The role of mixing and silicate in regulating phytoplankton community structure in the iron-limited Antarctic Polar Front

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Using a combination of physicochemical and biological measurements from the ANT-XXVIII/3 Eddy-Pump cruise conducted in austral summer 2012, we delineate the respective physiological responses of phytoplankton communities under varying nutrient and light regimes in the Antarctic Polar Front (APF) between 45° S to 55° S in the Atlantic sector of the Southern Ocean. Our results show that under iron-limited conditions, high total chlorophyll-a (TChl-a) concentrations can be observed at stations with deep mixed layer across the APF. In contrast, at stations with shallower mixed layer, light was excessive and phytoplankton were producing higher amounts of photoprotective pigment at the expense of TChl-a. North of the APF, significantly lower silicic acid ($Si(OH)_4$) concentrations lead to the domination of nanophytoplankton, which produced higher ratios of photoprotectice pigment under relatively low irradiance conditions. The $Si(OH)_4$ replete region south of the APF, on the contrary, was dominated by microphytoplankton with lower ratios of photoprotective pigment, despite having been exposed to higher levels of irradiance. The significant correlation between nanophytoplankton and photoprotective pigment indicates that differences in taxon-specific response to light are also influencing TChl-a concentration in the APF during summer. Our results reveal that provided mixing is deep and $Si(OH)_4$ is replete, hight TChl-a concentrations are achievable in the iron-limited APF waters during summer.