

# Progress towards deep-sea mining

Phil Weaver

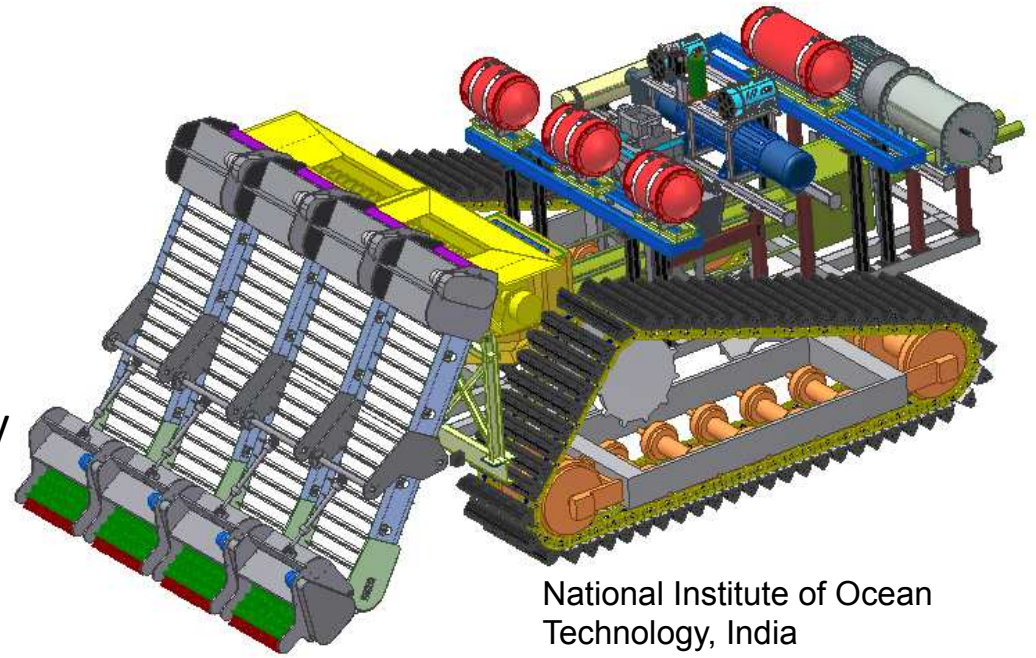




# Manganese Nodule mining

## Technology readiness:

- seabed rake device – several under development
- airlift riser with pumps – technologically challenging
- target: 2 mio t/year;  
~ 5,700 t Mn-nodules/day



National Institute of Ocean  
Technology, India



Mn-nodules are a **vast resource** for metals.



