

## Environmental Science Work:

References to peer reviewed publications and presentations arising from datasets and samples collected on the UK Seabed Resources-sponsored environmental survey cruises in the Pacific Ocean Clarion-Clipperton Zone. The cruises took place under Exploration Contracts awarded to UK Seabed Resources by the International Seabed Authority.

### 2022 Publications Arising from UK1 AB01 (2013), AB02 (2015) and RC01 (2020) Environmental Datasets

Neal, L., Wiklund, H., Rabone, M., Dahlgren, T.G. and Glover, A.G., (2022a). *Abyssal fauna of polymetallic nodule exploration areas, eastern Clarion-Clipperton Zone, central Pacific Ocean: Annelida: Spionidae and Poecilochaetidae*. *Marine Biodiversity*, 52(5), pp.1-48.  
<https://doi.org/10.1007/s12526-022-01277-1>

Neal, L., Wiklund, H., Laetitia M. Gunton, Rabone, M., Bribiesca-Contreras G., Dahlgren, T.G. and Glover, A.G., 2022b. *Abyssal fauna of polymetallic nodule exploration areas, eastern Clarion-Clipperton Zone, central Pacific Ocean: Amphinomidae and Euphrosinidae (Annelida, Amphinomida)*. *ZooKeys* 1137: 33–74. <https://doi.org/10.3897/zookeys.1137.86150>

Neal, L., Abrahams, E., Wiklund, H., Rabone, M., Bribiesca-Contreras, G., Stewart, E. C. D., Dahlgren, T., & Glover, A. G. (in review). *Taxonomy, phylogeny, and biodiversity of Lumbrineridae (Annelida) from the Central Pacific Clarion-Clipperton Zone*.

Stewart, E. C. D., Bribiesca-Contreras, G., Taboada, S., Wiklund, H., Ravara, A., Cunha, M. R., Pape, E., Neal, L., Jones, D. O. B., Smith, C. R., Glover, A. G., & Dahlgren, T. G. (in press) *Biodiversity, biogeography, and connectivity of polychaetes in the world's largest marine minerals exploration frontier. Diversity and Distributions*. <https://doi.org/10.1111/ddi.13690>

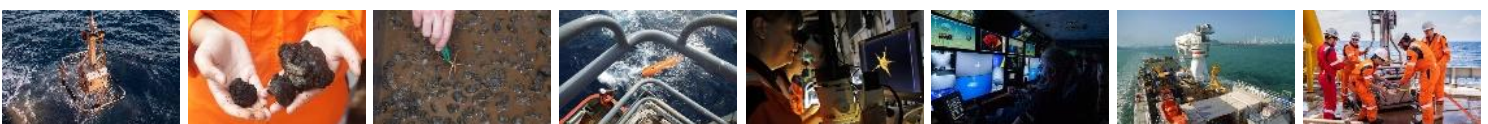
### 2021 Publications Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets

Bribiesca-Contreras G, Dahlgren TG, Horton T, Drazen JC, Drennan R, Jones DOB, Leitner AB, McQuaid KA, Smith CR, Taboada S, Wiklund H and Glover AG (2021) *Biogeography and Connectivity Across Habitat Types and Geographical Scales in Pacific Abyssal Scavenging Amphipods*. *Front. Mar. Sci.* 8:705237. doi: [10.3389/fmars.2021.705237](https://doi.org/10.3389/fmars.2021.705237)

Drazen JC, Leitner AB, Jones DOB and Simon-Lledó E, (2021) *Regional Variation in Communities of Demersal Fishes and Scavengers Across the CCZ and Pacific Ocean*. *Front. Mar. Sci.* 8:630616. doi: [10.3389/fmars.2021.630616](https://doi.org/10.3389/fmars.2021.630616)

Drennan R., Wiklund H., Rabone M., Georgieva M.N., Dahlgren T.G. & Glover A.G. 2021. *Neanthes goodayi sp. nov. (Annelida, Nereididae), a remarkable new annelid species living inside deep-sea polymetallic nodules*. *European Journal of Taxonomy* 760: 160–185.  
<https://doi.org/10.5852/ejt.2021.760.1447>

Gooday AJ, Lejzerowicz F, Goineau A, Holzmann M, Kamenskaya O, Kitazato H, Lim S-C, Pawlowski J, Radziejewska T, Stachowska Z and Wawrzyniak-Wydrowska B (2021) *The Biodiversity and Distribution*



