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Global distribution of iron formation constrained by coupling environmental and microbe‘s evolution

YUANFENG CAI[1], SIYI HUANG[2] AND HE ZHANG[1]

[1]Nanjing University
[2]Nanjing Univerisity

Two vitally important oxidation events occurred in the Precambrian, it altered heavily the global surficial environments. The advent of microbes in Archean no later than 3.6 billions (Dong et al., 2022) changed gradually the global surficial system. The first reported Iron Formation occurred at about 3.3 billions years and it was 300 million years later than the advent of microbes. The redox was recorded in the Iron formations and evaluated by the iron minerals with different valances. During 4.0-3.0 billions, the iron minerals was composed mainly by Fe(II) but evolved to mixed valences, such as siderite, magnetite, greigite ($[Fe^{2+}Fe^{3+}{}_2S_4$) and franklinite etc. This suggested the relative reduced environment and the deficiency of oxygen either in the ocean or atmosphere. During 3.0 – 2.5 billion years, large scale of iron formation occurred globally. Then, the hematite or its precursors were present in the iron formation as major minerals. And the levels of oxygen in the atmosphere elevated greatly to about 0.01 present atmospheric level (PAL). During 2.5-0.5 billion years, great oxidation event (GOE, 2.45-2.22 billion years) and Neoproterozoic Oxidation Event (NOE, 0.8-0.54 billion years) occurred, and finally elevated the level of oxygen to approximate present level and constructed one habitably Earth. Since then, large amounts of ferric minerals formed in the sediments and strata. The microbes evolved from simple to multiple cells to eukaryotes. However, the relation between the redox changing and microbe evolving is very fuzzy and much controversial. The efforts might be focused on the fine mineral study by screening the redox sensitive iron or manganese minerals, to build the sequence of redox minerals, and further combining microbe’s records. Finally to clarify the coevolution of microbe and minerals and its effect on the global environments.

Reference

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