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 sea water can amplify biological productivity. 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 unknown. We examined 3 sediment cores from the Equatorial Western Pacific to analyze the relationship between volcanic ash and biological productivity: RC14-44, RC14-66, and RC14-67. All contain black or dark-colored foraminifera within ash layers and white-shelled foraminifera outside ash layers. We attribute the dark material outside and inside the foraminifera to organic carbon and metals. In our 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 as barium is a marker for primary productivity. We found that barium levels within ash layers increased at least ten-fold. Within 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, perhaps related to 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, measuring markers for biological productivity like biogenic silica content and loss on ignition (LOI) within and outside ash layers would further clarify the relationship between volcanic ash deposition and biological productivity.