



TONGA OFFSHORE MINING LIMITED

TOML Environment
Studies in the CCZ
and reflections on the
EIA process discussed
at the ISA Workshop
23-24 November 2014

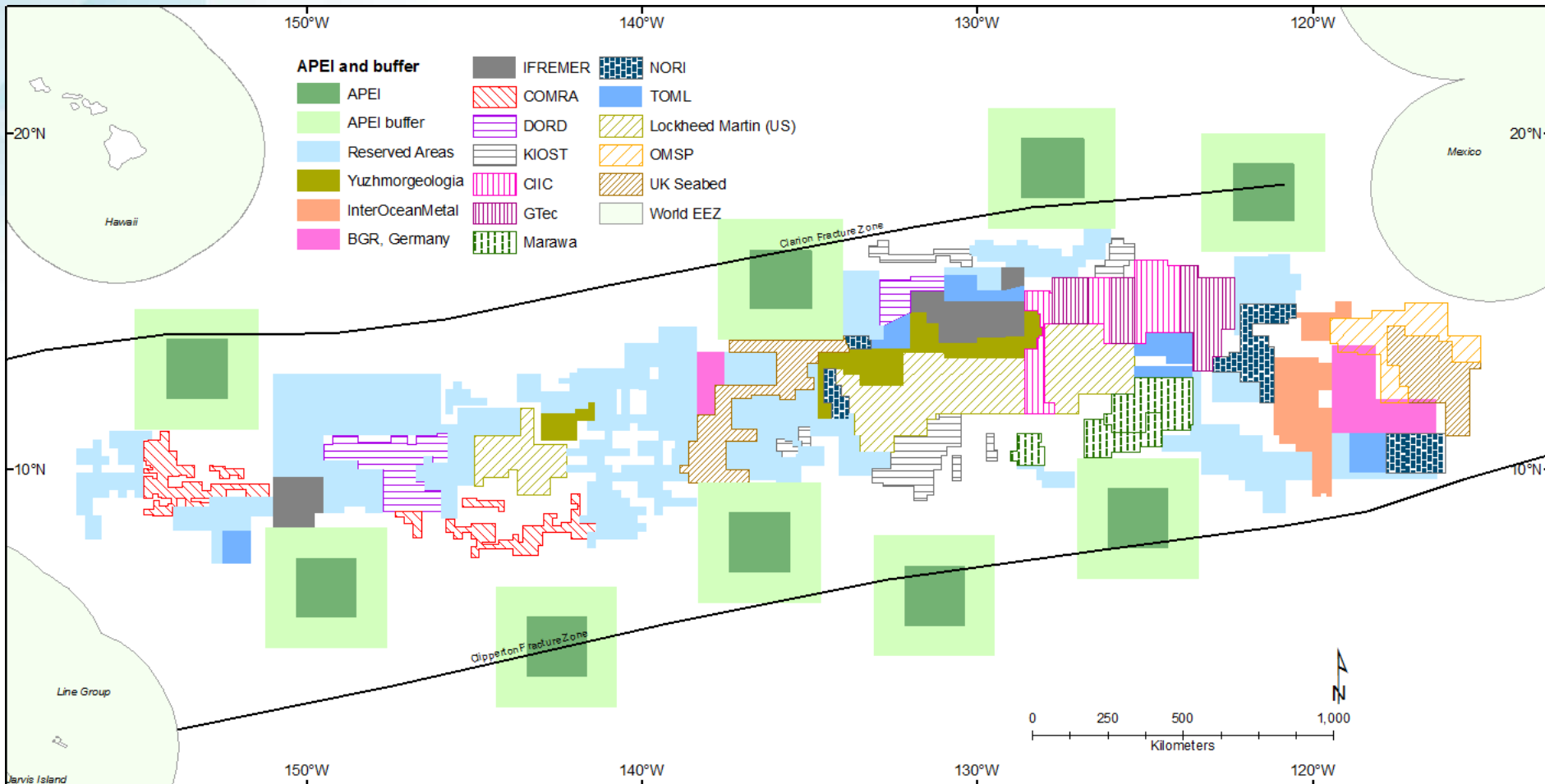


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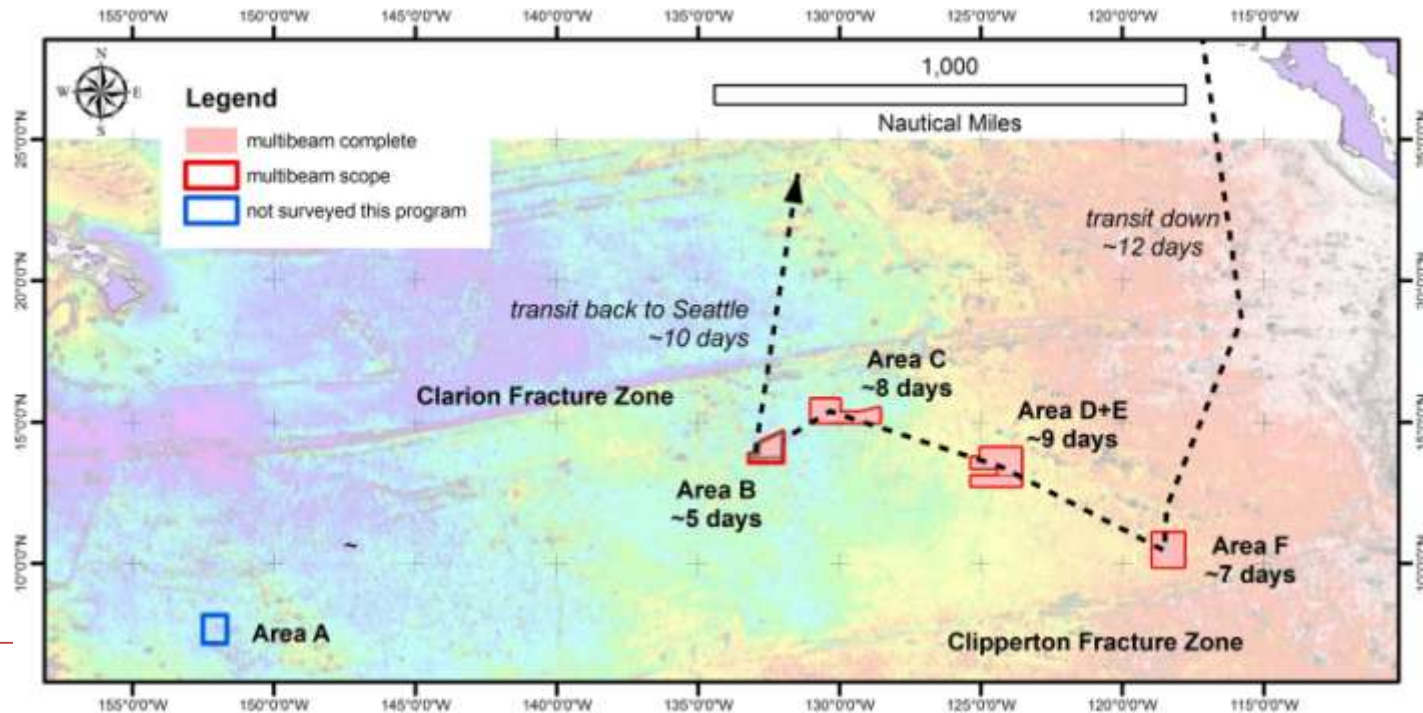
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- Material forward-looking statements and forward-looking information include, but are not limited to statements or information with respect to the obligations of the parties under the Agreement with the Independent State of Papua New Guinea, the Company's ability to locate, mine and transport mineralized material from the seafloor; estimates of future production; the method of transport and amount of mineralized material from the Company's Solwara and CCZ projects; estimates of anticipated costs and expenditures; development and production timelines and the cost, timing and effectiveness of the seafloor production tools, the riser and lifting system and the production support vessel.
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- As discussed in the Company's most recent Annual Information Form, the production decision for the Solwara 1 Project was not based on a feasibility study of mineral reserves demonstrating economic and technical viability. Accordingly, there is increased uncertainty and economic and technical risks of failure associated with this production decision. Production and economic variables may vary considerably due to the absence of a completed and detailed analysis as would be included in a feasibility study. The risks associated with this decision are set forth in the Company's Annual Information Form under the heading "Risk Factors".
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- Notes Regarding Technical Disclosure
 - Resource information for the Solwara project is derived from a technical report titled "Mineral Resource Estimate, Solwara Project, Bismarck Sea, PNG" dated and filed on SEDAR on March 23, 2012, and summarized in a news release dated November 25, 2011. Indicated resources of 74,000 tonnes of copper is based on 1.03 million tonnes at an average grade of 7.2%.
 - Resource information for the CCZ Project is derived from the technical report titled "Updated NI 43-101 Technical Report, Clarion-Clipperton Zone Project, Pacific Ocean" dated March 20, 2013 and filed on SEDAR on March 21, 2013, and summarized in a news release dated September 18, 2012, unless otherwise stated
 - Jonathan Lowe, a qualified person under National Instrument 43-101 Standards of Disclosure for Mineral Projects, has reviewed and approved the technical information in this presentation, unless otherwise stated.

