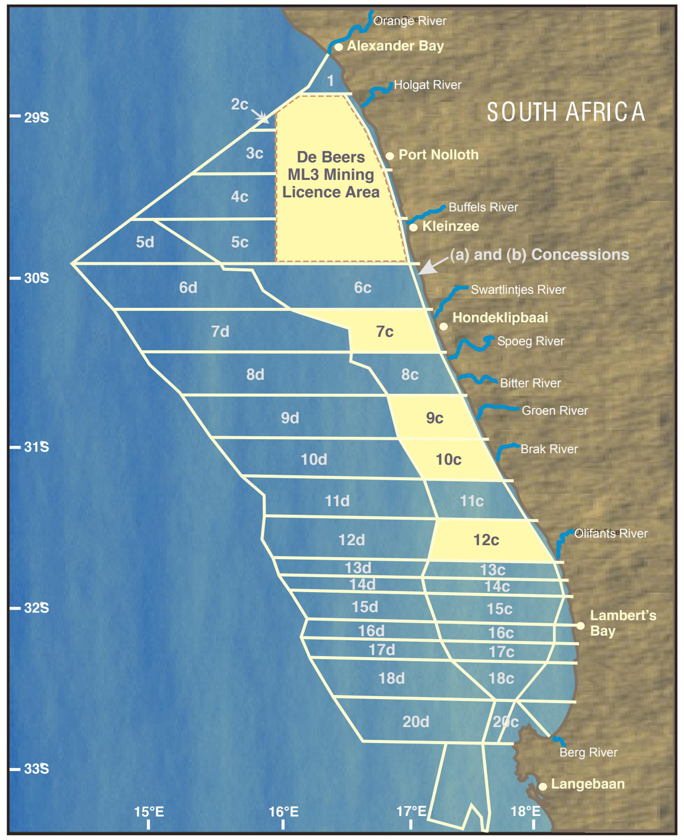
De Beers' South African deepsea diamond operations

- De Beers Consolidated Mines currently holds several deepsea diamond prospecting permits in South Africa as well as a mining licence, ML3/2003, issued in January 2003.
- De Beers Marine (Pty) Ltd operates these concessions on behalf of De Beers Consolidated Mines.
- De Beers Marine's vision is to develop a viable and sustainable mine in the De Beers' South African Sea Concessions.
- An approved Environmental Management Programme is in place covering all the concessions.



Map of South African marine diamond concessions, with De Beers concessions shaded in yellow

The information in this brochure is summarised from the following report produced by PISCES Environmental Services (Pty) Ltd:

PENNEY, A.J. and PULFRICH, A. (2004) *Recovery and Rehabilitation of Deepwater Marine Diamond Mining Operations off the Southern African West COAST - An Environmental Overview.*

PISCES Environmental Services (Pty) Ltd

DE BEERS

DE BEERS MARINE

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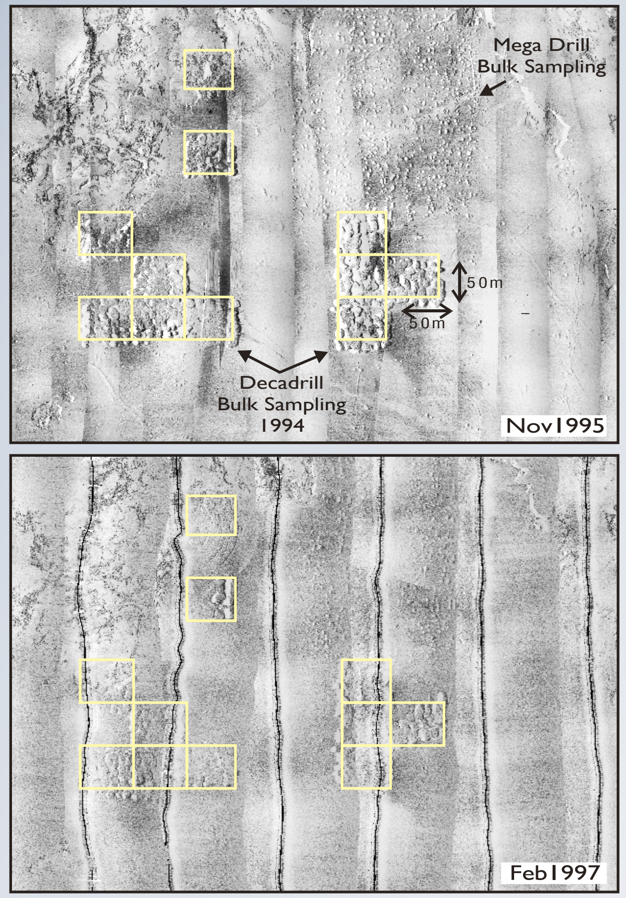
Recovery and rehabilitation

