

Long-term impact and biological recovery in a deep-sea mining track after 44 years.

Polymetallic nodules are rocks found in large numbers at 4000-5000 m depth across the Pacific Ocean. Mining these nodules for minerals will lead to impacts on this largely pristine wilderness. The decision on whether to allow deep-sea mining and under what conditions is being made by the International Seabed Authority. One of the critical questions to help with this decision making is whether the deep-sea ecosystems can recover from mining disturbance. SMARTEX had the unique opportunity to revisit mining machine tracks from 1979 to study how this deep-sea ecosystem has responded to mining disturbance over 44 years.

1979 OMCO trial



Figure 1: Prototype mining machine used for nodule collection at the OMCO site in 1979 (Credit: Lockheed Martin).

To address the problem of recovery we need to look to the past. In the 1970s the first flurry of industrial trials of deep-sea mining were carried out. This included the test of the first prototype self-propelled mining machine (Figure 1), resembling what is planned today for mining. Although this test mining was international news at the time, details of the site and the data collected around the time of the test were lost for several decades and only recently discovered amongst archive material.

Using this information, we launched an expedition in 2023 and were able to find the 1979 mining machine tracks on the seafloor at a depth of 4700 m in the Clarion-Clipperton Zone. We are now able to compare our survey of the tracks with archived data from the time of the mining test and control sites.

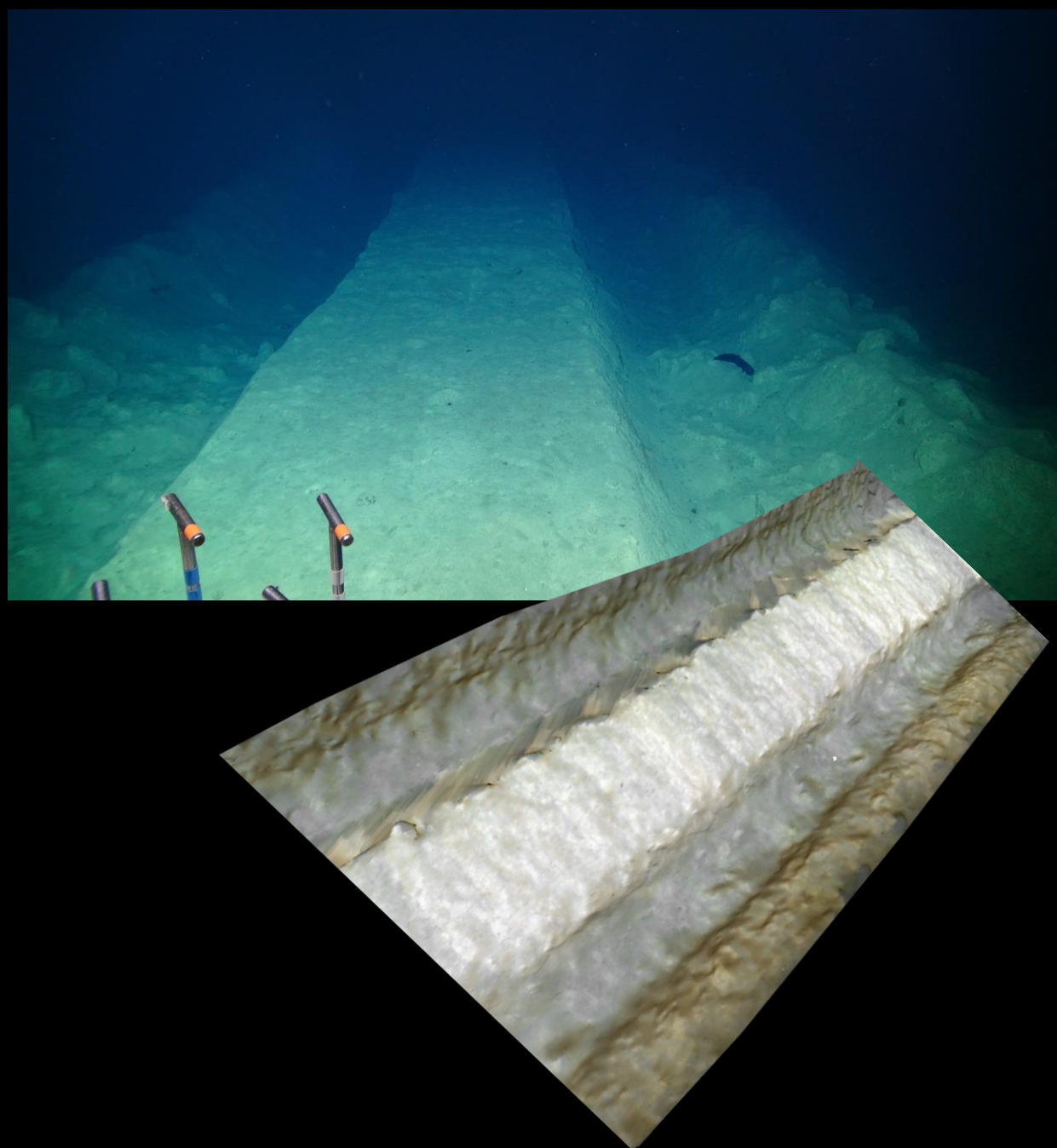


Figure 2: OMCO tracks rediscovered in 2023 (top) have been studied including through a 3D model (bottom). (Credit: SMARTEX).

