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Iron fertilization from the Amery Ice Shelf marine ice layer, East Antarctica

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The Antarctic continental shelf supports a high level of marine primary productivity and is a globally important carbon dioxide (CO_2) sink through the photosynthetic fixation of CO_2 via the biological pump. Sustaining such high productivity requires a large supply of the essential micronutrient iron (Fe); however, the pathways for Fe delivery to these zones vary spatially and temporally. Our study is the first to report a previously unquantified source of concentrated bio-available Fe to East Antarctic surface waters. We hypothesize that Fe derived from subglacial processes is delivered to euphotic waters through the accretion (Fe storage) and subsequent melting (Fe release) of a marine-accreted layer of ice at the base of the Amery Ice Shelf. Using satellite-derived Chlorophyll-a data, we show that the soluble Fe supplied by the melting of the marine ice layer is an order of magnitude larger than the required Fe necessary to sustain the large annual phytoplankton bloom in Prydz Bay. Our finding of high concentrations of Fe in AIS marine ice and recent data on increasing rates of ice shelf basal melt in many of Antarctica's ice shelves [Paolo et al., 2015] should encourage further research into glacial and marine sediment transport beneath ice shelves and their sensitivity to current changes in basal melt. This research also encourage new research into the formation of marine ice and its vulnerability to a warming ocean. Currently, the distribution, volume and Fe concentration of Antarctic marine ice is poorly constrained. This uncertainty, combined with variable forecasts of increased rates of ice shelf basal melt, limits our ability to predict future Fe supply to Antarctic coastal waters.