Supplementary Materials;

Hadal trenches are dynamic hotspots for early diagenesis in the deep sea

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Supplementary reference to Fig. 1

For figure production and context, regional bathymetry data were sourced from the open-access Global Multi-Resolution Topography (GMRT Synthesis; www.gmrt.org/ Ryan et al., 2009). The GMRT Synthesis compiles many data sources including public domain datasets from the NOAA National Centers for Environmental Information (www.ngdc.noaa.gov/), existing grids contributed by the international science community, gridded seafloor depths from the global compilation GEBCO_2014 (www.gebco.net), alongside terrestrial elevation data. Original data can be interrogated within the GMRT Synthesis MapTool (www.gmrt.org/GMRTMapTool/) and users who wish to access contributed multibeam bathymetry data will be linked directly to the Marine Geoscience Data System (MGDS; www.marine-geo.org) where original data and metadata can be interrogated.

For this study, only the gridded bathymetry tiles generated by GMRT Synthesis were utilised. Each gridded tile set involves computing weighted averages of depth estimates at the nodes for each grid tile, designed to ensure preservation of the data whilst avoiding introduction of data artefacts in the resultant Digital Elevation Model (DEM)[1]. ESRI ArcGIS was used to display the downloaded DEM with the 6000 m bathymetric contour generated in ESRI ArcGIS using the 3D Analyst extension.

Fig. S1. A Riever during deployment in the Kermadec Trench from RV Tangaroa, and selected images recorded at site K5 located in the Kermadec Trench at 10,010m depth (31° 56.14' S; 177° 17.48' W), and site A8 located in the Atacama Trench at 4000 m depth (22° 56.40' S; 72° 08.76' W). A total of 15 sites were targeted and one site had to be abandoned as rocky outcrops compromised any further benthic sampling work (panel c).