Mining footprint

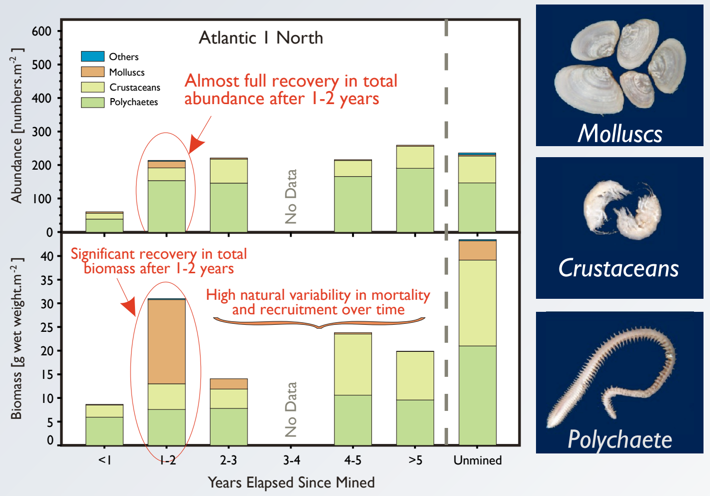
- Tailings re-deposited into the mining area result in some degree of immediate 'rehabilitation" of mined areas by back-filling.
- Subsequent in-filling by fine sediments continues over time, and side-scan sonar surveys show visible seabed recovery after 1 year.



Seabed sidescan sonar survey image of an ML3 megadrill and decadrill sampled area, showing a) Seabed impact a year after sampling; and b) Further in-filling, smoothing and recovery 15 months later.

Seabed organisms

- Benthic fauna surveys confirm recovery of the benthic (seabed) faunal community over 4-8 years, dependent on re-establishment of the fine, organic-rich surface sediments.
- Colonization is rapid after sediments return, and substantial recruitments into suitable sediment areas have been observed.
- Benthic organisms in the region are well adapted to high natural levels of perturbation, particularly sediment input, and are able to burrow upwards through rapid sediment deposition.



Comparison of abundance and biomass of the main benthic fauna taxonomic groups in samples from unmined sites, and sites mined at various times in the past, in the northern research area of the Atlantic 1 mining licence area.

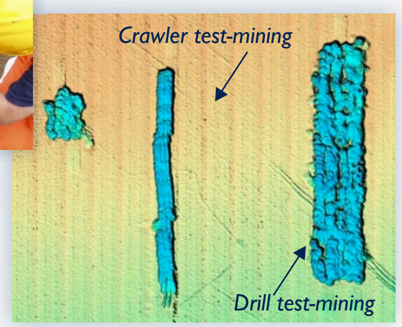
Implemented mitigation measures

- Deposition of tailings within as small an area as possible within and adjacent to the mining block.
- Facilitating biodiversity recovery by contiguous placement of the mining system, without leaving areas that may be subject to re-mining.

Financial provision and closure

- Management of the potential impacts of marine mining is currently integrated into the mining process.
- Annual environmental management costs include costs of implementing an ISO14001 Environmental Management System, environmental surveys, recovery of lost equipment, waste treatment, pollution control, insurances and preparation of EMPRs.
- Most potential impacts (waste, pollution, equipment loss) are prevented or minimised
- Other unlikely impacts (plume contamination, marine mammal behaviour) are monitored to detect and respond to any significant impact.
- The only significant environmental impact not prevented or minimised through integrated environmental management is the primary impact resulting from mining excavations. There is no way of actively "rehabilitating" these underwater excavated areas and gradual natural recovery of these areas has been found to continue over time through deposition of fine sediments and associated faunal community recovery.
- The most important preparatory financial requirement is the provision of adequate insurances to provide for emergency response in the event of shipping accidents, oil spills or equipment loss.
- Provided the above integrated environmental management measures are implemented, the only further environmental management requirement for these mined areas is the monitoring and demonstration of these natural recovery processes by means of pre- and post-mining seabed (sidescan sonar) and benthic faunal community surveys.

