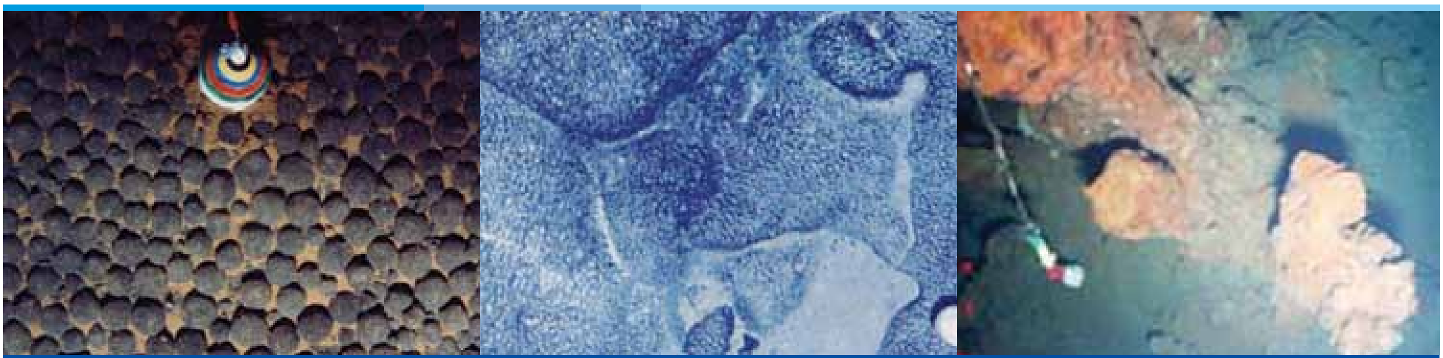
SPC
Secretariat of the Pacific Community
Applied Geoscience and Technology Division (SOPAC)

SPC-EU EDF10 Deep Sea Minerals (DSM) Project



Information Brochure 4
Marine Mining and Technology Development

Seabed mining can be subdivided into two components: shallow marine mining and deep sea mining. Shallow marine mining largely refers to the extraction of mud, sand and gravel for construction purposes and in some cases can also refer to the mining of valuable minerals in the nearshore shallow waters. Mining for construction sand and gravel in shallow marine areas has been ongoing in various parts of the world for a long time and is common in the Pacific Islands region. In contrast, mining for nearshore precious stones (diamond and other gemstones) has only been undertaken in recent times and is more common in the coastal areas of southern Africa.

On the other hand, mining of deep sea mineral resources is considered to be more challenging due to the water depth in which these minerals occur. Apart from a number of trial mining ventures there has yet to be any system successfully developed to undertake commercial mining in the deeper part of the ocean. However, recent development in technology suggests that deep sea mining will soon be a reality.

Figure 1. Sand and gravel dredging: (A) suction pump dredging at Mulifanua, Samoa (Figures 1A & 1B); and clamshell dredging in Tongatapu, Tonga.

Nearshore Mining for Sand and Gravel

Lagoon sand and gravel mining is common in many Pacific Island Countries (PICs) and has been ongoing for many years. With increasing pressure on limited onland resources, the sourcing of sand and gravel from nearshore areas is considered a better option for smaller island countries.

A number of dredging methods are commonly used for offshore sand and gravel extraction in the Pacific Islands region including suction pump (Figures 1A & 1B), clamshell (Figure 1C) and dragline. Most of these aggregate extraction activities have occurred nearshore in protected lagoon areas less than 15 metres deep. These dredged materials (i.e. mud, sand and gravel) are used for a range of purposes such as the construction of buildings, roads, seawalls, cement making, and land reclamation.

Nearshore Mining for Valuable Minerals

Interest in offshore diamond mining on the southern Africa coast (Namibia and South Africa) is reported to have gathered pace in the mid-1900's following the discovery of diamonds in a coastal area of Namibia. Some 1.5 million carats were extracted between 1961 and 1970. However, low diamond prices and lack of technology led to the down scaling of marine mining operations in the 1970's.