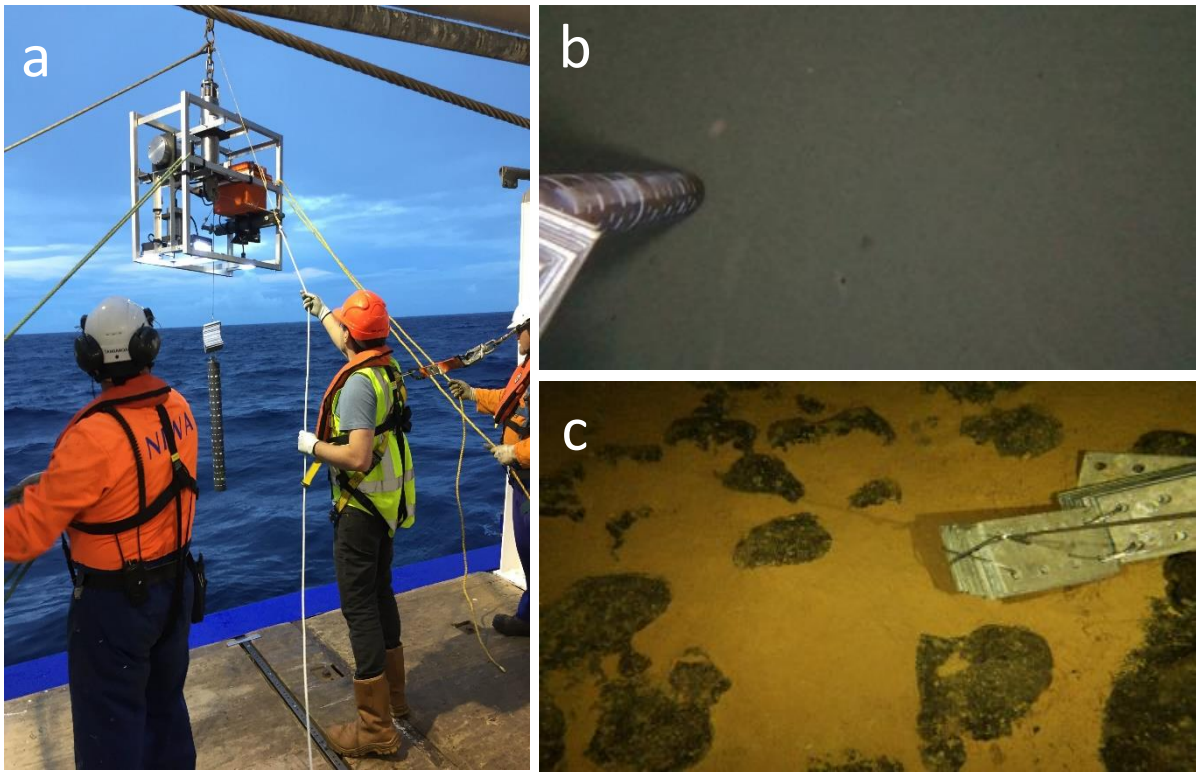
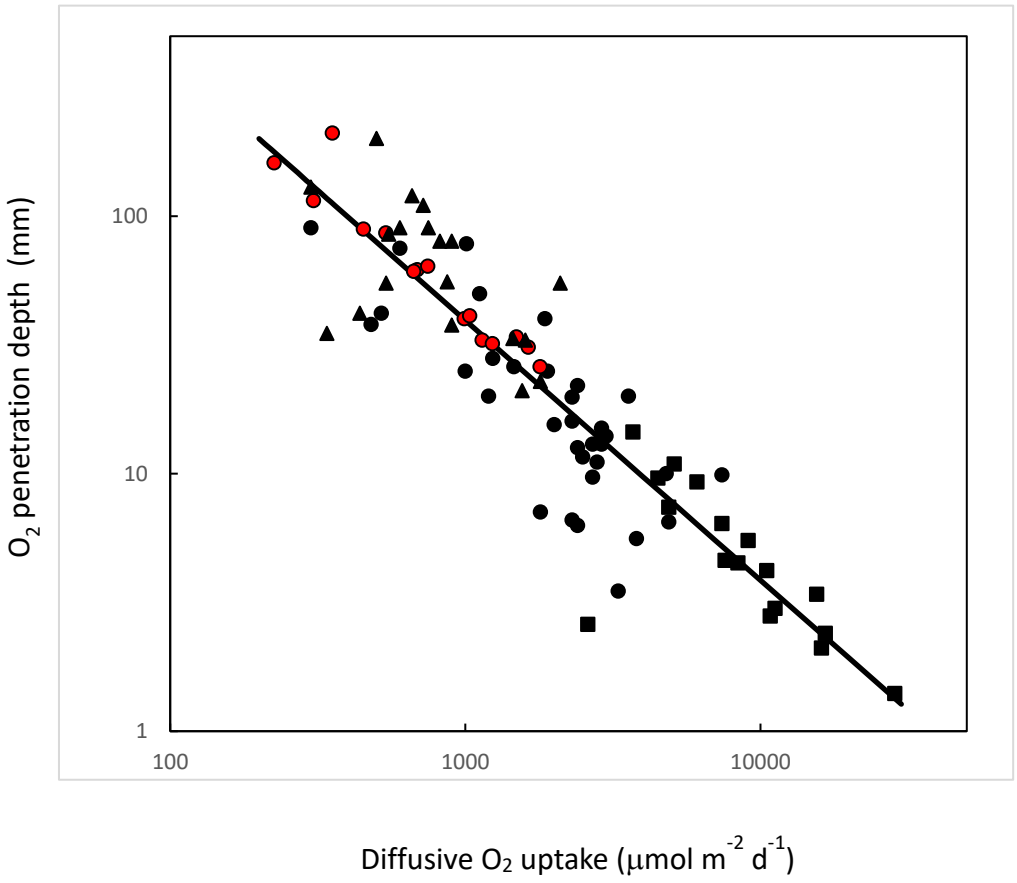


Fig. S2. The Oxygen Penetration Depth (OPD) as a function of the Diffusive Oxygen uptake (DOU), as derived from O_2 microprofiles measured in situ. symbols cover the depth range from 10-6000m and are extracted from Glud (2008); squares (shelve range 10-200 m depth), circles (slope range 200-3000 m), triangles (abyssal range 3000-6000). Red symbols represent the existing database from the hadal depth range[2,3] and from the current study. The compiled data set was fitted with the following power function $OPD = 41947(DOU)^{-1.009}$ ($R^2 = 0.83$).



Supplementary References

1. Ryan, W. B. F., Carbotte, S. M., Coplan, J. O., O'Hara, S., Melkonian, A., Arko, R., Weissel, R. A., Ferrini, V., Goodwillie, A., Nitsche, F., Bonczkowski, J., Zemsky, R. 2009. Global Multi-Resolution Topography synthesis. *Geochem. Geophys. Geosy.*10, Q03014.

2. Glud, R.,N., Wenzhöfer, F., Middelboe, M., Oguri, K., Turnewisch, R., Canfield, D., E., Kitazato, H. High rates of microbial carbon turnover in sediments in the deepest oceanic trench on Earth. *Nat. Geosci.* **6,** 284-288 (2013).

3. Wenzhöfer, F., Oguri, K., Middelboe, M., Turnewisch, R., Toyofuku, T., Kitazato, H., Glud, R., N. Benthic carbon mineralization in hadal trenches: Assessment by in situ O_2 microprofile measurements. *Deep-Sea Res. 1* **116,** 279-286 (2016).