Biomarker evidence for the Neoproterozoic marine redox condition in South China

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An important increase in atmospheric oxygen appears to have taken place during the late Neoproterozoic period [1, 2]. This increase may have stimulated the evolution of macroscopic multicellular animals [1, 3] and may have led to oxygenation of the deep ocean [4].

In order to understand more about the ocean oxygenation process during the Neoproterozoic period, a core spanning 450m of stratigraphic section across Cryogenian Datangpo Fm. and Nantuo Fm., Edicarian Doushantuo Fm. and Dengying Fm., and early Cambrian Niutitang Fm. (ca. 663–518 Ma), was drilled at Xiushan in South China. The paleogeographic reconstruction suggests that Xiushan region was located at the outershelf margin to slope in the central Yangtze platform of South China [5]. Here we report a secular change in biomarker and C_{org}- and C_{carb}-isotopic compositions based on this drillcore section, which aims to reveal the difference in organic matter sedimentation and marine redox condition between the interglacial Datangpo Fm. and postglacial Doushantuo Fm., and the difference between the outershelf-slope facies Doushantuo Fm. at Xiushan region and the innershelf basin facies at the Jiulongwan section.

Organic geochemical evidence shows that the Datangpo Member I and II could deposit in dysoxic and oxic condition, respectively. It means that the Datangpo Member I black shale was likely not deposited in an anoxic or euxinic condition as suggested before [6]. Obvious difference in Doushantuo biomarker assembly occurs between Xiushan region (outershelf–slope) and the Jiulongwan section (innershelf basin), which may have been caused by differential redox conditions or depositing processes of organic matters. Our data support the idea that the reconstruction of the redox condition in Cryogenian and Edicaran oceans should be based on approaches from various facies ranging from shallow marine shelf to deep marine basin [5, 7].

[1] Fike *et al*. (2006) *Nature* **444**, 744–747. [2] Canfield *et al*. (2007) *Science* **315**, 92–95. [3] McFadden *et al*. (2008) *PNAS* **105**, 3197–3202. [4] Rothman *et al*. (2003) ***PNAS*** 100, 8124–8129. [5] Jiang *et al*. (2011) *Gondwana Res*. **19**, 831–849. [6] Li *et al*. (2012) *EPSL* **331–332**, 246–256. [7] Zhu *et al*. (2007) *PPP* **254**, 7–61.

Interaction of Bioavailability of Soil Heavy Metals in Black Soil Region of Central Jilin Province

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Heavy metal, which endangers ecological environment directly and brings indirect harm by affecting the bioavailability of soil nutrients, is an important substance resulting in soil pollution and degradation. Correspondently, nutrient elements in soil also affect the eco-environmental impacts of heavy metals. Thus, the interaction between heavy metals and nutrient elements, as a new aspect of pollution ecology of heavy metals, is important for maintaining ecological balance.

In present study, it is analyzed that the total and bioavailability contents of heavy metals (Cr, Cd, Cu, Zn, Ni, As) and the contents of major nutrient elements (P, K, Ca, Mg, Fe, B) for 61 surface soil samples in black soil region of central Jilin province, NE China. The bioavailability characteristics of heavy metals are recognized according to the effective coefficients of soil elements (available contents of elements in soil accounting for total amounts). And the effective coefficient correlations for different heavy metal as well as the heavy metals and nutrient elements are calculated by SPSS (Ver. 13.0).

The obtained results indicate that all the following effective coefficient correlations are obvious positive, (1) Cd and Zn with the other heavy metals, (2) Cr with As, Cd, Zn and Ni, (3) Ni with Cr, Cd and Zn, (4) As with the Cr, Cd, Cu and Zn. These findings indicate that the bioavailability conversion of heavy metals have promoting effect to each other in study area.

Remarkably, the effective coefficients of six heavy metals show obvious positive correlations with P, which is consistent with the major standpoint about the interaction between P and heavy metals in soil, implying that the effective content of P plays a role in promoting the activation of heavy metals. Additionally, these results indicate that the following effective coefficient correlations also exhibit obvious positive, (1) micronutrient element B and Fe with As, Cu and Zn, (2) between Fe and Cr, (3) Mg with Cr, Ni and Zn. However, the effective coefficient of Ca has obvious positive correlations with heavy metals except Cu. And the correlations between the effective coefficients of K and As exhibits obviously negative.

In short, study on interaction of bioavailability of elements provides insights to understand the black soil degradation mechanism, prevent heavy metal pollution, balance the nutrients, and strengthen management of the black soil resource.

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