Changes in oceanic carbon and oxygen cycle during Heinrich event

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Weakening of the Atlantic Meridional Overturning Circulation (AMOC) during Heinrich events was often accompanied by the atmospheric CO_2 increase of 10-20 ppm over 1000 years. Previous modeling studies display conflicting atmospheric CO_2 response to an AMOC shut down. On the other hand, recent paleoproxy records suggest that dwindling iron fertilization by dust in the Southern Ocean can contribute millennial-scale CO_2 oscilations (Martínez-García et al., 2014). However, the effect of changes in iron cycle has not been considered in the previous modeling studies.
In this study, we investigate the response of atmospheric CO_2 to changes in ocean circulation and dust-bone iron supply using numerical models. In associate with the AMOC weakening from 26 Sv to 6 Sv, the atmospheric CO_2 decreases by 2 ppm over 1000 years. Combining AMOC weakening and decrease in dust-bone iron supply, the atmospheric CO_2 increases more than 10 ppm. Reduction in export production associated with dwindling iron supply in the Southern Ocean release carbon from the deep sea, contributing to the increase in the atmospheric CO_2. Reduction in export production simultaneously increases dissolved oxygen in the Antarctic Bottomo Water, which is consistent with proxy records. Our results show the significant contribution of changes in dust-bone iron supply to the millennial CO_2 change in the glacial periods.

Keywords: Ocean carbon cycle, dissolved oxygen, Ocean iron cycle, Heinrich event

