

The promise of the oceans

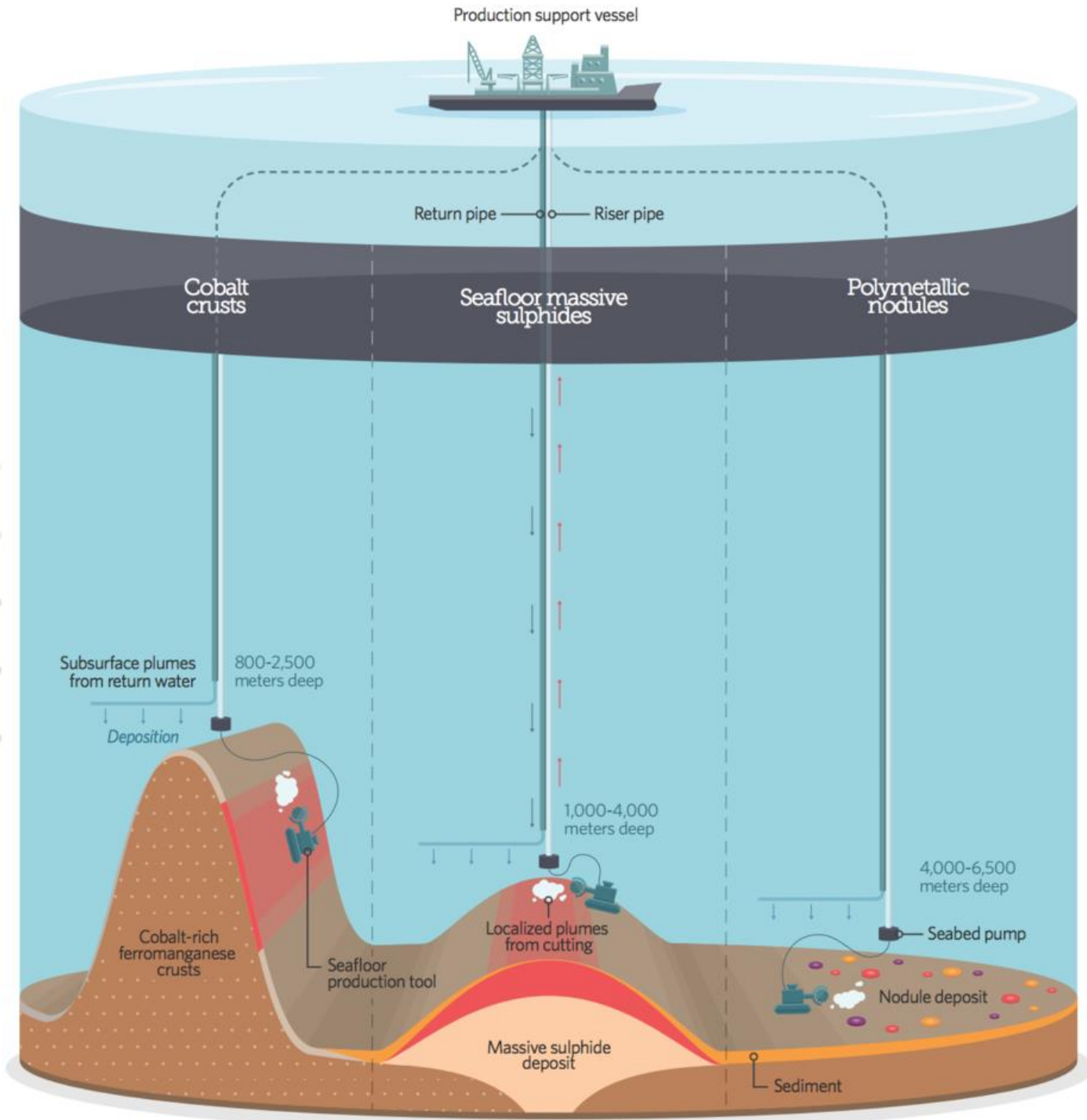
EuChems Periodic Table

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European Commission

DG MARE



three types of deposit

- nodules
- crusts
- sulphides

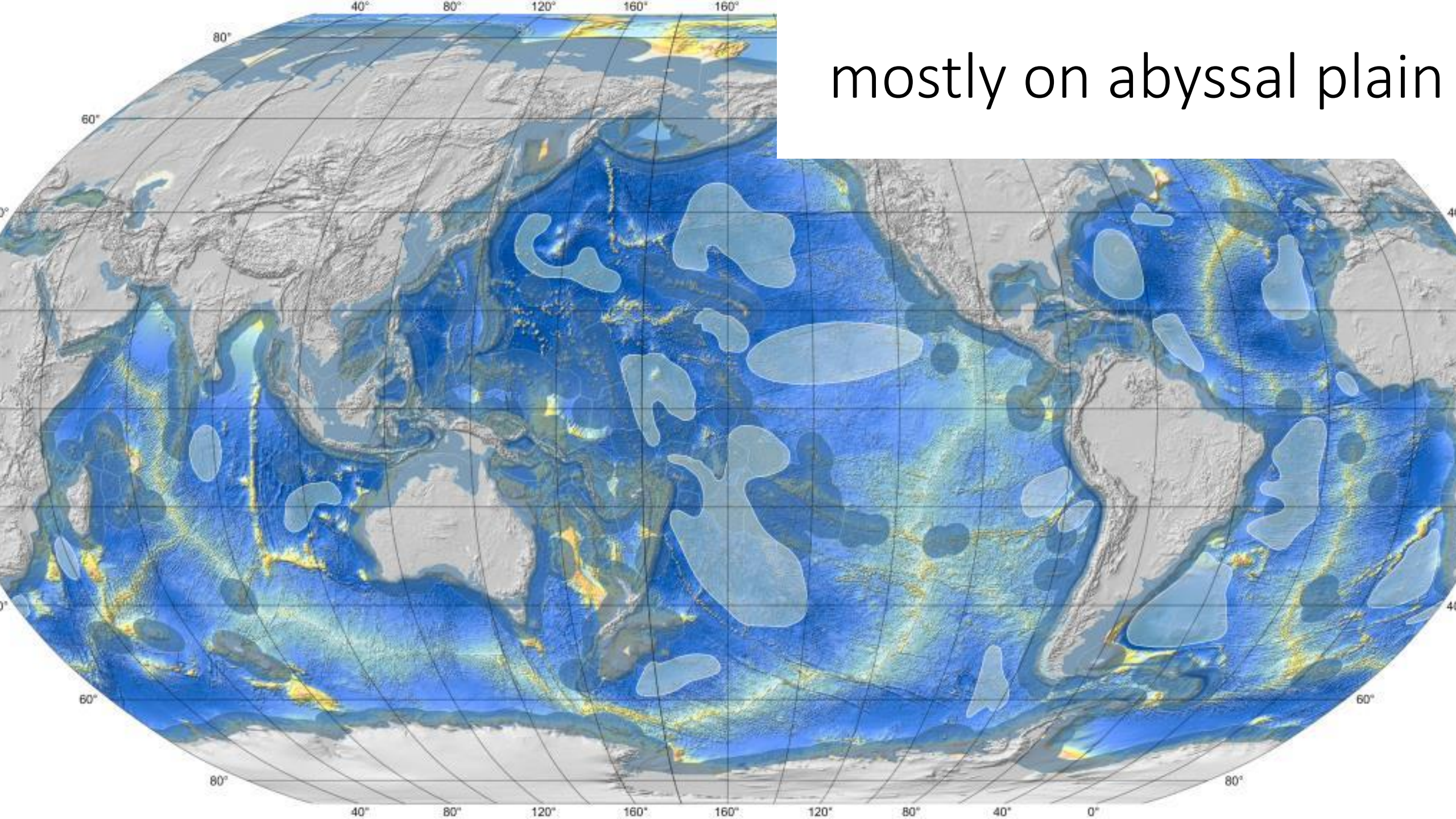


nodules

- formed over millions of years by crystallisation

0

0.5 m



mostly on abyssal plain

content of nodules

	Clarion-Clipperton	Indic	Peru Basin	Cook Islands
Mn (%)	28.4	24.4	34.2	17.6
Ni (%)	1.3	1.1	1.3	0.5
Cu (%)	1.1	1.0	0.6	0.2
Co (%)	0.21	0.11	0.05	0.41
Mo (ppm)	590	600	547	-
Li (ppm)	131	110	311	-
REE+Y (ppm)	813	1039	403	-

