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Exploring The Ocean’s Depths:

Unseen Worlds Beneath the Waves

By Sebastian Michael

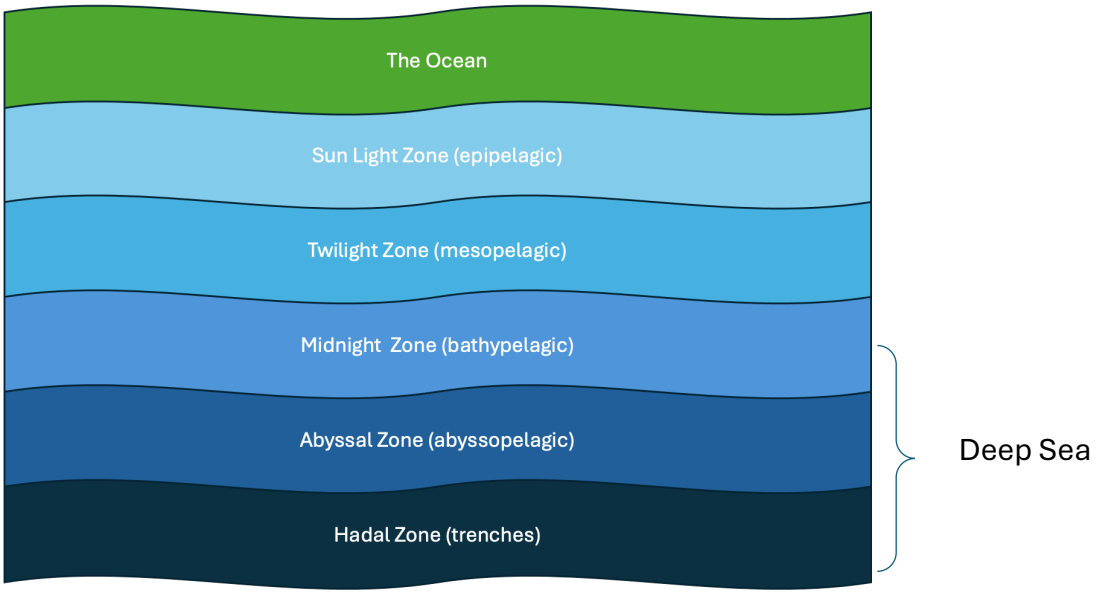
INTRODUCTION

The deep sea is an important part of our world's ecosystem but it is largely unexplored - more people have ventured to the moon than to the bottom of the deepest point in the Pacific Ocean (or any ocean), the Mariana Trench.[1] The deep seafloor takes up nearly half of the surface of Earth, but 80% of the seafloor remains unexplored at anything more than images of a coarse resolution of >1 km^2.[2]

The deep-sea isn't just fascinating, it may also hold vital information such as how our earth came to fruition, clues about the health of our environment, as well as new resources and technology. In 2024 Andrew Sweetman and his team reported one of the most intriguing discoveries of our time, Dark Oxygen!

Before we talk about Dark Oxygen, let's get to know our sea.

Scientists that study the ocean often refer to different zones of the sea: the Sunlight Layer, the Twilight Layer, and the Deep Sea. The Deep Sea is further divided into the Midnight Layer, the Abyssal Layer, and the Trenches.[3]



(Figure 1: Sebastian Michael, PowerPoint, 19th June 2025)

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[1] Gardner, J. V., Armstrong, A. A., Calder, B. R., & Beaudoin, J. (2014). So, How Deep *Is* the Mariana Trench? *Marine Geodesy*, *37*(1), 1–13. https://doi.org/10.1080/01490419.2013.837849

[2] National Centre for Environmental Information (NCEI). (2018). *Mapping Our Planet, One Ocean at a Time*. [online] Available at: https://www.ncei.noaa.gov/news/mapping-our-planet-one-ocean-time.

[3] WorldAtlas (2017). *The 5 Layers of the Ocean*. [online] WorldAtlas. Available at: https://www.worldatlas.com/articles/the-5-layers-of-the-ocean.html.

CHALLENGES OF EXPLORING THE DEEP SEA

You might be thinking that the deep sea is not as interesting as other ecosystems because of its lack of colourful creatures but the deep sea also has life! Exploring this unique environment comes with many challenges. Not only do humans have to worry about oxygen when they explore the deep, they must also consider the pressure of the water's weight - for every 33 feet (10.06 meters) you go down, the pressure increases by one atmosphere.[4] Another problem is the lack of light - once you get past the Midnight Zone (see above) there are only some types of light bulbs that can work underwater. LED lights can work, if rated to a water proofing standard called IP68.[5] There is also the problem of corrosive salt water and the freezing cold temperatures.

