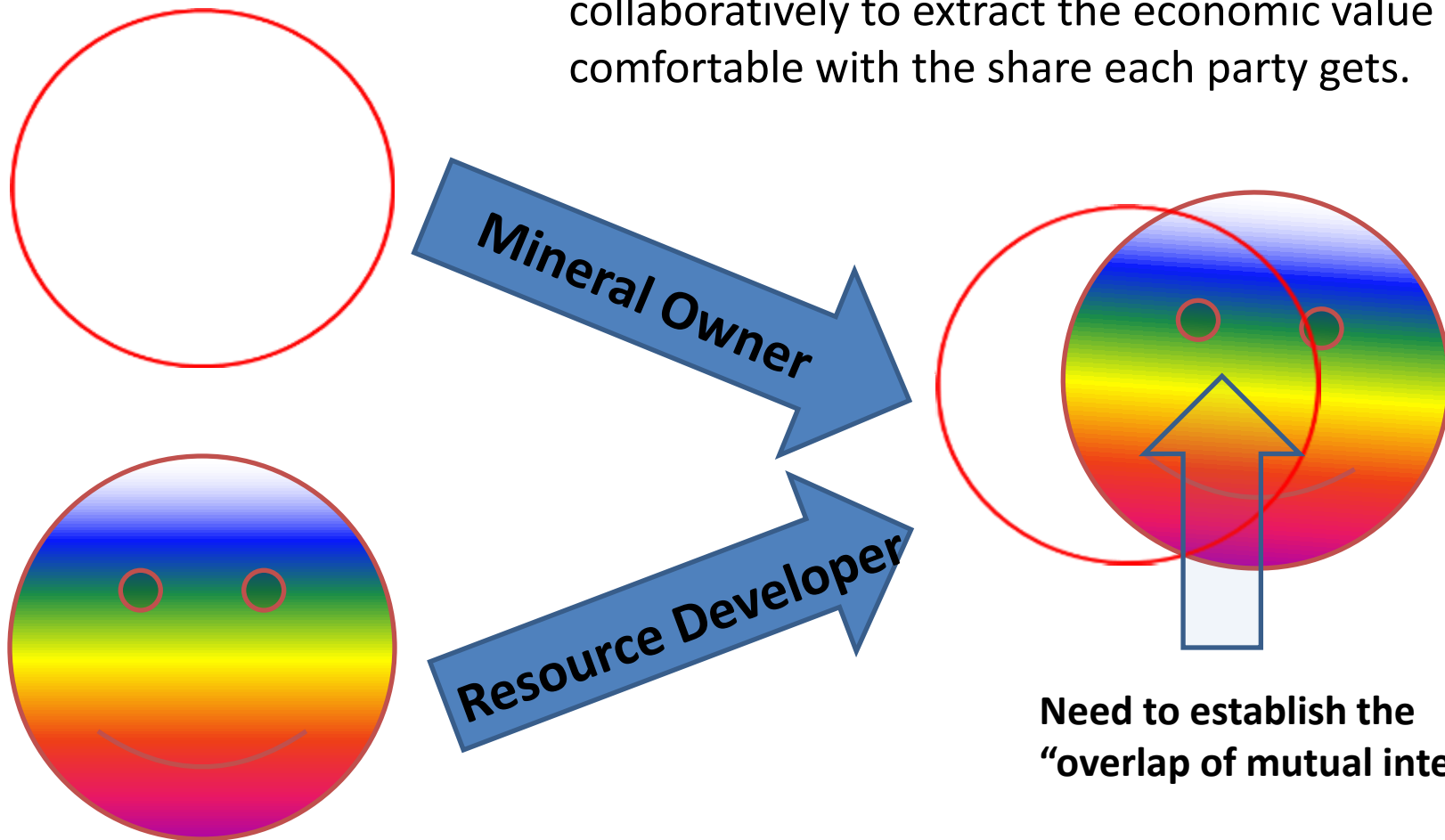


X Government can influence

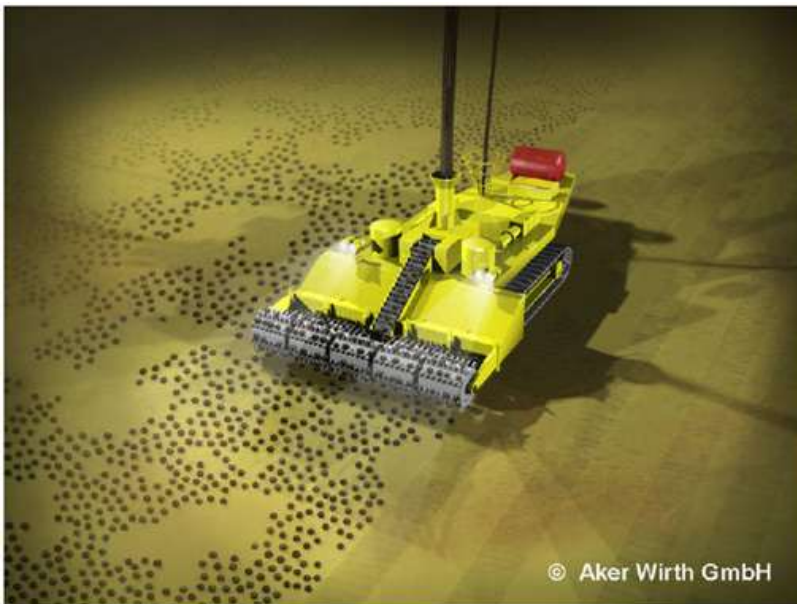
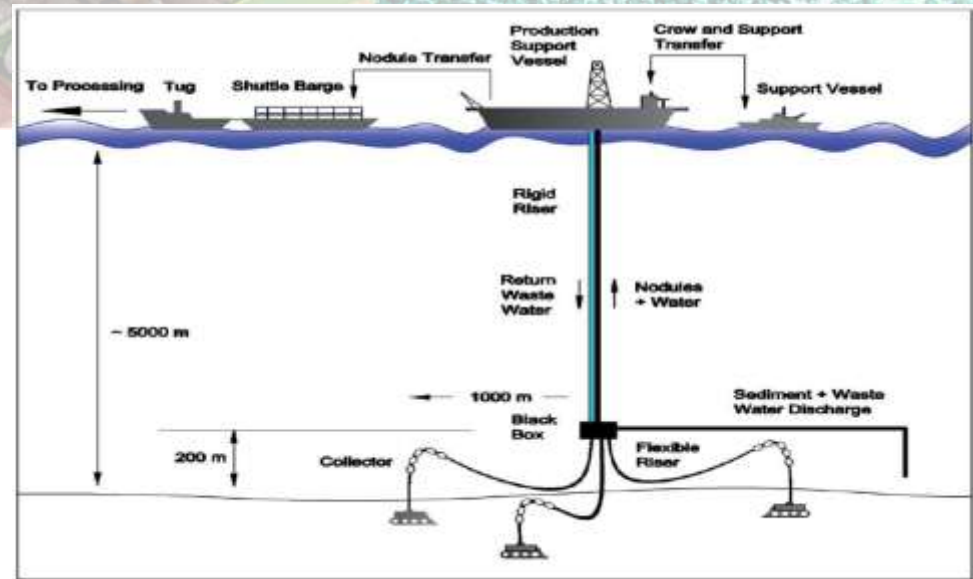
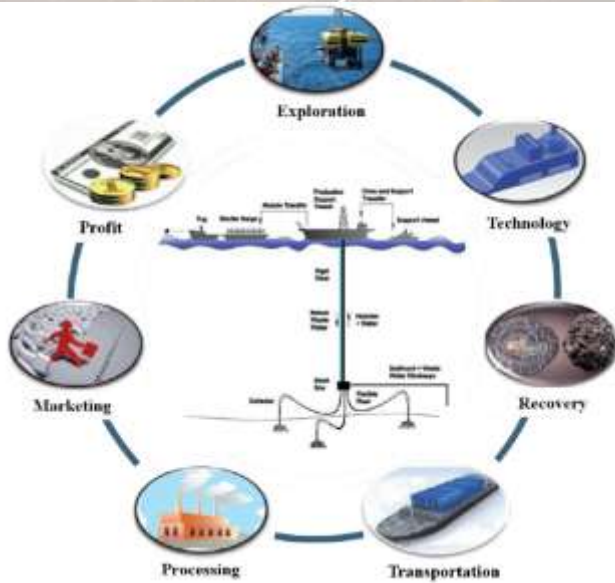
How does a Mineral Owner Extract its Wealth



Both parties need be able to “do the deal” and work collaboratively to extract the economic value and be comfortable with the share each party gets.