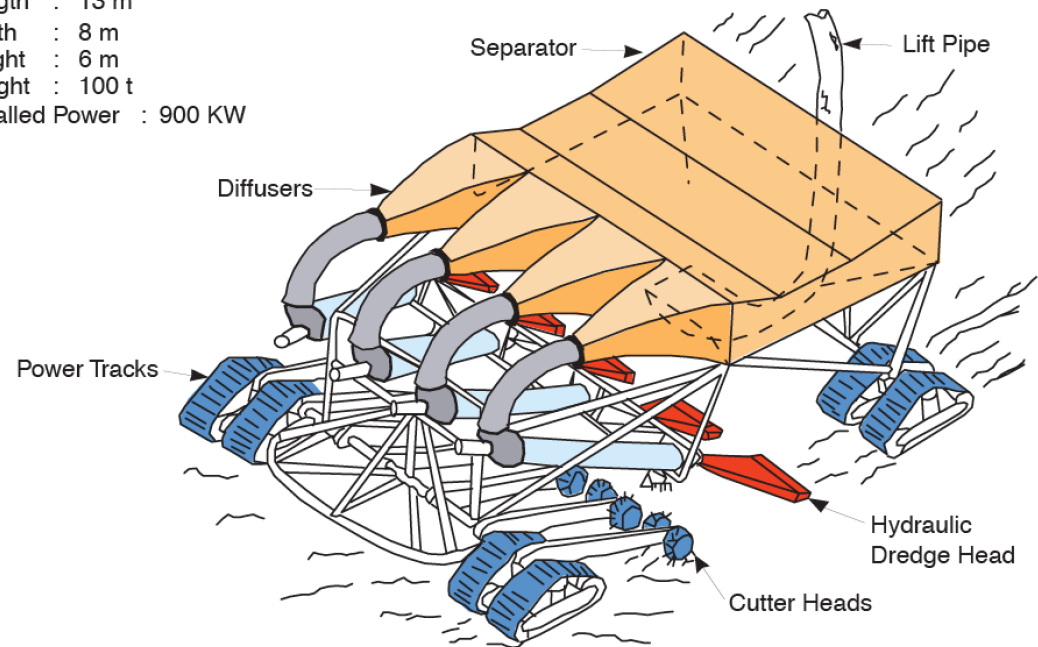
# Cobalt crust mining

## MAJOR DIMENSIONS

Length : 13 m  
Width : 8 m  
Height : 6 m  
Weight : 100 t  
Installed Power : 900 KW

## Technology readiness:

- Distinguishing crust from rock – major technological challenge
- seabed cutter/trenching device – technologically challenging to follow exact contour of crust in uneven terrain
- airlift riser with pumps – technologically challenging though depths will be shallower than for nodules



DOI-MMS and DPED-State of Hawaii

# Sulphide mining on ridges

Nautilus Minerals

Ordered 3 seabed machines \$84M

Bulk cutter completed April 2014



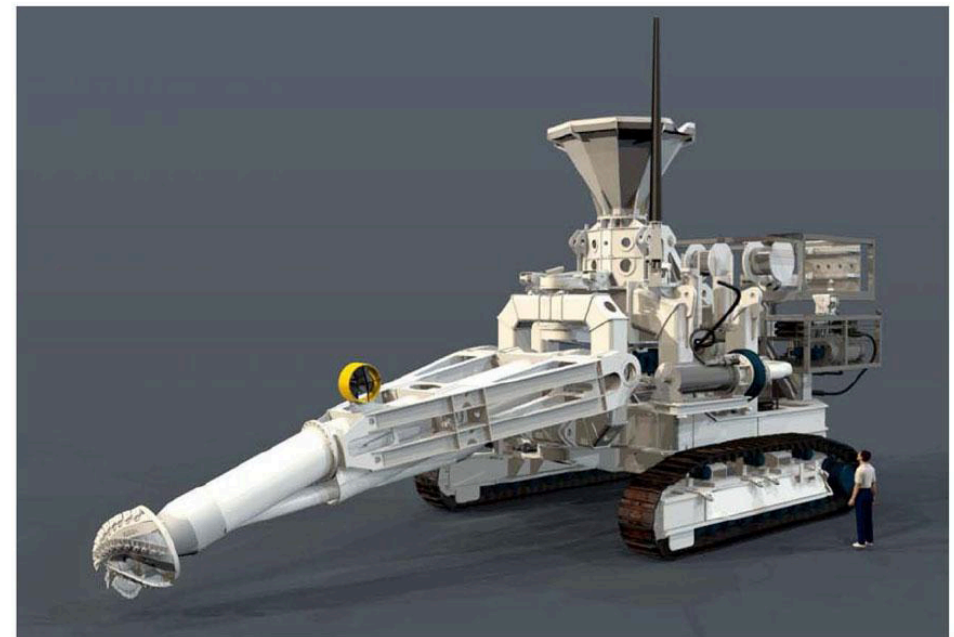
Figure 4.3 Auxiliary cutter ROV (left), Bulk-cutter ROV (right) and collecting machine (below)



Cutter (AC) - cuts material on uneven surfaces; benching the site



Bulk Cutter (BC) - cuts material at high rates on area benching by Auxiliary Cutter