All of this means that humans need protection to explore the deep sea. One way of doing this is using an underwater vessel, called a submersible. These are carefully made to be able to withstand pressure and saltwater corrosion. The humans on board must have breathing equipment and a way of staying warm. This means less manipulable ways to grab specimens.[6]

The equipment that is used for deep sea travel is extremely expensive (estimated €25 million).[7]

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[4] NOAA (2019). *How does pressure change with ocean depth?* [online] Noaa.gov. Available at: https://oceanservice.noaa.gov/facts/pressure.html.

[5] Lei (2022). *IP Rating for Underwater Lights*. [online] WAKING Lighting. Available at: https://wakinglighting.com/ip-rating-for-underwater-lights/ [Accessed 28 Jun. 2025].

[6] US Department of Commerce, N.O. and A.A. (n.d.). *Marine Biologist and Bioluminescence Specialist Edith A. Widder: Video Transcript: Ocean Exploration Careers: NOAA Office of Ocean Exploration and Research*. [online] oceanexplorer.noaa.gov. Available at: https://oceanexplorer.noaa.gov/edu/oceanage/04widder/transcript.html.

[7] Carpenter, E. (2024). *The Deep Sea Project: France to invest €25 million in seabed exploration - Monaco Life*. [online] Monaco Life. Available at: https://monacolife.net/the-deep-sea-project-france-to-invest-e25-million-in-seabed-exploration/ [Accessed 15 Jun. 2025].

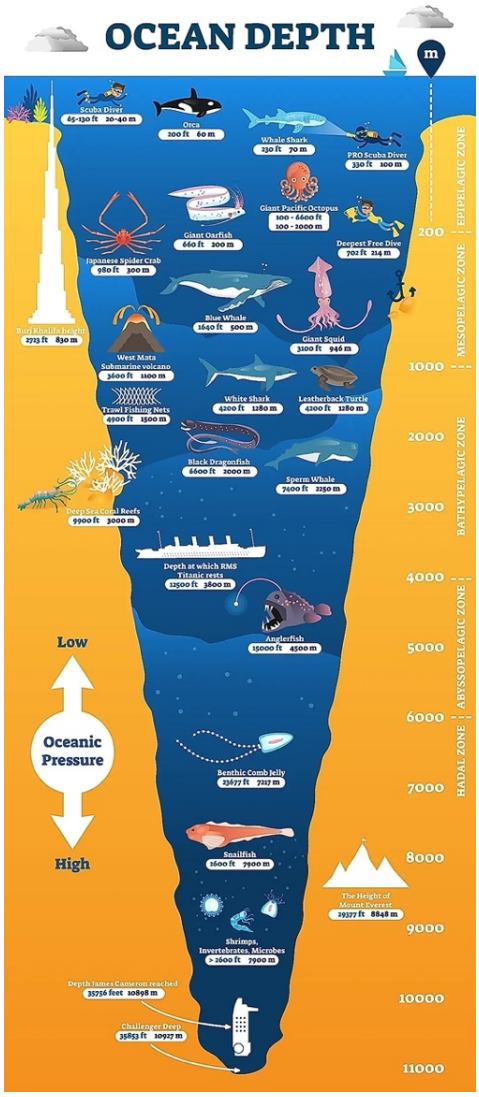

Figure 2: The 5 Layers of the Ocean (2017) [3]

These challenges and costs have led scientists to developing new ways to study the deep sea. One way used by scientists is Benthic chambers – a chamber lowered onto the sea floor to isolate a particular spot for study. When Benthic Chambers are used, heavy weights get attached to the legs of the lander. This means it sinks when thrown overboard. After landing on the seafloor a programmed computer starts the experiments at certain times after the Benthic chamber is stuck into the sediment of the sea floor. This seals off a tiny bit of the sea floor from the rest of the ocean. The computer then injects a small amount of food into the chamber which is eaten by the organisms in the sediment. This uses up oxygen and produces carbon dioxide and regenerating nutrients.

The use of these new technologies has brought back astonishing results. We have discovered many things down deep including seafloor heat waves, egg covered volcanos and a baffling methane leak.[8]

One exciting discovery is the phenomenon of Dark Oxygen.

DARK OXYGEN

Since 2013 Andrew Sweetman and his team had noticed oxygen levels were higher than expected on the deep-sea floor of the Pacific Ocean, in an area known as the Clarion-Clipperton Zone.

In 2024 Sweetman and his team decided to scientifically investigate this observation.[9] Dark Oxygen was discovered when Sweetman used Benthic Chambers to collect

[8] H.B. (2023). *10 mind-boggling deep sea discoveries in 2023*. [online] livescience.com. Available at: https://www.livescience.com/planet-earth/rivers-oceans/10-mind-boggling-deep-sea-discoveries-in-2023.