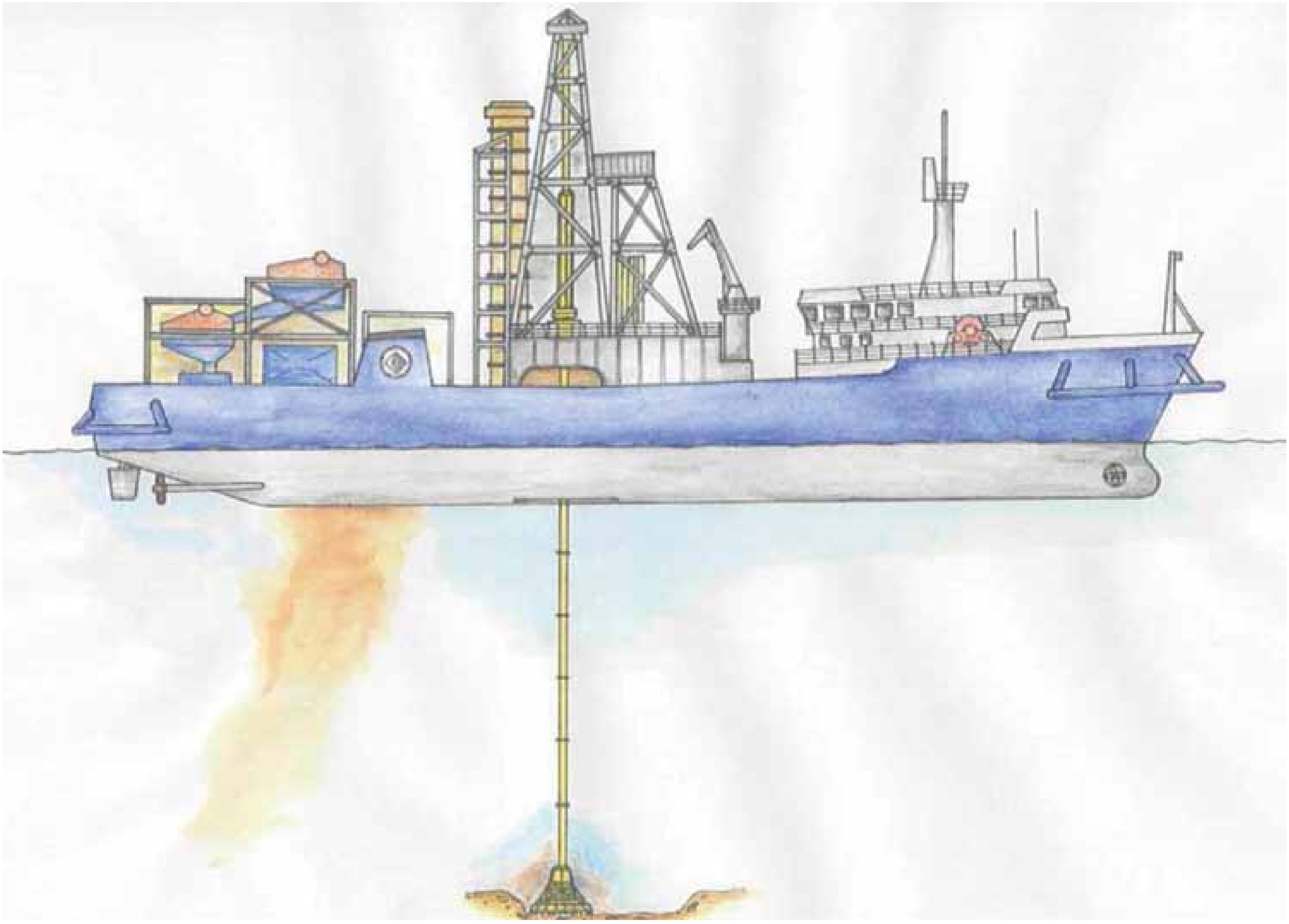


Figure 2. General configuration of the vertical technique of marine diamond mining[1].

[1] Heyes C. 2002. Offshore Diamond Mining

With the development of appropriate technology, the industry began to take shape again in the 1990's. Recently, larger scale diamond mining is conducted in relatively deeper continental shelf within and beyond the 300 metre water depth with the aid of vacuum pumps and Remotely Operated Vehicles (ROVs). The two commonly used methods of offshore diamond mining are horizontal mining and vertical mining (Figure 2).

Deep Sea Mining

Efforts to develop deep sea mineral resources (i.e. for Seafloor Massive Sulphides (SMS), manganese nodule and cobalt-rich crust) must consider the challenging environment in which they occur. Like onland mining, credible detailed assessment needs to be undertaken in order to gain sufficient knowledge and confidence on the viability of any mining operation prior to a decision to mine.

Some of the major issues that are likely to impact any mining operation and need to be addressed are: (i) appropriate mining methods that need to be used considering the nature of occurrence of these minerals, (ii) the development of robust mining equipment which can operate at such water depth and environments, (iii) impacts of fluctuating prices of mineral commodities on any mining operation, and (iv) issues relating to environment management and mitigation of possible environmental impacts.

Interest in the potential of manganese nodules generated a great deal of resource assessment activity in the 1960s and 1970s. Significant resources were invested in identifying potential deposits and conceptualisation of the technology for mining and processing nodules. This was followed by limited trial mining efforts for manganese nodules but at the time it was not considered feasible.

Mining Technology Development

Early efforts of developing offshore mining technology were undertaken in the 1970s and 1980s by multinational consortia composed of Governments, private companies and public agencies. Since the early 1990s, a number of developed countries including Germany, Japan, China, Korea, India and the United States, were reported to have been working on developing new offshore mining technology. Over the years, a number of these companies have made significant progress in the development of special mining systems for collecting and lifting nodules .