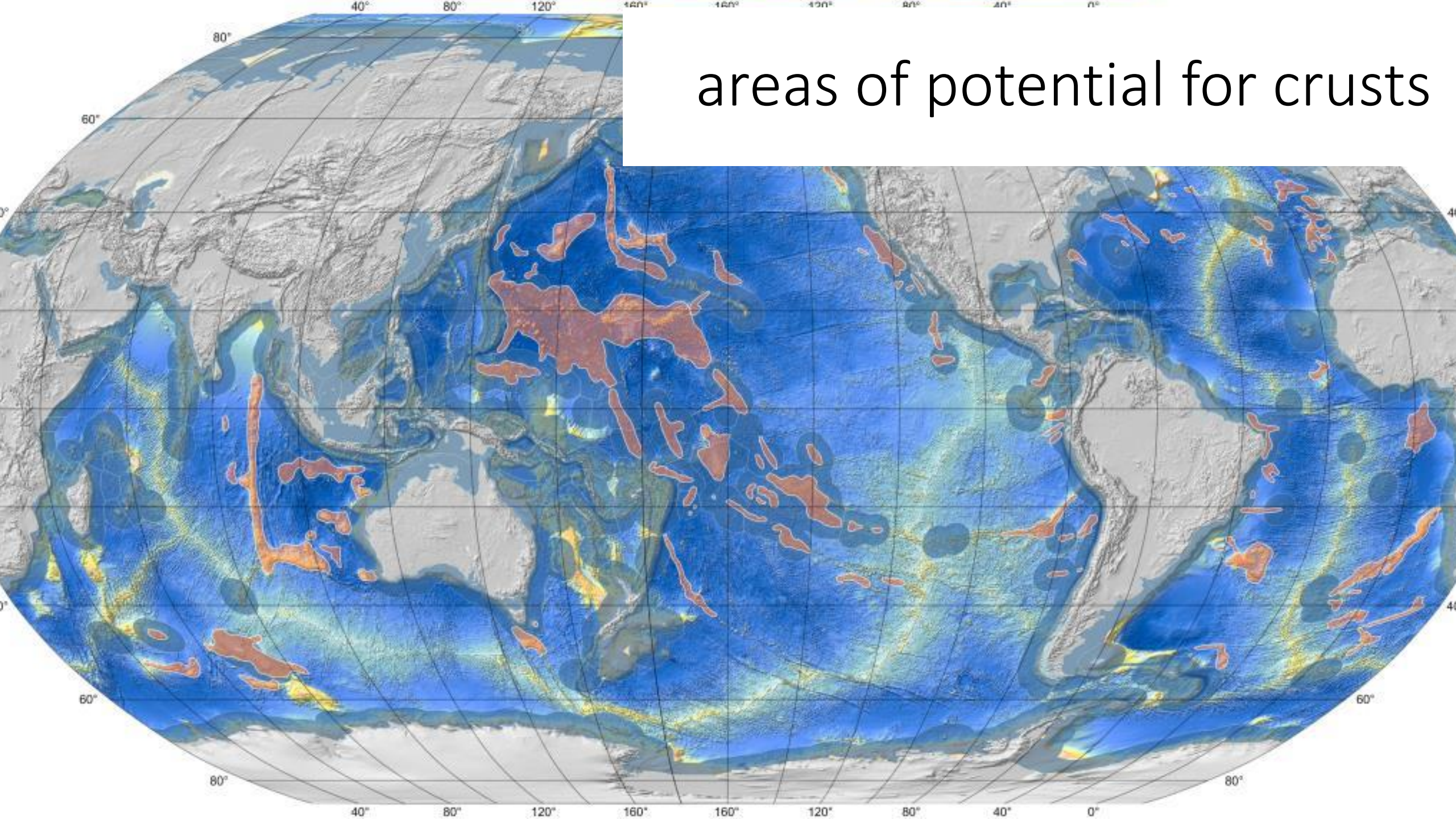


polymetallic crusts

- accumulate by chemical and sedimentary processes from ambient seawater.
- found on the sides and summits of seamounts

