The promise of the oceans

EuChems Periodic Table

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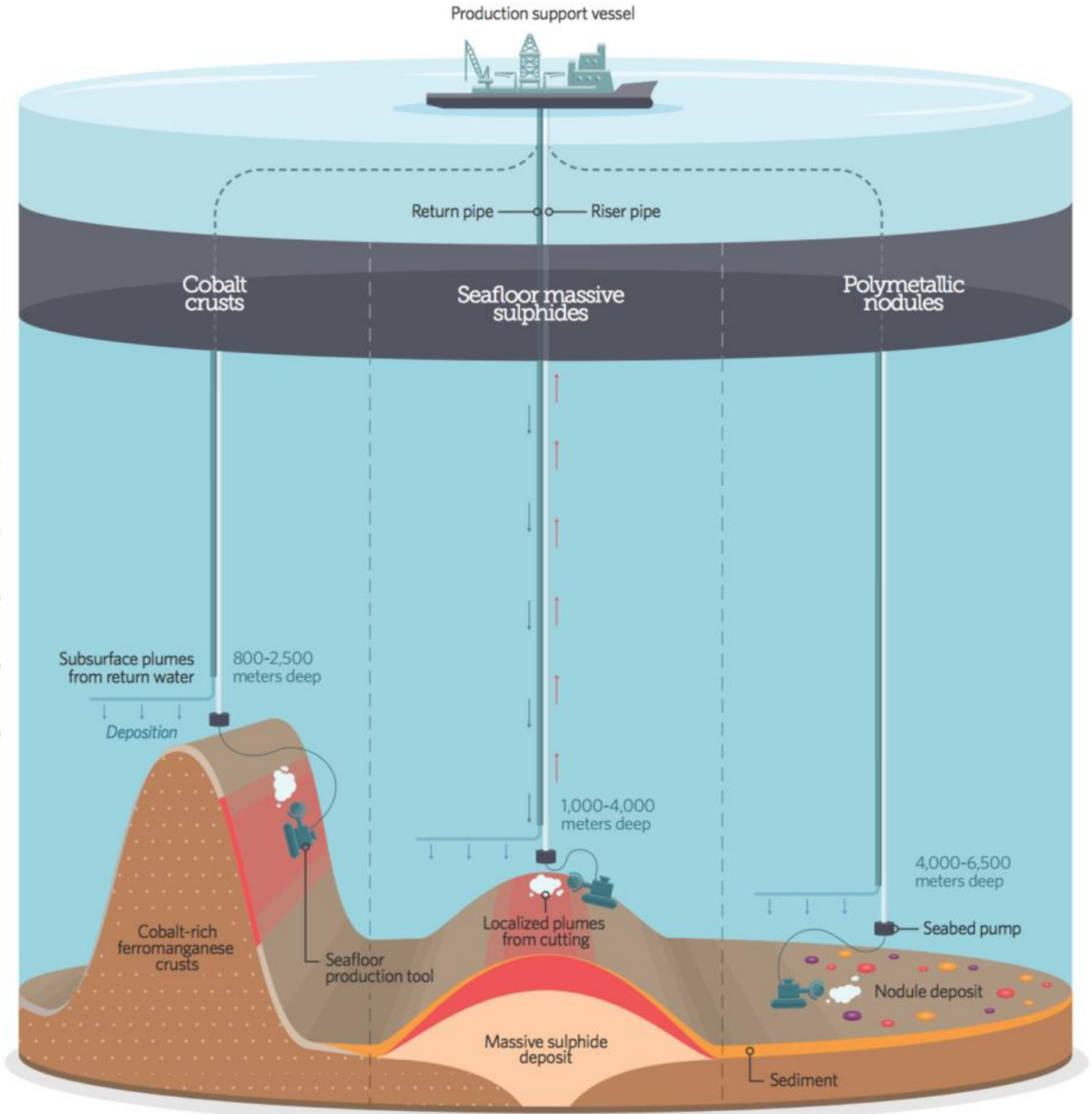
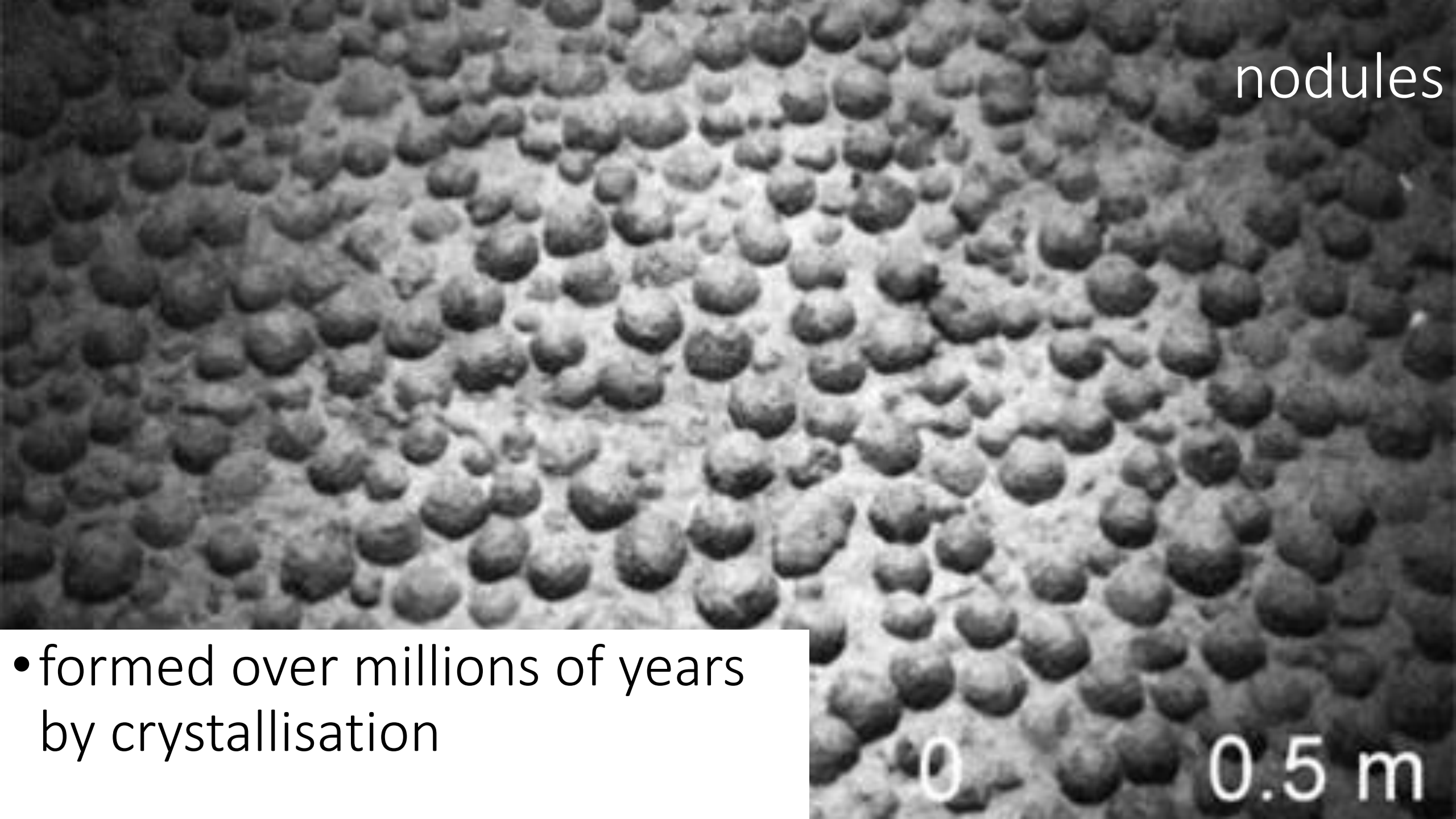
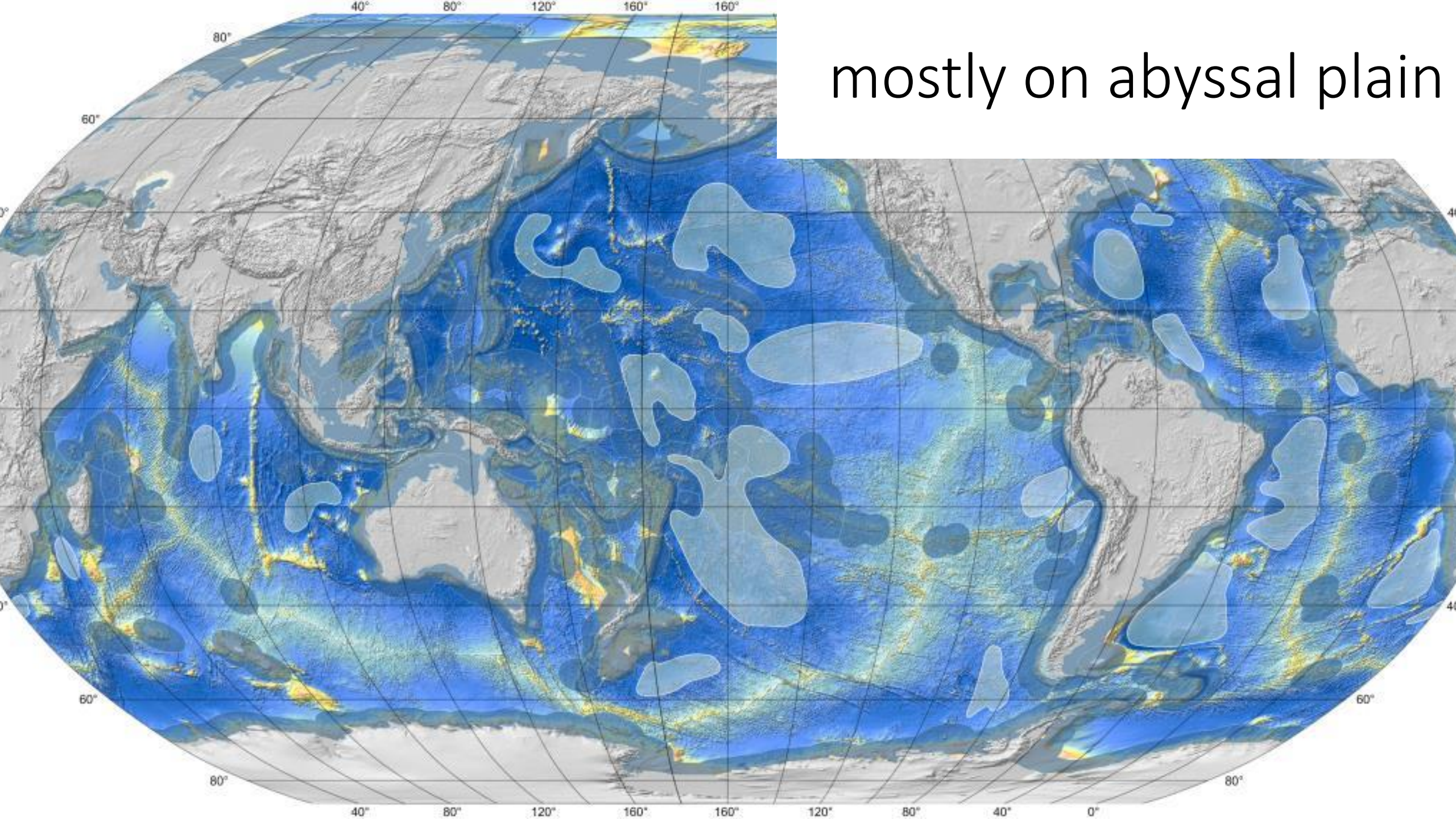


