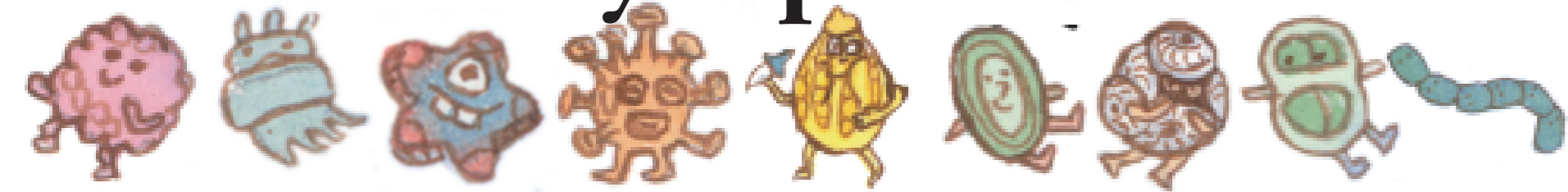





Marine Phytoplankton and the Great Oxygenation Event:




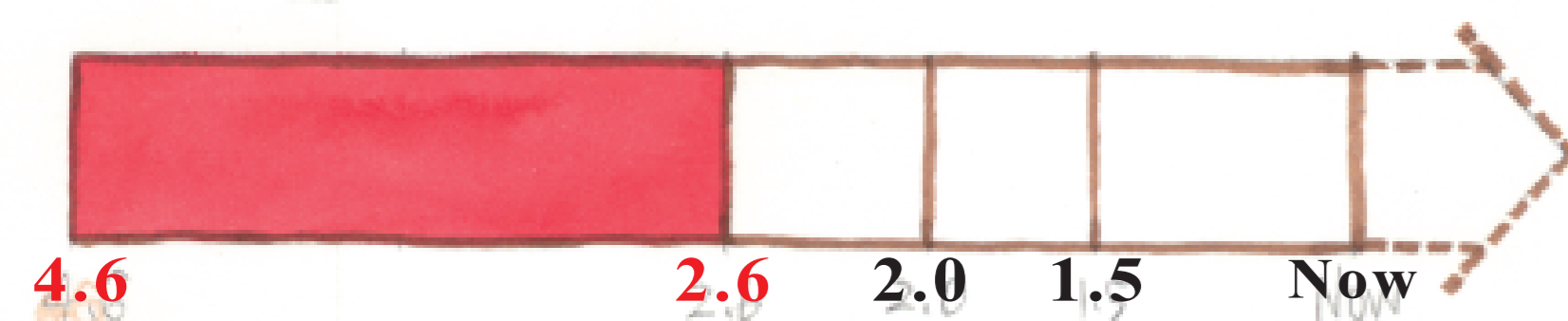