Removing a seabed grab sample for faunal analysis



Seabed visualisation showing crawler and drill test mining

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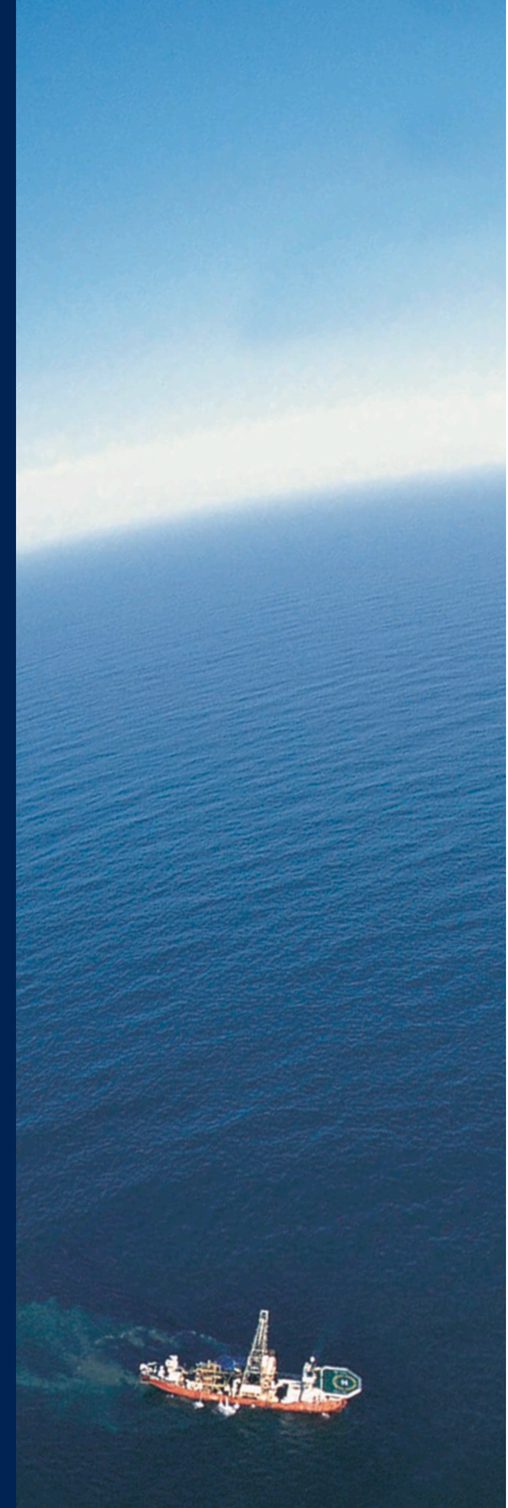


Deepwater Marine Diamond Mining

POST-MINING ENVIRONMENTAL RECOVERY & REHABILITATION

Deepsea diamond operations

De Beers Marine vessel

Marine diamonds along the southern African west coast were eroded out of inland kimberlite pipes and transported seawards by westward flowing rivers to be deposited onto gravel beaches. Diamond-bearing gravels deposited during lower sea levels are now submerged, and are being mined by deepwater mining operations. Mining of these gravels in deep water started in 1990. Current mining operations typically occur in 120-130m water depths, 12-20 nautical miles off the west coast of southern Africa.

Prospecting

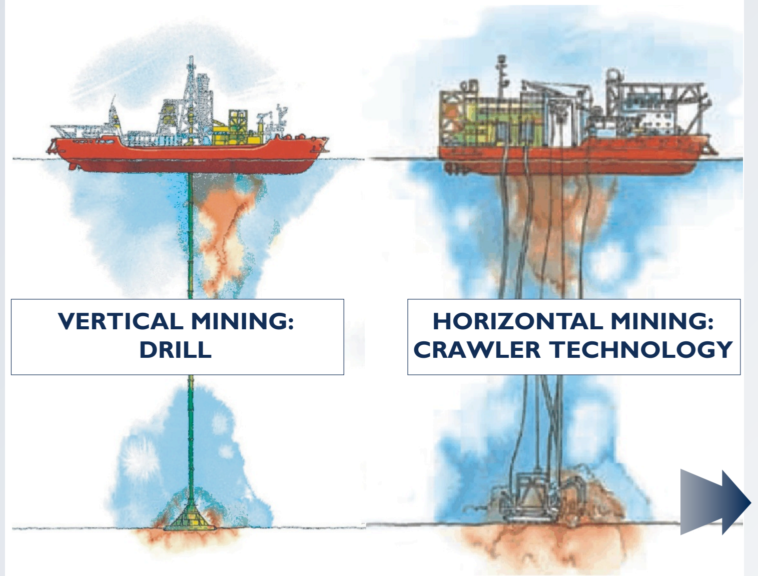
Seabed visualisation techniques such as side scan sonar and sub-bottom profiling are used to generate maps of gravel accumulations. Targets are then sampled to confirm the presence of diamond-bearing gravels.