TOML Contract Areas - CCZ



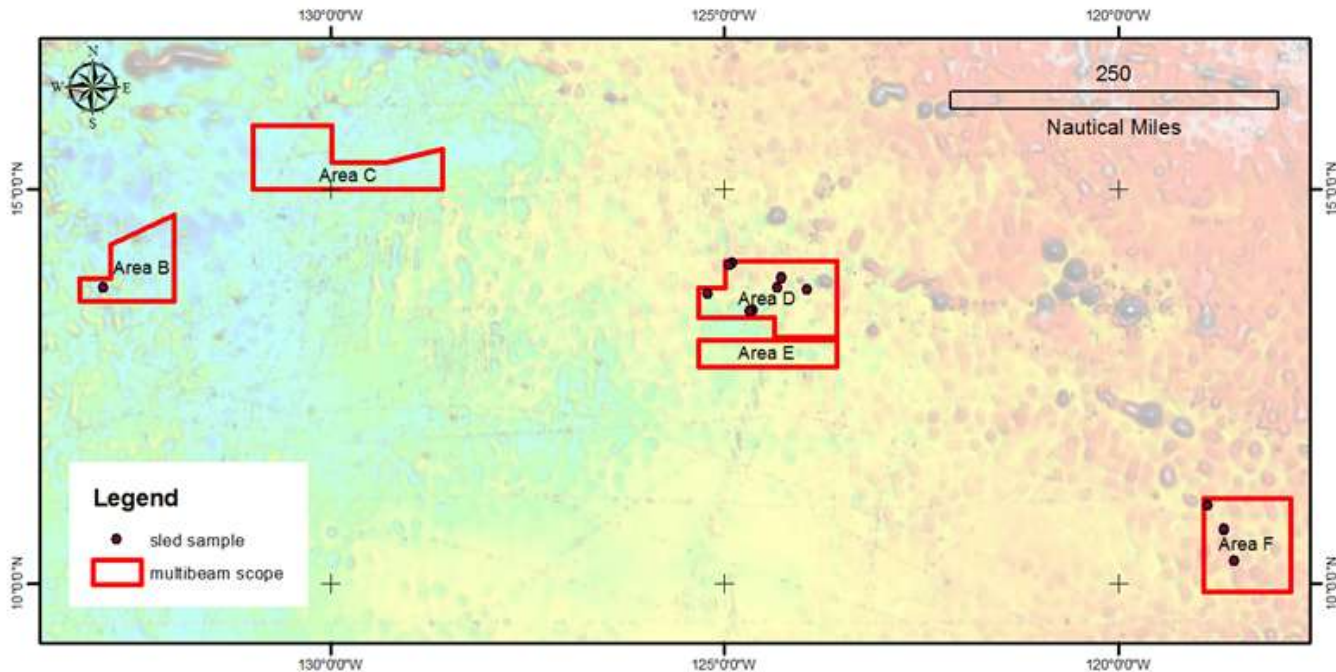
TOML 2013 Nodule Cruise (Exploration)

- TOML cruise conducted on its behalf by Nautilus Minerals Pacific between August and October 2013
- Completed approximately 64,000km² of multibeam survey
- Collected nodules and minor crust and associated fauna
- Demonstrated new design of epibenthic sled with skids to prevent digging in



2013 Cruise Sampling

- Benthic sled samples taken from three areas (due to loss of rope limiting deeper ocean sampling opportunities)
- Primary objective was to sample for metallurgical purposes
- Extremely low megafauna biomass (5 megafauna samples collected for ID), no macrofauna samples analysed



- Multibeam cruise complete (habitat mapping – substrate densities etc.)
- No faunal baseline studies completed
- Opportunistic sampling conducted as part of 2013 cruise (no standardised preservation techniques or sampling techniques, no standardised photography)
- Data submitted to ISA from 2013 cruise included limited environmental data

Challenges – Slide 1 of 2 ☹️

- The Tragic Incident of the Box Corer in the Night...
- Tell me how to talk to geologists....? (How to start looking before we know if it is a resource or not, with the least amount of on-boat processing)
 - Lack of understanding in terms of sample sorting and preservation
 - How can we maximise the value of the postman, when the gardener is not around? (Helena) – we **MUST** be able to gain value from the postman and the gardener. They will be different procedures, but both will add value
- Can I get value from old samples?
 - Photos, unpreserved samples, slides (Dr Moverley)