Value chain for Mn nodule recovery

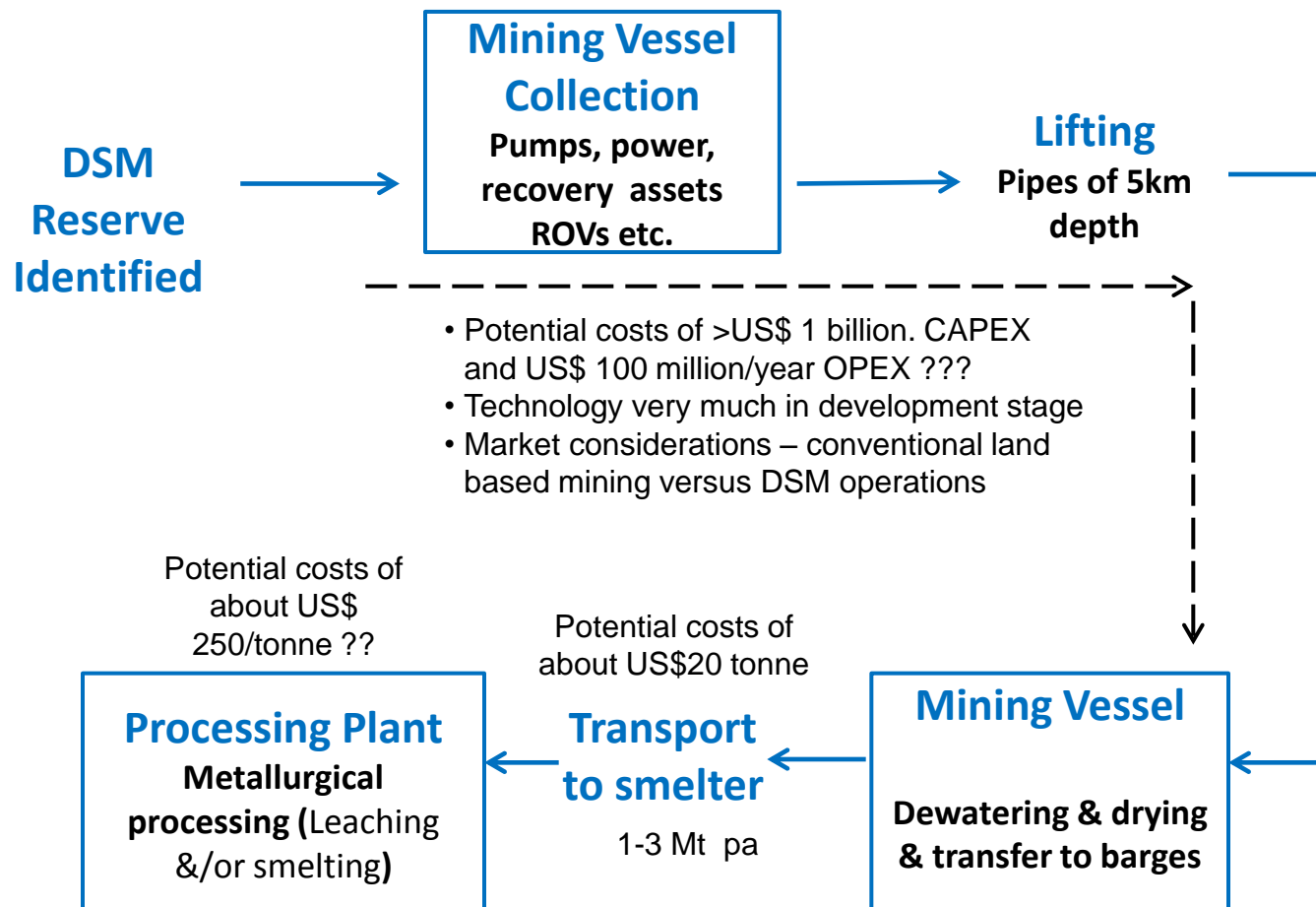


Value chain for Mn nodule recovery

DEEP SEA MINERALS OPERATION SUMMARY



After
ComSec ELS



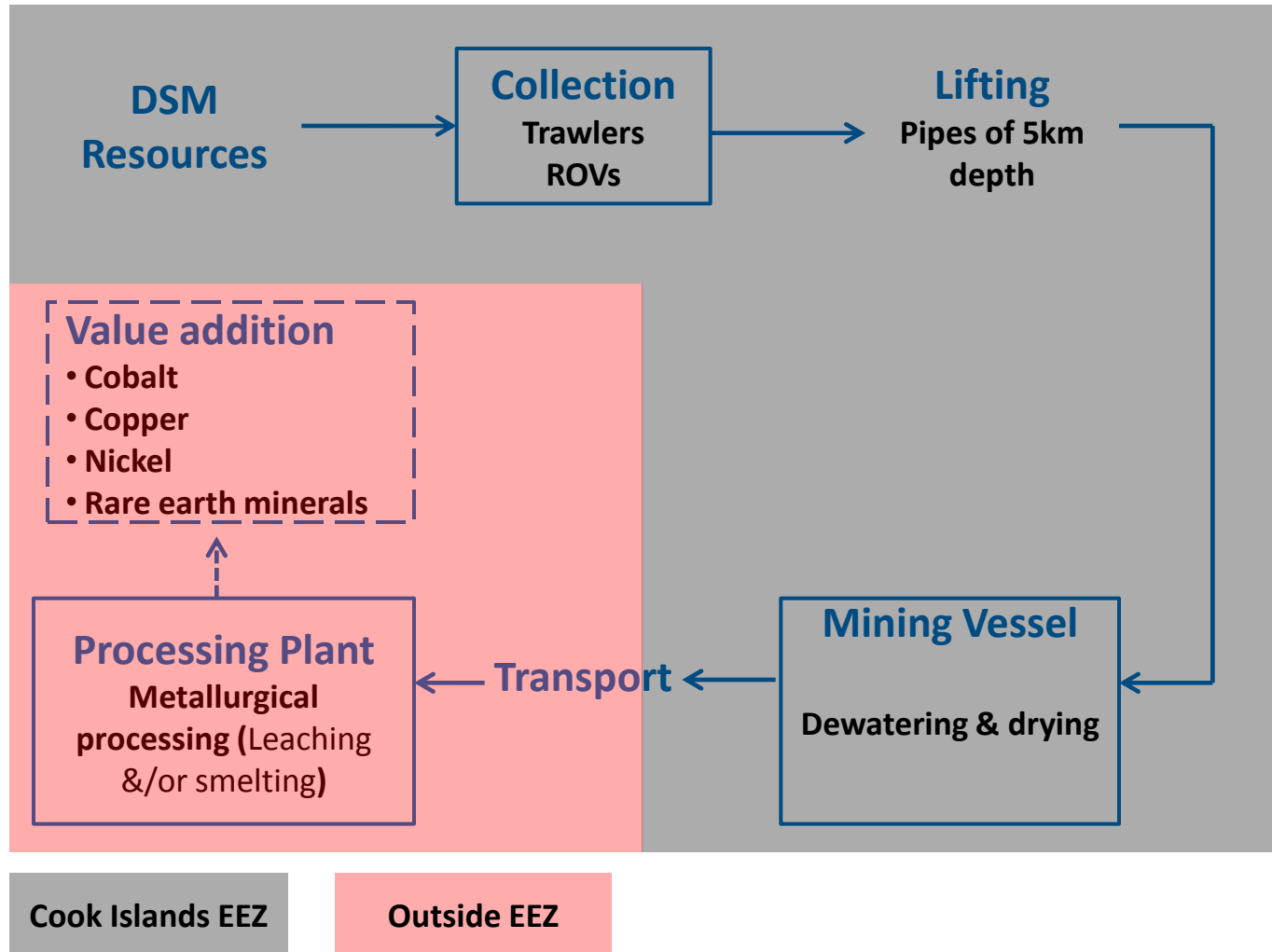
Value chain for Mn nodule recovery

JURISDICTION

JURISDICTION ISSUES



After
ComSec ELS

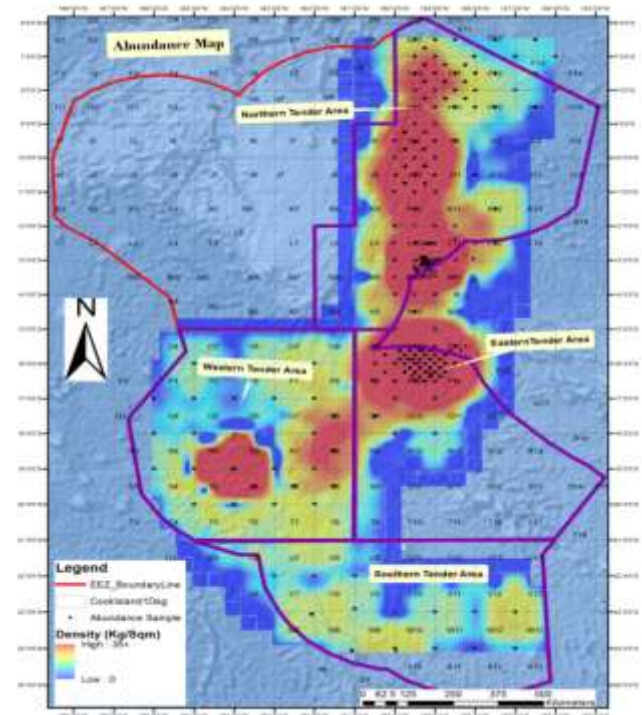
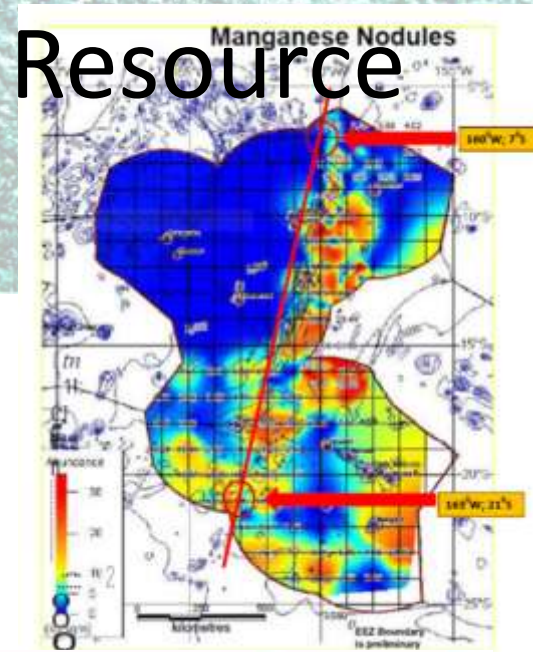


Cook Islands EEZ

Outside EEZ

Status of Cook Islands SBM Resource two years ago

- A world class resource in terms of size, grade?
- Resource will support a large scale operation
- Exceedingly high density of nodules over large areas cf other Mn nodule provinces
 - $130,000 \text{ km}^2 > 25 \text{ kg/m}^2$
 - $650,000 \text{ km}^2 > 5 \text{ kg/m}^2$
- 3mt pa 25 year recovery operation would require an area of 3,500 km^2 (2.8% of rich area)



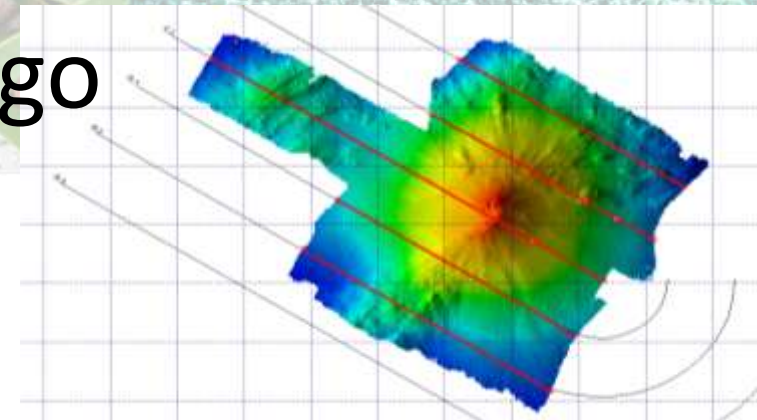
