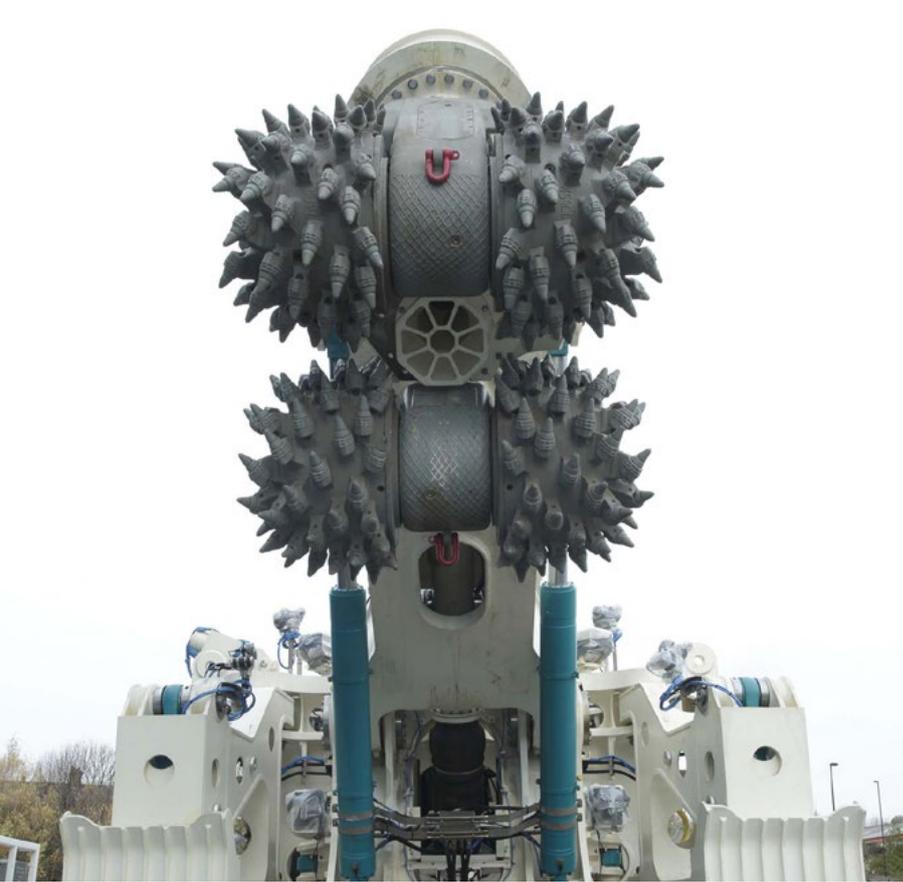


UNDERWATER MINERAL EXTRACTION PROJECTS



ENGINEERING
EXCELLENCE
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EXCELLENCE
UNDERWATER

We are committed to providing submerged solutions and systems that enable mineral extraction operations to be achieved in an environmentally acceptable, sustainable and economically viable manner.

We are experts in:

- High-power vehicles
- Jetting and cutting
- Deep water sea states

PIONEERS IN SUBSEA MINERAL EXTRACTION EQUIPMENT

SMD has an unrivalled history in the provision of bespoke remotely controlled underwater excavation and intervention equipment. Since 1971 SMD has supplied ploughs, trenchers and ROV's to the offshore telecommunications, oil & gas and renewables sectors. This extensive experience, coupled with improvements in technology have now enabled the provision of large remotely controlled underwater mineral extraction equipment for both deep-sea and inland water applications.

AVERAGE STRIPPING RATIOS ON LAND ARE INCREASING AND AVERAGE ORE GRADES ARE DECREASING.

At the same time populations and mineral demand per capita are increasing. This has led to increased interest in alternative mineral sources. By 2015, one-third of world oil production was from offshore sources. The same trend is emerging for harder minerals.

