Oxygenation of the Neoproterozoic to early Paleozoic atmosphere and ocean: impact on marine life

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The Neoproterozoic Era was a time of dramatic change in atmosphere and ocean oxygenation, but the timing and magnitude of the process(es) and link to the diversification and emergence of marine animal life remains elusive. Most sedimentary geochemical proxies are only indirectly linked to the gas composition of the atmosphere. Here we present direct measurements of atmospheric oxygen based on mid Neoproterozoic to earliest Paleozoic inclusion gases trapped in halites, with pO_2 contents in excess of 10 % for the mid Tonian (Blamey et al., 2016) and upwards of 18 % during the latest Ediacaran-earliest Cambrian. We also determined the dissolved oxygen contents in shallow and deep waters of the Neoproterozoic to early Paleozoic ocean. The shallow ocean was variably oxygenated (oxic) since the earliest Tonian, whereas the deep ocean was dysoxic/anoxic during this time. The seawater oxygenation process was interrupted by the dissolved oxygen crisis (DOC) and the consequent mass extinction during the Cryogenian that invariably was triggered and propagated by the Sturtian and Marinoan glaciations. Our pO_2 and DO results support a dynamic oxygenation process for the atmosphere and ocean. The mid to late Neoproterozoic ocean was impacted by the DOC, and the subsequently gradual recovery of dissolved oxygen in seawater preceded the emergence and diversification of the Ediacaran biota by 60 Myr, and the rise of complex metazoan animal during the Cambrian by about 100 Myr.

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