Side scan sonar image of seabed

Mining

Current deepwater mining methods involve the deployment of seabed mining systems from dynamically moored vessels, using multi-anchor/winch systems to position and move the vessel accurately over the mining area. Mining is currently conducted using 5.2m - 6.8m diameter drill systems or high-rate seabed crawlers. These systems are currently only effective in water depths up to ~150m. Both systems loosen the sediments, which are then air-lifted or pumped to the vessel for processing.

Mining drill head



Gravel processing

Sediments are screened on board to remove fine tailings and oversize fractions, and about 90% of the sediment is immediately discharged to sea. The remaining gravel fraction is separated using a ferrosilicon dense medium separation system, the diamonds extracted from the heavy fraction using an X-ray sorter, and the remaining gravel discarded to sea.

Crawler mining tool

Sorting screens

Impacts of marine mining

Disturbance of seabed sediments and benthic communities

This is the main impact of marine mining. Sediments in mining excavations are overturned, and associated benthic fauna inhabiting the top ~20cm of sediment typically destroyed. Discharged tailings land in and adjacent to the mined area, potentially doubling the extent of the disturbed area. However, the total area affected is small, typically less than 1% of the mining licence area, with 99% of the area remaining undisturbed.

Unmined seabed

Mantis shrimp

Impact on other marine resources

Deepwater mining operations in the C-concessions do not overlap or interact with the rock lobster fishery, which occurs in depths <50m, nor the offshore trawl fishery, which occurs primarily in depths >200m. Concerns of the rock lobster fishery relate primarily to activities of the boat-based and shore-based diver operations in the A- and B-concessions. The offshore trawling industry operates almost entirely in the deeper D-concession areas.

While diamond concession areas overlap with petroleum lease areas, current petroleum prospecting activities occur in deeper waters.

Sole

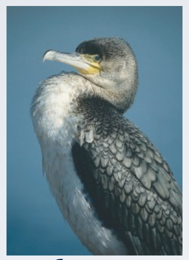
Kingklip

Loss of equipment on the seabed

Equipment such as anchors are occasionally lost on the seabed, but every effort is made to recover these, usually successfully. Positions of all lost items are accurately recorded and reported to maritime authorities.

Heaviside's dolphin

Cape fur seal

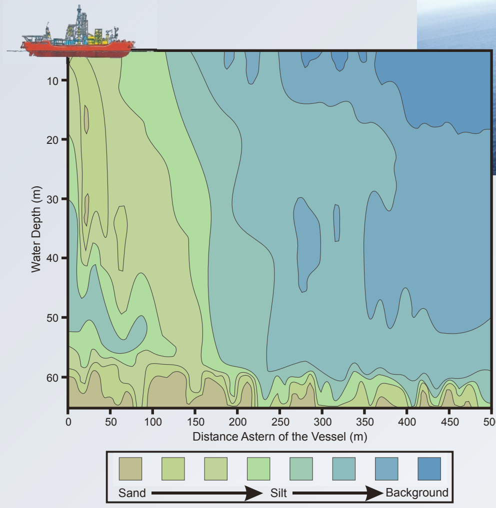


Cormorant

Generation of tailings plumes

Concerns regarding the potential impacts of fine tailings sediment plumes from mining vessels appear to be unfounded. These plumes typically extend for only a few kilometres from the vessel, and settle fairly rapidly. Most of the silt sinks within minutes, during the initial descent of colder bottom water. Mixing with descending seawater then results in dilution of the discharge, with the remaining particulate matter settling over a period of hours. Heavy metal and pesticide contamination in these muds appears to be low, and water sampling has confirmed that contaminant levels in plumes are well within water quality guideline limits.

