Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28773

Meteorite impact event recorded in 3.2 Ga banded iron formations of Moodies Group, S. Africa

PROF. TAKESHI KAKEGAWA, PH.D.

Tohoku University

Many Archean sedimentary rocks recorded meteorite impact events (1). It has been discussed as to if such meteorite impacts had positive or negative roles to activate the Archean microbial life (1), although no clear answers existed.

Sedimentary rocks of Moodies Group, Barberton Greenstone Belt contain information of 3.2 Ga surface environments and microbial activities. Various locations of Moodies Group were successfully drilled by the ICDP-Barberton Archean Surface Environment project (2). Recovered core samples contain banded iron formations (BIFs) deposited at 3.2 Ga coastal environments. These BIFs are mainly made of hematite/quartz layers. Barite ($BaSO_4$) layers are also found in BIFs. On the other hand, siderite ($FeCO_3$) layers, which only formed in strictly reduced environments, underlay hematite/quartz layers. Such mineralogical change indicates that local sedimentary environments radically changed from anoxic to oxic. More surprisingly, Ir-rich layers are identified in the hematite/quartz layers by micro-XRF analyses. Sandstones associated with BIFs also contain Ir-rich micro grains. Those Ir-rich materials were most likely delivered from the meteorite, which impacted before the BIF deposition.

Appreciable amounts of organic matter are found in BIFs and associated rocks. This suggests the high microbial activities when BIFs deposited, similar to other BIFs of Moodies Group (3). Meteorite impacts most likely caused physical change of Moodies oceans (1). In addition, the radical redox change of local environments could be caused by the meteorite impact by production of oxidized species by meteorite/water interactions (4). Those physical and chemical change may have influenced on the local microbial activities associated with BIFs depositions, although it is difficult to specify if oxygenic or anoxygenic photosynthesizers were active when BIFs deposited.

References: (1) Drabon et al. (2024) PNAS 121,No.44; (2) Heubeck et al. (2024) Sci.Drill., 33, 129-172;;(3) Suzumeji et al. (2024) Prec.Res.413, 107574; (4) Nakazawa et al. (2005) EPSL 235, 356-360