three types of deposit

- nodules
- crusts
- sulphides



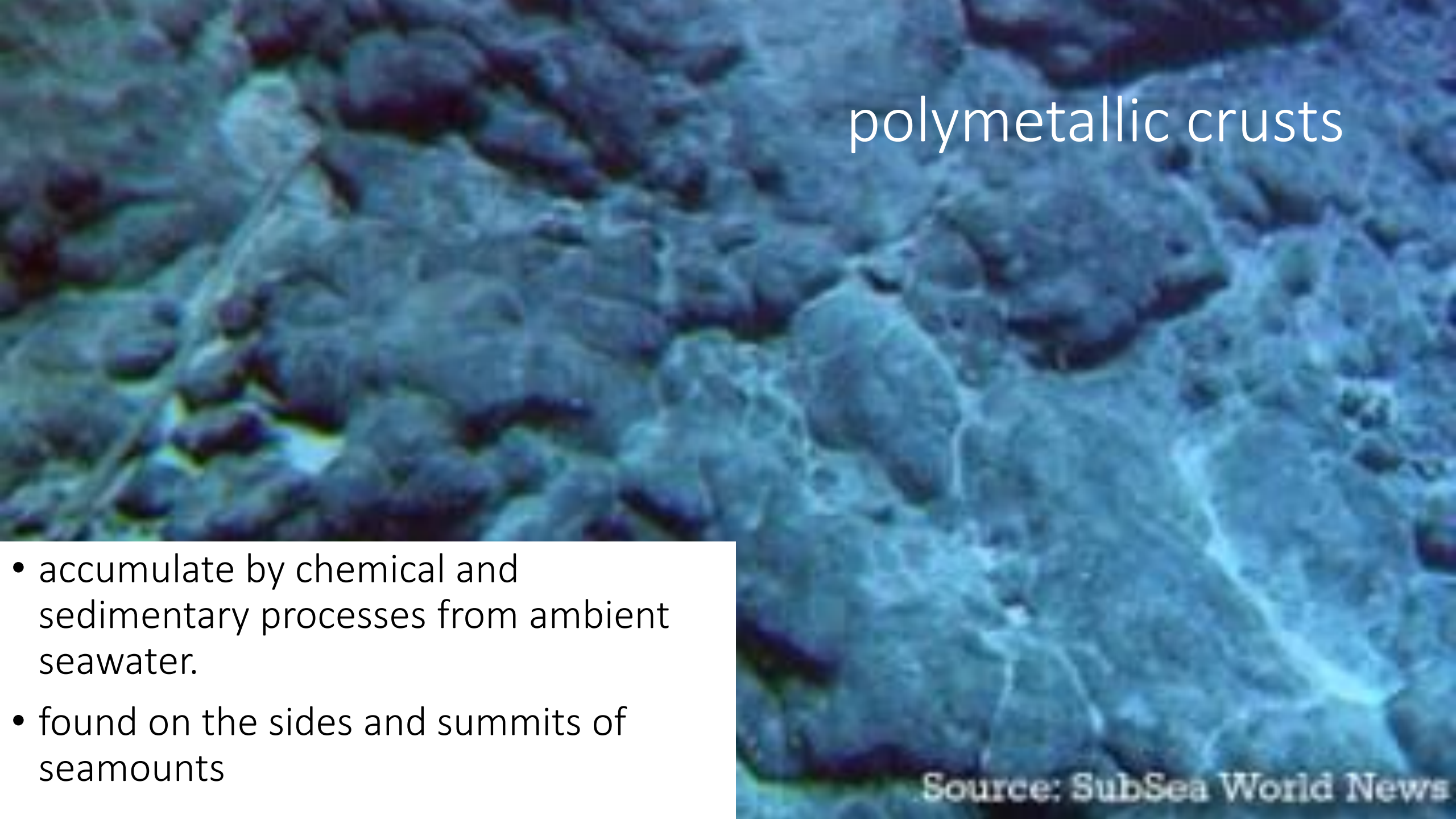
- formed over millions of years by crystallisation


