

## The origin and Sulphur characteristics of Early Cambrian barite deposits in East Guizhou, China

F. XIA<sup>1,2</sup>, J.-Y. PAN<sup>1,2</sup>, F. XIA<sup>3</sup>, D.-S. MA<sup>2</sup>, F.-S. GUO<sup>1</sup>,  
AND Z.-X. SUN<sup>1</sup>

<sup>1</sup>Key Laboratory for Nuclear Resources and Environmental Research of Ministry of Education, East China Institute of Technology, Nanchang 330013, China (xf730@163.com)

<sup>2</sup>State Key Laboratory for Mineral Deposits Research, Department of Earth Sciences, Nanjing University, Nanjing 210093, China (jypan@nju.edu.cn)

<sup>3</sup>Shanghai Environmental Monitoring Centre, Shanghai 200030, China (xiahoufan@sohu.com)

### Geological Setting

The Lower Cambrian black shale sequence of the Niutitang Formation in southeast Guizhou China hosts a barite layer. The ore-bearing rock series is composed of black silicalite, carbonaceous shale interbedded with phosphorite, barite and carbonaceous shale in ascending sequence. The stratified main ore bodies, partially in lenticular form, are dominantly embodied in the silicalite and black shale of the lower section of the Niutitang Fm. of the early Cambrian.

### Discussion of Results

Systematic samplings for the analysis of sulphur by isotope mass spectrometry were taken in the Dahebian barite deposit in Tianzhu County of Guizhou Province China. Samples of barite ore were analyzed using MAT-253 in the Key Laboratory for Nuclear Resources and Environmental Research of Ministry of Education, East China Institute of Technology.

Based on the analysis of sulphur by isotope mass spectrometry, the sulphur characteristics were reported for the barite deposits (Table 1). The study provides sulphur isotopic evidence for the submarine hydrothermal exhalative genesis of Dahebian and Xinhuan barite deposits.

Sample No	DHB-4	DHB-5	DHB-6	DHB-7	GT-4	GT-6	GT-8	GT-10	TZ-12	TZ-27
$\delta^{34}\text{S}(\text{‰})$	40.85	37.27	36.73	39.10	41.43	40.94	41.5	40.90	33.86	40.89

**Table 1:** The sulphur characteristics in Dahebian and Xinhuan barite deposits ( $\delta^{34}\text{S}$  (‰)).

This research was jointly supported by the State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences (Grant No. GPMR0508) and the Key Laboratory for Nuclear Resources and Environmental Research of Ministry of Education Foundation of China (Grant No. 060608).

## Geochemistry and petrogenesis of Hulu Ni–Cu-bearing mafic-ultramafic intrusions, Eastern Xinjiang, Northwest China

MINGZHE XIA\*, CHANGYI JIANG, ZHUANGZHI QIAN,  
TAO SUN, ZHAODE XIA AND RONGHUI LU

Department of Earth Sciences, Chang'an University, Xi'an 710054, China (\*correspondence: xzm23199@163.com)

The Hulu intrusions is one of the typical magmatic Cu-Ni deposits related to mafic-ultramafic magmatism, in Jueluotage orogenic belt, the eastern of Xinjiang, China. The intrusions consist of diorites, gabbro-diorites, pyroxenite, olivine pyroxenite, hornblendite peridotite. They are enriched in light rare earth elements ((La/Yb)  $n=2.02-3.08$ ) and LIL elements (Rb, Ba, Th, U) and depleted in high field strength elements (Nb, Ta Ti), with a weak Eu ( $\delta\text{Eu}=0.8-1.3$ ) anomaly. Similar REE patterns indicate that they are the product of fractionation from the same primary magma. Petrography, lithochemistry and crystal chemistry of petrogenetic minerals suggest they experienced fractional crystallization of olivine, clinopyroxene, orthopyroxene, plagioclase. The rocks exhibit  $\epsilon\text{Nd}$  values (+ 5.3 to + 6.0),  $^{87}\text{Sr}/^{86}\text{Sr}$  values (0.704062 to 0.704893), and Pb isotopic compositions ( $^{206}\text{Pb}/^{204}\text{Pb}=18.09-18.51$ ;  $^{207}\text{Pb}/^{204}\text{Pb} = 15.46-15.53$ ;  $^{208}\text{Pb}/^{204}\text{Pb}= 37.53-38.13$ ). These geochemical characteristics suggest they have been derived from a depleted asthenospheric mantle source that was previously contaminated by subduction of oceanic crust. Therefore, contamination by a small amount of subducted-related components and fractional crystallization play an important role in the Ni–Cu–(PGE) mineralization.