*of Abyssal Benthic Foraminifera and Their Possible Ecological Roles: A Synthesis Across the Clarion-Clipperton Zone.* Front. Mar. Sci. 8:634726. doi: [10.3389/fmars.2021.634726](https://doi.org/10.3389/fmars.2021.634726)

Hollingsworth AL, Jones DOB and Young CR (2021) *Spatial Variability of Abyssal Nitrifying Microbes in the North-Eastern Clarion-Clipperton Zone.* Front. Mar. Sci. 8:663420. doi: [10.3389/fmars.2021.663420](https://doi.org/10.3389/fmars.2021.663420) (NOC JC120 Survey in UK1 and APEI-6)

Lejzerowicz F, Gooday AJ, Barrenechea Angeles I, Cordier T, Morard R, Apothéloz-Perret-Gentil L, Lins L, Menot L, Brandt A, Levin LA, Martinez Arbizu P, Smith CR and Pawlowski J (2021) *Eukaryotic Biodiversity and Spatial Patterns in the Clarion-Clipperton Zone and Other Abyssal Regions: Insights From Sediment DNA and RNA Metabarcoding.* Front. Mar. Sci. 8:671033. doi: [10.3389/fmars.2021.671033](https://doi.org/10.3389/fmars.2021.671033)

Mohrbeck, I., Horton, T., Jazdzewska, A.M. et al. *DNA barcoding and cryptic diversity of deep-sea scavenging amphipods in the Clarion-Clipperton Zone (Eastern Equatorial Pacific).* Mar. Biodivers. 51, 26 (2021). <https://doi.org/10.1007/s12526-021-01170-3>

Wear EK, Church MJ, Orcutt BN, Shulse CN, Lindh MV and Smith CR (2021) *Bacterial and Archaeal Communities in Polymetallic Nodules, Sediments, and Bottom Waters of the Abyssal Clarion-Clipperton Zone: Emerging Patterns and Future Monitoring Considerations.* Front. Mar. Sci. 8:634803. doi: [10.3389/fmars.2021.634803](https://doi.org/10.3389/fmars.2021.634803)

#### **2020 Publications Arising from UK1 AB01 (2013), and AB02 (2015) and Ocean Minerals Company (OMCO) Environmental Datasets**

McQuaid K.A., Attrill M.J., Clark M.R., Cobley A., Glover A.G., Smith C.R. and Howell K.L. (2020) *Using Habitat Classification to Assess Representativity of a Protected Area Network in a Large, Data-Poor Area Targeted for Deep-Sea Mining.* Front. Mar. Sci. 7:558860. <https://doi.org/10.3389/fmars.2020.558860>

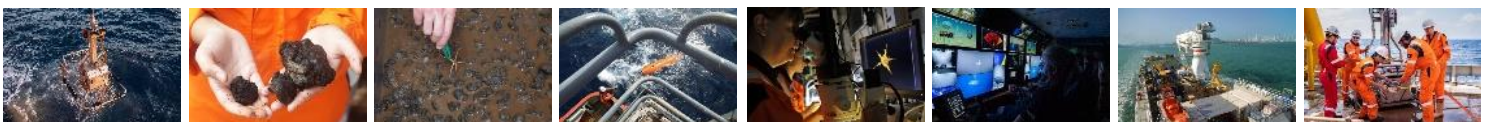
McQuaid K.A., (2020) *Ecological Studies of an Abyssal Nodule Province to Inform the Management of Deep-sea Mining.* PhD Thesis, University of Plymouth, <https://dx.doi.org/10.24382/469>

Hestetun, J. T., Bye-Ingebrigtsen, E., Nilsson, R. H., Glover, A. G., Johansen, P. O., & Dahlgren, T. G. (2020). *Significant taxon sampling gaps in DNA databases limit the operational use of marine macrofauna metabarcoding.* Marine Biodiversity, 50(5), 1-9., <https://doi.org/10.1007/s12526-020-01093-5>

Clark, M., Smith C.R., et al, *Deep CCZ Biodiversity Synthesis Workshop*, Friday Harbor Lab, Washington, USA, 1-4 October 2019, International Seabed Authority, [.isa.org.jm/workshop/deep-ccz-biodiversity-synthesis-workshop](https://www.isa.org.jm/workshop/deep-ccz-biodiversity-synthesis-workshop)

#### **2019 Publications Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets**

Gooday AJ and Goineau A (2019) *The Contribution of Fine Sieve Fractions (63–150m) to Foraminiferal Abundance and Diversity in an Area of the Eastern Pacific Ocean Licensed for Polymetallic Nodule Exploration.* Front. Mar. Sci. 6:114. doi: [10.3389/fmars.2019.00114](https://doi.org/10.3389/fmars.2019.00114)



