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Distribution and dynamics of anoxic water mass in Beppu bay: Establishing TEX_{86} paleothermometry in the modern coastal sea

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It is widely known that atmospheric carbon dioxide concentration is rapidly increasing in these 200 years. Because of enhanced global warming effect with the surplus global warming gasses, annual mean air temperature around the Japanese island, and annual mean sea surface water temperature (SST) off Shikoku have also been increased by 1.1 and 1.3 degreeC in these 100 years, respectively. On the other hand, annual mean SST in the Seto Inland Sea seems to be much more drastically increased in these 30 years. For example, SSTs are warming by up to about 1.5 dgreeC in these 30 years in Beppu Bay, Bungo Strait, Iyo-nada, etc. However, it is impossible to estimate SST feedback to the global warming forcing in the Seto Inland Sea because systematic and precise instrumental SST data have been obtained only in these 30 years. Therefore we need to employ a certain SST proxy preserved within sediments in the Seto Inland Sea for investigation of feedback dynamics and mechanisms in these 100 or 200 years. Because planktic foraminifers are quite scarce in the Seto Inland Sea, except for deeper channels connecting inland sea with the Pacific Ocean, oxygen isotopic paleothermometry can't be applied. Thus, we fixed our target on TEX_{86} paleothermometry which have been utilized for deep sea sediments in these years. However, TEX_{86} paleothermometry have never been systematically used for such the shallow inland sea, so we must establish and evaluate applicability of TEX_{86} in the Seto Inland Sea.

As a very first step of this establishment and evaluation, we observed physical and chemical characteristics in the Seto Inland Sea water at Beppu Bay. Water depth of an observed site is about 72 m deep. We have started a series of observation form September, 08. We observed temperature, salinity, dissolved oxygen (DO), chlorophyll concentration, and nutrient concentration within a water column once a month. One of the very interesting features of this water column is represented by distinct thermocline between September and December. Cold bottom water with temperature of about 12 degreeC and warm upper water can be clearly identified. Upper water temperature became gradually cold from 25 degreeC in September to 17 degreeC in December. While thermocline depth in September was 55~60 m deep, the thermocline was gradually deepening toward 65~70 m in December. That thermocline was finally disappeared in January, 09, and water temperature was 13.5 degree C at all depth. DO in the water column also showed distinctive cline at the thermocline depth. Above the thermocline, DO was higher than 150 micro-mol/L and up to 300 micro-mol/L at sea surface in every month. On the other hand, DO was lower than 10 micro-mol/L below the thermocline. Interestingly, Ammonium shows a inverse trend to DO in water column, less than 2 micro-mol/L above the thermocline and up to 16 micro-mol/L below. These profiles indicate that cold bottom water was isolated from upper water convection and ventilation, and organic decomposition in the bottom water consumed DO and produced ammonium. In contrast, temperature, salinity, and DO of a water column in January, 09 show a vertically uniform distribution at 13.5 degreeC, 33.9 psu, and 310 micro-mol/L, respectively, which indicates bottom water was completely mixed with upper water. However, new colder and less saline bottom water was observed in February, 09. Although density of water above 30 m deep in February is quite similar to that in January, density of bottom water is obviously higher than that of upper water. Considering distributions of surface temperature and salinity in the Seto Inland Sea, this dense, colder and less saline water must be produced and sank at Suo-nada and transported to Beppu Bay. This immigrant water mass occupy a water column deeper than 30 m deep in February.