

Significance of pyrobitumen in ca. 1.9 Ga Gunflint Formation: Unique feature of Paleoproterozoic Earth?

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Occurrence of pyrobitumen has been known in Paleoproterozoic sedimentary rocks. However, their exact age, source rocks and extents have been constrained poorly. Here I report detailed description and new geochemical data of pyrobitumen in ca. 1.9 Ga Gunflint Formation. Pyrobitumen disseminated in oolitic carbonate, conglomerate and shale of Gunflint Formation. Some pyrobitumen occur as thin veins concordant with sedimentary bedding. These features suggest that large quantity of bitumen (or oil) introduced and disseminated in Gunflint sediments, when the sediments were still soft.

Carbon isotope compositions are much lighter than sedimentary organic matter, e.g., kerogen, in the same rocks. Kerogen in Gunflint Formation has a contrast compositions of pyrobitumen, suggesting that bitumen was generated elsewhere. Carbonaceous rocks are completely absent except Gunflint Formation in the studied area. This postulate bitumen (oil) generation and migration within Gunflint Formation.

Results of the present study suggest that (1) examined pyrobitumen is analogous to other Paleoproterozoic Shungite, (2) burial of organic matter were intensive even at 1.9 Ga, largely affecting C and N cycles of biosphere, (3) oil generation, migration, and solidification were most likely promoted by intensive Paleoproterozoic igneous activities. In particular, the combination of above (2) and (3) were unique to Paleoproterozoic Earth, largely contributing to remove atmospheric CO₂.

Evidence of various microbial activities was reported from Gunflint Formation. There exist a possibility that a part of the past geochemical and electron microscopic evidence were records of microbial activities in migrating oil, rather than representing activities of Paleoproterozoic marine microorganisms.

Keywords: Paleoproterozoic, pyrobitumen, Gunflint