Guggolz T, Meißner K, Schwentner M, Dahlgren TG, Wiklund H, Bonifacio P, Brandt A (2020) *High diversity and pan-oceanic distribution of deep-sea polychaetes: Prionospio and Aurospio (Annelida: Spionidae) in the Atlantic and Pacific Ocean*. Organism, Diversity and Evolution 109:138–19. <https://doi.org/10.1007/s13127-020-00430-7>

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Rabone M., Harden-Davies H, Collins JE, Zajderman S, Appeltans W, Droege G, Brandt A, Pardo-Lopez L, Dahlgren T.G., Glover A.G., Horton T. (2019) *Access to Marine Genetic Resources (MGR): Raising Awareness of Best-Practice Through a New Agreement for Biodiversity Beyond National Jurisdiction*. Frontiers in Marine Science. 6:520. <https://doi.org/10.3389/fmars.2019.00520>.

Wiklund, H., Neal, L., Drennan, R., Rabone, M., Dahlgren, T.G.; (2019). *Abyssal fauna of polymetallic nodule exploration areas, eastern Clarion-Clipperton Zone, central Pacific Ocean: Annelida: Capitellidae, Opheliidae, Scalibregmatidae, and Traviidae*. ZooKeys 883: 1–82. <https://doi.org/10.3897/zookeys.883.36193>

#### 2018 Publications Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets

Gooday, A.J., Sykes, D., Góral, T., Zubkov, M.V., and Glover, A.G.; (2018). *Micro-CT 3D imaging reveals the internal structure of three abyssal xenophyophore species (Protista, Foraminifera) from the eastern equatorial Pacific Ocean*. Nature - Scientific reports, 8(1), p.12103. <https://doi.org/10.1038/s41598-018-30186-2>

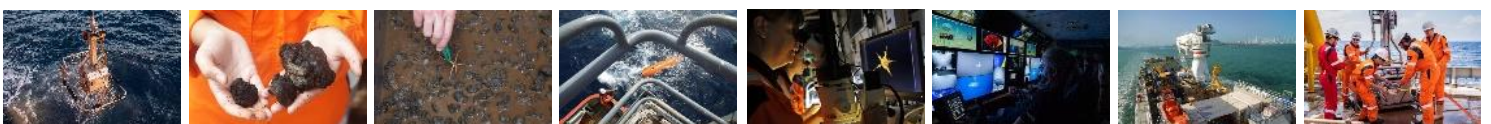
Gooday, A.J., Holzmann, M., Goineau, A., Kamenskaya, O., Melni, V.F., Pearce, R.B., Weber, A. A.-T. and Pawlowski, J.; (2018). *Xenophyophores (Rhizaria, Foraminifera) from the Eastern Clarion-Clipperton Zone (equatorial Pacific): The Genus Psammia*. Protist, Vol. 169, 926–957, <https://doi.org/10.1016/j.protis.2018.09.003>

Lindh, M.V., Maillot, B., Smith, C.R., and Church, M.J.; (2018). *Habitat filtering of bacterioplankton communities above polymetallic nodule fields and sediments in the Clarion-Clipperton zone of the Pacific Ocean*. Environmental Microbiology Reports 10: 113-122, <https://doi.org/10.1111/1758-2229.12627>

Sweetman, A.K., Smith, C.R., Shulse, C.N., Maillot, B., Lindh, M.V., Church, M.J., Meyer, K.S., van Oevelen, D., Stratmann, T., and Gooday, A.J.; (2018). *Key role of bacteria in the short-term cycling of carbon at the abyssal seafloor in a low particulate organic carbon flux region of the eastern Pacific Ocean*. Limnology and Oceanography, 9999, 1-20, <https://doi.org/10.1002/lno.11069>

Glover, A.G., Wiklund, H., Chen, C. and Dahlgren, T.G., 2018. *Point of View: Managing a sustainable deep-sea 'blue economy' requires knowledge of what actually lives there*. eLife, 7, p.e41319. [doi: 10.7554/eLife.41319](https://doi.org/10.7554/eLife.41319)

Taboada, S., Riesgo, A., Wiklund, H., Paterson, G.L., Koutsouveli, V., Santodomingo, N., Dale, A.C., Smith, C.R., Jones, D.O., Dahlgren, T.G. and Glover, A.G., 2018. *Implications of population connectivity studies for the design of marine protected areas in the deep sea: An example of a demosponge from the Clarion-Clipperton Zone*. Molecular ecology. <https://doi.org/10.1111/mec.14888>



## 2018 Conference Presentations Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets

Glover, A.G., Dahlgren T.G., Wiklund H., Smith C.R.; (2018). *The biodiversity of animals living on polymetallic nodules in the eastern Clarion-Clipperton Zone*. 15th Deep Sea Biology Symposium, Monterey California, USA.

