

## Change by a diagenesis of first minerals in 1.9 Ga sedimentary rocks of the Gunflint Formation

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Some microfossils in the 1.9 Ga Gunflint Formation show clear morphology of aerobic microorganisms. However, carbon isotope compositions of microfossils and other geochemical characteristics suggest the activity of anaerobic microorganisms in the same rock sample. This leads to the skepticism if the 1.9 Ga surface ocean environments were essentially anoxic and oxic environments were very limited.

In order to examine if oxic world were more common or anoxic world were more common, shallow water sedimentary rocks were collected from Kakabeka (the bottom of the Gunflint) and Telly Fox (the top of the Gunflint) areas. The following features were found in the present study. (1) Chemistry of carbonate change into either Fe-rich or Mg-rich from calcite during diagenesis. Fe-rich feature is only found at the bottom of the Gunflint Formation, suggesting wide injection of reduced fluids in sediments. (2) Carbon isotope compositions were similar to cyanobacteria value, and feature of anaerobic bacteria were not detected. This suggests that previous report of carbon isotope compositions of anaerobic bacteria was limited in a few places and not widespread in the Gunflint Formation. Therefore, aerobic microorganism was the major life forms. (3) Sulfur isotope compositions of pyrite range from -2 to +15 per mil, suggesting closed system sulfate reduction. The closed system was most likely isolated oxic seawater from anoxic sediments, probably high sedimentation of SiO<sub>2</sub> and CaCO<sub>3</sub>. In addition, isolated sediments were anaerobic bacterial world, where organic matter from the oxic world was largely consumed.

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