[9] Hunt, K. (2024). *Scientists discover 'dark' oxygen being produced more than 13,000 feet below the ocean surface*. [online] ABC11 Raleigh-Durham. Available at: https://abc11.com/post/scientists-discover-dark-oxygen-being-produced-more-13000/15084853/ [Accessed 28 Jun. 2025].

samples. They also used multimeters, genomic sequencing technologies and electro chemical analysis.

According to Popular Mechanics, Dark Oxygen is oxygen generated without light or photosynthesis.[10] Sweetman has hypothesised that Dark Oxygen is created by splitting water molecules into oxygen and hydrogen. This requires electricity, Sweetman believes it can be created by polymetallic rocks on the ocean bed, but this is only the beginning of investigations into this area, more studies are needed to confirm it.

If Dark Oxygen is proved to be a necessary life source for sea creatures, then anything creating large amounts of Dark Oxygen would be protected by the government. Some mining companies including Metals Company dispute the claims of Dark Oxygen. Many believe that this must be false, and the companies aim to prevent protection over the valuable polymetallic rocks that they mine.

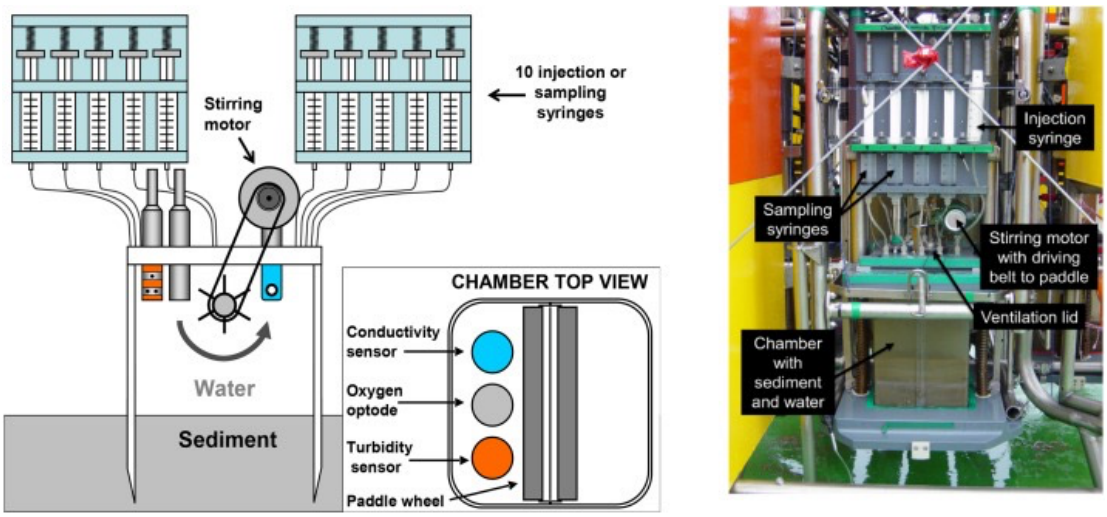

Figure 3: In situ incubations with the Bothnburg benthic chamber landers: Applications and quality control (Kononets et al. 2021)[11]

[10] Orf, D. (2025). *4,000 Meters Below Sea Level, Scientists Have Found the Spectacular 'Dark Oxygen'*. [online] Popular Mechanics. Available at: https://www.popularmechanics.com/science/environment/a64390388/scientists-find-dark-oxygen/.

[11] Mikhail Kononets, Anders Tengberg, Nilsson, M., Nils Ekeroth, Hylén, A., Robertson, E.K., van, Stefano Bonaglia, Rütting, T., Sven Blomqvist and Per O.J. Hall (2021). In situ incubations with the Gothenburg benthic chamber landers: Applications and quality control. *Journal of Marine Systems*, 214, pp.103475–103475. doi:https://doi.org/10.1016/j.jmarsys.2020.103475.

CONCLUSION

Dark Oxygen is important for our world because it could reveal new information about how life began on Earth and how scientists understand oxygen creation. Dark Oxygen means that there could possibly be life on other planets that we thought was impossible - if oxygen can be created without photosynthesis maybe other aspects of life can be to!

In summary, the deep ocean and all the ocean needs to be protected, not just because of thriving ecosystems or polymetallic rocks. It should be protected because the ocean and deep ocean is the fuel of our imaginations. It is a huge unexplored place on our very own planet. To protect it we protect ourselves, and our imaginations too!

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The word count for this document is 867 words.