Intensification of North Pacific Intermediate Water during Younger Dryas and Stadials: ODP Site 1017, California Margin

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Possibility for stronger North Pacific Intermediate Water [NPIW]during Younger Dryas [YD] and stadials is important to test. Although Kennett et al. suggest intensification of NPIW during YD and stadials based on their study of the Santa Barbara Basin, still uncertainty remains. Here, we present the result of X-ray radiograph and grain size studies at ODP Site 1017, California Margin. We found weak scouring surface at YD and faint parallel lamination of possible contourite origin in some of the stadials. These intervals are also characterized with coarser size of silt fraction and smaller clay fraction. Together with the evidences of increased bottom-water oxygenation level by other studies, our results strongly argue for increased intensity of NPIW during stadials and YD.

The mechanism of the large and abrupt climatic changes during the last glacial period is a matter of continued discussion during the last several years. Based on their study of bottom-water ventilation at ODP Site 893 in the Santa Barbara Basin of southern California, Kennett and his coworkers demonstrated the possibility for intensification of North Pacific Intermediate Water [NPIW] in association with stadials of the Dansgaard-Oeschger Cycles and Younger Dryas [YD]. Their idea has significant implication when considering the mechanism of large and abrupt climatic changes in association with the Dansgaard-Oeschger Cycles. However, it is argued that since the Santa Barbara Basin is a marginal basin that is potentially influenced significantly by the surrounding lands, the bottom-water ventilation changes within the basin may not represent the changes in the intensity of NPIW but may represent changes in productivity or circulation within the basin in response to the variation of local climate. It is also possible that the changes in bottom-water oxygenation level could have been caused by changes in intensity of coastal upwelling, which, in turn, modulates surface productivity and intensity of the oxygen minimum zone.

In order to test the possibility for changes in the intensity of NPIW, we investigated cores from ODP Site 1017 located on the upper slope of central California Margin with the water depth of 955 m. The site is close from the entrance to the Santa Barbara Basin, thus suitable for testing the possibility. We examined the X-ray radiographs of the cores and detrital grain sizes to identify strong bottom current and winnowing events and variation in intensity of the bottom current. We found a non-depositional to weakly scouring surface that represent a strong winnowing event corresponding to the onset of YD. We also found faint parallel lamination, which is considered as representing contourite, in some of the intervals corresponding the stadials. The intervals corresponding to YD and stadials of the Dansgaard-Oeschger Cycles are also characterized by coarser size of silt fraction as well as smaller content of clay fraction compared to the adjacent interstadials. Together with the evidence of increasing bottom-water oxygenation level based on the assemblage of benthic foraminifers by Cannariato and Kennett and concentrations of redox-sensitive trace elements by Irino and Pedersen, our results strongly argue for increased intensity of well-oxygenated NPIW during stadials and YD.