Marine mining tailings plume



Acoustic Doppler Current Profiler (ADCP) longitudinal section along a tailings plume

Reduction in seawater dissolved oxygen content

Localised reduction in oxygen levels as a result of decomposition of organic matter also does not seem to occur. Rather, aeration of water air-lifted to the surface results in a substantial localised increase in oxygen content. Descending plumes act as suppliers of oxygenated water to the seabed, rather than contributing to oxygen depletion. Natural decomposition of plankton deposited on the seabed is responsible for seabed oxygen depletion.

Other potential impacts

Integrated environmental management measures are implemented to prevent or minimise pollution from wastes and sewage, disturbance of marine mammals and birds or maritime disasters such as shipwreck or oil spillage. Adequate insurances are maintained to cover all possible shipwreck or oil spill disaster response costs.

Benguela system natural events

Substantial quantities of natural river and wind borne sediments are deposited annually into the Benguela system.

Water borne sediments

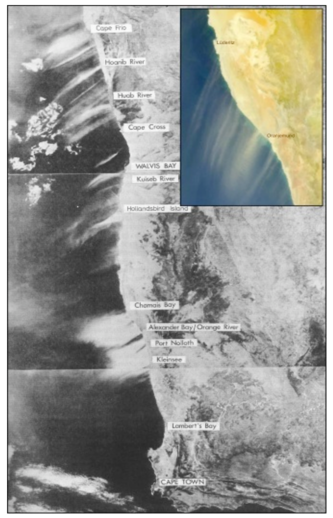
One of the principal impacts on the seabed off the southern African west coast results from the annual deposition of large quantities of silt and mud from the Orange River and other westward flowing rivers, particularly during flood events.

Average historic annual sediment discharges by the Orange River have been estimated to be about 60.4 million tons.

During the flood of March 1988, it is estimated that the Orange River discharged some 64.2 million tons of bed-load and suspended sediment into the region over a period of a few days.

Orange River mouth area during the flood of March 2000

Wind borne sediments



Aerosol plumes of sand and dust being blown out to sea

In addition to the rivers, offshore winds blowing across sandy desert areas along the northern Cape and southern Namibian coasts also blow large quantities of fine sand out to sea. For example, it is estimated that 50 million tons of dust and fine sand were blown out to sea during extensive berg wind induced sandstorms over at various sites between Kleinsee and Cape Frio over a few days in May 1979.

Organic inputs

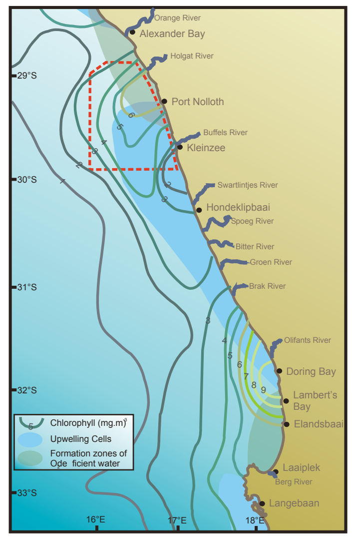
Vast quantities of organic material are deposited annually on the seabed as a result of mortality of plankton blooms.

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms support large populations of other marine organisms. Natural mortality of marine organisms result in the deposition of organic matter on the seabed. Around ~5.6 million tons of phytoplankton and ~315,000 tons of zooplankton is lost annually to the seabed in the Benguela region. In comparison, any organic re-suspension by marine mining is insignificant.

Low oxygen events

Decomposition of naturally deposited organic matter results in depletion of seabed oxygen

Deepwater areas in the Benguela region are characterised by a continual natural decomposition process. This natural decomposition depletes the oxygen in waters near the seabed over large areas of the continental shelf, creating deep, low-oxygen water masses. 'Low oxygen events', result when oxygen-depleted water upwells and moves inshore. These low oxygen events can have dramatic effects on nearshore resources, including mass migration and mortality of species such as rock lobster.



Main upwelling areas, mean phytoplankton production & areas of low oxygen water

Sulphur eruptions

In areas of chronic low-seabed oxygen levels, sulphur reducing bacteria generate large quantities of hydrogen sulphide (H_2S). This is occasionally released to the surface in the form of substantial 'sulphur eruptions'. The rising gas causes upwelling of low-oxygen water and further depletes water column oxygen levels, causing mortality of marine organisms, and forming extensive plumes of sulphur discoloured water.