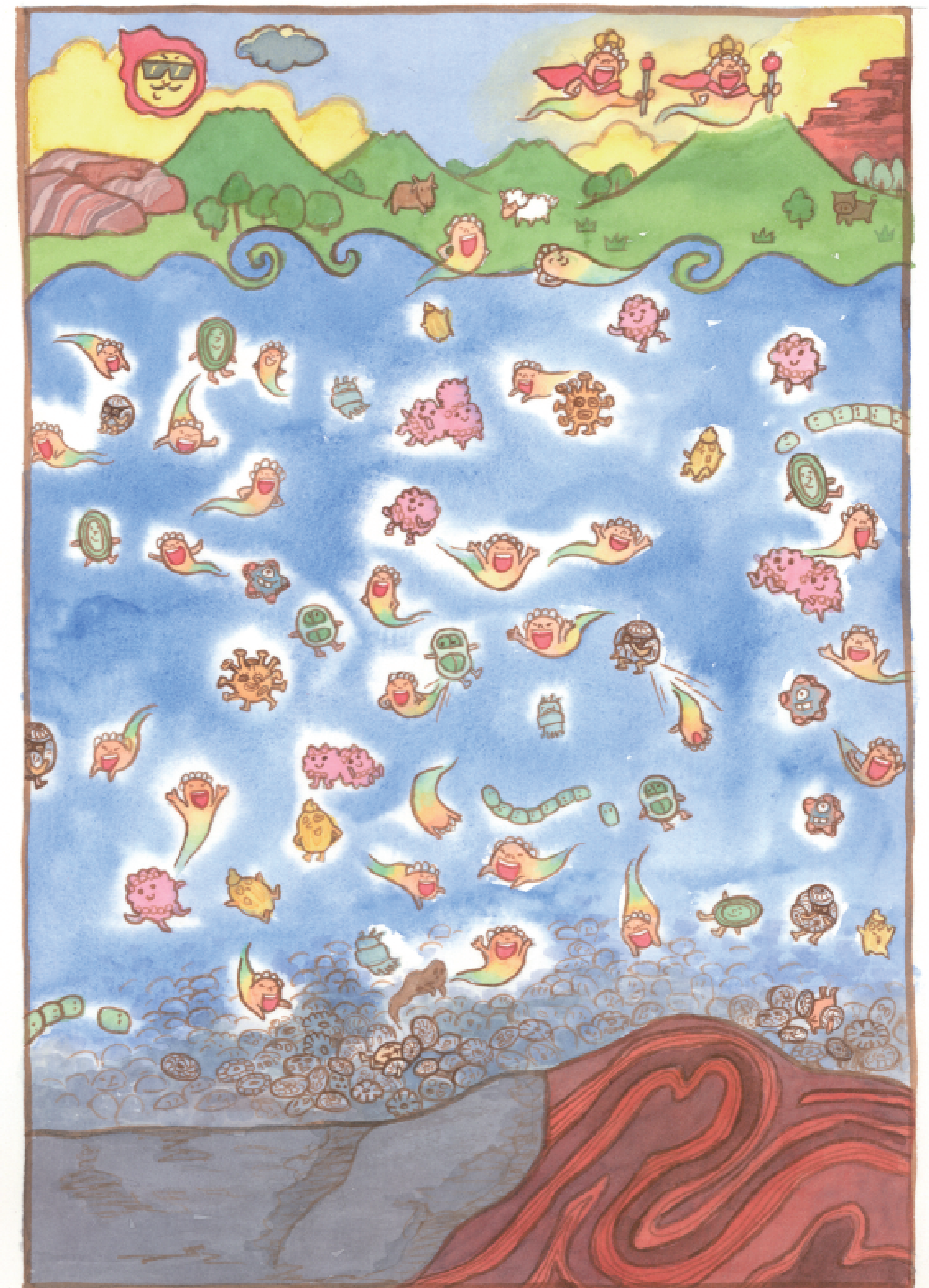
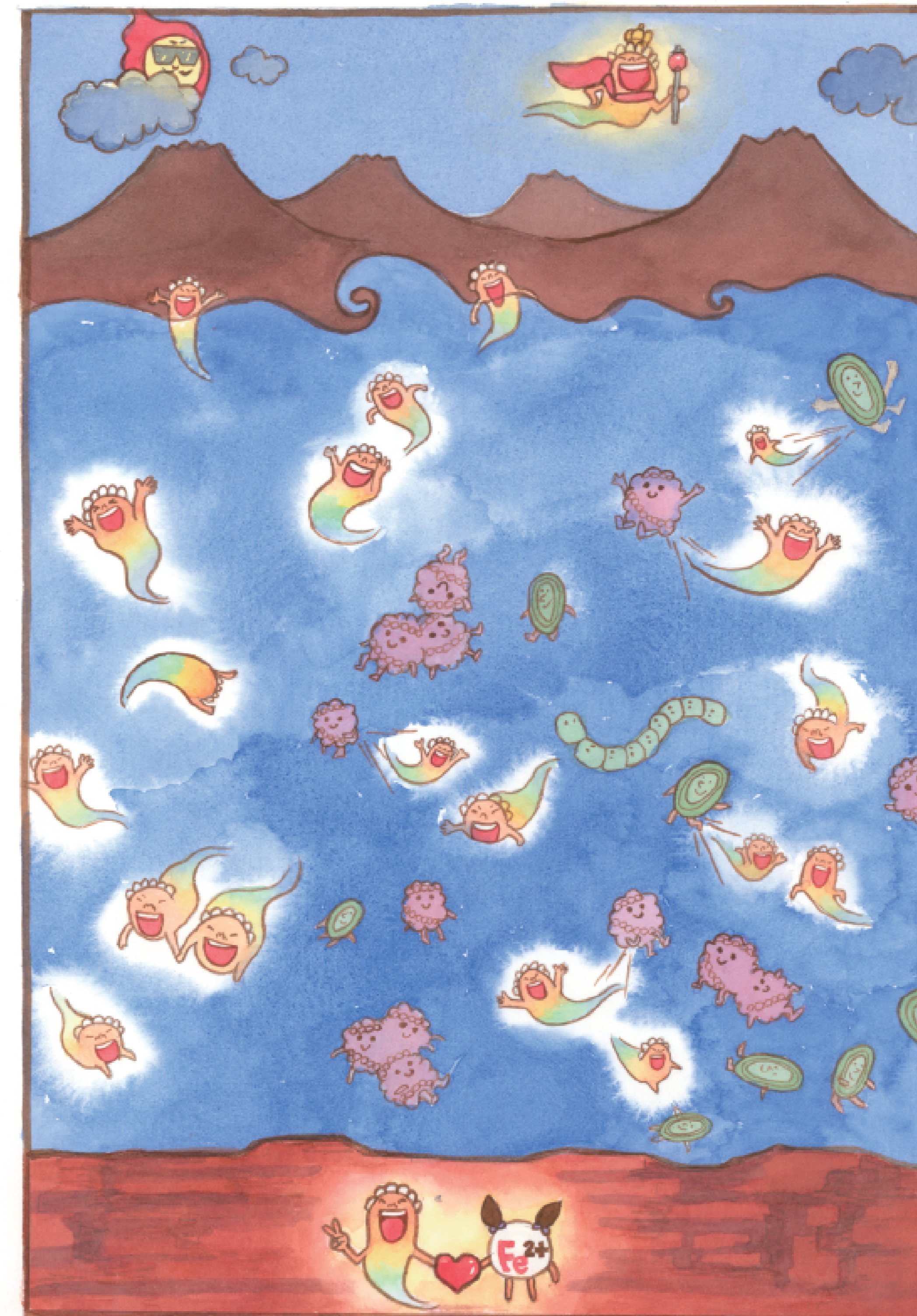
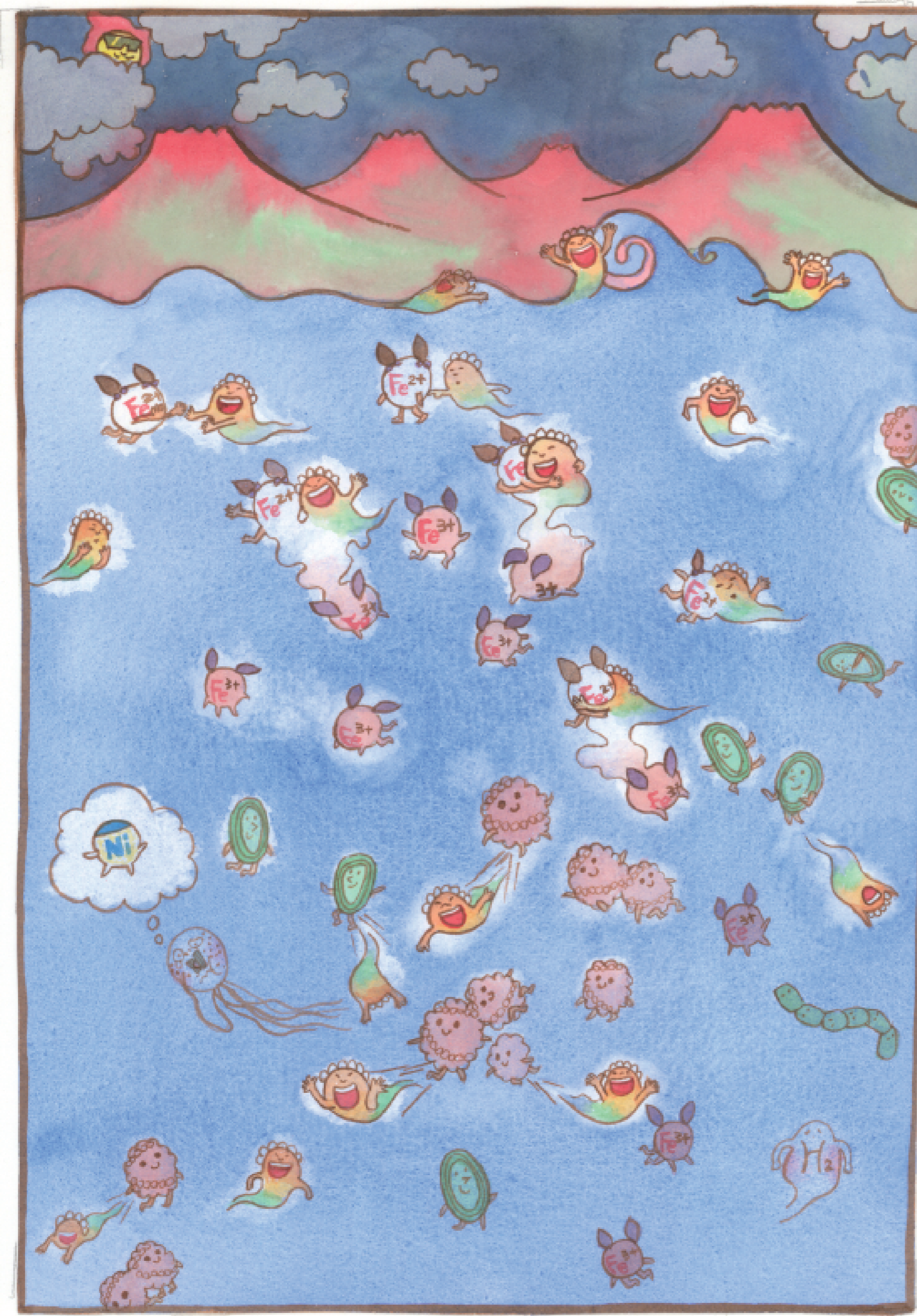
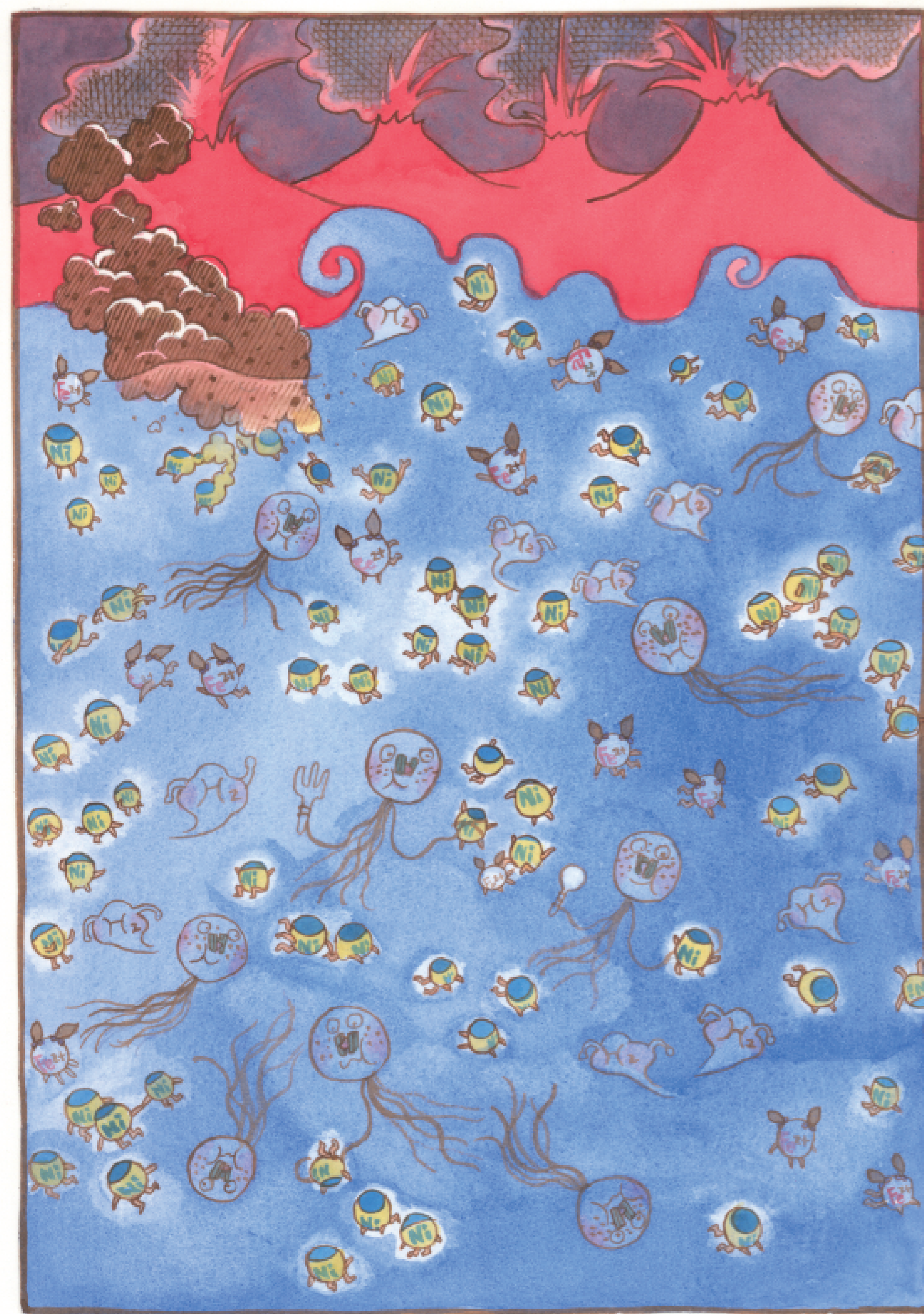
Based on the dating information from ancient sediment samples containing phytoplankton specific organic matter, scientists estimate that prokaryotic phytoplankton began to appear about 3.5 billion years ago. However, atmospheric oxygen  did not appear until about 2.4 billion years ago, almost one billion years later.