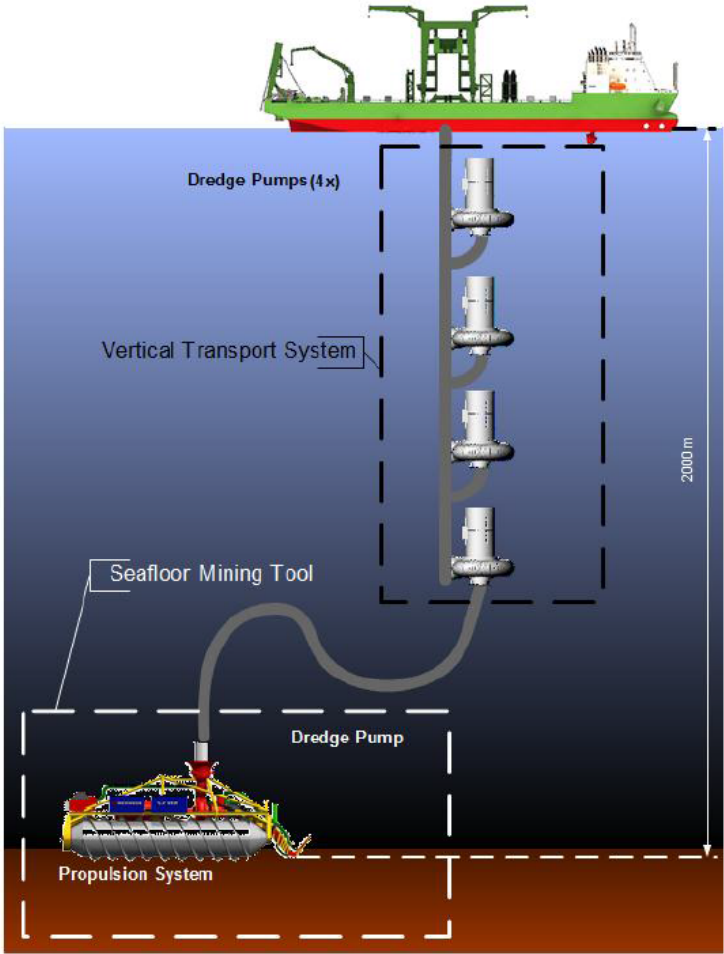
Collecting Machine (CM) - collects cut material with seawater, pumping and transfers the slurry to the RALS