OFFSHORE RESOURCES ARE PLENTIFUL WITH HIGH ORE GRADES.

In many cases these resources are unburied. The international seabed authority has put draft legislation in place for mining in international waters. In parallel, some governments have already put in place mining and environmental legislation for their exclusive economic areas. For particular types of mineral deposits, the new technology can also be used inland below the water table with many advantages over conventional mining from both a technical and environmental perspective.

NAUTILUS DEEP SEA MINERAL EXTRACTION EQUIPMENT



Solwara 1

Nautilus's first mineral extraction site, Solwara 1, is 30 kilometers off the shore of Papua New Guinea's New Ireland Province. The company's Solwara 1 Project is located at 1600 metres water depth in the Bismarck Sea, New Ireland Province. It was planned to be the world's first deep-sea mineral extraction project.

DEEP SEA MINERAL EXTRACTION VEHICLES

These three remotely-controlled mineral extraction machines, the largest of which is 300t are designed to recover seafloor massive sulphides in the Bismarck Sea off Papua New Guinea.

The mineral deposit has an average depth of 1600m below mean sea level. They were produced in 2016 for Nautilus Minerals Inc. an early pioneer in deep-sea mineral exploration and exploitation.



THE WHOLE PACKAGE

Each of the vehicles is controlled remotely from the ship's control room via an umbilical. This supplies power to multiple copper cores, as well as communications, data and control commands via fibre-optic cables, which are all wrapped in an armoured casing. The umbilical has a bend restrictor to prevent it from contacting the seabed.

Each machine also has an intervention panel that can be accessed by a remotely operated vehicle (ROV), which can help couple and uncouple hoses and tools without the need to return the big machines to the surface and can also help in emergency situations.



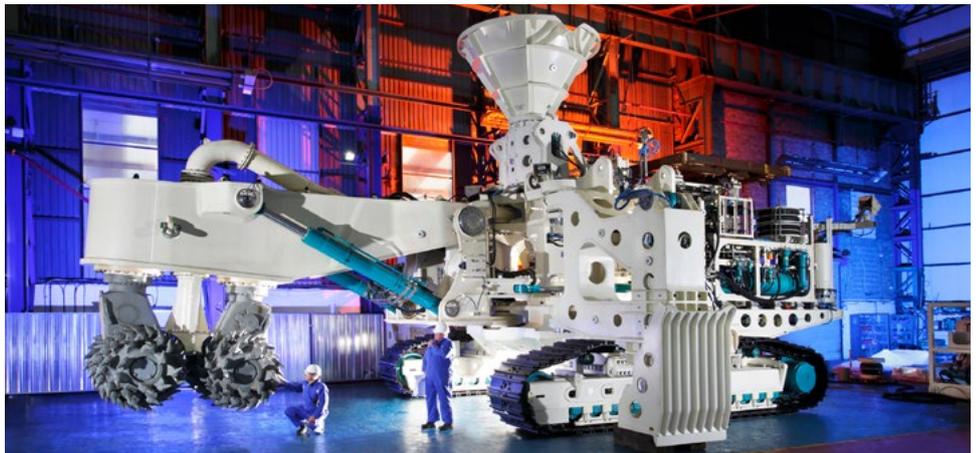
In late 2007 SMD was awarded the contract to design and build the world's first deepsea mineral extraction vehicles for Canadian listed company Nautilus Minerals. Eight years on, having worked in close partnership with the customer, SMD completed this massive feat of engineering. The SPTs and associated equipment, totalling over 1,000 Tonnes, were loaded onto a vessel that set sail for Duqm Port in Oman where they underwent further testing.

SOLWARA 1 DEPOSIT KEY FACTS

- 7.5% Copper.
- 6g/t Gold.
- 25g/t Silver.
- Calm sheltered location with low seastate.
- Independent environmental and social benchmarking analysis undertaken.
- Lower carbon footprint than conventional mining.
- Mining licence in place.
- Production Support Vessel under construction.
- Part government ownership.
- Ore take-off agreement in place.