This work is financially supported by the National Natural Science Foundation of China (Grant No.40534020).

## Health risk of Cadmium: A hidden health killer in areas of coal-combustion related fluorosis?

T. XIAO<sup>1\*</sup>, J. TANG<sup>1,2</sup>, J. LEI<sup>2</sup> AND F. YANG<sup>1,3</sup>

<sup>1</sup>State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, 550002, China

(\*correspondence: xiaotangfu@vip.gyig.ac.cn)

<sup>2</sup>Sichuan Southeast Geological Survey, Chongqing, 400038, China

<sup>3</sup>Graduate School of the Chinese Academy of Sciences, Beijing, 100039, China

Coal-combustion related chronic fluorine toxication, a specific endemic disease occurred in China, has been causing serious health problems with teeth and bone damages in the Three Gorges region, China, which was attributed for the intake of elevated levels of fluoride emitted through domestic combustion of high fluorine coal, often without stoves or chimneys in the house. However, recent epidemical study found that the fluorosis in the coal-combustion related endemic disease areas in Three Gorges region was not significantly alleviated, but in some specific areas, the number of population with symptom of fluorosis, i.e. teeth and bone problems, showed increasing tendency. Our recent study found that the endemic disease areas showed high cadmium (Cd) concentrations in the environment and in the urine and hair substrates of the local population. We determined high concentrations of Cd in the local black shales (77.3-212.2 ppm), domestic coals (11.5-54.5 ppm) and arable soils (1.07-59.7 ppm), showing obvious geochemical anomaly. The high Cd in the local environment also contributed to high Cd in the local human substrates, i.e. 6.73 ppm in hair and 5.1 µg/L in urine on average.

The studies for toxicological effects of F and Cd on human demonstrated that the patients suffered from F and Cd toxication had similar clinical symptom, such as yellow macula on teeth and body bone damages, although the symptoms occurred different extents each other due to diverse exposures and nutritional conditions. Therefore, we hypothesized that Cd is a hidden health killer to affect the local endemic disease of the coal-combustion related fluorosis. Our hypothesis was supported by the recent epidemical finding (2003-2007) that the fluorosis in the coal-combustion related endemic disease areas in Three Gorges region was not significantly alleviated but the size of epidemical areas tended to be more overspreading. Therefore, it is significant to further understand and pinpoint the health risk for a better prevention of the local endemic disease.

## Zircon SHRIMP U-Pb dating of Echeng granite in the southeastern Hubei, MLYB, Eastern China

GUIQING XIE<sup>1,2</sup> AND JINGWEN MAO<sup>1</sup>

<sup>1</sup>State Key Laboratory of Geological Process and Mineral Recourse, China University of Geosciences, Beijing, 100083, China (guiqingxie@sohu.com)

<sup>2</sup>Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing, 100037, China

The MLYRB represents one of the most important economic mineral districts in China [1]. Late Mesozoic granitoids occupy approximately 17% of the area in the southeastern Hubei, in which the granites originated from somewhat deeper source than that porphyry quartz diorite and monzonite intrusions, and were dominantly emplaced in a lithospheric thinning tectonic regime [2]. The timing of these granites has not been well constrained and we present new Zircon SHRIMP U-Pb age for Echeng granite to constrain the timing of these granites.

The Echeng granitoid intruded a Late Triassic, intercalated sandstone-carbonate sequence and consists predominantly of granitic, and subordinate quartz diorite and monzonite phases. The granites are composed of K-feldspar (45 ~ 55%), plagioclase (13 ~ 18%), quartz (30 ~ 35%) and rare biotite, as well as accessory minerals such as zircon, titanite, magnetite and apatite. Sample preparation and the detailed analytical procedure were undertaken on SHRIMP II at the Beijing Ion Probe Center, CAGS.

The <sup>206</sup>Pb/<sup>238</sup>U apparent ages of 16 zircon grains in this study range between 105.6± 6.4 Ma and 136.8± 3.6 Ma. Apart from the exception of two spots, the apparent ages of the other 14 spots are plotted with the inverse <sup>238</sup>U/<sup>206</sup>Pb - <sup>207</sup>Pb/<sup>206</sup>Pb U-Pb concordia diagram, and the weight average <sup>206</sup>Pb/<sup>238</sup>U age of 121.2 ± 3.1Ma was acquired. This result indicates that the Echeng granite emplaced during the Cretaceous period.

