Variation in detrital provenances at ODP site 1017, off California, during the last 30 ky

Tomohisa Irino[1], Thomas F. Pedersen[2], Ryuji Tada[3], Sohei Sato[4]

[1] Marine Geology Dept., GSJ, [2] EOS, UBC, [3] Geol. Inst., Univ. of Tokyo, [4] Geological Institute, University of Tokyo

In order to examine the sources and transport paths of sediments deposited at ODP site 1017, off California, during the last 30 k.y., we analyzed selected minor and trace element contents. Elements are subsequently classified as being of diagenetic, biogenic, and/or terrigenous origins. Variation in detrital 12 elements could be explained by relative contribution from sand- and silt-sized detritus, and fine fractions with mafic and felsic characteristics. Temporal variations in the relative contribution from mafic materials shows that more detritus from the mafic Franciscan Complex was transported to the site during MIS 2 than during the Holocene. This was probably due to enhanced southward littoral transport of detritus along the California Margin during the MIS 2.

Recent results from the analyses of cores in the Southern California Borderland Basins imply that high-frequency variability in intermediate-water renewal (Behl and Kennett, 1996) and sea-surface temperature (Mortyn et al., 1996) correlate very closely with Dansgaard-Oeschger cycles (Dansgaard et al., 1993) in central Greenland. In order to establish whether such millennial-scale climatic changes are manifested throughout the North Pacific or whether they are limited to the enclosed Southern California Borderland Basins, it is necessary to examine open-ocean, high-sedimentation-rate sites along the California Margin.

Ocean Drilling Program (ODP) Site 1017 on the southern California Margin is ideally located to shed light on questions relating to interactions between the ocean and both high- and low-frequency climate changes. The site sits at 960 m water depth on the continental slope off Point Conception near the bottom of the modern oxygen minimum zone. Surface waters in the region are characterized by high primary and export production, a result of upwelling in the California Current system, and the area is located within the modern transition between the subarctic and subtropical zooplankton faunal zones. The chemical composition of sediments at Site 1017 is expected to be sensitive to variations in the provenance of terrigenous detritus and transport paths, both of which could be affected by changes in the California Current and/or terrestrial climate. Thus, sediments at this location can be expected to contain high resolution records of changes in the intensity of the oxygen minimum zone, the intensity of surface circulation, ecological responses to climate shifts, and variability in detrital input through time.

In order to examine the sources and transport paths of sediments deposited at ODP site 1017 during the last 30 k.y., we analyzed selected minor and trace element contents. Trace and minor element compositional information can provide a way to deduce changes in both bottom-water oxygen level (Calvert and Pedersen, 1993), the sedimentary redox boundary depth (Crusius et al., 1996), and the history of biogenic deposition, all of which relate to the histories of upwelling, export productivity, and intermediate-water renewal. To set the stage for future exploration of such phenomena, it is necessary to distinguish the relative contributions of diagenetic, biogenic, and detrital inputs and to establish the provenance of terrigenous detritus.

Elements at site 1017 are subsequently classified as being of diagenetic, biogenic, and/or terrigenous origins. Re, U, Mo, and As are diagenetically enriched within sediments, reflecting millennial-scale variability in bottom-water oxygenation and/or the sedimentary redox boundary depth. Sr variation is largely controlled by the input of biogenic carbonate. Using Q-mode factor analysis, variations in the 12 elements of detrital origin that remain can be explained by three factors (endmembers) attributable to sand- and silt-sized detritus (Factor 2), and fine fractions with mafic (Factor 3) and felsic (Factor 1) characteristics. Following elimination of the influence of grain size, temporal variations in the relative contribution from mafic materials shows that more detritus from the mafic Franciscan Complex was transported to the site during Marine Isotope Stage 2 than during the Holocene. This was probably due to enhanced southward littoral transport of detritus along the California Margin during the latest Pleistocene.