Source: SubSea World News

areas of potential for crusts



content of crusts

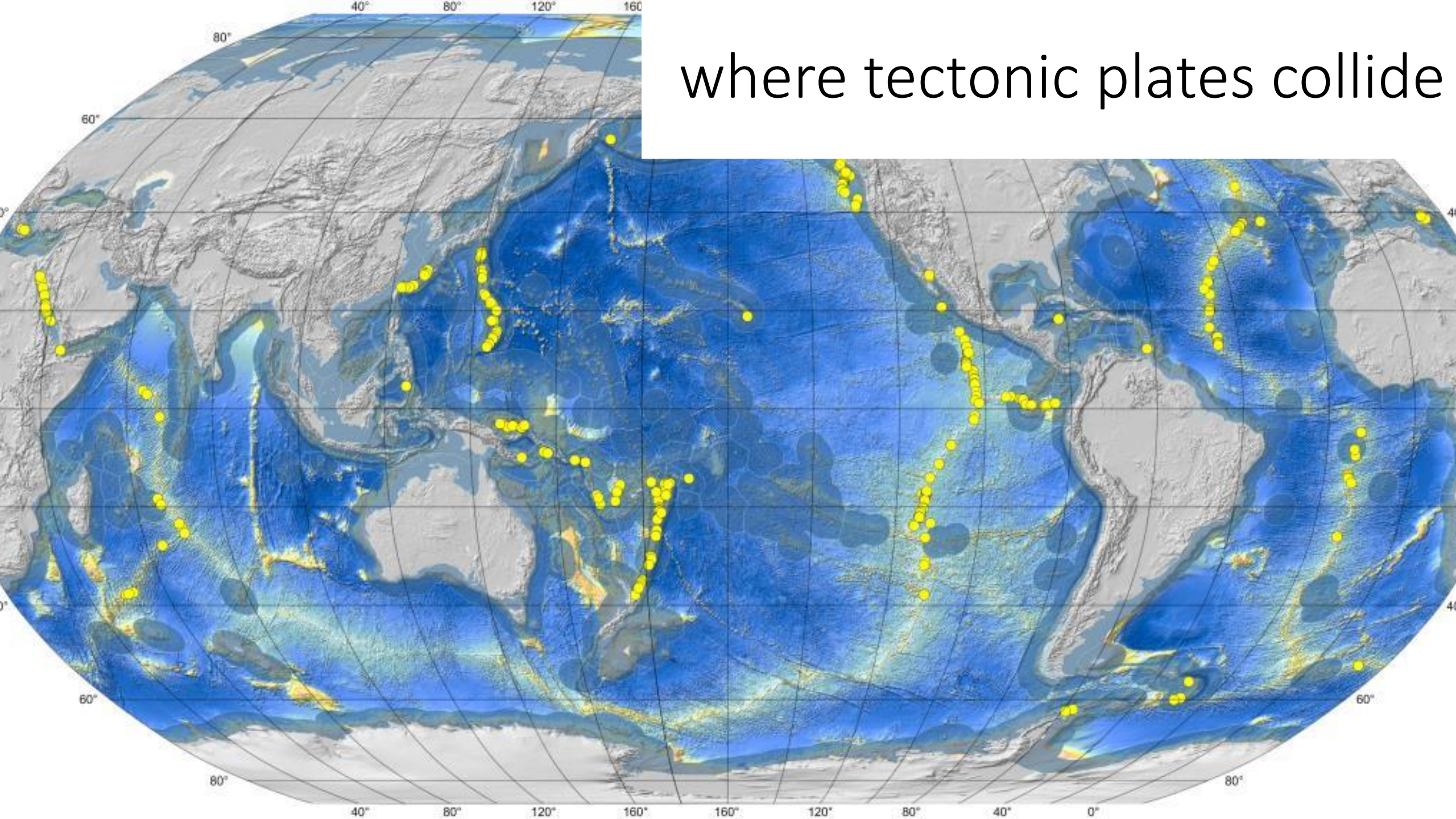
	NW Pacific	S Pacific	Atlantic	Indic
Fe (%)	16.8	18.1	20.9	22.3
Mn (%)	22.8	21.7	14.5	17.0
Ni (%)	0.42	0.46	0.26	0.26
Cu (%)	0.10	0.11	0.09	0.11
Co (%)	0.67	0.62	0.36	0.33
Bi (ppm)	42	22	19	30
Nb (ppm)	54	59	51	61
Pt (ppm)	0.5	0.5	0.6	0.2
REE+Y (ppm)	2454	1634	2402	2541
Te (ppm)	60	30	43	31
Y (ppm)	222	177	181	178
Zr (ppm)	559	754	362	535