RESOURCE ESTIMATES

	Total Nodule Tonnes	Cobalt (Co)	Manganese (Mn)	Nickel (Ni)	Copper (Cu)	Titanium (Ti)
Cronan, 2013	10,266 >5 kg/m ²	43	1,891	36	18	164
<i>Value of metal in ground \$B (Cronan)</i>	1,747	1,118	-	504	125	-
Clark et al 1995	7,474	33	-	24	14	-
<i>Value of metal in ground \$B (Clark)</i>	1,134	967	-	136	31	-
CCZ ISA Tech Study 6	27.1	58	7,300	340	290	-

**Comparison of Nodule and Metal Tonnage in the Cook Islands EEZ
(in millions of metric tonnes)**

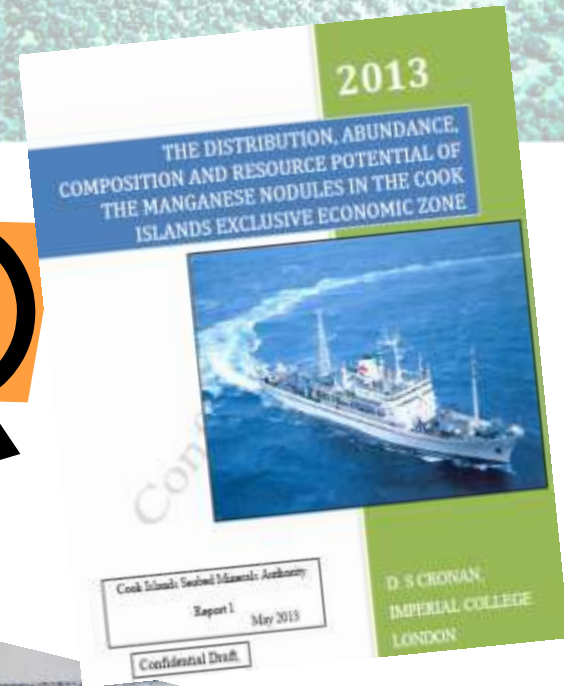
Status of Cook Islands SBM Resource two years ago

- Resource needs modern exploration, seabed topography detail needed.
- Cook Islands and its vast seabed minerals resource not well known in the international arena.
- Targeted promotion at key conferences and direct marketing through developing relationships with key players



