Manganese and iron deficiency in Southern Ocean Phaeocystis antarctica populations revealed through taxon-specific protein indicators

Miao Wu,[a,]

[a] Dept. of Molecular Sciences, Swed. Univ. of Agricultural Sciences (SLU), Uppsala, Sweden

Iron and light are typically recognized as major limiting factors controlling phytoplankton growth and primary productivity in the Southern Ocean. Recent field-based evidence suggests, however, that manganese concentrations in this region can be low enough to impact the growth of primary producers. Here we examine the influence of iron and manganese deprivation on protein expression and physiology in Phaeocystis antarctica, a key Antarctic primary producer, and provide taxon-specific proteomic evidence; from natural, in-situ Southern Ocean Phaeocystis populations; indicating that they regularly experience stress due to combined low manganese and iron availability. In culture, combined low iron and manganese induced large-scale changes in the Phaeocystis proteome and resulted in reorganization of key components of the photosynthetic apparatus. Natural Phaeocystis populations produced protein signatures indicating late-season manganese and iron stress, consistent with concurrently observed stimulation of chlorophyll production upon additions of manganese or iron. These results implicate manganese availability as an important driver of Southern Ocean productivity and demonstrate the utility of peptide mass spectrometry as a tool for unraveling the role of manganese in incomplete macronutrient consumption in the Southern Ocean.

Figure 1. Southern Ocean