An underwater photograph of a hydrothermal vent chimney. The chimney is a dark, jagged, and porous structure rising from a dark, rocky seafloor. The top of the chimney is illuminated, showing a bright, white, crystalline structure. The surrounding water is dark, and the seafloor is covered in dark, jagged rocks.

massive sulphides

- precipitating volcanic material

where tectonic plates collide



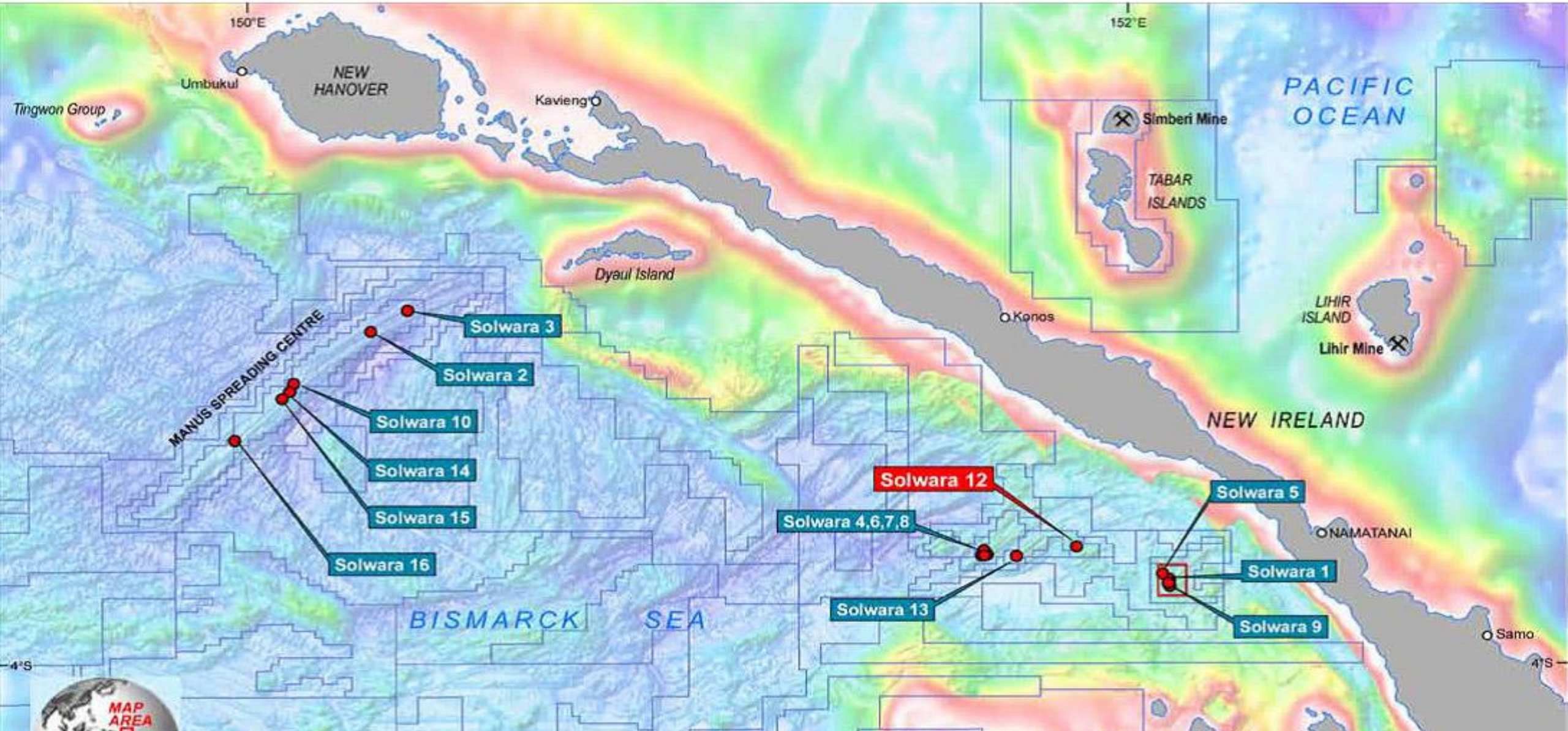
content of sulphides

Setting [□]	Cu-%	Zn-%	<u>Pb-%</u>	Fe-%	Au- ppm [□]	Ag- ppm [□]	As- ppm [□]
sediment-free-MOR [□]	4.9	8.0	0.2	26.9	1.2	93	365 [□]
ultramafic-hosted-MOR [□]	13.6	9.8	0.1	27.0	8.5	84	212 [□]
sediment-hosted-MOR [□]	1.1	3.6	0.5	24.7	0.5	84	1692 [□]
<u>intraoceanic-back-arc</u> [□]	3.5	15.7	0.7	13.5	6.1	226	885 [□]
transitional-back-arcs [□]	5.6	18.4	1.5	7.1	12.0	312	10573 [□]
intracontinental-rifted-arc	3.3	19.0	9.7	7.1	5.3	916	4950 [□]
volcanic-arcs [□]	3.8	12.7	2.0	9.8	12.6	328	2010 [□]



Figure 1
TERRITORIAL WATERS, PAPUA NEW GUINEA
LOCATION OF SOLWARA 12 PROSPECT
8 February 2011 © Nautilus Minerals