Long-term changes, also signs of early recolonisation.

The tracks themselves look very similar to when they were first made (Figure 2) and the mining has clearly caused long-term physical and chemical changes.

We provide evidence of sustained impacts over nearly half a century in some animal groups, while others are beginning to recover. There is evidence of recolonisation and recovery of the number of mobile and small-sized animals in and on the sediment surface. Giant protozoans have recolonised the track. Large-sized animals fixed to the seafloor show little signs of recovery.

Sediment plumes, previously considered to be a likely major impact on the seafloor community, had limited long-term physical impacts and no detectable or slightly positive biological impacts in this experiment. Our data over this time period also highlights potential natural shifts in background communities undisturbed by mining, which need further investigation.

This evidence of the first stages of long-term ecological recovery, which likely happens over centuries or longer in this deep-ocean habitat, reveals processes that will shape the long-term prospects for seabed populations in deep-sea regions exposed to deep-sea mining.

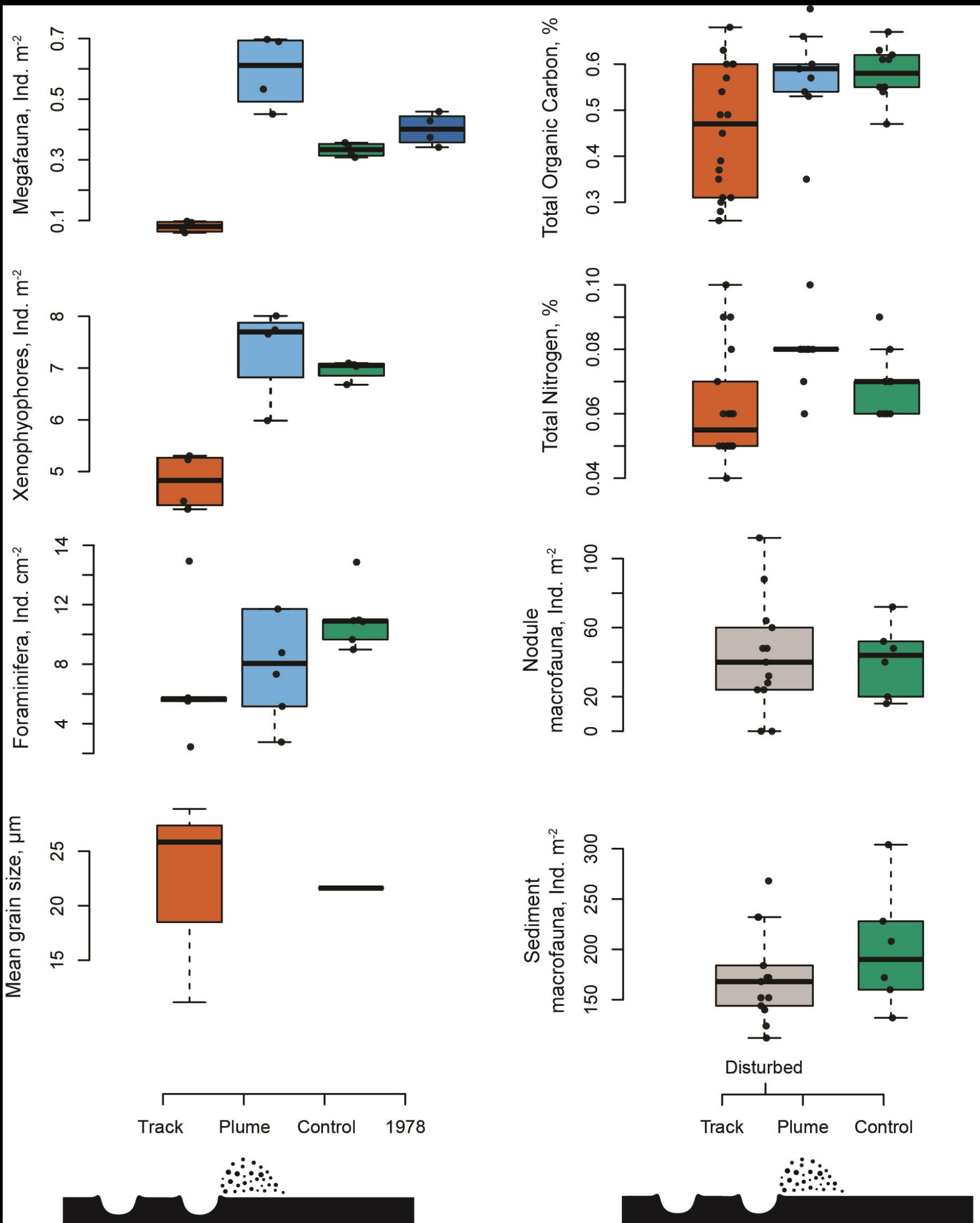


Figure 3: Observed changes in Megafauna density, Xenophyophore density, Foraminifera density, Mean grain size, sediment Total Carbon and Total Nitrogen, Nodule macrofauna density, and sediment macrofauna density between sites affected by the track, disturbance, the plume and control sites (2023 and 1978). From Jones et al. (in press).