Why? The most plausible explanation is that the oxygen released from phytoplankton photosynthesis was removed by redox reactions with the large amount of the reducing substances in the early ocean. This way, oxygen in the ocean did not have the opportunity to appear in the atmosphere.

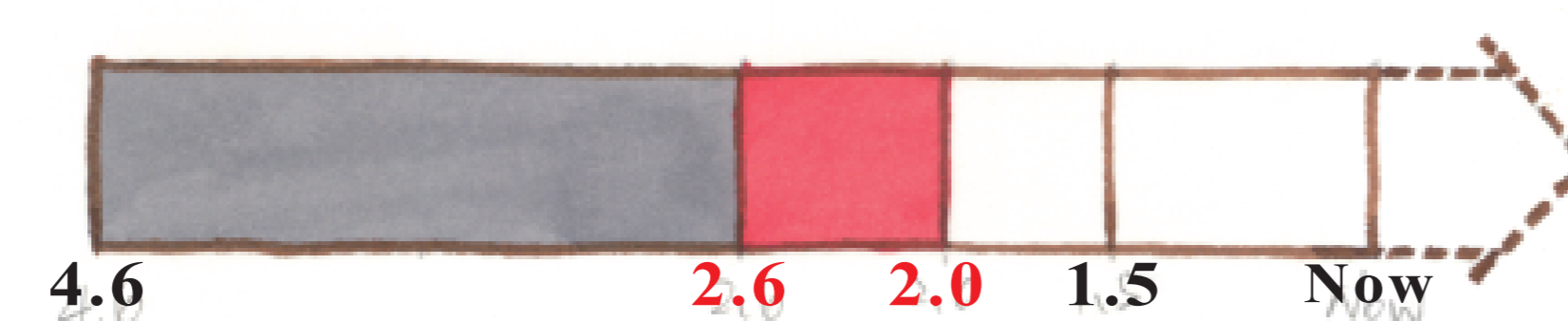
These reducing substances include ferrous iron , methane , and so on. Methane produced by methanogens also was stored in the ocean earlier than 3.5 billion years ago. Under high UV conditions, methane reacts with oxygen. Moreover, iron abundance in rocks reaches as high as 5% by mass. That is why the ancient ocean could contain up to mM concentrations of iron (II). Oxygen released from phytoplankton photosynthesis was oxidized by ferrous iron, forming the iron(III) oxide and iron hydroxide particles, which were deposited onto the ocean floor.



The formation of the Banded Iron Formation (BIF) is a powerful piece of evidence. The oxygen used to form the BIF is more than twenty times greater than the amount of oxygen currently in the atmosphere. One billion years later, ferrous iron and methane in the ocean have been exhausted, causing the start of oxygen accumulation in the ocean and the atmosphere. Thus also launching the evolution of organisms! Why has all the methane in the ocean been used up? It is probably because the numbers of methanogens kept dropping. How come methanogens did not keep dominating in the ancient ocean?  Please take a look at the poster on the Nickel Hypothesis.



單位：十億年



Unit: one billion years