Leitner, A.B., Durden, J.M., Smith, C.R., and Drazen, J.C.; (2018), *Topographic Effects on Bait-Attending Fauna: Examining the Effect of Abyssal Hills Using Baited Cameras*. Oral presentation. 15th Deep Sea Biology Symposium, Monterey California, USA.

Smith, C.R., Sweetman, A.K., Nunnally, C.C., Lewis, M., Young, E., Vernet, M., and Ziegler, A.F.; (2018). *Very high macrofaunal diversity in an area targeted for nodule mining in the eastern CCZ*. Oral presentation. 15th Deep Sea Biology Symposium, Monterey California, USA.

Amon, D.J., Simon-Lledo, E., Boessenecker, R., Jones, D.O.B., Chim, C.K., Wong, H.P.S., Tan, K.S., Ziegler, A.F., Glover, A.G., Smith, C.R.; (2018). *Cetacean and shark fossils are abundant in the eastern Clarion Clipperton Zone*, Oral presentation. 15th Deep Sea Biology Symposium, Monterey California, USA.

McQuaid, K., Attrill, M., Glover, A., Jones, D.O.B., Simon-Lledo, E., and Howell, K.; (2018). *A habitat classification to support spatial planning associated with deep-sea mining*, Oral presentation. 15th Deep Sea Biology Symposium, Monterey California, USA.

## 2017 Publications Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets

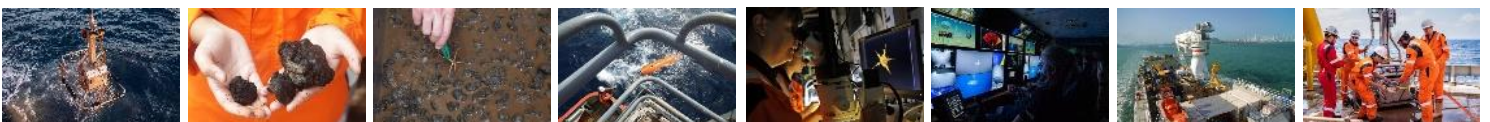
Amon, D.J., Ziegler, A.F., Drazen, J.C., Grischenko, A.V., Leitner, A.B., Lindsay, D.J., Voight, J.R., Wicksten, M.K., Young, C.M., and Smith, C.R.; (2017). *Megafauna of the UKSRL exploration contract area and eastern Clarion-Clipperton Zone in the Pacific Ocean: Annelida, Arthropoda, Bryozoa, Chordata, Ctenophora, Mollusca*, Biodiversity Data Journal. <https://doi.org/10.3897/BDJ.5.e14598>

Amon D.J., Ziegler A.F., Kremenetskaia A, Mah C., Mooi R., O'Hara T., Pawson D., Roux M., and Smith C.R., (2017) *Megafauna of the UKSRL exploration contract area and eastern Clarion-Clipperton Zone in the Pacific Ocean: Echinodermata*. Biodiversity Data Journal 5: e11794. <https://doi.org/10.3897/BDJ.5.e11794>

Goineau, A., and Gooday, A.J.; (2017). *Novel benthic foraminifera are abundant and diverse in an area of the abyssal equatorial Pacific licenced for polymetallic nodule exploration*. Scientific Reports, DOI: [10.1038/srep45288](https://doi.org/10.1038/srep45288)

Gooday, A.J., Holzmann, M., Caille, C., Goineau, A., Kamenskaya, O., Weber, A. A.-T., and Pawlowski, J.; (2017). *Giant protists (xenophyophores, Foraminifera) are exceptionally diverse in parts of the abyssal eastern Pacific licenced for polymetallic nodule exploration*, Biological Conservation, Volume 207, Pages 106-116. <http://dx.doi.org/10.1016/j.biocon.2017.01.006>

Gooday, A.J., Holzmann, M., Caille, C., Goineau, A., Jones, D.O.B., Kamenskaya, O., Weber, A. A.-T., and Pawlowski, J.; (2017). *New species of the xenophyophore genus Aschemonella (Rhizaria)*:



*Foraminifera*) from areas of the abyssal eastern Pacific licensed for polymetallic nodule exploration, *Zoological Journal of the Linnean Society*, XX, 1–21, <https://doi.org/10.1093/zoolinnean/zlx052>

Gooday, A.J., Holzmann, M., Goineau, A., Pearce, R.B., Voltski, I., Simon-Lledó, E. Weber, A. A.-T., and Pawlowski, J.; (2017). *Five new species and two new genera of xenophyophores (Foraminifera: Rhizaria) from part of the abyssal equatorial Pacific licensed for polymetallic nodule exploration.* *Zoological Journal of the Linnean Society.* <https://doi.org/10.1093/zoolinnean/zlx093>

Kaiser, S., Smith, C.R., and Martinez Arbizu P.; (2017). *Editorial: Biodiversity of the Clarion Clipperton Fracture Zone*, *Senkenberg*, <https://doi.org/10.1007/s12526-017-0733-0>.

Kersten, O., Smith C.R., and Vetter, E.W.; (2017). *Abyssal near-bottom dispersal stages of benthic invertebrates in the Clarion-Clipperton polymetallic nodule province.* *Deep Sea Research 1, Oceanographic Research Papers*, Volume 127, September 2017, Pages 31-40. <https://doi.org/10.1016/j.ds.2017.07.001>

Leitner, A.B., Neuheimer, A.B., Donlon, E., Smith, C.R., and Drazen, J.C; (2017). *Environmental and bathymetric influences on abyssal bait-attending communities of the Clarion Clipperton Zone*, *Deep-Sea Research Part I*, Volume 125, July 2017, p. 65-80. <https://doi.org/10.1016/j.dsr.2017.04.017>

Lim, S.-C., Wiklund, H., Glover, A. G., Dahlgren, T. G., & Tan, K.-S. (2017). *A new genus and species of abyssal sponge commonly encrusting polymetallic nodules in the Clarion-Clipperton Zone, East Pacific Ocean.* *Systematics and Biodiversity*, 15(6), 507-519. <http://dx.doi.org/10.1080/14772000.2017.1358218>

Lindh, M.V.; Maillot, B.M.; Shulse, C.N.; Gooday, A.J.; Amon, D.J.; Smith, C.R.; and Church, M.J.; (2017). *From the surface to the deep-sea: bacterial distributions across polymetallic nodule fields in the Clarion-Clipperton zone of the Pacific Ocean.* *Frontiers in Microbiology*, 8. <http://doi.org/10.3389/fmicb.2017.01696>

Shulse, C.N., Maillot, B., Smith, C.R., and Church, M.J. 2017. *Polymetallic nodules, sediments, and deep waters in the equatorial North Pacific exhibit highly diverse and distinct bacterial, archaeal, and microeukaryotic communities.* *Microbiology Open*, 6: e428, <https://doi.org/10.1002/mbo3.428>

Taboada, S., Kenny, N.J., Riesgo, A., Wiklund, H., Paterson, G.L., Dahlgren, T.G., Glover, A.G.; (2017). *Mitochondrial genome and polymorphic microsatellite markers from the abyssal sponge *Plenaster craigi* Lim & Wiklund: tools for understanding the impact of deep-sea mining.* DOI 10.1007/s12526-017-0786-0

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Amon, D.J., Ziegler, A.F., Dahlgren, T.G., Glover, A.G., Goineau, A., Gooday, A.J., Wiklund, H., and Smith, C.R.; (2016). *Insights into the abundance and diversity of abyssal megafauna in a polymetallic-*



*nodule region in the eastern Clarion-Clipperton Zone*. Scientific Reports 6: 30492. DOI: [10.1038/srep30492](https://doi.org/10.1038/srep30492)

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Dahlgren, T.G., Wiklund, H., Rabone, M., Amon, D.J., Ikebe, C., Watling, L. Smith, C.R., and Glover, A.G.; (2016). *Abyssal fauna of the UK-1 polymetallic nodule exploration claim, Clarion-Clipperton Zone, central Pacific Ocean: Cnidaria*, Biodiversity Data Journal 4: e9277 (30 June 2016). doi: [10.3897/BDJ.4.e9277](https://doi.org/10.3897/BDJ.4.e9277)

