

Deep-sea mining

What are the minerals found in the deep ocean?



Polymetallic nodules

FORM ON ABYSSAL PLAINS



1-100 mm / million years

²⁶Fe ²⁵Mn ²⁸Ni ²⁷Co ²⁹Cu

Relatively high concentrations of iron and manganese, as well as nickel, copper and cobalt.



Polymetallic crusts

FORM ON SEAMOUNTS



1-5 mm / million years

²⁶Fe ²⁵Mn ²⁸Ni ²⁷Co ²⁹Cu

Relatively high concentrations of iron and manganese, as well as nickel, copper and cobalt.



Polymetallic sulphides

FORM IN TECTONICALLY ACTIVE AREAS

²⁹Cu ³²Zn ⁸¹Pb
³³As ²⁷Co ⁴⁷Ag ⁷⁹Au ...

Relatively high concentrations of copper, zinc, lead, arsenic, cobalt, silver, gold, and other metals.

Why may deep-sea mining occur?



TERRESTRIAL SOURCES OF KEY MINERALS ARE RUNNING OUT
WHILST CLEAN ENERGY DEMAND IS GROWING RAPIDLY

MINERALS FOUND IN THE DEEP-SEA ARE USED IN EVERYDAY PRODUCTS:

²⁵Mn

MANGANESE

Combined with aluminium and used in drink cans to avoid corrosion.



²⁹Cu

COPPER

A good conductor of electricity, copper is used in motors, for electrical wiring and in electronic goods such as radio and TV sets.



²⁸Ni

NICKEL

Nickel resists corrosion and is used in high strength alloys.



²⁷Co

COBALT

Cobalt remains magnetic at very high temperatures, therefore is used for specialised magnets in generators and hard drives, as well as in rechargeable batteries.



Phases of deep-sea mining



Prospecting

Searching for deposits and estimating size, distribution, composition and economic value



Exploration

Further analysis of deposits
Testing equipment and facilities
Completing environmental, technical, economic and commercial assessments



Exploitation

Construction and operation of mining, processing and transportation systems
Commercial recovery of desposits and subsequent processing

POSSIBLE IMPACTS FROM

- **LIGHTS**, which can disrupt creatures' biological processes linked to natural light, such as spawning events.
- **NOISE**, which can disturb creatures that use sound to search for food and mates.
- **OPERATIONAL DISCHARGES/EMISSIONS COMPARABLE TO DRILL SHIPS AND DREDGERS**, which can pollute the surrounding water.



Barge/bulk carrier

Production Support Vessel

RETURN PIPES

Once the nodules have been separated from transport slurry, filtered water is returned back to the deep sea.

PLUMES FROM RETURN WATER

Disturbance can stir up fine sediments on the seafloor, creating plumes of suspended particles.

These may disperse beyond the mining area and affect ecosystems and species, for example harm filter-feeding animals that depend on clear, clean water to feed.

RISER PIPE

Slurry containing nodules, sediment and water is transported several kilometres up to the surface.

IMPACTS FROM

LOSS OF SEAFLOOR SUBSTRATE
SEAFLOOR COMPACTION
HABITAT REMOVAL
SUSPENDED SEDIMENT AKA PLUMES
LIGHT - NOISE - VIBRATION



Polymetallic nodules on abyssal plains

SEAFLOOR COLLECTOR for nodules

VENTS

1,000 - 4,000 m.

ABYSSAL PLAIN

4,000 - 6,000 m.

SEAMOUNT

800 - 2,500 m.