only commercial project
recently collapsed



built in Newcastle UK with
components from Italy,
Netherlands, Poland

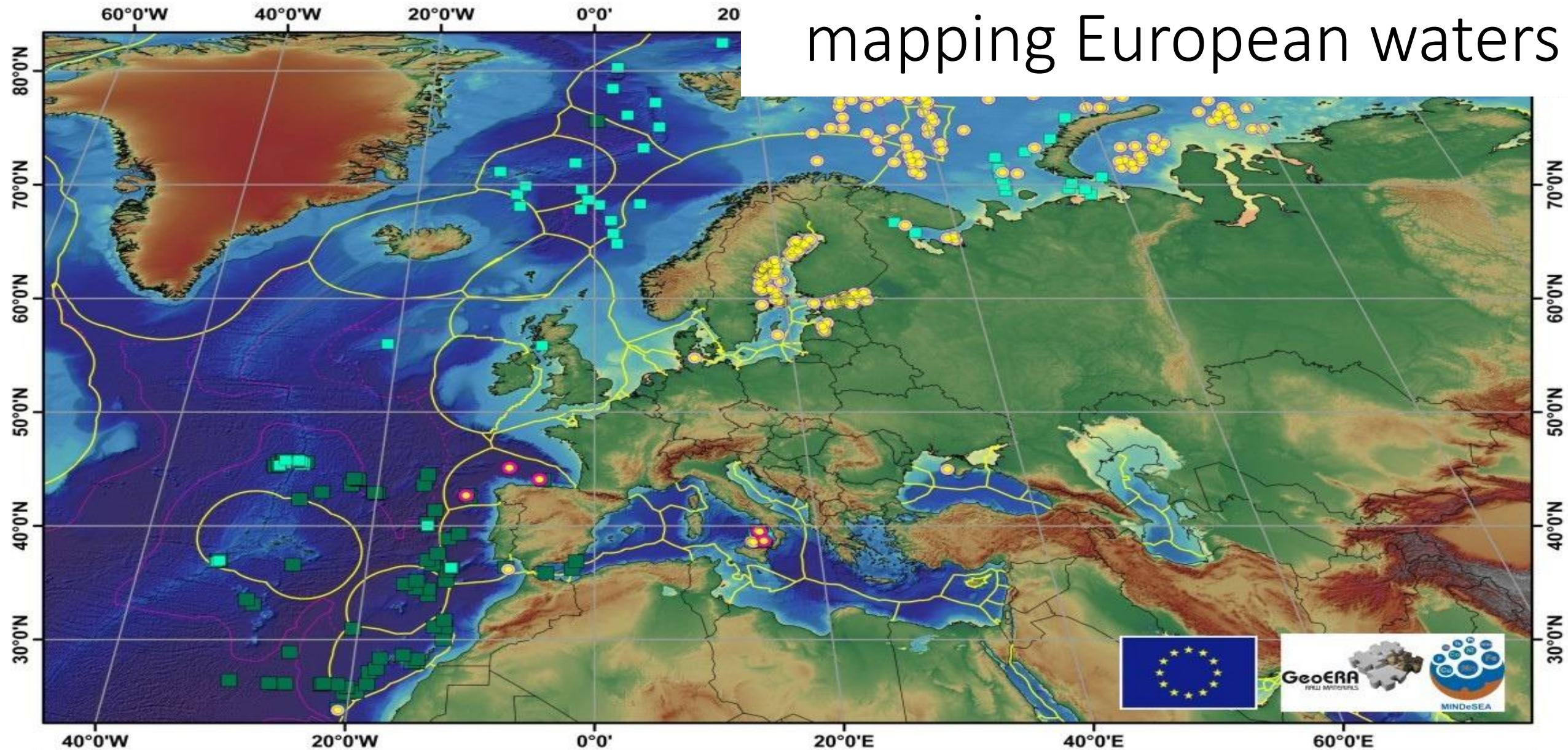


International Seabed Authority

- established under the 1982 United Nations Convention on the Law of the Sea
- issues exploration licences for areas outside national jurisdiction
 - 16 contracts for nodules
 - 4 contracts for crusts
 - 6 contracts for sulphides
- currently setting rules for exploitation
 - revenue sharing (common heritage of mankind)
 - environmental protection