Status of Cook Islands SBM Resource two years ago

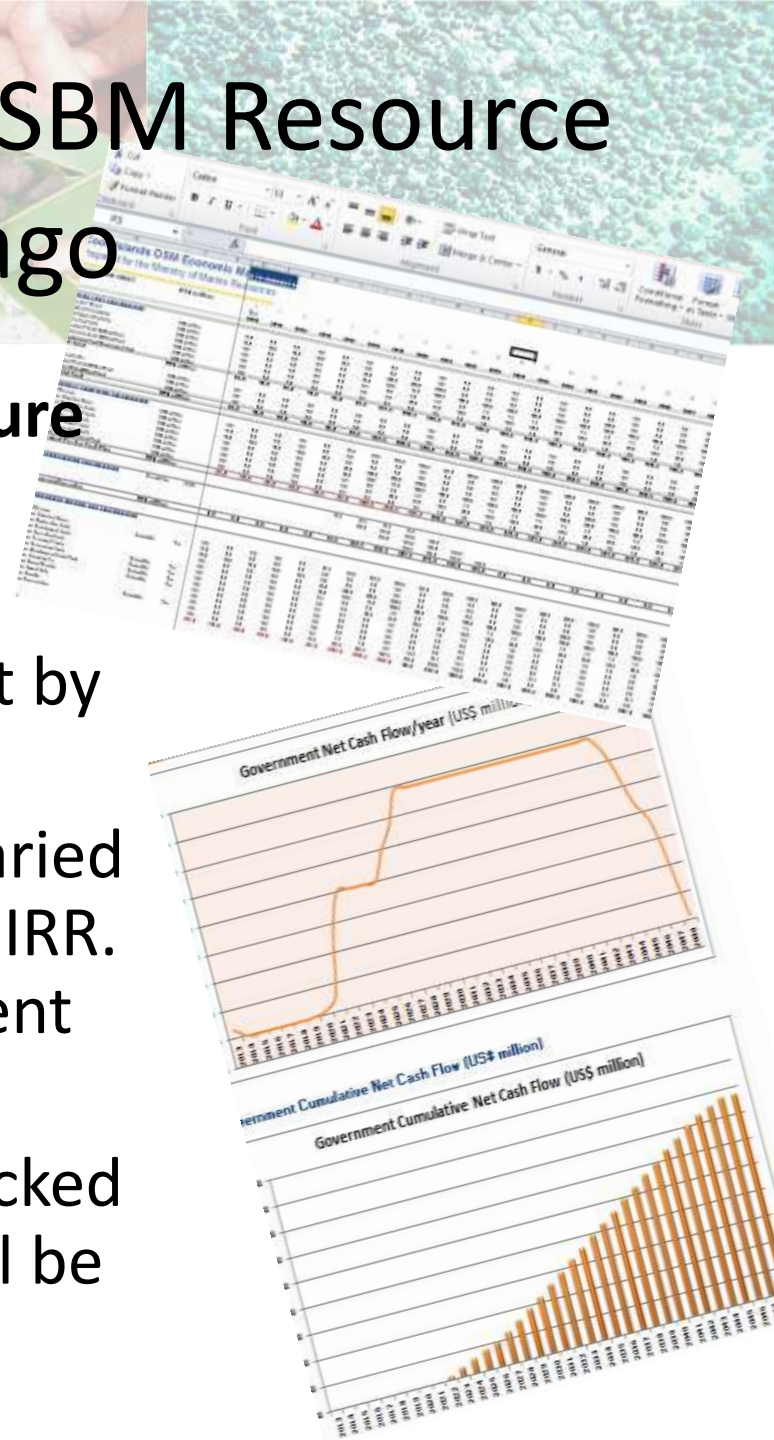
- Primary data on nations nodules “lost” – major task in tracking it down and rebuilding primary data base.
- Considerable amount tracked down through internet, various government offices and building up references
- Cronan report pulled together considerable knowledge of SW Pacific Area
- SOPAC/Japan surveys of 1980-2000 and primary data tracked down in SOPAC’s digital archives



Status of Cook Islands SBM Resource two years ago

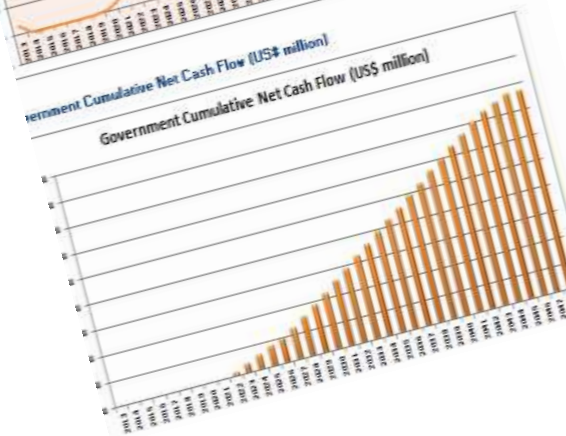
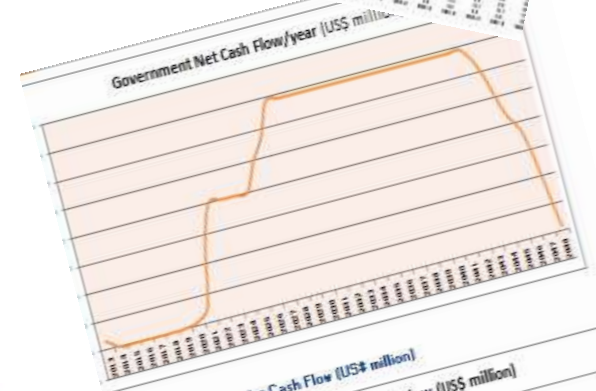
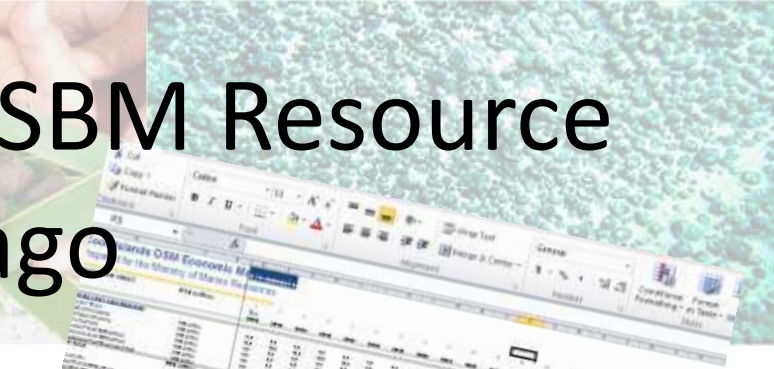
Financial Modelling to decide on future programme

- Flexible DSM Economic Model built by Commonwealth Secretariat.
- Provides for various inputs to be varied to test project indicators, payback, IRR. NPV, revenue streams to government and company.
- Model assumes that revenue is tracked to sale of metal, in practice this will be unlikely



Status of Cook Islands SBM Resource two years ago

- Model showed that even with large CAPEX and OPEX settings, a hypothetical mining operation likely to be robust.
- Over time model evolved to reflect likely price inputs
- Model used to test and set the policy settings for Cook Islands fiscal regime



