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Reconstruction of 3.2Ga Ocean Floor Environment Using Magnetic Susceptibility and Carbon Istope , from Mapepe Formation

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Introduction

The Mapepe Formation (Heinrich,1980) is the lowermost part of the Fig Tree Group in the Barberton Greenstone belt, and its sedimentary age of single zircon U-Pb datings is 3260 to 3230 Ma (Kroner et al. 1991). Komati section is located along the Komati River near the border to Swaziland. This section preserved more than 300m-long continuous outcrop and consists of well-stratified sedimentary sequence with bedded chart and shale. We performed 1/100 scale geologic mapping to identify stratigraphic continuity. The Komati section is divided into 6 units (B1-, B2-, C-, D1-, D2- and E-unit) bounded by the deformed zones. Thickness of each unit is 6.8m, 45m, 22.8m, 19m, 5.7m and 23m, respectively. Total thickness of the studied reaches 128m.

Lithology

The studied section may be divided into the following four rock types. 1) white chart (massive); 2) red chart: It consists of laminated, red-colored bedded chart and white-red chart that changes its color from white to red with sharp boundary and partly with podded structure. 3) black shale: It consists of massive one and laminated one and gradational shale that changes its color from black to red-brown. 4) red-brown (ferruginous) shale. In each unit, the red-brown shale amounts to 62%, white chart 17%, red chart 12% and black shale 9%. Red chart is increasing to the top at each unit.

Carbon isotope data

The total organic carbon content of black shale from all units is ranging between 0.10% and 16.12wt%, with an average of 2.54wt% (n=201), red shale between 0.23% and 0.96wt%, with an average of 0.61wt% (n=6), white chart between 0.01% to 0.06wt%, with an average of 0.12wt% (n=5).

Carbon isotope analyses of the black shale from all unit revealed negative delta13C values ranging between -38.84 per mil and -20.52 per mil, with an average of 26.84 per mil (n=201), red shale between -35.36 per mil and -23.76 per mil, with an average of -30.88 per mil (n=6), white chart between -24.96 per mil and -19.58 per mil, with an average of -23.25 per mil (n=5). Following stratigraphy, the average delta13C values vary to negative, -25.10 per mil (n=40) at B unit, -26.59 per mil (n=60) at C unit, -26.03 per mil (n=44) at D unit, and -28.81 (n=56) at E unit. The red-colored rock of green-red shale has negative value of carbon isotope relative to green-colored rock (˜-5 per mil, n=2).

The average delta13C of massive shale is -24.11 per mil (n=10) and the one of laminated shale is -28.01 per mil (n=24).

Magnetic susceptibility data

Magnetic susceptibility; mag-sus (k) is measure of the degree of mineralization for a material in response to applied magnetic field. In this study, we measured magnetic susceptibility at two ways. 1) Vertical sections: To understand stratigraphic variation, we measured two times of the whole stratigraphic vertical section (total 128m thick) at 3cm intervals. 2) Horizontal sections: To understand horizontal variation in each bed, we measured 4m along in each bed, and totally 83 beds from all units.

The mag-sus both of white chart and black shale is very low (k=˜1.0∗10-3). Red chart and ferruginous shale mag-sus is varying between 1.0∗10-3˜420∗10-3. Especially, there is the continuous high mag-sus (k=100∗10-3˜) alteration of bedded red chart and magnetite zone at the top of D1 unit, the thickness is 9.00m. The mag?sus of podded red chart is increasing to the top.

Conclusion

1)There are gradational shale all over the 6 units with no reverse pattern. This suggests that the units are not reverse.

2)The delta13C value of laminated shale is more low relative to the that of massive shale. This suggests that the thin black shale between laminas has low delta13C value.

3)the ratio of red chart and the mag-sus of podded red chart is increasing to the top. This suggests that the precipitation of iron is increasing to the top, and there is the sedimentation of magnetite at the top.

Keywords: Barberton, magnetic susceptibility, organic carbon isotope