National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

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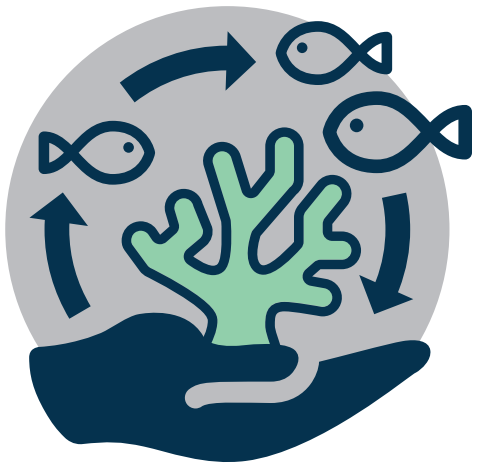
# AN OCEAN OF OPPORTUNITY?



Mn

Te

Co

## PROTECT OR PROSPECT?

With the majority of base metals as well as critical elements such as 90% of global tellurium and 60% of global cobalt, deep-sea mineral deposits pose a major source of raw materials to enable the development of global society and securing a low carbon sustainable future.

Yet the deep-sea is also a near-pristine environment that needs protection. Much of the resource potential is likely to be biological, including extremophiles, whose vulnerability we don't yet know.

The responsible extraction of deep-sea mineral resources, for the benefit of humankind, demands understanding of the geological controls on their location, grade and preservation as well as the inevitable impact on deep-sea ecosystems.

The NOC works on several deep-sea mining research projects, including MarineE-tech, Blue Mining, MIDAS, JPIO and ABYSSLINE, an environmental baseline for the UK-1 claim area.

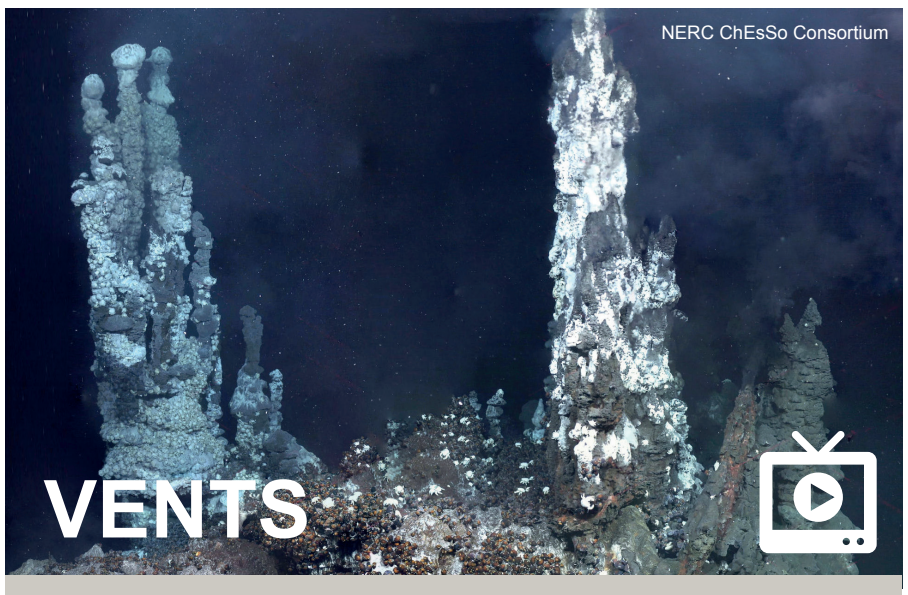

## Fe, Mn, Co, Ni, Cu, Te, REE

Cobalt-rich minerals are encrusted on the rocky outcrops of underwater mountains known as seamounts. These are typically extinct volcanoes.

**Depth:** 100-4000m

**Resource:** iron and manganese but also include cobalt, nickel, copper, tellurium and Rare Earth Elements (REE's). The use of cobalt and tellurium in the next generation of solar panels could revolutionise the use of this green energy and technology in our homes, portable devices and cars.

**Life:** a high number of many different animals live on the rocky surfaces of seamounts. Some of these animals, such as corals, are long-lived and are unable to move. We already know that deep-sea fishing using trawls has led to rapid and long-lasting damage on the summits of these underwater mountains, therefore, the mining of cobalt crusts could pose a high-risk for the species that inhabit them.



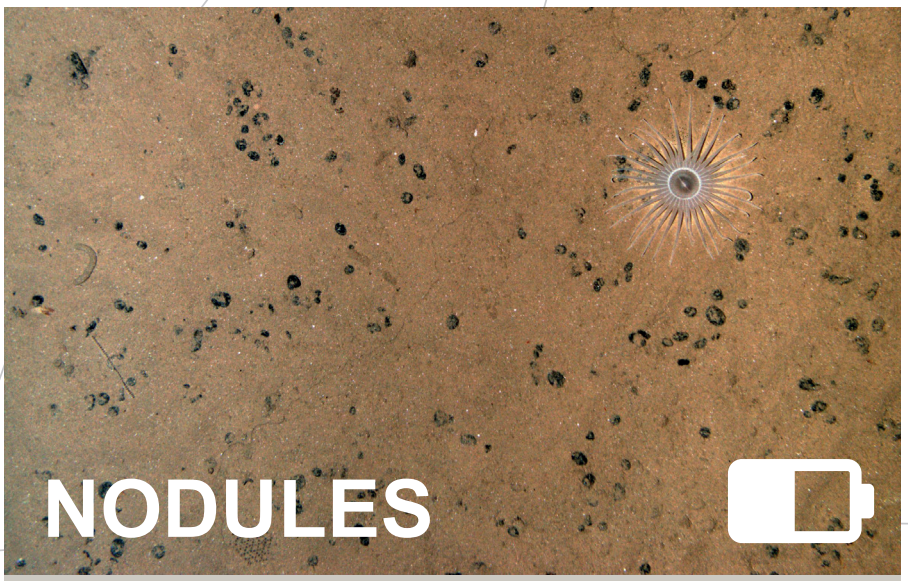

## Cu, Zn, Fb, Au, Ag

Seafloor Massive Sulfides are associated with hydrothermal vents - fissures in the Earth's crust from which super-heated, mineral-rich water is ejected into the deep ocean as "black-smoke". As this water cools, minerals are deposited in the form of chimneys on the seafloor.

**Depth:** 2000-5000m

**Resource:** copper, zinc, lead, gold, silver and small quantities of other metals. These minerals form vital components in current communication technology including our televisions and radios.

**Life:** deep-sea creatures that live at hydrothermal vents are unique in that they host bacteria that use chemical energy from the mineral-rich water to make food. Different communities of animals are associated with vents found at different spreading rates, some communities may be able to recover from disturbances in their environment.




## Mn, Ni, Cu, REE

Polymetallic nodules are potato-sized rock deposits scattered over the plains of the ocean's deep abyss. These polymetallic nodules are formed by dissolved metal compounds in seawater and sediment that precipitate in concentric layers over millions of years. The nucleus may be a rock fragment or even a fossil shark tooth.

**Depth:** 4000-6500m

**Resource:** manganese, nickel, copper and small quantities of other metals and Rare Earth Elements (REE's). Alkaline and Lithium batteries, reliant on nickel and manganese, are found everywhere; from pacemakers, hearing aids, smartphones to electric cars.

**Life:** many different animals live on polymetallic nodules or the sediment that surrounds them. Although not in high-numbers, many of these species have yet to be described by scientists, which means it is difficult to understand how many animals live where and how they will be impacted if mining in these areas was to occur.