2011 年南極海 60˚S, 110˚E における石灰質動物プランクトンによる無機炭素輸送

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Downward inorganic carbon flux of calcareous zooplankton observed at 60˚S, 110˚E in the Antarctic Ocean in 2011

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Rising of atmospheric carbon dioxide (CO_2) concentration is causing ocean acidification. Elevated partial pressure of CO_2 (pCO2) leads to the calcium carbonate saturation horizon to shoal in many regions, particularly in high latitudes. It is important to know the transport and loss processes of biogenic carbonate particles in the water column of the Southern Ocean, and very limited information on the spatio-temporal changes of carbonate shell bearing planktonic foraminifera and pteropods has been obtained. This study was made to know the contributions of foraminifera (calcite shells) and pteropods (aragonite shells) to total carbon flux to mesopelagic and bathypelagic depths at 60˚S, 110˚E in the Antarctic Ocean (bottom depth of 4400 m) from 2 January to 14 December in 2011. Sediment traps (Nichiyu SMD 13W-6000) were deployed at 780 m, 1750 m and 2820 m during the Shirase and the Umitaka-maru cruises. After recovery of the trap, large swimmer zooplankton (>1 mm) were removed by hand from entire samples. The sample was quantitatively split into several fractions for microscopic and carbon analyses. Total particulate carbon (TPC) and particulate organic carbon (POC) were determined using a CN analyzer without acid huming, and with acid huming, respectively. TPIC was the difference between TPC and POC. Foraminifera (>25 μm in size) and pteropods (>100 μm in size) were manually removed from the subsamples and they were identified and counted under dissecting microscope. We estimated each PIC from empirical formula (calcium carbonate weight vs size).

Planktonic foraminifera collected were *Neogloboquadrina pachyderma* (Np), *N. incompta* (Ni), *Globigerina quinqueloba* (Gq), *Globigerinita uvula* (Glau), and *Gla. glutinata* (Glag). Nspp indicates Np and Ni. Numerically dominant pteropod species were *Limacina helicina antarctica* (Lh) and *Limacina retroversa australis* (Lr). The total flux of foraminifera varied with season and depth with the highest at 2820 m (1.5×10^5 cells m^{-2} d^{-1}) in a period from 16 to 30 January and the lowest at 780 m (720 cells m^{-2} d^{-1}) from 15 July to 31 August. The total flux of pteropods also varied with season with the highest at 780 m (1.0×10^4 ind. m^{-2} d^{-1}) from 16 February to 15 March and the lowest at 2820 m (0.3 ind. m^{-2} d^{-1}) from 1 to 14 November.

Figure 1 showed the highest flux of POC (12 mg m^{-2} d^{-1}) at 780 m and TPIC (2.3 mg m^{-2} d^{-1}) at 2820 m were found in February to mid-March. The fluxes of POC decreased with increasing depth from 780 m to 1750 m in February to March and November. TPIC did not change with depth or slightly increased with depth. Figure 2 showed the highest PIC flux found at 2820 m in January was dominated by Nspp (>80% of the total PIC). The dominance of Nspp in PIC was found through the year. The secondary dominating foraminifera was Gq. The total foraminifera PIC flux was greater than total pteropod PIC flux through the year other than the depth at 780 m in February to April when the highest PIC fluxes with Lh was observed (approx. 72% of the total PIC). Measured TPIC fluxes were generally lower than PIC fluxes estimated based on the abundances of foraminifera and pteropods. In the high flux periods in summer to fall (February to April), the pteropod flux markedly decreased with depth, and the total foraminifera flux did not change with depth or slightly increased with depth. While the reduction in the average POC between 780 and 2820 m was 30 %, the TPIC increase was 322 % in the same depth range. The Lh reduction was 96 % and the Nspp increase was 575 %. According to the present study, the Nspp was the most influential component to the TPIC increase in the mesopelagic and bathypelagic zones.

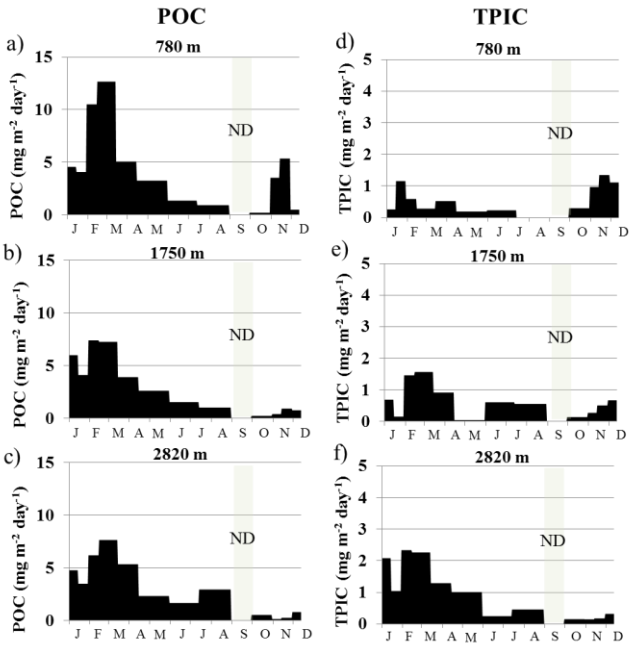

Fig. 1. Seasonal changes in the downward particle flux of organic carbon (POC) and total inorganic carbon (TPIC) at 780 m (a), 1750 m (b) and 2820 m (c).

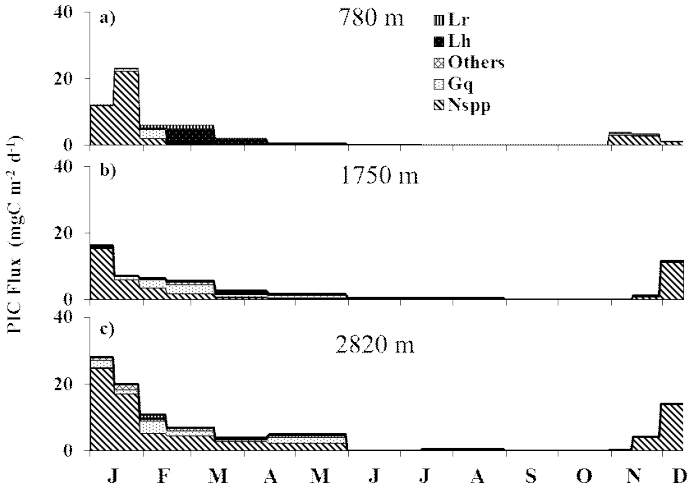

Fig. 2. Seasonal changes in the downward PIC flux of planktonic foraminifera and pteropods at 780 m (a), 1750 m (b) and 2820 m (c).