mostly on abyssal plain

content of nodules

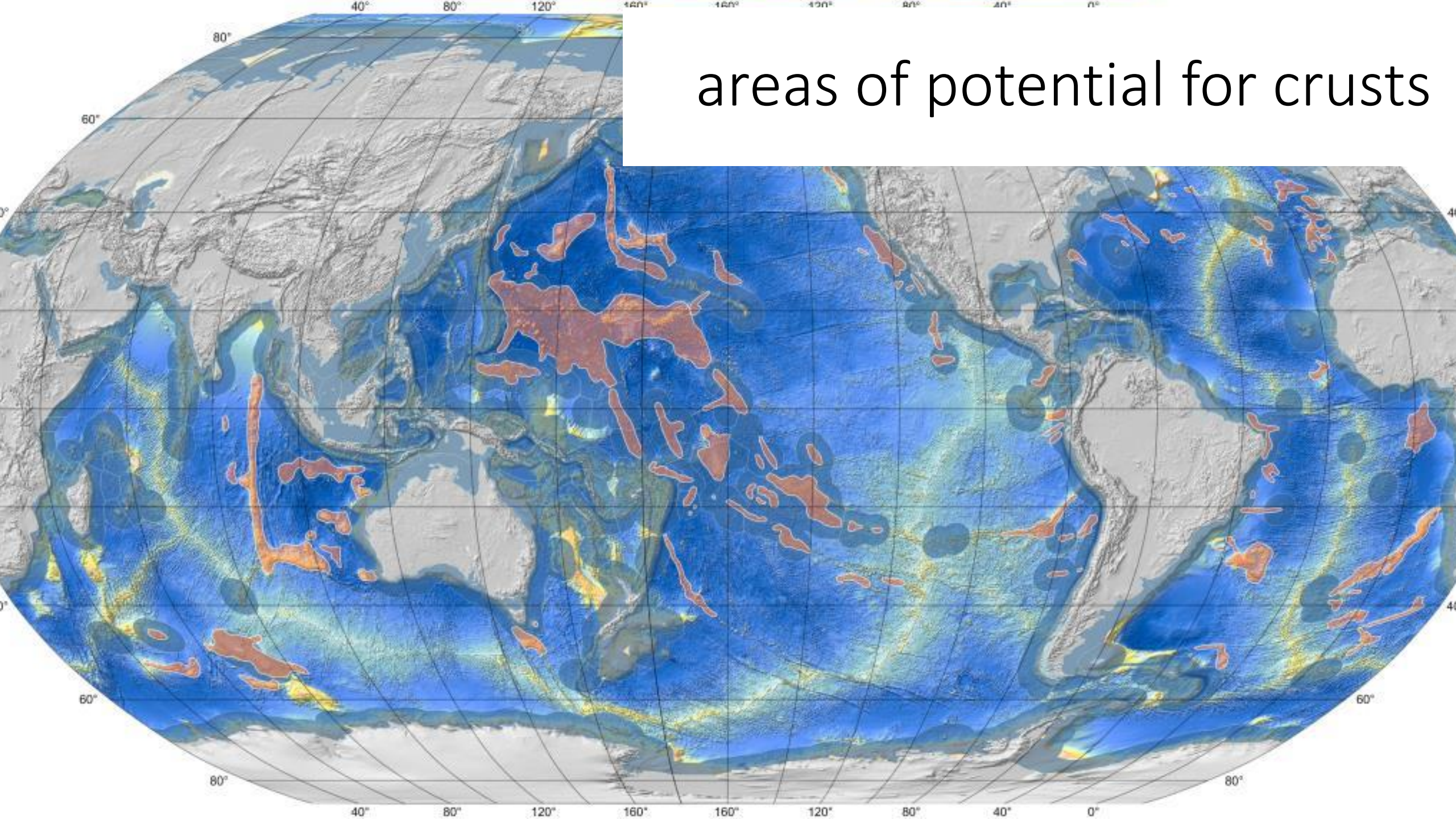
	Clarion-Clipperton	Indic	Peru Basin	Cook Islands
Mn (%)	28.4	24.4	34.2	17.6
Ni (%)	1.3	1.1	1.3	0.5
Cu (%)	1.1	1.0	0.6	0.2
Co (%)	0.21	0.11	0.05	0.41
Mo (ppm)	590	600	547	-
Li (ppm)	131	110	311	-
REE+Y (ppm)	813	1039	403	-

