Biomarkers – Indicators for the identification of ancient tsunami deposits (Kahana, Hawaii)

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Threatened by both far-field and less frequent local tsunami events, the Hawaiian Islands are prone for extreme wave events, such as the 1946 Aleutian, 1952 Kamchatka, 1957 Aleutians or the 1960 Chile tsunami. In the coastal marshland of the Kahana Bay, Oahu, the event layer from the respectively 1946 or 1957 tsunamis additional paleo-tsunami layers can be observed. Dating back to the 12th-14th century these prehistoric event layers have been analyzed using a multi-proxy approach including organic geochemical applications, such as biomarkers. For the biomarker application, samples were extracted in three different ways to obtain the free and bound organic compounds out of the sediments. Free compounds were extracted using a solid-liquid extraction (acetone and n-hexane), whilst bound compounds were extracted twice using first a basic hydrolysis and then pyrolysis. All three extracts were fractionated and analyzed by gas chromatography-mass spectrometry (GC-MS).

Several different natural compounds (n>120) were detected, of which most can be affiliated to compound groups, such as n-alkanes, fatty acids (saturated and unsaturated), steroids or carboxylic acids. Results show clear differentiation between sedimentary layers deposited before and following the event. In contrast to these layers is the paleo-tsunami deposit, showing concentration differences as well as a deviant occurrence of biomarkers. However, the occurrence of marine biomarkers remains difficult as the coring sites are located relatively far inland and an inundating wave would erode and incorporate large amounts of terrestrial material on its way inland, leading to a dilution of the marine signal. Still, the organic geochemical signature has been successfully used to characterize and distinguish the paleo-tsunami event layer from predecessing and subsequent depositional environments.