Source: Nautilus Minerals

Collector completed January 2015

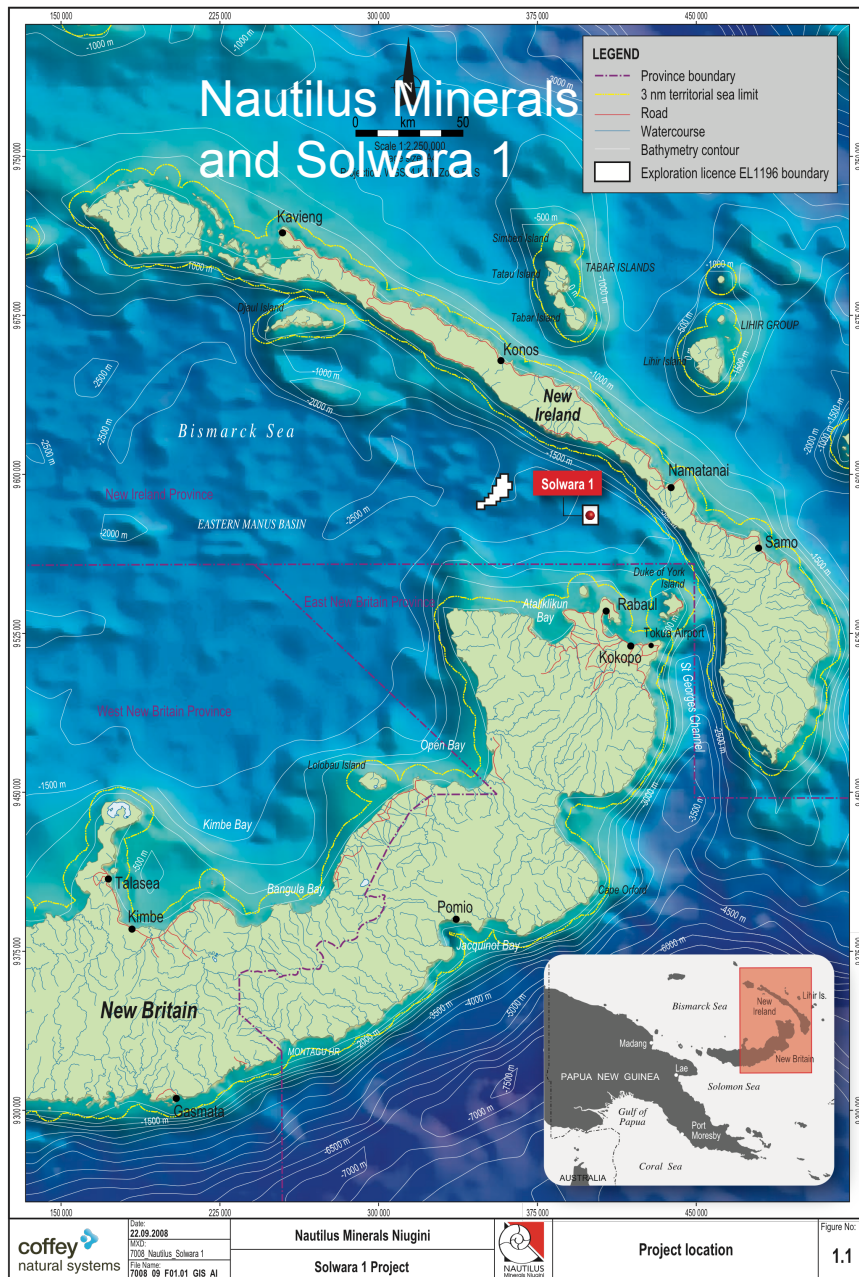
# Nautilus Minerals

Ordered riser development \$116M



Nautilus Minerals has signed contract to hire new ship – to be built in China and rented at \$200,000 per day

# Progress towards mining in National waters



New Zealand has licensed areas for exploration for Sulphide deposits in the Kermadec arc

Cook Islands ready to license part of its 2 million km<sup>2</sup> EEZ for nodule mining

Fiji, Solomon Islands, Tonga and Vanuatu have all issued exploration licenses for sulphide deposits

Japan has initiated exploration in the Okinawa Trough

Red Sea Atlantis II deep basin (in dispute)

# Massive sulphides

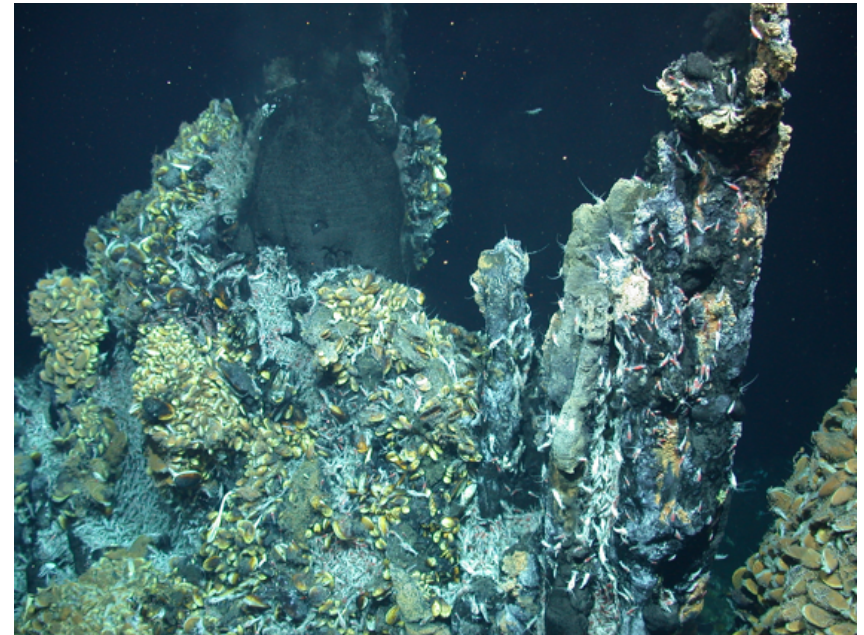
Most seafloor sulfide sites:

- are too small
- are of low grade
- are too deep
- or are active

but: mining few sites might be economically feasible

We are currently only looking for active deposits.

