Chemical weathering of large river catchments in China and the global carbon cycle

WEIHUA WU [1*], HONGBO ZHENG [1], JIEDONG YANG [2] AND CHAO LUO [1]

[1] Institute of Surficial Geochemistry, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210093, China. wuwh@nju.edu.cn (* presenting author)
[2] Center of Modern Analysis, Nanjing University, Nanjing 210093, China.

Analyzing chemical compositions of river waters, rain waters, sediments, and rocks of large river catchments in China and combining with hydrological information, we use the forward model to generally assess the chemical weathering rates and capacity and mechanism of the atmospheric CO_2 consumption, and discuss the variation trend of chemical weathering and their controlling factors in different environments of climate, lithology, topography, and vegetation. The atmospheric CO_2 consumptions derived from silicate and carbonate weathering are 421~ 627×10^9 mol/y and 1323×10^9~ 2025×10^9 mol/y, which accounts for about 4.8 ~ 7.1 % and 11.1 ~ 16.1 % of the total consumption from the global rivers, respectively. The results show that China as a country of karst wide distribution, the influence of carbonate weathering on the global carbon cycle is more important. The atmospheric CO_2 consumptions from silicate and carbonate weathering in the Yangtze River, Yellow River, and Pearl River catchments account for about 2/3 and 90 % of river catchments in China.

By comparing the characteristics of chemical weathering in some small river catchments draining the typical silicate rock regions, the Nandujiang River flowing on basalt formations in tropical climate zone has the highest silicate weathering rates (7.2×10^5 mol/km^{2}a), and followed by the Beijiang River (6.99×10^5 mol/km^{2}a) and Dongjiang River (5.39×10^5 mol/km^{2}a) flowing on granite formations in tropical climate zone, which close to those rivers in New Guinea near the equator. Under similar lithology conditions, atmospheric CO_2 consumption rates have positive correlation with temperature and rainfall and negative correlation with elevation.

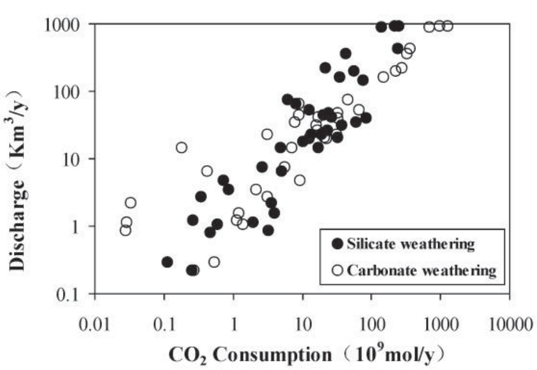

Figure 1: Scatter plots of atmospheric CO_2 consumptions resulted from silicate and carbonate weathering vs. water discharge. Good positive correlation indicates that discharge is an important factor affecting CO_2 consumption flux.

Biomineralization of deep-sea iron reducing bacteria *Shewanella piezotolerans* WP3

WENFANG WU [1,2*], YONGXIN PAN [1,2]

[1] Key Laboratory of the Earth's Deep Interior, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
[2] Franco-Chinese Biomineralization and Nano-Structures Laboratory, Chinese Academy of Sciences, Beijing 100029, China
wuwenfang@mail.iggcas.ac.cn(* presenting author)
yxpan@mail.iggcas.ac.cn

Introduction

Iron reducing bacteria (IRB) that can utilize Fe(III) as its terminal electron acceptor are ubiquitously distributed on earth surface and subsurface. They are of great significance in iron biogeochemical cycling, environmental bio-remediation and magnetic nanoparticle bio-synthesis. However, the biomineralization of deep-sea IRB is rarely studied, whereas the deep-sea environment is quite different, for example, dark, microaerobic or anaerobic, oligotrophic. Besides, bacteria live in deep sea often tolerate great high hydrostatic pressure and quite low temperature, which can exert great influence on microbes.

Here we investigated the laboratory iron reduction and biomineralization behavior of a deep-sea IRB *Shewanella piezotolerans* WP3 under various hydrostatic pressures (0.1, 5, 10, 20 and 50 MPa) at 4°C and 20°C, in the aim of understanding pressure and temperature effects on microbial mineralization.

Results and Conclusion

S. piezotolerans WP3 was isolated from West Pacific deep-sea sediments at a water depth of ~1,914 m. It is a Gram-negative, facultative anaerobic psychrotolerant and piezotolerant bacterium, highly adaptive to dynamic environments. Ferrihydrite was quickly reduced by *S. piezotolerans* WP3 with an initial iron reduction rate of 175 μM/h at 20°C and 0.1 MPa. During iron bio-reduction, the pH increased while the Eh (redox potential) decreased greatly, which were favorable for magnetite formation and precipitation. During biomineralization, room-temp and low-temp magnetic parameters (e.g., M_s, M_{rs}, B_{cr}, B_c and T_p) of the bio-products changed systematically, corresponding to the mineral transformation from ferrihydrite to magnetite. The final bio-products are well crystalline superparamagnetic magnetite nanoparticles (<10 nm) [1].

Under all the tested pressures *S. piezotolerans* WP3 can reduce ferrihydrite and induce magnetite biomineralization. A slower iron reduction and magnetite formation accompany with diminished cell growth were observed at elevated pressures. Under the same pressure, it was slower at 4°C for the iron bio-reduction and mineralization as well as the cell growth than that at 20°C. Low-temp magnetic characterization showed a smaller average particle size for the magnetite biominerals at either higher pressure or lower temperature.

As *S. piezotolerans* WP3 can reduce Fe(III) and mediated magnetite biomineralization at high hydrostatic pressure and low temperature, this study suggests that IRB like WP3 can play an important role in deep-sea iron cycling and sedimentary magnetism that we might have previously overlooked.

[1] Wu et al. (2011) *J. Geophys. Res.* **116**, G04034.