polymetallic crusts



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

areas of potential for crusts



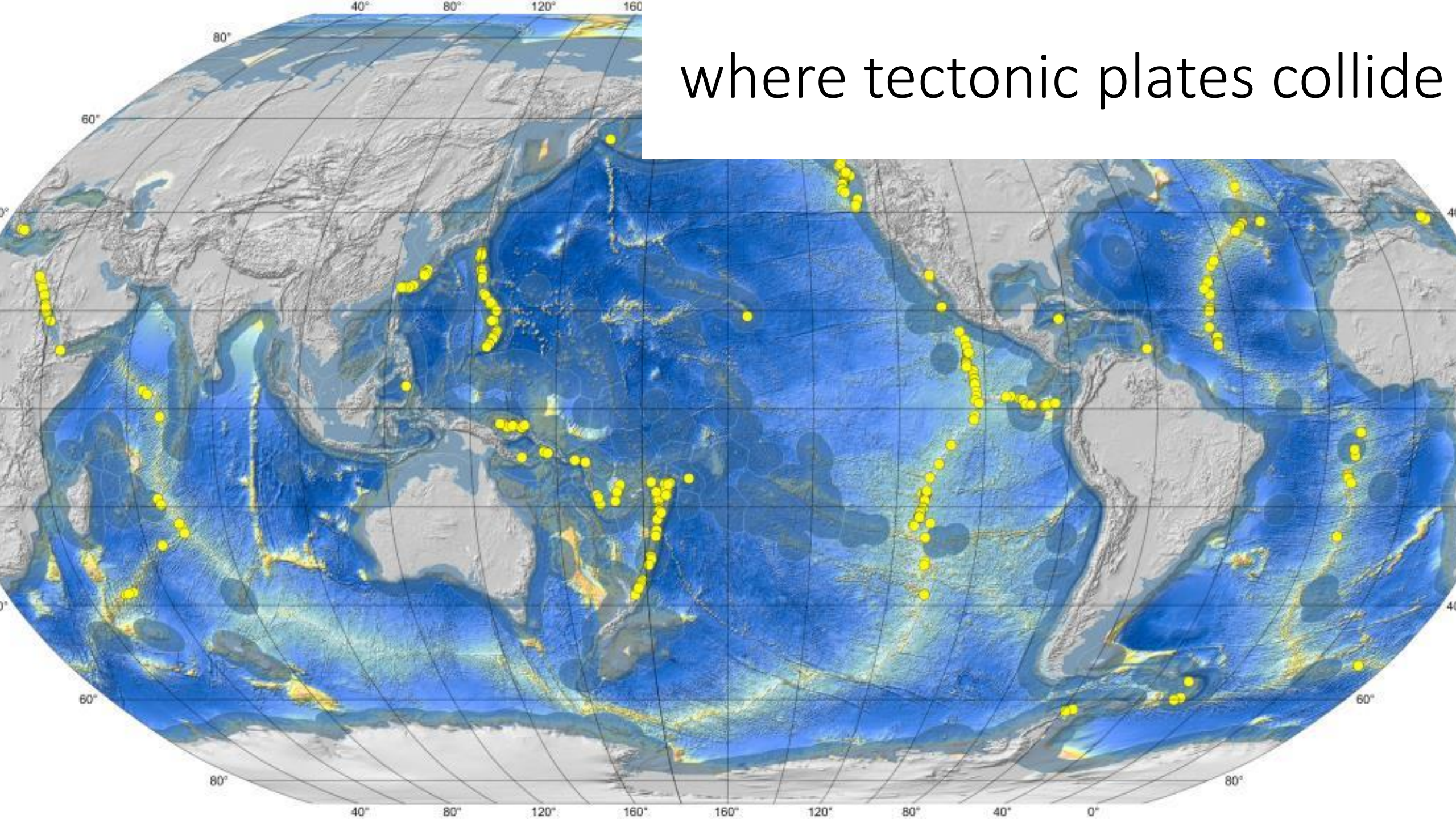
content of crusts

	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

massive sulphides

- precipitating volcanic material