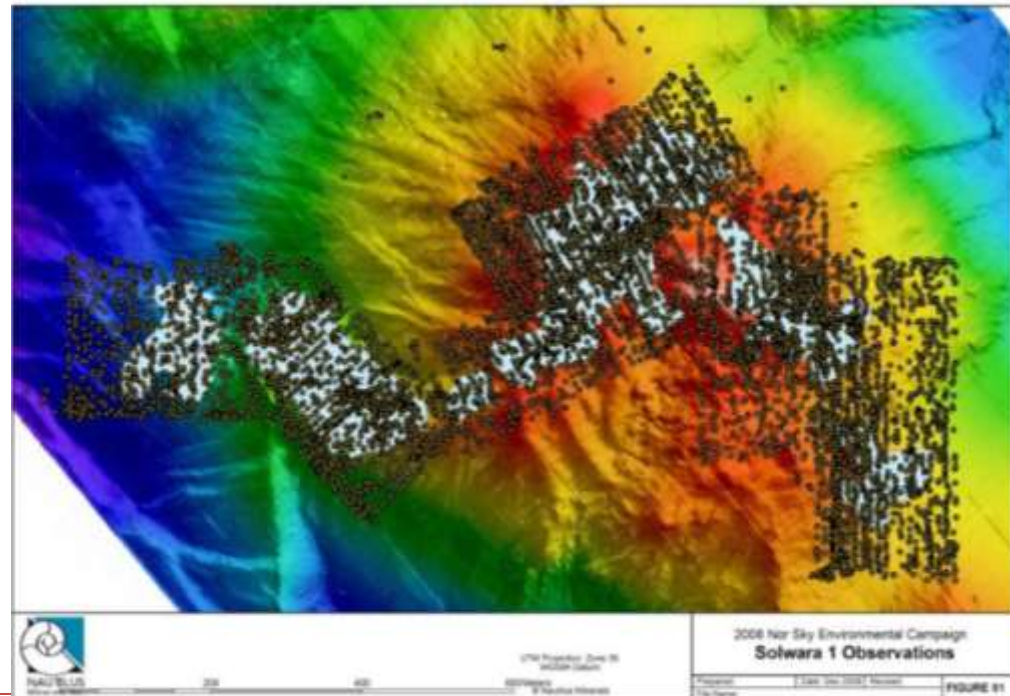
Challenges – Slide 2 of 2 😊

- Does eDNA (from water and sediment) have a place in the EIA process?
 - Coarse measurements over large scales?
 - Temporal measurements in the same locations?
 - Do we have enough primers/barcodes – can we standardise?
 - Can we try this with ‘no penalty’ in case of surprises (green spotted tree frog, or no primers), common barcode database (which/where?)
- How do I budget an EIA?
 - How much is enough? Variability (geographically - Thomas), temporally (Sandor)
 - How high is our tolerance of known unknowns? (Gordon)
- What are we trying to achieve? How much can be lost/impacted without losing connectivity, species, value??

- Exploration cruises take 4 standard (progressive) forms, including multibeam, box-corer, AUV, ROV
- Develop internal procedures for each of these cruise types to standardise the environmental data collected
- NUS has started this for SMS...but ISA workshop feedback will help!
- Future objective to align internal procedures with ISA regulations and other external EIS guidelines to turn 'geological' cruises into 'enviro' cruises

Standardisation

- Everyone benefits from standardisation – ROI, pooled data, informed management decisions, level economic playing field, independent review
- Elements for standardisation (including how to talk to geologists...):
 - Sample size/ scale 😊
 - Sampling procedures (different levels of study?)
 - Sample preservation and storage procedures
 - Metadata, photography
 - Combined morphological and molecular studies (Annika)
 - “Taxonomic clearing house”? (Tammy)
 - Standardised data reporting for sharing/inclusion in databases
 - Description, stored specimen, publicly available (Thomas)



Environmental Data Collection for Resource Cruises (multibeam and box corer)



■ Multibeam

- CTD (conductivity, temperature, depth, sound velocity for multibeam, DO, pH, turbidity)
- Water samples – metals, TSS, eDNA*
- Multibeam and backscatter – habitat profiling and substrate mapping
- Some benthic samples (sled/box corer) – taxonomic identification*, eDNA *

■ Box Corer

- CTD data and water sampling (TSS, metals, eDNA *)
- Still photography (not real time)
- Multiple large, undisturbed seafloor samples (habitat stratum, fauna, etc.) incl. Taxonomic identification*

* = additional budget

Environmental Data Collection for Resource Cruises (AUV and ROV)