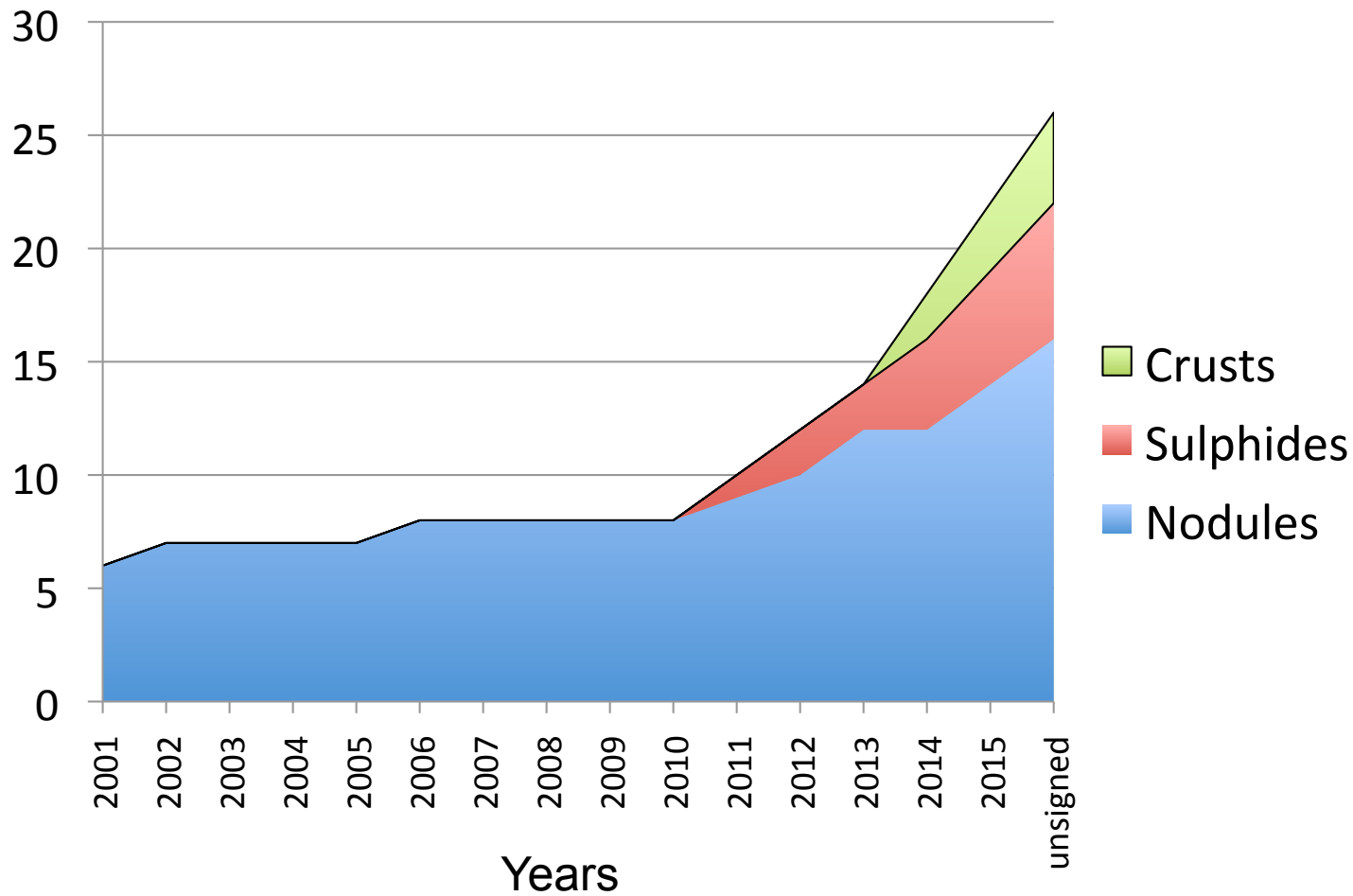
**Techniques to search for deposits under sediment cover are lacking, but may eventually reveal large deposits in off ridge locations**