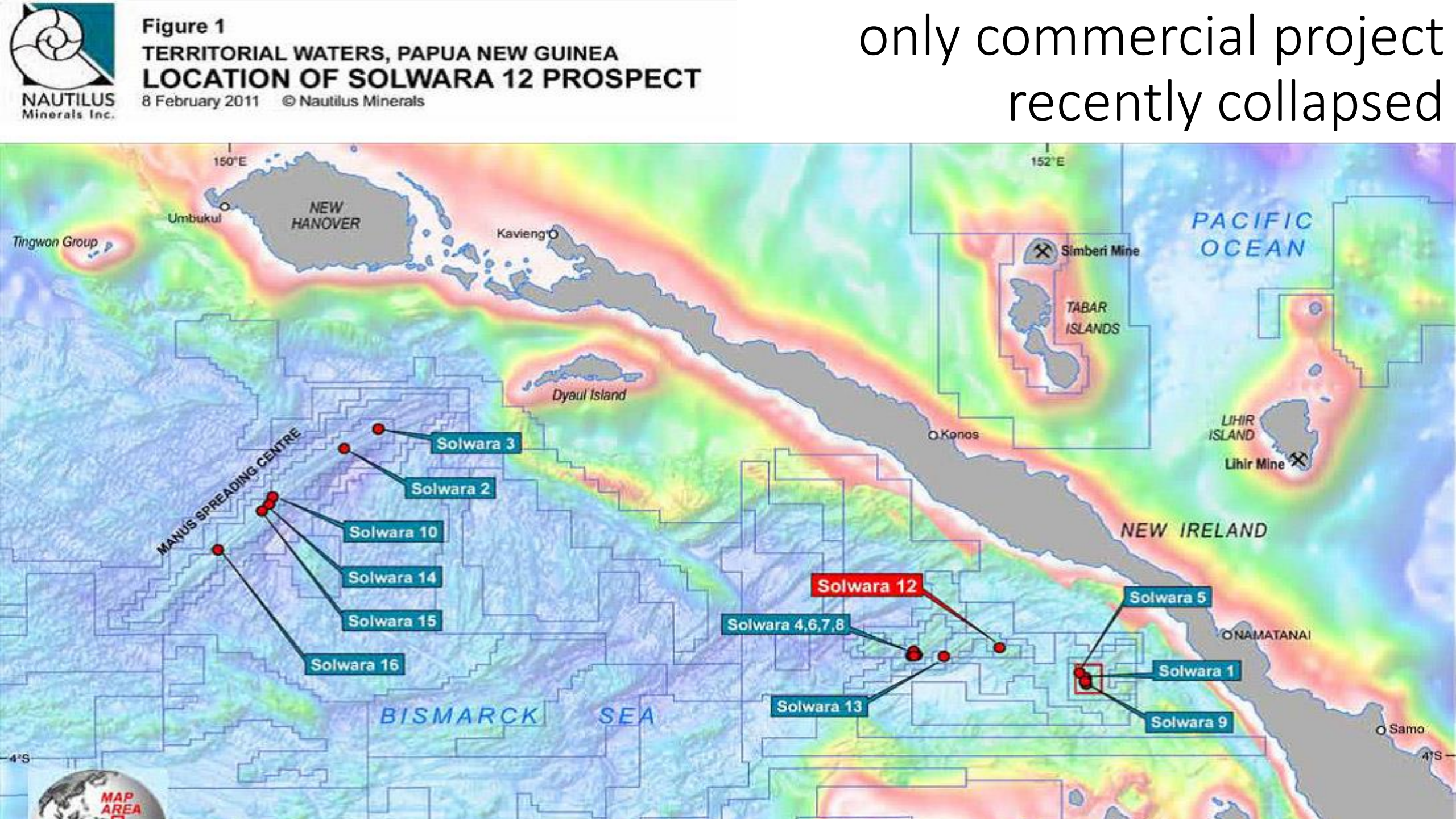
where tectonic plates collide



content of sulphides

Setting	Cu·%	Zn·%	Pb·%	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
intraoceanic·back-arc	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