Project Summary

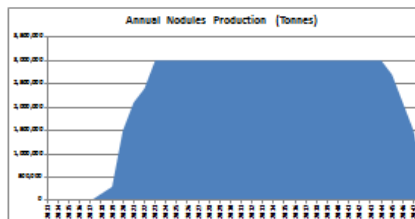
KEY PARAMETERS	QUALIFIER	VALUE
Currency	US\$	millions
Maximum Annual Nodule Production	Tonnes	3,000,000
Recovery	%	80%
lb/tonne conversion factor	2204	
Manganese Mn Value	% in nodules	18.0% 1.0 2,204
Cobalt Co Value	% in nodules	0.4% 12.79 28,189
Copper Cu Value	% in nodules	0.2% 3.31 7,295
Nickel Ni Value	% in nodules	0.3% 6.39 14,084
Titanium Ti Value	% in nodules	1.1% 2.00 4,408
Gross Revenue	Life cycle metals value	39,771.5
Project Pre-Tax Cash Flow	Life cycle metals value	14,329.4
Company Net Tax Cash Flow	Life cycle metals value	14,654.8
NPV Company Net Cash Flow (0%)	Life cycle metals value	6,912.2
NPV Company Net Cash Flow (12.3%)	Life cycle metals value	721.7
NPV Government Net Cash flow (0%)	Life cycle metals value	8,980.3
NPV Government Net Cash flow (12.3%)	Life cycle metals value	940.3
Cost Profile		
Environmental Bond		10.0
Exploration costs/yr		10.0
Development Costs		1,547.0
Operating Costs/yr		100.0
Signature Bonus	Life cycle metals value	15.0
Exploration Costs	Life cycle metals value	50.0
Development Costs	Life cycle metals value	1,547.0
Operating Costs	Life cycle metals value	2,835.0
Transport/tonne		10.0
Processing costs /tonne		240.0
Financial Profile		
3-tier Rate of Return System		
RoR Threshold RRT Rate		
RRT	20%	25%
	20%	0%
royalty	% of gross megal value	3%
Corporate Income Tax		28%
Withholding Tax		15%
Royalty	Over life of project US\$m	1,193.1
Corporate Income Tax	Over life of project US\$m	3,730.1
Signature Bonus	Over life of project US\$m	15.0
Withholding Tax	Over life of project US\$m	1,245.3
Resource Rent Tax 1	Over life of project US\$m	2,767.3
Resource Rent Tax 2	Over life of project US\$m	8,950.8
NPV of Company Net Cash Flow	US\$m @ 12.3% rate	721.7
NPV of Government Net Cash Flow	US\$m @ 12.3% rate	940.3
Company Take	%	42.1%
Government Take	%	57.9%
Company Post-tax IRR	%	55.3%
Company Payback Period	Yrs	9

Cook Islands DSM Economic Model

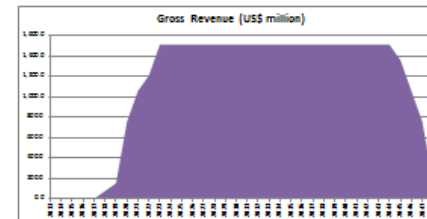
Prepared for the Ministry of Marine Resources

CHARTS SHEET

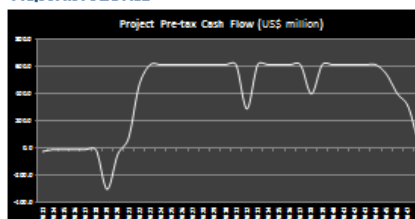
Nodular Production Profile



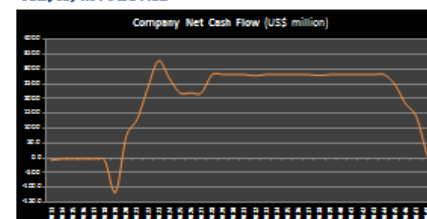
Gross Revenue Profile



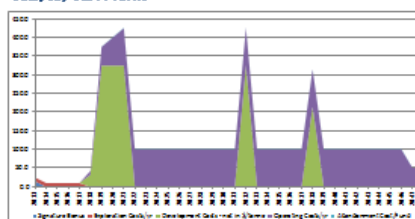
Project Net Cash Flow



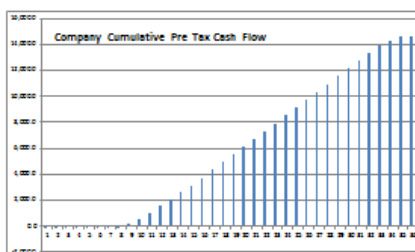
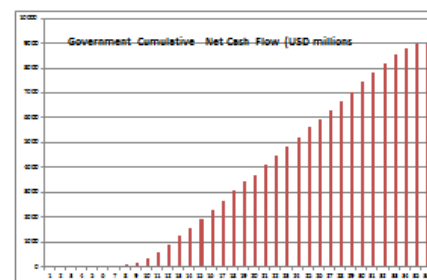
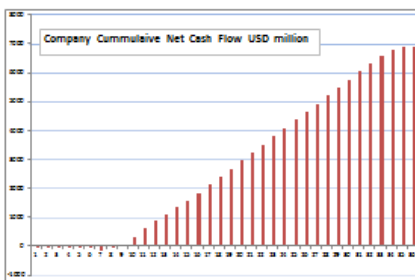
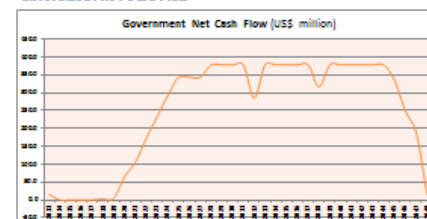
Company Net Cash Flow



Company Cost Profile



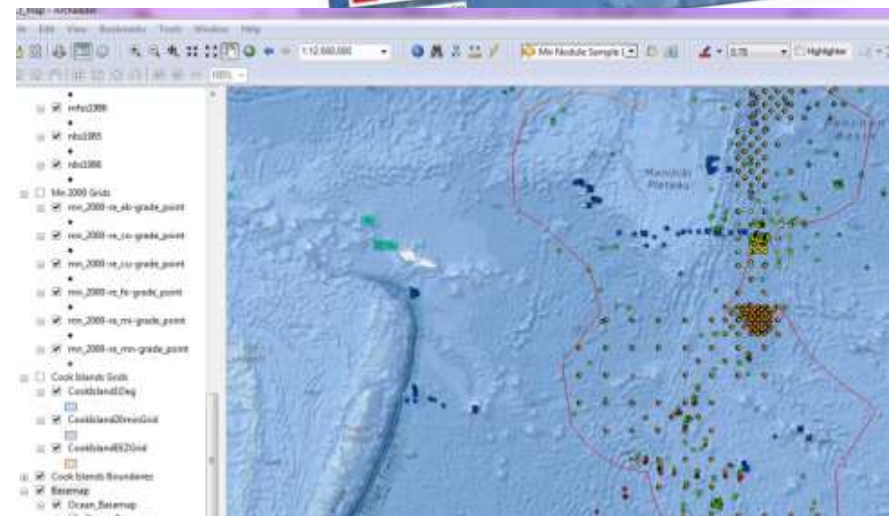
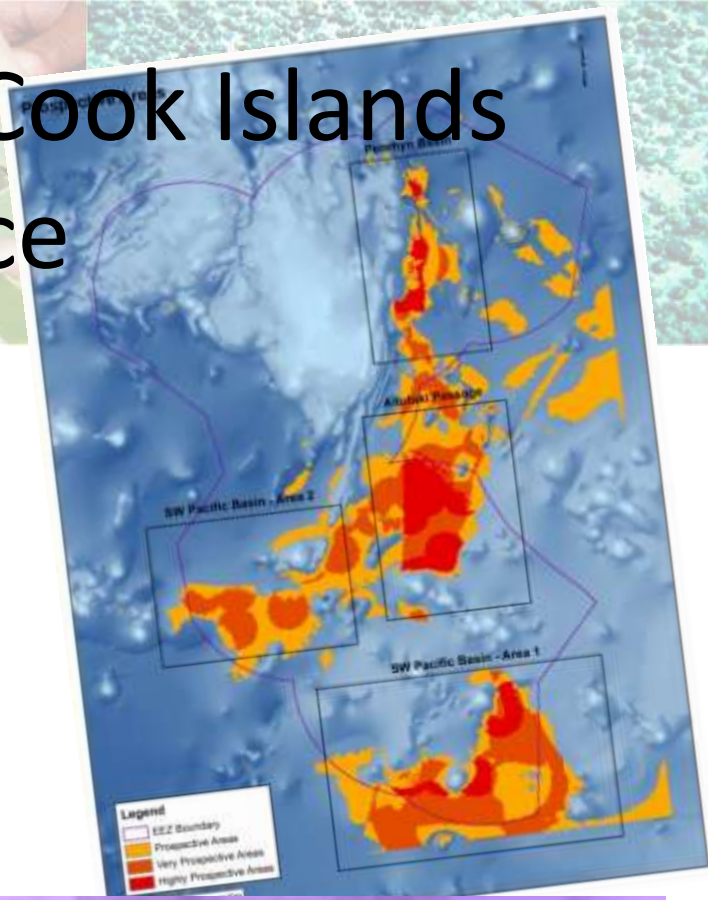
Government Net Cash Flow



