

Volcanic Ash Deposition from Large Eruptions Within the Last 150,000 Years Increases Biological Productivity in the Pacific Ocean at Low Latitudes

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Known as a bio-limiting metal, high abundances of iron in water columns can amplify biological productivity in the surrounding area. This plethora of iron comes from volcanic eruptions emitting volcanic ash and being swept away by the wind. The growth of diatoms and other photosynthetic organisms increases, providing more food for grazing organisms like foraminifera. The net result is more organic matter in surface waters and ultimately in surface sediments. Existing satellite data show increases in ocean chlorophyll in areas affected by volcanic eruptions. We infer from this that iron derived from volcanic ash does increase biological productivity. However, the relative increase in productivity is not known. In this paper, we examine sediment cores from the Equatorial Western Pacific to analyze the relationship between volcanic ash and biological productivity within three cores: RC14-44, RC14-66, and RC14-67. These cores contain black or dark-colored foraminifera within several ash layers and white-shelled foraminifera outside of the ash layers. We attribute the dark material both outside and inside the foraminifera to organic carbon and metals. In these Robert Conrad cores, some foraminifera are covered in iron sulfide (FeS), which could be pyrite, and contain large amounts of carbon as well as high abundances of aluminum and silicon. We examined barium concentrations to gain further knowledge of biological productivity at specific core depths since barium is a marker for primary productivity. Gathered data show that the barium levels within ash layers have increased at least ten-fold. Within these ash layers, we also noticed that the ashes with higher amounts of fine silt and clay sized material have the greatest increase in barium content, which can be further explained by wind patterns and explosion size. This pattern of increases in Ba, metals and organic carbon within ash layers compared to surrounding sediments shows that volcanic ash deposition increases marine productivity. For future research, testing components of biological productivity like biogenic silica content in the ash layers and outside them and loss on ignition (LOI) for these sediments would further clarify the relationship between volcanic ash deposition and biological productivity.