■ AUV

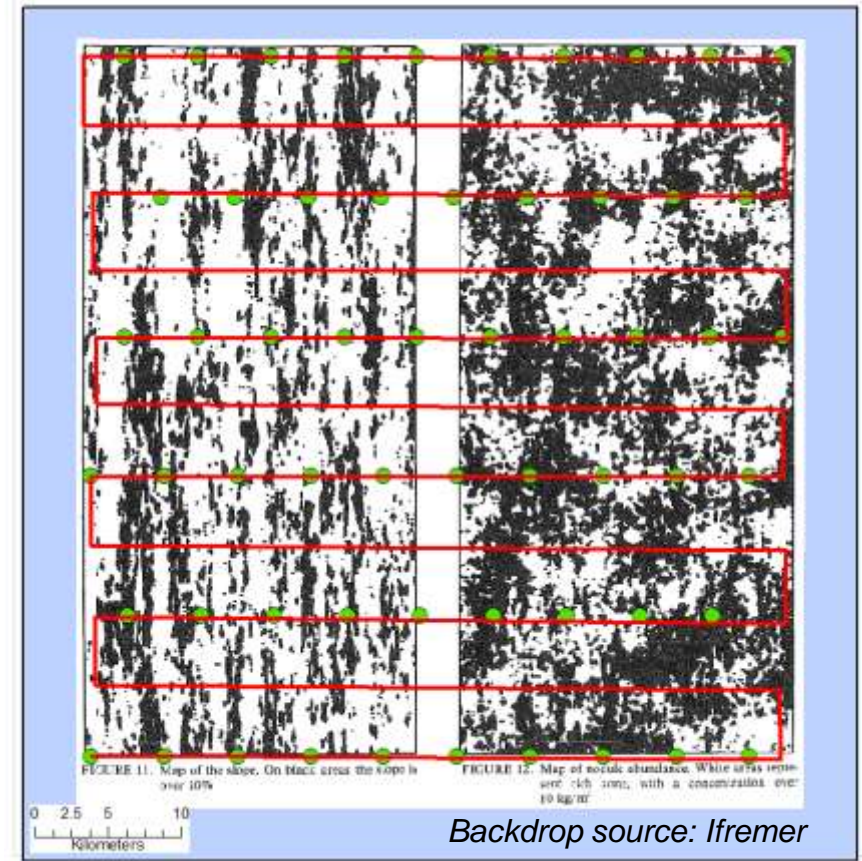
- Seafloor CTD data and water sampling (TSS, metals, eDNA *)
- Micro-bathymetry (high resolution), acoustic imaging (high resolution)
- Video camera transects for megafauna identification* (not real time)
- Still photography (not real time)

■ ROV

- Video and still photography transects (real time)
- Precision sediment sampling with real time video
- Precision benthic fauna sampling/collection for taxonomic identification*
- Placement of sediment traps, fauna traps, hydrophones, ADCPs, with acoustic release*

* = additional budget

- Systematic box-coring planned to support an indicated mineral resource (3000-5000 km²)
- Supported by deep-tow or AUV optical-acoustic survey
- Objective to have environmental and geotechnical work at the same scale as geological work (AUV and Box Corer Procedures)



Stairways to Heaven... (RLG's blue sky)

- Learning from terrestrial mining
 - EIA contributes to resource/reserve definition, feasibility study, and has a defined financial cost and value (e.g. JORC, SAMREC)
 - Shared data on impacts monitoring and adaptive management
 - Opportunity to adapt the mine design according to high value areas (moving the pieces of the puzzle)
 - Pausing for lessons learned at the right moments
 - Standardised procedures for sampling and EIS
 - Legislative management of rare species/short range endemics – “if X then Y”

Stairways to Heaven... (RLG's blue sky)

- Cumulative impacts assessment
 - Assumptions - % loss?
 - Difficult issues - rare and endemic species, gene flow
 - First past the post? Most abundant areas win (ROI?)
 - Is it ok to build a cumulative picture of cumulative impacts? (molecular studies on species/connectivity)?

IFC Guidelines – do they have a place?

- EHS Guidelines for mining, processing, shipping, oil and gas
- Performance standards for EIS, biodiversity, social impacts, water management, waste management, etc. etc.
- Guidance on cumulative impacts
- IFC Guideline on Deep Sea Mining?



Good Practice Handbook

**Cumulative Impact Assessment and Management:
Guidance for the Private Sector in Emerging Markets**

Good practice requires that, at a minimum, project sponsors assess during the ESIA process whether their development may contribute to cumulative impacts on VECs and/or may be at risk from cumulative effects on VECs they depend on.

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Many Connections. One Focus.