The Commonwealth

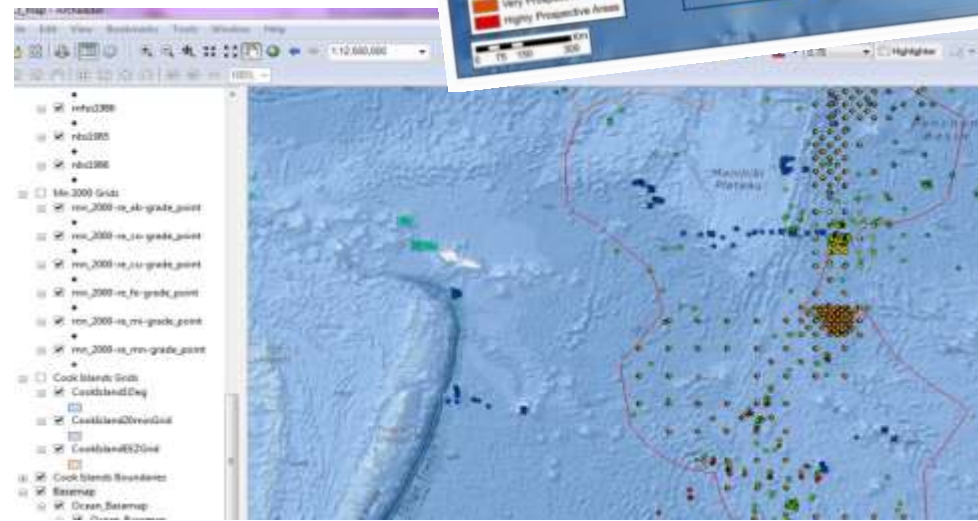
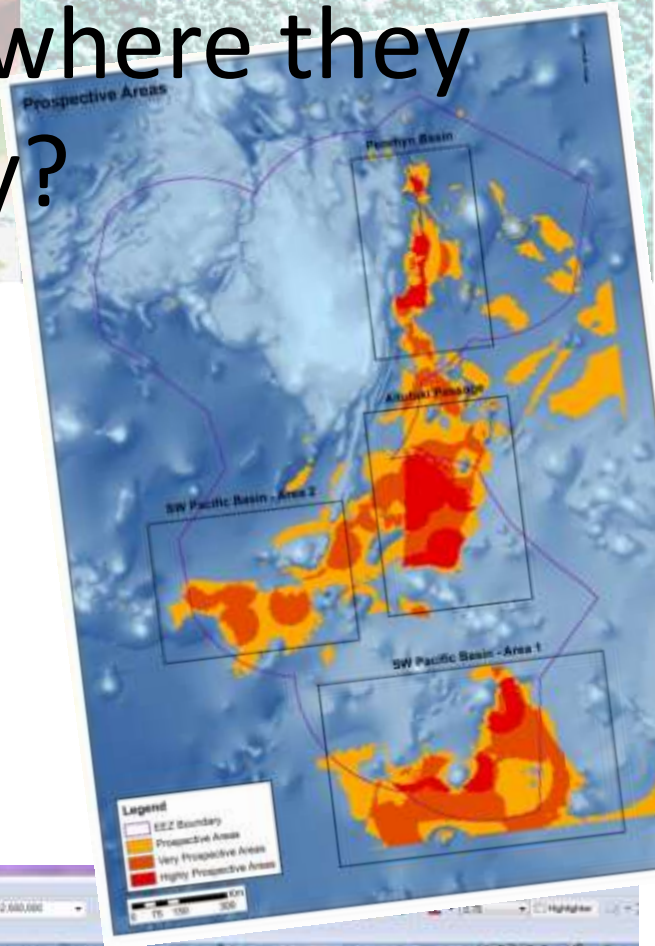
On-going valuation of Cook Islands SBM Resource

- Economics stack up so.....
- Next phase developing geological model - understanding of the deposit, the why, why not and where questions – Cronan report went a long way towards this.
- Digitised all the spatial data from the various surveys since the 1980's, a massive data compilation achieved.



Where are the Cherries, where they are not and why?

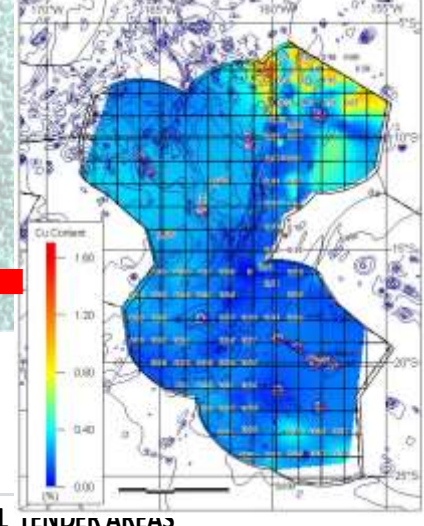
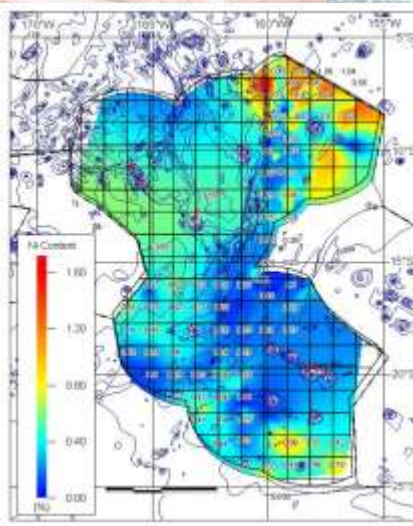
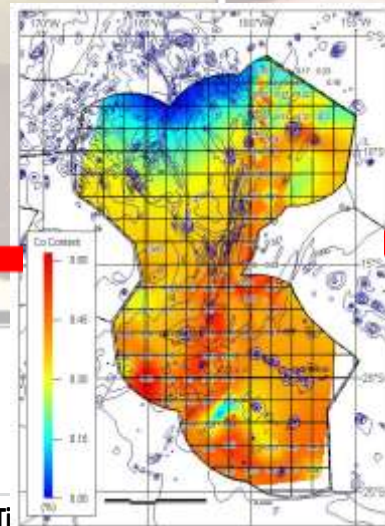
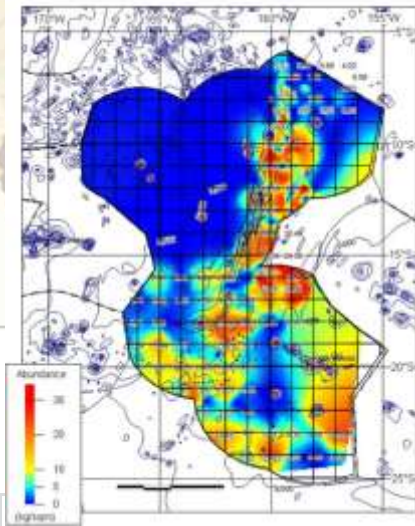
- Can now rapidly model the resource on a range of parameters using GIS software.
- Followed this up with a predictive assessment for where there might be further resources – sampling in south very sparse – 100 km centres in places
- Identified areas of interest in south and central west



