Predictive modelling of polymetallic nodule deposits in the Cook Island Exclusive Economic Zone

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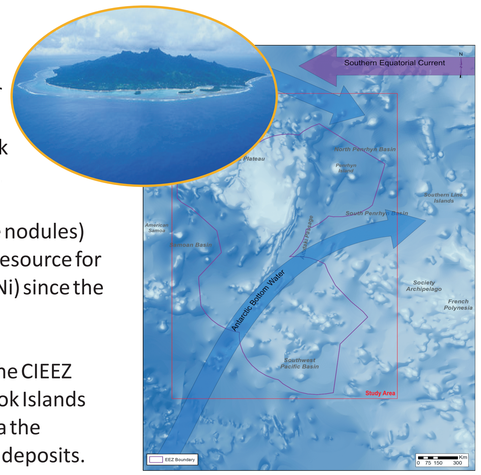
Kenex Creating opportunities in the spatial world

Cook Islands Seabed Minerals Authority
Runanga Takere Moana

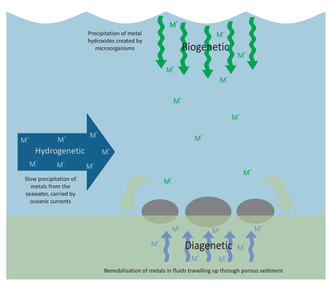
Kenex Ltd has completed mineral prospectivity modelling of polymetallic nodule deposits over the Cook Island Economic Exclusive Zone (CIEEZ) for the Cook Island Seabed Minerals Authority.



Polymetallic nodules (manganese nodules) have been explored as a possible resource for many metals (e.g. Co, Cu, Fe, Mn, Ni) since the early 1970s.

The polymetallic nodules within the CIEEZ present an opportunity for the Cook Islands nation to prosper economically via the exploration and recovery of these deposits.

DEPOSIT MODEL



Manganese nodules are rock concretions formed by layering of Fe and Mn hydroxides (around a core) deep on the seafloor (4,000 to 6,000m).

Nodules commonly grow on siliceous and pelagic sediment, as calcareous and glauconitic sediments inhibit nodule growth

The rate of sedimentation needs to be very low, or another method (such as bioturbation) is required to prevent the nodules from being buried to allow continuous growth.

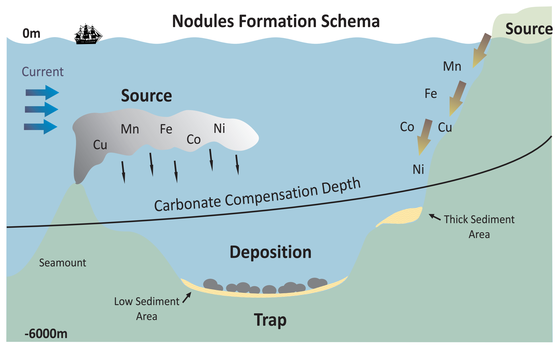
FIVE BROAD CATEGORIES OF NODULES

hydrogenetic
diagenetic
hydrothermal
halmyrolitic
biogenetic

TWO GENERAL CLASSES OF NODULES

smooth surface texture
(related to hydrogenetic processes)

an intermediate to rough surface texture
(related to diagenetic processes)



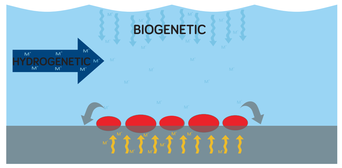
LOCAL MORPHOLOGY

CIEEZ has large variations in bathymetry

There are two major ocean currents
- *Antarctic Bottom Water*
- *Southern Equatorial*

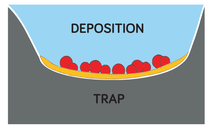
Nodule abundances vary greatly from North to South

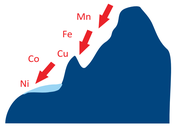
PROSPECTIVITY MODEL

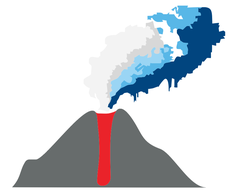


A **DEPOSIT MODEL** for polymetallic nodules is defined based on the mineral system concept (Wyborn et al., 1995)

