The redox cycle of Mn in the Ross Sea and its impacts on other bio-limiting trace elements
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Studies on trace in the Southern Ocean have shown atypical vertical profiles for Mn, Fe, Cu and Co. In particular, no there is no evidence of scavenging for these elements, compared to other oceanic sites. This was previously explained by low particle abundance, and/or by mixing rates exceeding scavenging rates, but may be better explained by a unique Mn redox cycle. The scavenging of Mn, Fe, Cu and Co is largely governed by adsorption onto manganese oxyhydroxides, which are thought to be the main component of particulate Mn in seawater. However, there are only a handful of studies that measure the oxidation state of Mn in the particulate phase, which may mean that at productive sites along the West Antarctic Peninsula, the assumption that particulate Mn is oxidized may be incorrect. Indeed, our preliminary data found that Mn oxides are absent in the Ross Sea in a 2018 austral summer sampling campaign. Mn oxides are thought to be predominantly formed via microbial oxidation and surface catalysis, as the abiotic oxidation of Mn(II) is kinetically very slow in seawater. Thus, perhaps an absence of Mn-oxidizing bacteria and/or catalytic surface sites prevents the formation of Mn oxides in the Southern Ocean. In particular, we find that intermediate Mn(III)-L is stabilized in surface waters of the Southern Ocean, and is concentrated in first year ice (10 x higher than surrounding seawater). To address the inputs, coupled cycling and bio-influence of Mn in the Southern Ocean, we propose to measure the soluble and particulate phase speciation of Mn along the GP17 transect and during the characterization of sea ice.