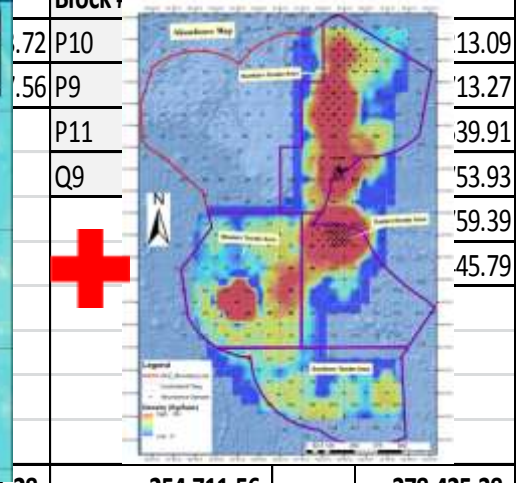
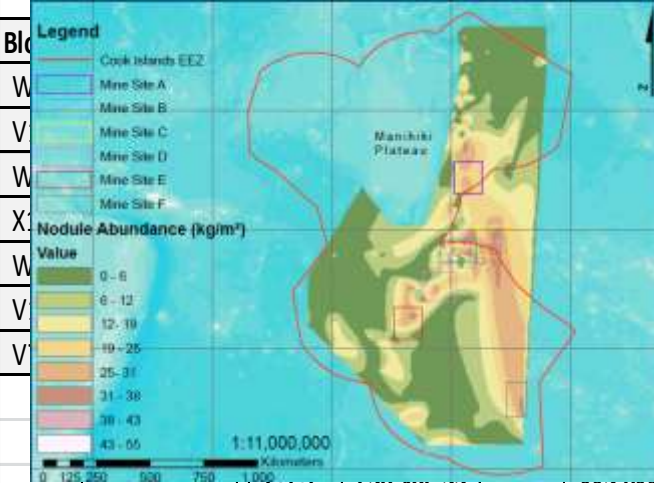
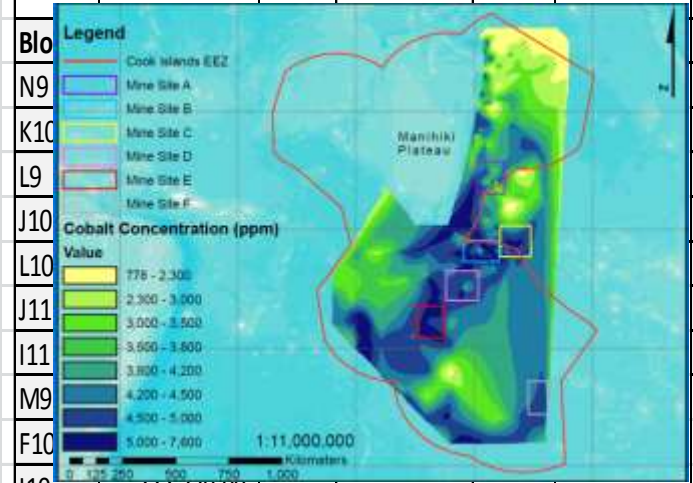


Where the berries are

- Took all available data and maps available SOPAC/Japan survey
- In house GIS mapping
- Geological model
- Calculated in-ground value for 1° longitude by 1° latitude blocks (12,000km²) Co, Cu, Ni & Co, Cu, Ni +Mn, Ti - did not include REE
- Will do a further probabilistic based estimate GIS
- Information used for next phase of programme – tender of exploration licences late 2014

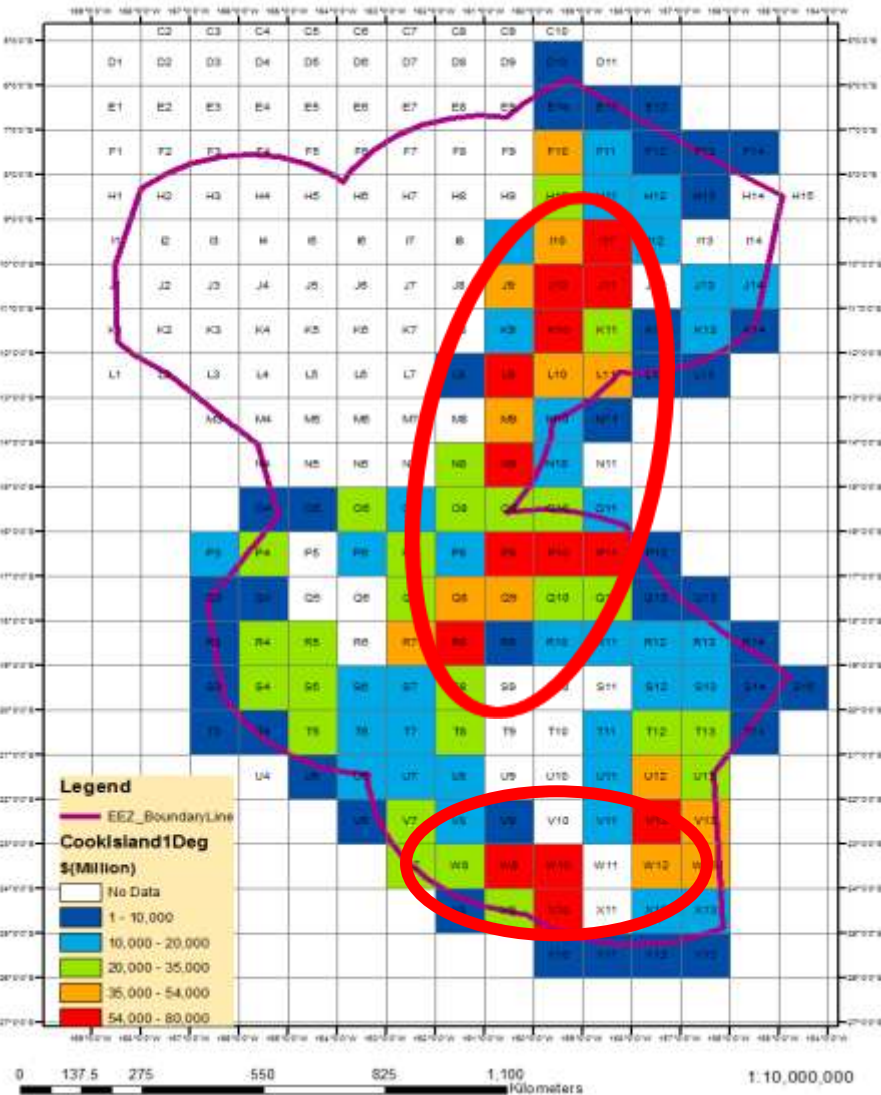


REGIONAL TENDER AREAS				REGIONAL TENDER AREAS			
Northern Tender Area	Western Tender Area	Eastern Tender Area	Southern Tender Area	Northern Tender Area	Western Tender Area	Eastern Tender Area	SW Pacific Basin (West) Area
Block #	Block #	Block #	Block #	Block #	Block #	Block #	Block #
N9				P10			
K10				P9			
L9				P11			
J10				Q9			
L10							
J11							
I11							
M9							
F10							
I10	222,339.09			Total	639,406.33	112,811.28	254,711.56
J9	196,530.62						378,425.38
Total	3,116,408.37	669,392.01	1,313,658.18				1,385,354.55
			Regional Total high values	6,749,779.26			