All available data relating to the nodules deposit model in the CIEEZ is compiled



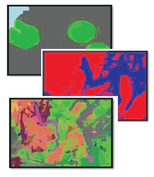


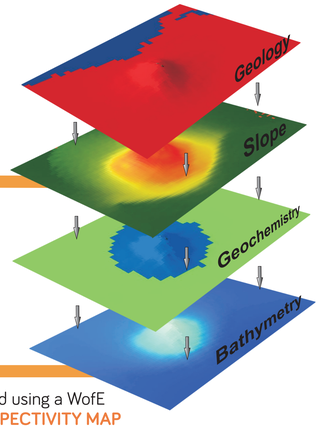


DEPOSITION AND PRESERVATION
CCD, Sediment Thickness
Mn/Fe Ratio

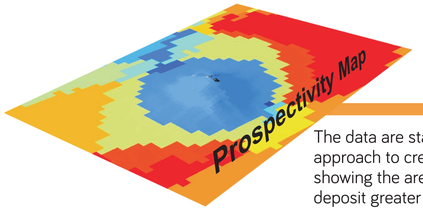
FORMATION AND TRANSPORT TO TRAP
Seafloor Depth
Seafloor Slope

SOURCE OF METALS
Volcanoes
lithology





WEIGHTS OF EVIDENCE is used to assess and weight the data based on the relationship to known locations of nodules



The data are statistically combined using a WofE approach to create a single **PROSPECTIVITY MAP** showing the areas most likely to contain nodule deposit greater than 5 kg/m2

The model has successfully confirmed that 11% of the CIEEZ - more than 230,000 km^2 - is prospective for polymetallic nodules. Broad regions of high prospectivity and equally importantly areas of low prospectivity have been identified by the modelling results.

From these regions 72 very prospective targets and 16 highly prospective targets are delineated. The high probability areas have been ranked based on their probability values and it is anticipated that this ranking will be utilised by the Cook Island Seabed Mineral Authority to, amongst other things, prioritise follow up investigations.

USE OF THE MODEL

The Cook Island Seabed Authority is in a position whereby the model results can be utilised in many ways to assist with their objectives in relation to allocation of exploration rights.

FROM A PLANNING PERSPECTIVE:

· Structuring any tender process – short, medium and long term objectives

· Prepare acreage for tender

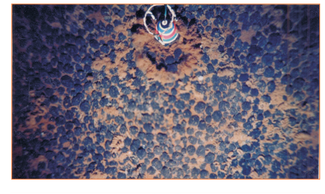
· Advising on exploration block size for allocation

· Determining areas to be set aside for economic and/or strategic and/or environmental reasons

· Identifying appropriate work programme or expenditure requirements from explorers

· Generating maps to visually aid planning requirements

· Meaningfully valuing the exploration acreage through using probability values to constrain estimations

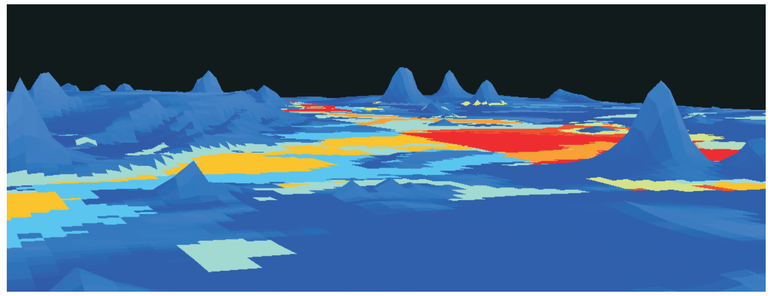


FROM AN EXPLORER OR INVESTORS POINT OF VIEW:

· Enabling an estimate to be made of the geological potential of a given location to host poly-metallic nodules

· Allows for the identification of missing data in areas of lower probability that if collected could increase the prospectivity of an area

· Plan and budget exploration programmes



3D overview of the probability map for polymetallic nodules deposition

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