## typical contents

Cu (%)	2 - 20
Zn (%)	2 - 20
Pb (%)	0 - 5
Au (ppm)	<0.1 - 30
Ag (ppm)	<1 - 500

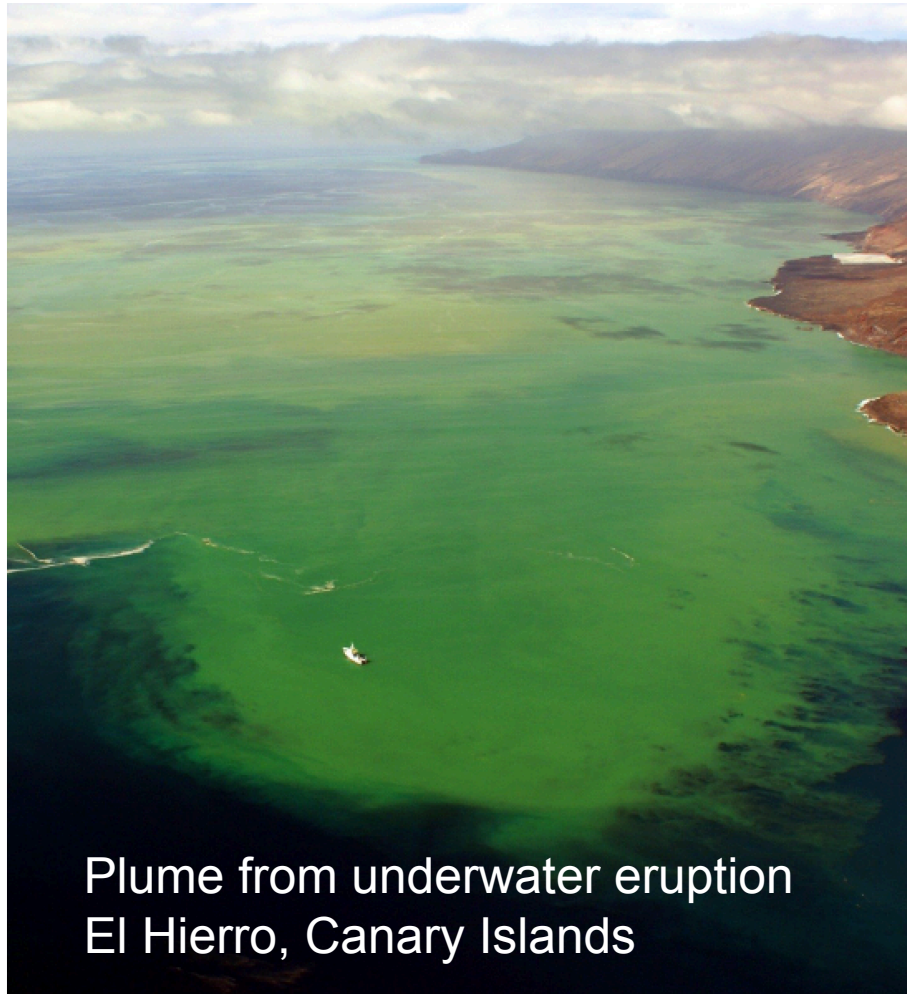
# Total number of ISA Contractors



How many can operate at any one time??



## Plumes could extend footprint of mining by ???



Plume from underwater eruption  
El Hierro, Canary Islands

### Components of plumes

1. Particle laden
2. May contain toxic chemicals
3. May cause pH changes
4. Can spread very long distances
5. May rise in the water column

Depending on where they are discharged/created plumes may affect

6. Plankton
7. Pelagic organisms
8. Benthic organisms