With lessons learnt from the shallow offshore mining industry and gas and oil production, technology developers have confirmed that aspects of these technologies are transferable to deep seabed mining. In recent years, technology development has shifted to a growing interest in the mining of SMS deposits.

Recently, Nautilus Minerals has reported that it is in the process of developing a production system using existing technologies adapted from the offshore oil and gas industry to enable the extraction of high grade SMS deposits on a commercial scale. This planned mining system has three major components: a Mining Support Vessel (MSV), a Riser and Lifting System (RALS), and a Seafloor Mining Tool (SMT) (Figure 3). The system is designed to operate at a production rate of 6,000 tonnes of SMS ore a day at Nautilus Minerals' Solwara 1 Project site in PNG.

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[2] International Seabed Authority and Government of India. 2008. Workshop on Polymetallic Nodule Mining Technology – Current Status and Challenges Ahead. National Institute of Ocean Technology, Chennai India 18 to 22 February 2008.

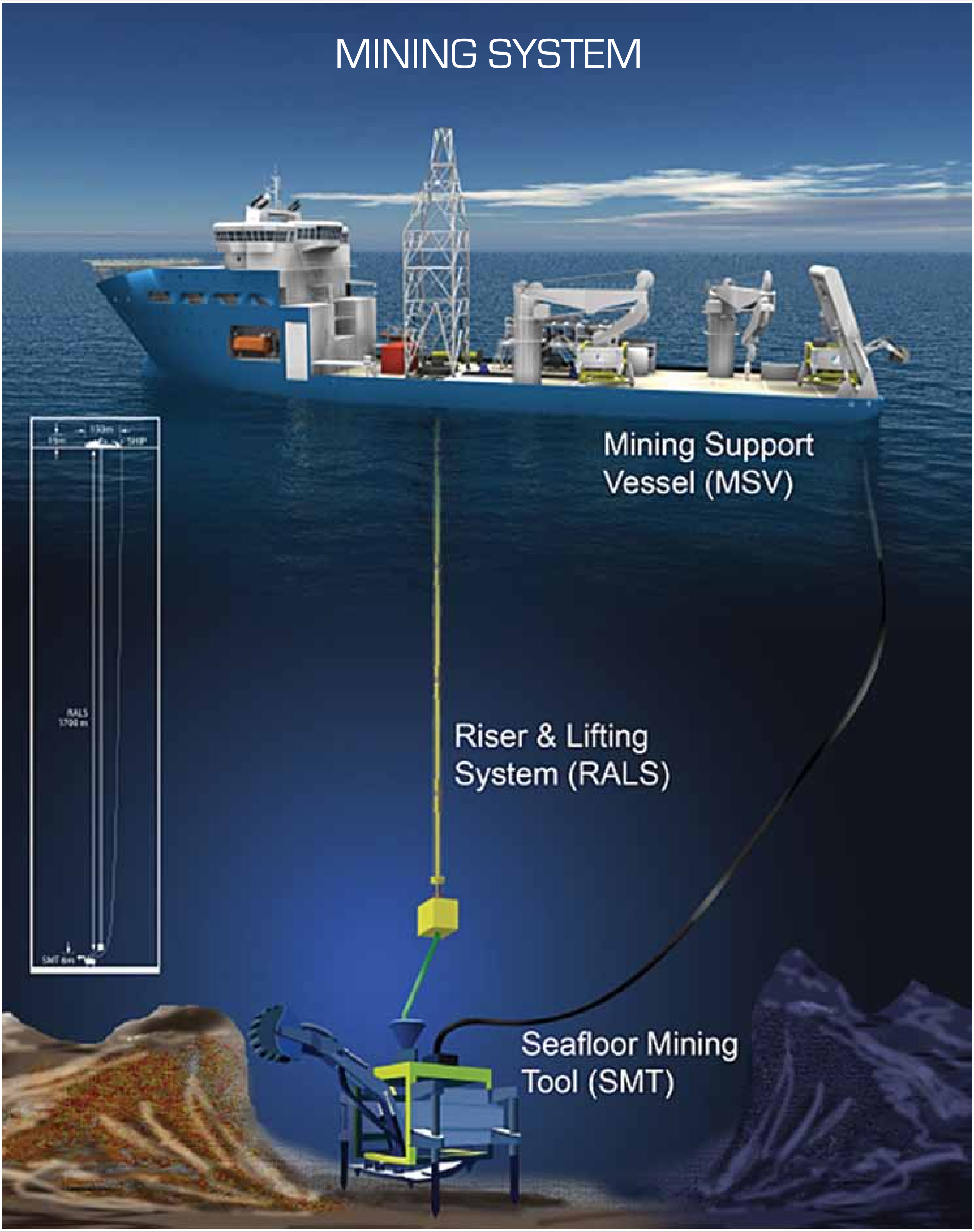

Figure 3. A configuration of the planned Nautilus Minerals Seafloor Mining System (Nautilus Minerals, 2009)[3].

[3] Nautilus Minerals. 2009. Offshore Technology Conference Presentation, May 2009.