Progress in the Geochemical Analysis of Tsunamis and Coastal Environments

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Understanding Earth's environment in the past is crucial to helping understand its future. The evidence for past climatic and environmental changes are archived in a variety of environments such as sediments, ice, coral, etc. Understanding the geochemical record preserved in these archives is an invaluable tool for learning about past environments. For example, the long-term prediction of ongoing global warming is based on our understanding of past global and local climate changes that have been reconstructed by using geochemical analysis.

The over the past decade or so, geochemical techniques have been applied to the study of past tsunamis. A tsunami is invariably a high-energy event that erodes coastal and nearshore sediments that are subsequently deposited in and around the littoral zone. The age and magnitude of an individual event is generally reconstructed from a detailed study of these sediments that are left behind. Determining a tsunami origin for such sediments has conventionally relied upon a suite of sedimentological and micropaleontological features, however these are not always present or well preserved. More recently, the study of geochemical characteristics has also been used as a proxy for determining the tsunami origin of a deposit. Seawater incursions and the introduction of marine organic matter can be detected through geochemical analysis thus providing strong evidence that event deposit was formed by saltwater inundation. Furthermore, the marine geochemical signature of an event has the potential to estimate the full extent of tsunami inundation far more precisely that the sediment alone. Studies of recent modern tsunamis (e.g. 2011 Tohoku-oki tsunami) have revealed that the visible sedimentary evidence invariably does not extend as far as the inundation limit, indicating that estimates of the magnitude of past events have undoubtedly been under-estimated. The geochemical signature of a tsunami extends beyond the sediment limit to the maximum point of inundation thus allowing a better estimation of its magnitude. Moreover, these geochemical data can be used is many other aspects of coastal environmental science. For example, tsunami inundation often causes secondary disasters such as salt damage and soil pollution. Geochemical analysis is therefore invaluable in helping to determine the extent of damage and pollution from which appropriate rehabilitation plans can be developed.

In this talk, I will address recent progress in the study of the geochemistry of past tsunamis and coastal environmental science.