Glover, A.G., Wiklund, H., Dahlgren, T.G., Rabone M., Amon, D.J., Smith C.R., and O'Hara, T.; (2016). *Abyssal fauna of the UK-1 polymetallic nodule exploration claim, Clarion-Clipperton Zone, central Pacific Ocean: Echinodermata*, Biodiversity Data Journal 4: e7251, doi: [10.3897/BDJ.4.e7251](https://doi.org/10.3897/BDJ.4.e7251)

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Paterson, G.L., Neal, L., Altamira, I., Soto, E. H., Smith, C. R., Menot, L., Billett, D.S.M., Cunha, M. R., Marchais-Laguionie, C., and Glover, A.G.; (2016). *New Prionospio and Aurospio Species from the Deep Sea (Annelida: Polychaeta)*. Zootaxa, 4092 (1): 001-032. <https://doi.org/10.11646/zootaxa.4092.1.1> (Includes species descriptions of macrofaunal polychaetes collected by the ABYSSLINE project.)

Shulze, C., Maillot B., Smith C.R., and Church M.J.; (2016). *Polymetallic nodules, sediments, and deep waters in the equatorial North Pacific exhibit highly diverse and distinct bacterial, archaeal, and microeukaryotic communities*. Microbiology Open. <https://onlinelibrary.wiley.com/doi/10.1002/mbo3.428>

Zinssmeister, C., Wilke, T., Hoppenrath, M., and von Ossietzky, C.; (2016). *Species diversity of dinophysoid dinoflagellates of the Clarion Clipperton Fracture Zone, eastern Pacific*. Marine Biodiversity. <https://doi.org/10.1007/s12526-016-0607-x>.



## 2016 Conference Presentations Arising from UK1 AB01 (2013) and AB02 (2015) Environmental Datasets

Goineau, A.; (2016). "*Monothalomophobia*" or the tragedy of the monothalamous benthic foraminifera: can we ignore them? TMS Foraminifera and Nanofossil Spring Meeting, 19-24 June 2016, Angers, France

Goineau A., and Gooday A. J.; (2016). *High abundance and diversity of novel benthic foraminifera in the abyssal equatorial Pacific (Clarion–Clipperton Zone)*. MeioScool, Brest, France, June 2016.

Gooday, A.J., and Goineau, A.; (2016). *Recent research on benthic foraminifera (Protista) in the abyssal equatorial Pacific (Clarion-Clipperton Zone)*. Talk given at Challenger Society - UK Deep-Sea Ecosystems Special Interest Group, University of Liverpool, 9th September 2016.

Mohrbeck, I., Neira, C., and Martinez Arbizu P.; (2016). *Abyssal Meiofauna Communities in the UK-1 Exploration Area in the Clarion-Clipperton Zone (Northeast Pacific)*, International Meiofauna Conference (ISIMCO 03. -08.07.2016), Heraclion, Greece.

## 2015 Publications Arising from UK1 AB01 (2013) Environmental Datasets

Cairns, S.; (2015). *New abyssal Primnoidae (Anthozoa: Octocorallia) from the Clarion-Clipperton Fracture Zone, equatorial northeastern Pacific*. Marine Biodiversity, 1-10, <https://doi.org/10.1007/s12526-015-0340-x> (Includes species descriptions of cnidarians collected by the ABYSSLINE project.)

Goineau A., Gooday A. J.; (2015). *Radiolarian tests as microhabitats for novel benthic foraminifera: Observations from the abyssal eastern equatorial Pacific (Clarion–Clipperton Fracture Zone)*. Deep-Sea Research I 103, 73–85. <https://doi.org/10.1016/j.dsr.2015.04.011>

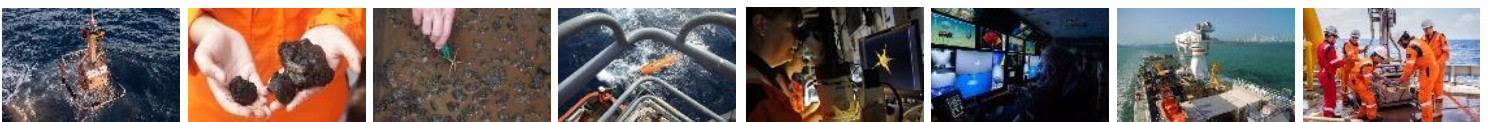
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## 2015 Conference Presentations Arising from UK1 AB01 (2013) Datasets

Amon, D.J., Smith, C.R., Ziegler, A.F.; (2015). *Megafaunal community structure and biodiversity in the UK-1 claim area of the Clarion-Clipperton Zone*. Oral presentation. 14th Deep-sea Biology Symposium, Aveiro, Portugal, September 2015

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