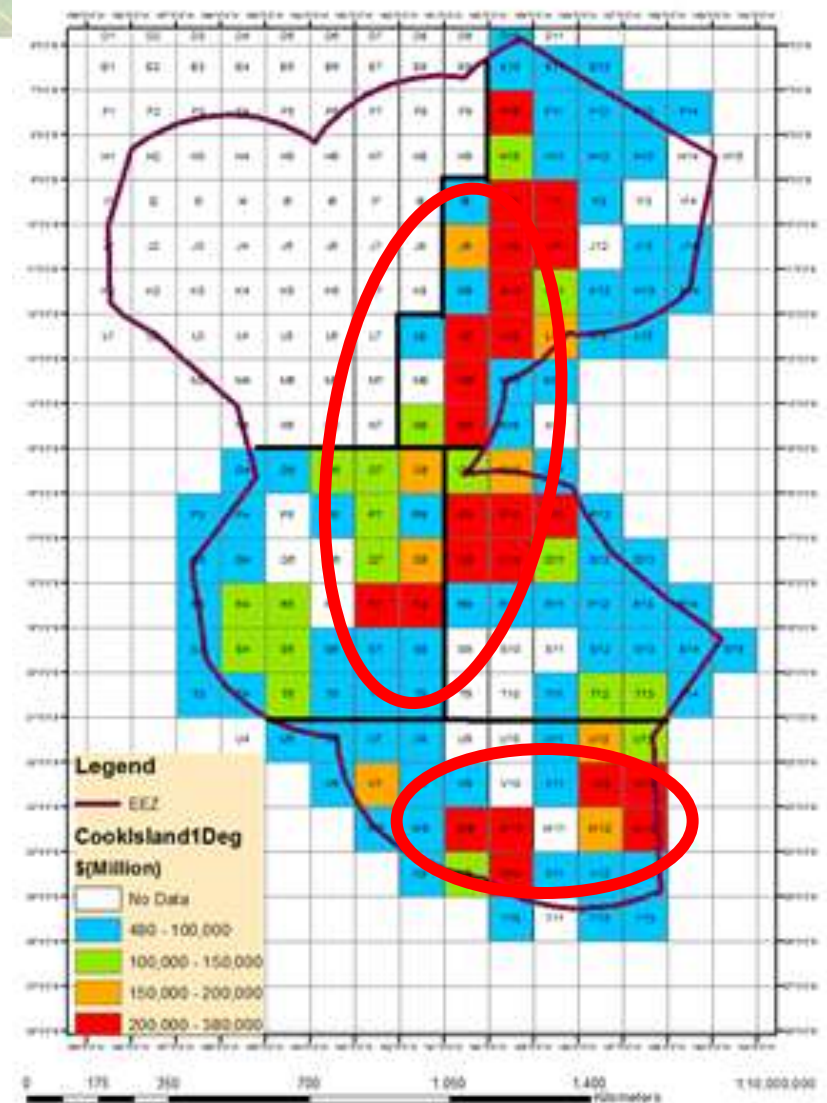


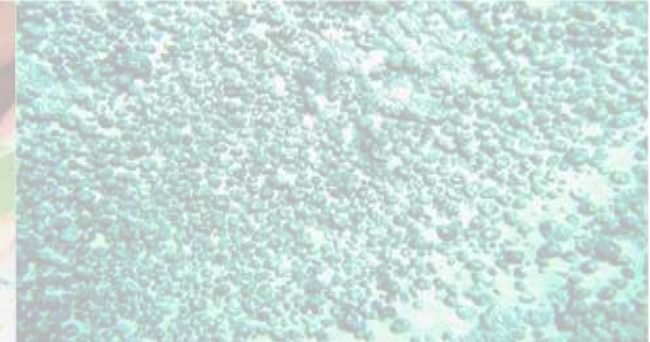
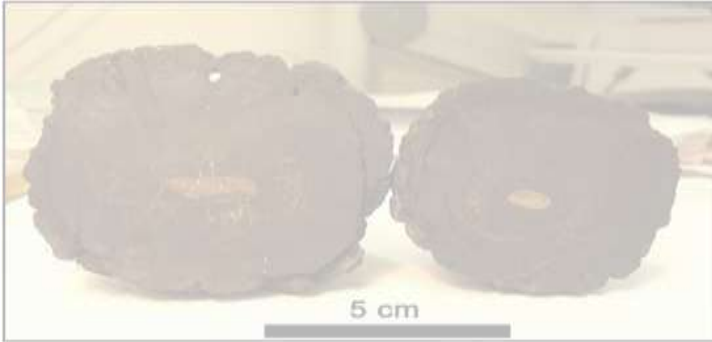
Where the berries are

Dollar Value of Co, Cu, and Ni per 1 Degree Cell



Dollar Values of Cu, Co, Ni, Mn and Ti per 1 Degree Cell

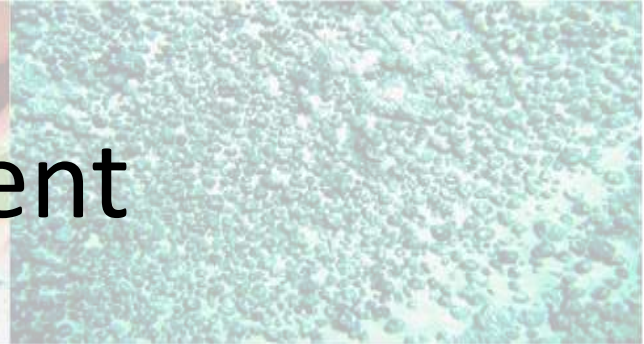
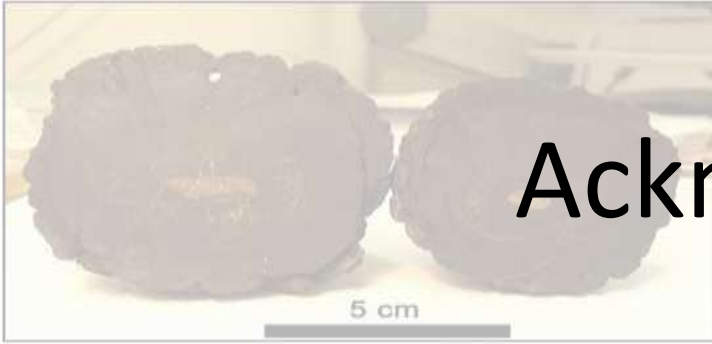




Key points

- Important to understand the economics early – what are the key inputs and drivers
- Economic model needs to be “adaptive” and fit the geological model
- DCF models only as good as the inputs
- Enables a range of economic scenarios to be rapidly modelled and tested

Acknowledgement



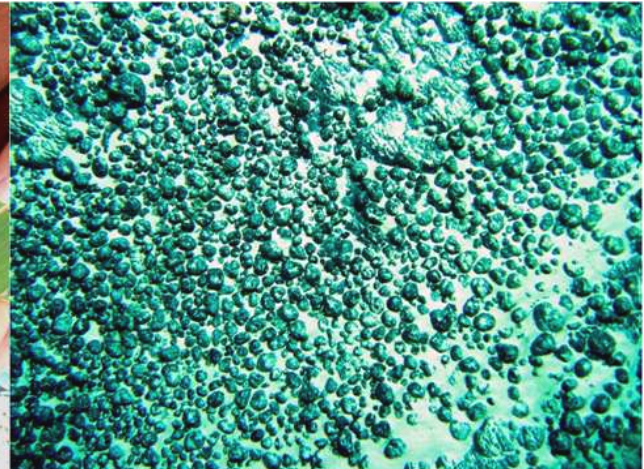
- Cook Islands Seabed Minerals Authority



- Commonwealth Secretariat



The Commonwealth



Any questions? Meitaki Maata

www.seabedmineralsauthority.gov.ck



The Commonwealth