only commercial project recently collapsed

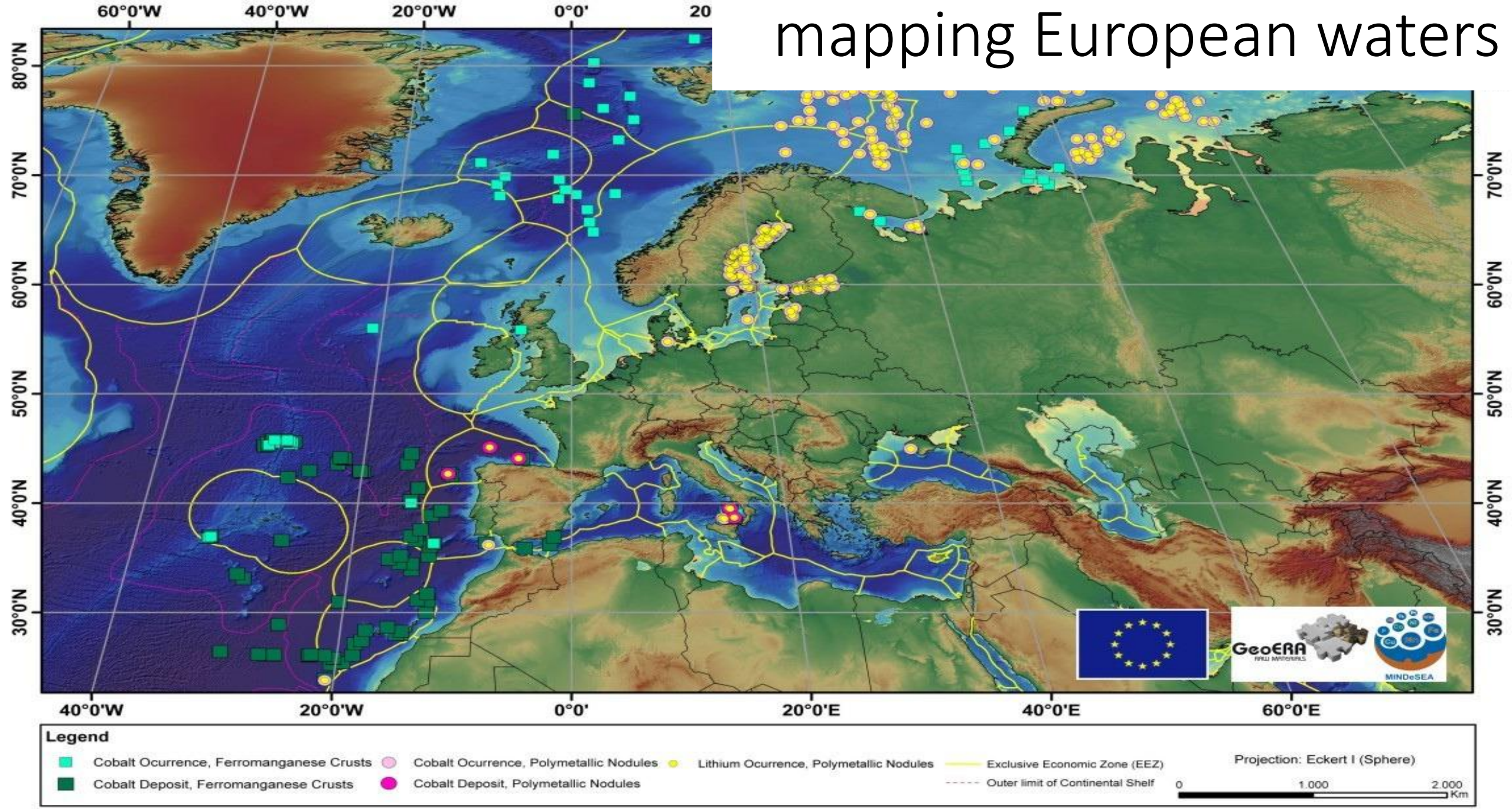


built in Newcastle UK with components from Italy, Netherlands, Poland

International Seabed Authority

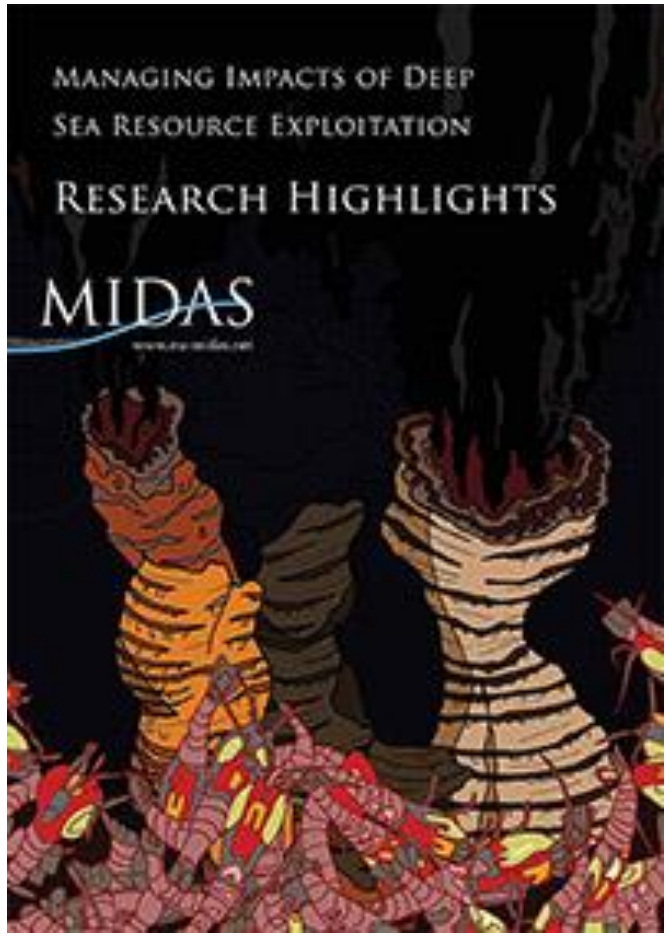
- established under the 1982 United Nations Convention on the Law of the Sea
- issues exploration licences for areas outside national jurisdiction
  - 16 contracts for nodules
  - 4 contracts for crusts
  - 6 contracts for sulphides
- currently setting rules for exploitation
  - revenue sharing (common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

