Geological and geochemical study of banded iron formation in the Fig Tree Group at Eureka Syncline area, Barberton Greenstone Belt, South Africa

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Introduction

Radical change of lithology of ca. 3.2 Ga Fig Tree Group changed is corresponded to rapid change of sedimentary environments. It is unclear as to how microbial ecosystem responded to such environmental change in the Fig Tree Group. In order to approach this problem, geological survey was performed on banded iron formations (BIFs) and associated sedimentary rocks of the Fig Tree Group in Eureka Syncline area. Eight different banded iron formations and black cherts, which belong to Belvue Road Formation, were identified around Waggon Road Au Mine. Shale and sandstone of Sheba Formation are underlying these BIFs concordantly.

Result and discussion

Siderite is abundant in examined BIFs and cherts. Siderite was most likely diagenetic mineral, because relatively large grain size (30-200 μm). On the other hand, euhedral hematite crystals (< 5 μm), which were protected by microcrystalline quartz, were found, implying the possibility of preserved primary oxides. Sulfide minerals, such as pyrite and arsenopyrite, are more abundant in Sheba Formation as ferrugineous minerals. Chalcopyrite and sphalerite rich black shale is also found near Sheba Mine area in the same Sheba Formation. Common occurrence of these sulfides in Sheba Formation suggests sedimentation of black shale was taking place under the influence of submarine hydrothermal activities. Concentrations of organic carbon in Sheba Formation are from 0.05 to 0.50 wt %. Their $\delta^{13}C$ values range from −27.7 to −24.1 ‰ (PDB). Black cherts in Belvue Road Formation contain organic carbon from 0.03 to 0.13 wt %. Thier $\delta^{13}C$ values are more variavle (−30.1 to −17.5 ‰(PDB)), compared to those of Sheba Formation. This probably indicates more diverse microbial activities during sedimentation of Belvue Road Formation. Nitrogen isotope compositions of kerogen in Belvue Road Formation range from 2.1 to 2.6 per mil, implying microbial nitrogen-fixing and/or denitrification.