Review of manuscript bg-2019-348

Scars in the Abyss: Reconstructing sequence, location and temporal change of the 78 plough tracks of the 1989 DISCOL deep sea disturbance experiment in the Peru Basin

By

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General comments

This manuscript provides legacy data from previous cruises and new data from a recent research cruise from the Disturbance and Recolonization Experiment area (DISCOL) in the Peru Basin, SE Pacific. In 1989 an area of about 11 km² was ploughed using a plough harrow to simulate Mn nodule mining in this area. The data used in the provided study include ship-based multibeam bathymetric data (MBES), video data from deep-towed instruments as well as MBES, side-scan sonar and video data from an Autonomous Underwater Vehicle (AUV). The authors digitized and geo-referenced the old data, matched different data types (bathymetric, side-scan sonar and optical data) with different resolution and investigated the disturbance intensity of this area including sediment suspension and re-settling.

Major findings of this study are (1) old data with lower resolution and lower position accuracy can principally be used for comparison with modern high-resolution, high accuracy data provided a number of anchor points such as bathymetric features or sampling footprints are present, (2) there is an initial impact given through the mixing (ploughing) of the top 20 to 30 cm of the sediment and the related suspension of sediment into the bottom water (3) there is a secondary impact characterized by re-sedimentation of the initiated sediment plume and (4) the settling of the plume sediment is rapid in the immediate vicinity of the disturbance and causes high sedimentation rates which will be harmful to the benthic community which is not adapted to such high sedimentation rates.

Specific comments

The manuscript is well written and contains relevant references. Especially the methodology is well documented and convincing. However, I still have a number of issues the authors might take into account:

The description of data processing, i.e., how to match the old and new data, covers the largest part of the manuscript, whereas the discussion of the results and their implication (especially point (4) above) is rather short. A more in-depth discussion of the results is needed. Moreover, there are a number of repetitions mainly in chapters 1.3, 2.4 and 4.2 so that the manuscript should be shortened by removing these repetitions. This is already obvious in the abstract which mainly contains methods for data processing but no results!

The paper must critically review the fact that the DISCOL disturbance approach is very different to real nodule mining since no nodules were removed and sediments were only ploughed and not sucked into a device and subsequently dispersed a few meters above the seafloor as it would be done during real mining and as it has been done with the DSSRS. The manuscript does not say anything in this direction. Moreover, it should be discussed in this respect how the results of this study can be transferred to a real mining situation.

During reading I wondered about the significance of the age sequence of the disturbance tracks and why the authors put so much effort into it….It became clear to me in the lower part of the manuscript, i.e., to be able to differentiate between short-term settling of plume sediments with high sedimentation rates and natural sedimentation with low rates. Maybe it would be helpful if the authors present some clear objectives of their study within the introductory chapter.

As I already said above, this paper is mainly about the methods of data processing in order to compare old and new data with different quality. Some of these methodological approaches have been repeated a couple of times throughout the manuscript. I suggest that the authors should present a better separation of the method and the results of their study. In this respect they should provide a more in-depth interpretation of their results. For instance, they could discuss in detail the maps provided in figure 11.

I also suggest that the author might provide suggestions how precise navigation during Mn nodule mining impact studies should be and how this navigation accuracy could be realized, e.g. through the installation of a transponder array on the seafloor within which all instruments used on or above the seafloor should navigate.

Technical corrections

Apart from these comments, there are a number of special issues which I address below:

Line 36: References Kuhn et al., 2011 and Oebius et al., 2001 are missing in the reference list.

Line 59: Reference OMI; EC, 2013 is unclear and missing in the reference list.

Line 176: explain the abbreviation OFOS.

Line 208-209: What was the accuracy of the USBL system during the different cruises?

Line 224: the reference Devey et al. is missing in the reference list.

Line 225: ….between 4300m and 3850 m…

Lines 220 – 234: Please provide some information about slope angles.

Line 250 – 255 / Figure 3: How do the authors know that the NNW-SSE striking structures are ripple structures? To me they look like small grabens filled with sediment as well? On the east side of DEA these structures seem to be bent at their southern ends. Are these natural or artificial structures? Authors should discuss those obvious structures on the seafloor.

Figure 4: The contours shown in Fig. 4 are based on the ship-based MBES? Why? Why the authors didn't take the AUV-based MBES for the contours? If the latter is the case, please correct the figure caption.

Line 283 – 285: There is no information about the accuracy of the USBL sampling positions in sect. A2…The way how USBL position was detected is described in Appendix D, instead. But no information about accuracy is provided. Since USBL was probably run in transponder mode, accuracy is normally around ±0.2% of slant range, in this case, water depth (4000 m), i.e., accuracy should be ±8m. Is this correct?

Lines 286 – 294 (Fig. 5): What is the accuracy of the position of the sampling locations which act as anchor points?

Line 349: Were current measurements being carried out during the DISCOL experiments in 1989? Or how do the authors know the overall long-term current speed and direction?

Line 360-363: The capability of particles to flocculate is very important to consider (see also Guillard et al., 2019).

Line 400, formula 1: Provide reference for the application of this exponential function.

Line 470: Figure Caption of Fig. 11: Explain the abbreviations in the figure or give reference to where the reader can find this explanation.

Line 578: "….to the disturbance map of this study."

Line 610: There is no other N-S running track to the east of track V02 in Fig. 12A. But there are some other tracks running either E-W or ENE-WSW which were crossed by the OFOS stations during the different years.

Line 625-630: Is this conclusion supported by the disturbance intensity map presented in Fig. 11?

Lines 910 and 917: Reference Sharma & Nath, 1997 occurs twice.

Recommended reference:

B. Gillard et al. 2019. Physical and hydrodynamic properties of deep sea mining-generated, abyssal sediment plumes in the Clarion Clipperton Fracture Zone (eastern-central Pacific). Elem Sci Anth, 7: 5. DOI: https://doi.org/10.1525/elementa.343