Evaluation of the biogeochemical impact of iron-rich shelf water to the Green Belt in the southeastern Bering Sea

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The Green Belt (GB) in the southeastern Bering Sea lying along the continental slope is a biological hotspot where summertime high primary production is sustained by continuous input of nutrients and iron. To understand the mechanisms to sustain the GB, we need to know how dissolved iron (D-Fe), which regulates the GB production, is drawn from the abundant source in the adjacent shelf should be clarified, but no quantification has ever done yet. In the present paper, using hydrographic and D-Fe data taken by a cruise and hydrographic database, we estimate horizontal D-Fe flux from the outer-shelf along 25.4 $\sigma_\theta$and 26.2 $\sigma_\theta$density surfaces, which are proposed as possible pathways by previous studies. The hydrographic data shows that the cold outer-shelf water is distributed in the slope region, and we estimate that 10 % (65 %) of the water-mass in the slope is originated from the outer-shelf at 25.4 (26.2) σ_θ. Assuming that this portion of the along-slope geostrophic transport is derived from the shelf through horizontal isopycnal mixing, and using the observed D-Fe concentration, we estimate the D-Fe flux of $O(10^3)$ molFe/day at 25.4 $\sigma_\theta$and $O(10^4)$ molFe/day at 26.2 σ_θ. The large flux at 26.2 $\sigma_\theta$is consistent with the vertical maximum of D-Fe concentration previously observed off the shelf break at this density range, and the flux provides sufficient iron into the euphotic zone via the subsequent enhanced vertical mixing off the shelf break, which is estimated to be $O(10^3)$ molFe/day based on our prior studies. Since our estimated D-Fe flux through horizontal mixing at 25.4 $\sigma_\theta$and the vertical mixing off the shelf break altogether are comparable to the minimum D-Fe requirement by phytoplankton in the GB, which is estimated as $O(10^3 - 10^4)$ molFe/day, we suggest that both processes could play important roles in providing D-Fe to the euphotic zone in the GB.

Keywords: Bering Sea, Green Belt, Mixing, Dissolved iron flux