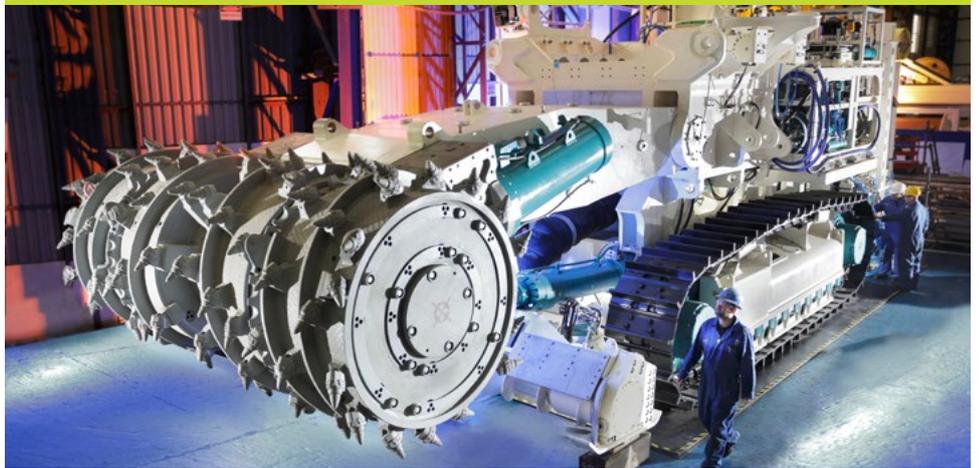
AUXILIARY CUTTER

The first machine used as part of the extraction is the auxiliary cutter, which creates a level working surface for the subsequent bulk cutter and collector machines.



BULK CUTTER

The bulk cutter is the main production machine and the heaviest deep-sea mineral extraction unit ever built, weighing in at over a colossal 300 tonnes. Designing a ship-based launch and recovery system was challenging for something of this size so we settled on a cantilever system. The installed power of the cutter head is also bigger than any other rock cutter at 1.2MW. The power is supplied via an umbilical from the vessel.



COLLECTING MACHINE

In the planned mining technique, the giant bulk cutter grinds up the seafloor with each pass, before the collector sucks up material from the piles made by the bulk cutter, which is then transferred via a riser pipe to the production support vessel on the surface, where it is dewatered.



VAMOS INLAND MINERAL EXTRACTION SYSTEM



ADVANTAGES OF THE TECHNIQUE

- No draw-down of aquifer(s) affecting neighbours.
- No blasting noise, ground vibration, dust or fume nuisance.
- No discharge of mine water.
- Safer as no personnel in the mine.
- Improved slope stability and reduction in stripping ratio.
- No toe-seepage, weathering or erosion of side-walls.
- No blast over-break or blast vibration.
- Water pressure balanced across pit wall.
- No dewatering costs and/or barrier construction / maintenance.
- Cheaper capital cost than an u/g mine and quicker setup.
- Access to barrier pillars, buffer zones etc.
- Infrastructure and mill life extended.
- Chance to finalise rehabilitation problems that have been left behind.

VIABLE ALTERNATIVE MINE OPERATING SYSTEM

For soft to medium strength semi-vertical inland ore deposits below the water table, a new technique is now available. A submerged remotely operated mining machine is used to crush and pump the ore as a slurry to the surface where it is dewatered. The water is returned to the pit maintaining the pit water level. The dewatered ore is delivered at typically minus 50mm, bypassing primary crushing circuits.



APPLICATIONS

Applications include abandoned open-pit mines, extensions of existing mines and new deposits where mining has not taken place previously due to hydrological or other environmental constraints on conventional mining.

Mineral extractors can be configured to carry multiple tools, interchangeable underwater to suit every ore deposit.



FOR MINERALS ENQUIRIES
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