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Biogenic opal changes in the Gulf of Alaska for the last 50 kyrs

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Gulf of Alaska is known as high productivity area mainly by diatoms. Diatom is a phytoplankton with biogenic frustules and can be frequently preserved in sediments. Therefore, sedimentary biogenic opal content is used as a proxy for past diatom productivity (e.g. Ragueneau et al., 2000). During the Integrated Ocean Drilling Program (IODP) Expedition 341 held in 2013, Site U1418 was drilled near the continental margin of the Gulf of Alaska (58 ′ 46.6 ″ N, 144 ′ 29.6 ″ W, and 3,667 m water depth)(Expedition 341 Scientists, 2014). At Site U1418, continuous sediments for the past 1 Myrs with foraminifera and diatoms were recovered from five holes. Age model was constructed by oxygen isotope stratigraphy of planktonic foraminifera (*Neogloboquadrina pachyderma* sinistral) supported by paleogeomagnetic and microfossil datums (Asahi et al., 2014). In this study, biogenic opal contents for the last 50 kyrs were measured using 120 samples from upper 60 m core depths. Biogenic opal was analyzed by extracting with an alkaline solution (2M $NaCO_3$) and molybdenum yellow colorimetric method (Mortlock and Froelich, 1989). In order to estimate paleo-flux of biogenic opal, accumulation rate (AR; g cm^{-2} kyr^{-1}) was calculated based on wt% of biogenic opal, sedimentary density, and sedimentation rate between age control points. Averaged biogenic opal ARs at Site U1418 during the Marine Isotope Stages (MIS) 2 and 3 were 3.60 g cm^{-2} kyr^{-1} and 6.89 g cm^{-2} kyr^{-1}, respectively. Note that most of Holocene sediments were not recovered at U1418. Because of low biogenic opal AR during MIS 2, it is possible to consider that diatom productivity was low during deep glacial period. The present Gulf of Alaska is known as high nutrient low chlorophyll (HNLC) region owing to lack of iron which phytoplankton needs in their production. It is also well-known that eolian dust increased in glacial periods and provided iron to the sea (e.g., Kohfeld and Harrison, 2001). Decreased biogenic opal AR during MIS 2 at U1418 does not support iron fertilization scenario which expects increased productivity by iron supply from eolian dust during glacial period. As these results, the decrease in diatom productivity may have been driven by increased light limitation due to expanded sea-ice cover in the Gulf of Alaska (de Vernal and Pedersen, 1997).

References

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