

## Oxidation of pyrite in anoxic aquifers in the presence of nitrate

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Denitrification coupled to pyrite oxidation has been observed in many groundwater aquifers, although a direct reaction between nitrate and pyrite can not be detected [1, 2]. Our understanding of the mechanisms of this redox process is, however, still limited. Since Fe(II) is detected as a well-known oxidant for pyrite in the presence of oxygen even at neutral pH [3], we postulate that electron transfer is being mediated through this reaction also in the presence of nitrate as terminal electron acceptor. Microbial catalysis by bacteria, such as Fe(II) oxidizing or sulfide reducing bacteria, is considered to affect the denitrification and pyrite oxidation rates significantly. Therefore, bacteria are supposed to mediate the electron transfer from pyrite to nitrate.

The goal of the work is to understand the mechanism of the anaerobic oxidation of pyrite coupled to nitrate reduction in anoxic groundwater sediments. To this end batch experiments have been set up in which synthesized pyrite is exposed to nitrate-dependent Fe(II)-oxidizer strain *BoFeNI* [4] and nitrate-reducing Fe(II)- and sulfide-oxidizing bacteria--*Thiobacillus denitrificans* [5] testing kinetics of this process--the effect of initial concentration of pyrite and nitrate.

### Results

Pyrite was oxidized with nitrate by *Thiobacillus denitrificans*, but not by *BoFeNI*. The reaction rate is dependent on the initial conc. of nitrate, in contrast, the initial conc. of pyrite did not show any effect of the rate.

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## Petrogenesis of the Mesozoic intermediate intrusive rocks in the central North China Craton: Constraints from zircon U–Pb chronology and geochemistry

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The nature of the Mesozoic lithospheric mantle in the central North China Craton (NCC) is the key for us to reveal the mechanism of the NCC destruction [1]. However, LA–ICP–MS zircon U–Pb ages and whole rock geochemical data of the Mesozoic alkaline intrusive rocks, including quartz syenite and quartz monzonite, from the Shuiye, Huyanshan, Wanrong, and Erfengshan intrusions in the Shanxi and Henan provinces, central North China, provide insights for the nature of the Mesozoic lithospheric mantle beneath the central NCC.

The analyzed zircons show typical oscillatory growth zoning and striped absorption in CL images, indicating a magmatic origin. LA–ICP–MS zircon U–Pb dating results indicate that the Shuiye, Huyanshan, Wanrong, and Erfengshan quartz syenite – quartz monzonite intrusions formed in the Early Cretaceous [2], i.e., their weighted mean <sup>206</sup>Pb/<sup>238</sup>U ages being 130±5 Ma, 130±3 Ma, 125±2 Ma, and 127±2 Ma, respectively. Several inherited zircon cores yield Paleoproterozoic to Neoproterozoic ages of 1791 Ma, 2088 Ma, 2208 Ma, 2339 Ma, and 2559 Ma, indicating the presence of Paleoproterozoic and Neoproterozoic lower crustal basement rocks of the NCC.

These quartz syenite – quartz monzonite, together with the contemporaneous Huanglongnao nepheline syenite and Taershan quartz syenite [3], have SiO<sub>2</sub> = 59.42 ~ 64.98 wt%, MgO = 0.21 ~ 1.38 wt% (Mg<sup>#</sup> = 21 ~ 45), and (Na<sub>2</sub>O+K<sub>2</sub>O) = 7.45 ~ 14.38 wt%. They are enriched in large ion lithophile elements (e.g., Rb, Ba, Sr, and K) and light rare earth elements, depleted in high field strength elements (e.g., Nb, Ta, Zr, Hf, and Ti) and heavy rare earth elements, and display prominent positive Pb anomalies. The initial <sup>87</sup>Sr/<sup>86</sup>Sr ratios and ε<sub>Nd</sub> (130 Ma) values of the Mesozoic intermediate intrusive rocks in the central NCC range from 0.7031 ~ 0.7062 and –13.3 ~ –20.0, respectively.

Based on the presence of the Paleoproterozoic and Neoproterozoic inherited zircons, whole rock Sr–Nd isotopic compositions, and their prominent positive Pb anomalies, we propose that the primary magma for these Mesozoic intermediate intrusive rocks could be mainly derived from partial melting of an enriched lithospheric mantle modified by the delaminated NCC lower crust. The Early Cretaceous quartz syenite – quartz monzonite intrusions in the Shanxi and Henan provinces could form under an extensional environment related to the subduction of the Paleo-Pacific plate beneath the Eurasian continent.

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