mapping European waters

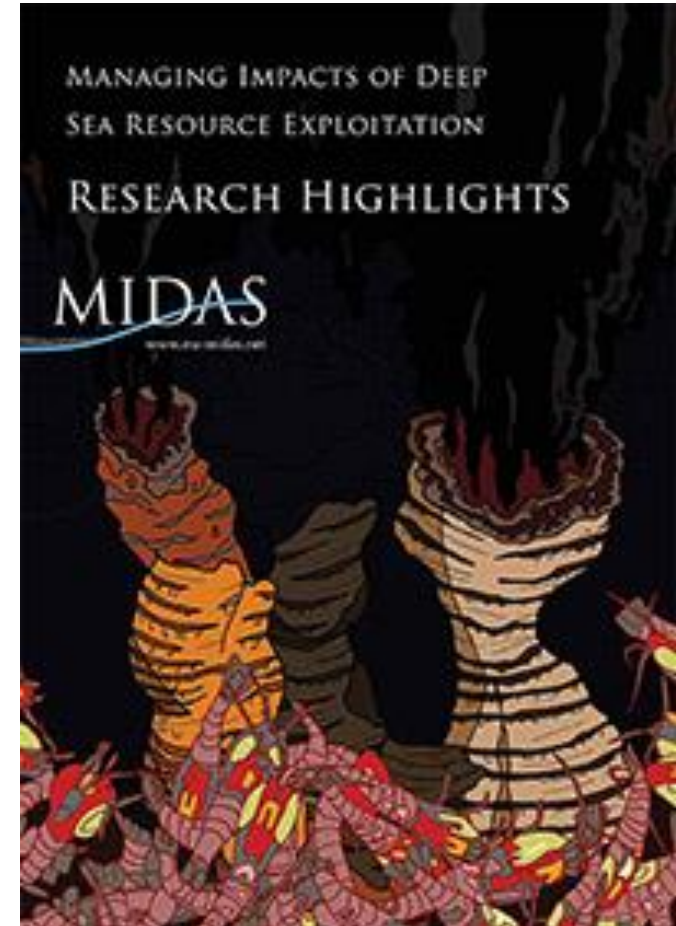


Legend

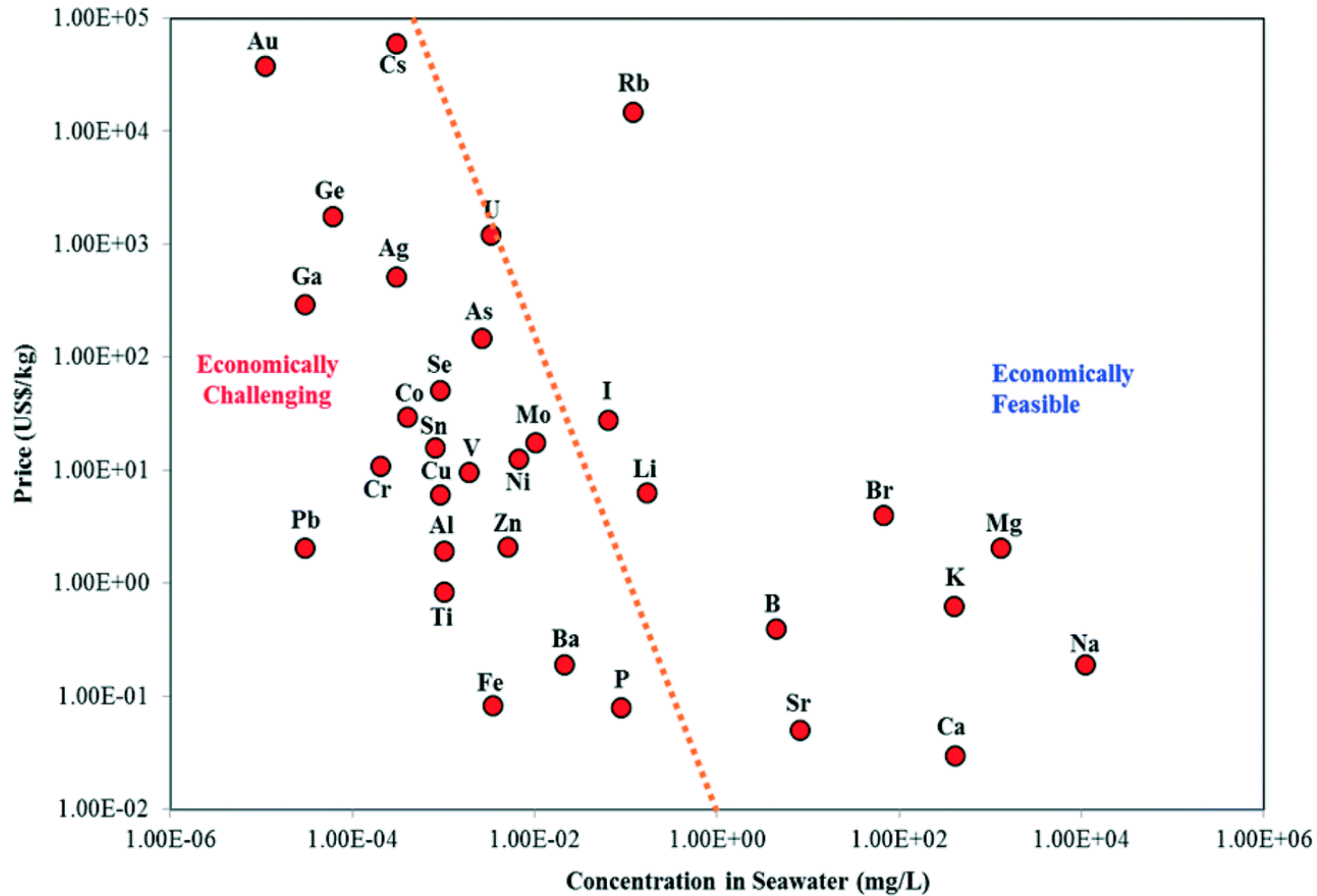
- Cobalt Occurrence, Ferromanganese Crusts
 - Cobalt Deposit, Ferromanganese Crusts
 - Cobalt Occurrence, Polymetallic Nodules
 - Cobalt Deposit, Polymetallic Nodules
 - Lithium Occurrence, Polymetallic Nodules
 - Exclusive Economic Zone (EEZ)
 - Outer limit of Continental Shelf
- Projection: Eckert I (Sphere)
- 0 1,000 2,000 Km

EU research projects

	<u>MIDAS</u>	<u>Blue Mining</u>	<u>Blue Nodules</u>	<u>Ecological aspects of deep-sea mining</u>	<u>Viable Alternative Mine Operating System</u>
Budget	€12 M	€15 M	€8 M	€13.2 M	€12.6 M
EU contribution	€9 M	€10 M	€8 M		
Partners	32	19	14		17
Countries		6	9	11	9



alternative approach?



- extraction from seawater?
- combined with desalination?
- still a research effort

What next?

- security of supply?
 - does Europe have the raw materials it needs to move to a zero-carbon economy?
- can European industry compete?
 - can it maintain competitiveness in face of state-backed efforts from other countries?
- can it be economically viable?
 - volatility of prices
 - unknown composition of many deposits
- can environmental impact be minimised?
 - is it worse than driving roads through tropical forests or child labour in the Democratic Republic of Congo?