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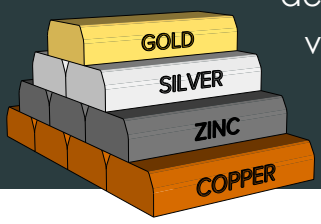
Sub-sea mining mission

European project builds on scientific legacy to reveal potential of seafloor hot springs

The rich mineral value of extinct deep sea deposits was first discovered in the 1970s, but because of the availability of terrestrial resources, the full potential of so-called seafloor hot springs remained untapped. In recent years, scientific and societal interest has been reignited, prompted by the demands of a growing global population coupled with a downturn in the oil and gas industry, and the expansion of mineral extraction activities in China, Russia and India.

Blue Mining project

Data amassed by the International Ocean Discovery Program (IODP) has been instrumental to the **Blue Mining project, a multi-million European program** which in 2018, found the most detailed evidence yet for informing the economic viability and environmental sustainability of mining for these extinct seafloor massive sulphides.



Seafloor massive sulphides (SMS) are found beneath deep sea hydrothermal vents and contain high grades of copper, gold, silver and zinc. The IODP and its earlier incarnations has been exploring the structure and setting of subseafloor mineral deposits since 1994, most notably, during **ODP Leg 158**, which focused on a 40-km long ridge segment in the Trans-Atlantic Geotraverse (TAG) hydrothermal field at 26°N on the Mid-Atlantic Ridge (MAR).

ODP Leg 158 was the first study that resulted in the classification of the internal structure and sub-surface stratigraphy of this large SMS deposit, and subsequently led to the realisation that SMS deposits were the modern analogue to the ancient volcanogenic massive sulphide (VMS) deposits, found on land.

Thermodynamic data, drill cuttings and physical properties measurements taken during ODP Leg 158 have since proved vital to the Blue Mining project, a NERC-funded collaboration between 19 scientific and industry partners.

Blue Mining further investigated hydrothermal vents – otherwise known as seafloor hot springs – that have been extinct for 50,000 years, during which time they have accrued an abundance of **mineral rich deposits**, which are commonly used in smartphones, aircraft, solar panels and wind turbines.

Dr Bramley Murton, principal investigator of the Blue Mining Project, and head of the National Oceanography Centre at the University of Southampton, said the project would not have been possible without the scientific legacy of the IODP:

> *"Although the questions that the IODP at the time were addressing were strictly scientific and curiosity driven, it's because of those early expeditions that we've been able to formulate new hypotheses around how we might evaluate and test the potential of alternative mineable systems."*

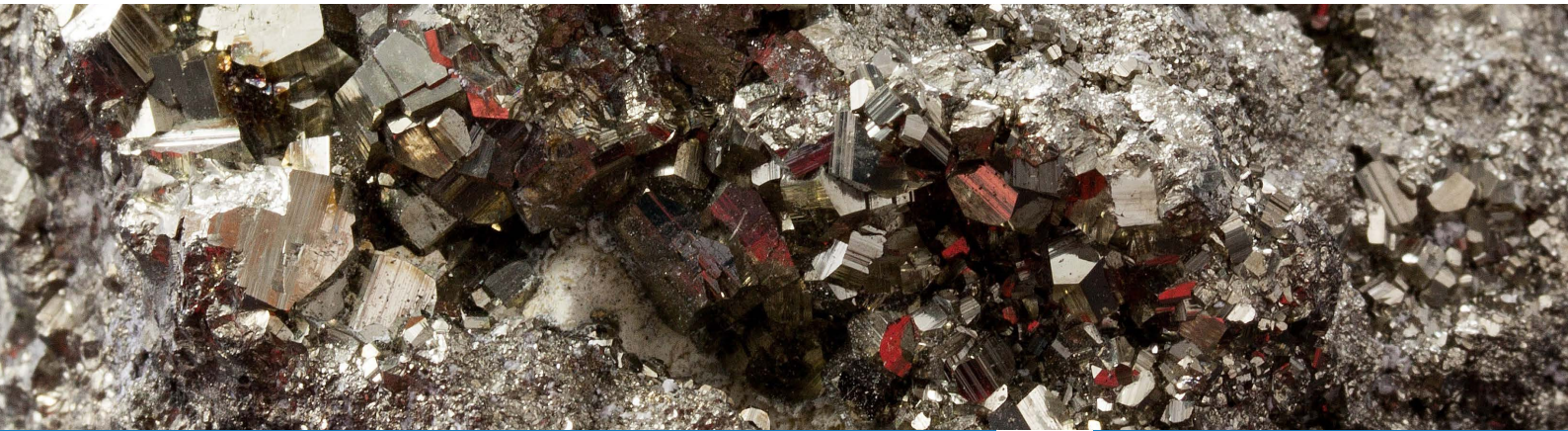
Dr Bramley Murton
Principal investigator of the Blue Mining Project
National Oceanography Centre at the University of Southampton

Estimates by the **Blue Mining** team suggest that there are about ten times more extinct SMS deposits exposed on the seafloor or under a few metres of sediment, within 20 km each side of the mid-ocean ridge axis, compared with the number of known hydrothermally active systems. Of these, 350 are known, with another 1000 estimated yet to be discovered. If eSMS deposits are added to the mix, then the accessible inventory may be of the order of 15,000 worldwide.

Frank Lim is the Director of global engineering contractor 2HOffshore, an industry partner in Blue Mining. While Lim cautions that "we are still around ten years away in terms of deep sea mining signalling a new frontier in resource exploitation", he believes the evidence-based potential for deep sea minerals, as unearthed by Murton and his team, provides the sector with significant cause for hope at a time when it needed it most:

> *Deep sea mining has certainly given our industry something to look forward to. We have many years' of experience, expertise and resources that could be utilised in this venture, which is an exciting development to consider for the future."*

Frank Lim
Director of global engineering contractor 2HOffshore



Scientists and industry agree that Blue Mining represents the tremendous scope that exists through multinational and multidisciplinary collaboration, building on the foundations of programs like the IODP with its unparalleled resource of material that helps chart the past, present and future of human and environmental potential.

> **For the earth science community the IODP is the equivalent of NASA.** *It sends probes back into time. It's like a Mars mission that goes back billions of years in history. You can drill a pile of mud and get an idea of what the oceans were like, what forest fires were like, going back tens of millions of years - it's absolutely phenomenal."*

Dr Bramley Murton
Principal investigator of the Blue Mining Project
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Additional Information

■ **Blue Mining** ran between February 2014 and January 2018 and involved a total of four years of data collection including survey design, instrument development, deployment across ten weeks of ship time, and deep-seafloor drilling. Further information is available here: www.bluemining.eu

■ **Dr Bramley Murton** is lead of the National Oceanography Centre (NOC) Marine Mineral Research team. Further information about his research is available here: http://noc.ac.uk/people/bjm

■ The **International Ocean Discovery Program** has been at the forefront of sub-seafloor scientific exploration for more than 50 years, with an increasing emphasis on scientific outputs that are societally relevant through that time. Uniquely, IODP is a legacy scientific programme with data and samples routinely made publicly available one year after each expedition has concluded. UK is a member of IODP via the European Consortium for Ocean Research Drilling (ECORD), funded as a NERC directed research programme. www.iodp.rocks

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Composing in motion...

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