mapping European waters

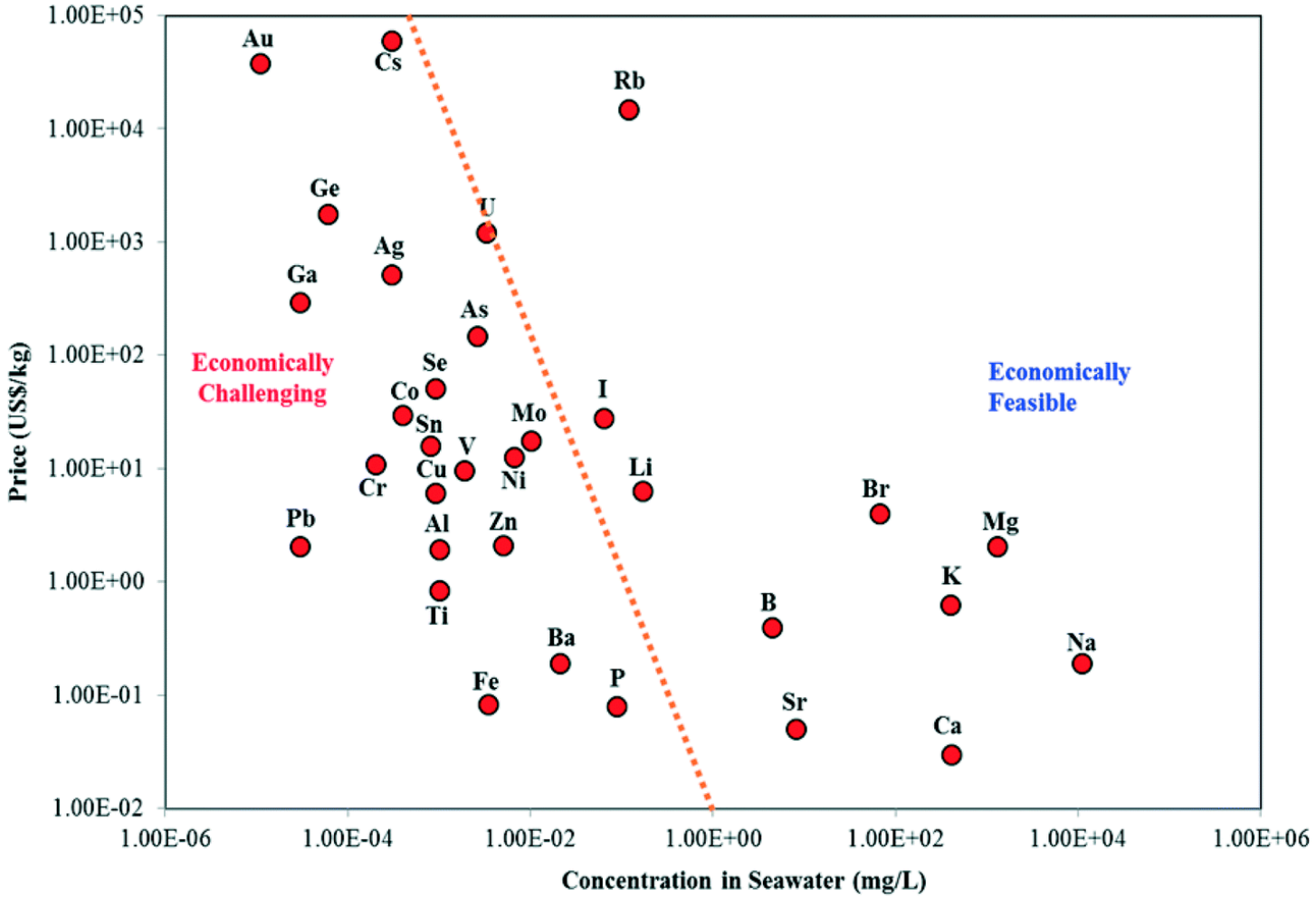


EU research projects

	MIDAS	Blue Mining	Blue Nodules	Ecological aspects of deep-sea mining	Viable Alternative Mine Operating System
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 competiveness 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?