The importance of dispersed volcanic ash as an input to the Nankai Subduction Zone

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Volcanic ash plays an important role for geochemical budgets in the context of "Subduction Factory", which are of interest to the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE). Our work examines the effect of dispersed volcanic ash on the mass balance of aluminosilicate sediment entering the Nankai Trough. The geochemical dataset includes the major, trace, and rare earth element composition of the bulk sediment and respective discrete ash layers at Integrated Ocean Drilling Program (IODP) Sites C0011 and C0012.

Multivariate statistical analyses quantitatively determine the abundance and accumulation of four sources to each site consisting of one dust source and three ash sources. Some of these ash sources may themselves represent mixings of ash inputs, although the final compositions appear statistically distinct. Regardless, the mass of volcanic ash and chemically equivalent alteration products (e.g., smectite) that are dispersed throughout the stratigraphic succession of bulk sediment is 15-25 times greater than the mass of discrete ash layers.

At Site C0011, the composition of the dispersed ash component appears linked to that of the discrete layers, and the mass accumulation rate for dispersed ash correlates best with discrete ash layer thickness. In contrast, at Site C0012 the mass accumulation rate for dispersed ash correlates better with the number of ash layers. Below the Unit I/II boundary at both sites, the number of ash layers, as well as their individual thickness, decreases to zero while the dispersed ash component remains high. This observation is largely consistent with the data gathered from smear slides. We suggest that the overall trends result from a balance between the influx of detrital smectite to Shikoku Basin (which decreases up-section through time) and the production of authigenic smectite (which increases with temperature down-section). Together, the discrete ash layers, dispersed ash, and clay-mineral assemblages present a complete record of volcanism and erosion of volcanic sources, and indicate that mass balances and subduction factory budgets should include the mass of dispersed ash for a more accurate assessment of volcanic contributions to large-scale geochemical cycling.