This work was supported jointly by the National Science Foundation of China (40434011, 40402011), National Basic Research Program of China (2007CB41107, 2007CB41105) and China Postdoctoral Science Foundation

[1] Pan *et al.* (1999) *Ore Geology Reviews* **15**, 177- 242.

[2] Xie *et al.* (2008) *Lithos*, oi:10.1016/j.lithos. 2007.12.008.

## Pyrite Re-Os dating from the Xinqiao Cu-S-Fe-Au deposit in Tongling area, East China

J.C. XIE<sup>1,2</sup> AND X.Y. YANG<sup>1,2\*</sup>

<sup>1</sup>CAS Key Laboratory of Crust-Mantle Materials and Environments, School of Earth and Space Sciences, University Science and Technology of China, Hefei 230026, China (\*correspondence: xyang@ustc.edu.cn)

<sup>2</sup>Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an, 710069, China

The Tongling region of Anhui Province is an important ore district of the famous Middle-Lower Yangtze Cu-Au-Fe-S metallogenic belt in east China. The Cu-S-Fe-Au deposit at Xinqiao is situated 24 km east of Tongling. It is a large-scale polymetallic deposit with drilling indicated reserves of 0.5 million tonnes of Cu averaging 0.71%, 75.5 million tonnes of S averaging 29.3% and 24.9 million tonnes of Fe averaging 46%, as well as 11.2 tonnes of Au averaging at 4.7g/tonnes. There are two major mineralization types in the Xinqiao deposit: the significant stratiform orebody hosted in the Carboniferous and skarn-type mineralization related with the Yanshanian quartz diorite. The origin of the Xinqiao deposit has been discussed by precious workers since its discovery, with views varying from the magmatic hydrothermal deposit, through skarn-type deposit, to hydrothermally modified sedimentary deposit, so the isotopic precise dating for ore and quartz diorite is very important to understand its genesis.

In this study, 12 pyrite samples from pyrite ore were collected for Re-Os precise dating. These pyrite samples were analyzed by the ICP-MS method in National Research Center of Geoanalysis, Chinese Academy of Geological Sciences. The <sup>187</sup>Re/<sup>188</sup>Os and <sup>187</sup>Os/<sup>188</sup>Os values on the 12 samples by the ICP-MS method yield 4414±131 to 18338±879 and 12.0±1.04 to 65.1±1.04, respectively. The isochron age calculated with the ISOPLOT is 126±11 Ma with an initial Os ratio of 1.2±1.9 (MSWD=2.6). We believe the age represents the ore-forming time of the Cu-S-Fe-Au deposit, which indicates that the Yanshanian magmatism is of great significance for polymetallic mineralization in the district.

This study is supported by Chinese Ministry of Science and Technology (2006CB403500).

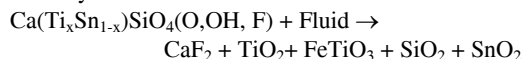
## Crystal-chemical constraints on Sn-accumulation capability of titanite from Qitianling granite, Hunan province, China

L. XIE, R.C. WANG AND D.Z. WANG

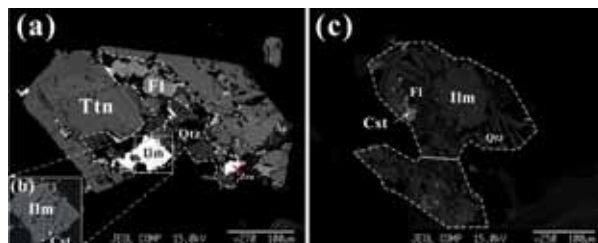
State Key Laboratory for Mineral Deposits Research (Nanjing University), Department of Earth Sciences, Nanjing 210093, China (xielei@nju.edu.cn)

Titanite, CaTiSiO<sub>4</sub>(O,OH,F), occurs in a variety of types of rocks, especially in calc-alkaline granites. It is a scavenger for trace elements, such as Nb, Sn, Ta, Y, U, REEs, etc. In this study, we suggested that the titanite is an important Sn-rich mineral except for cassiterite in Qitianling granite, which is a super-large granite-related tin deposit recently found in Hunan province (China). We present tin transference and accumulation by alternation of primary magmatic titanite grains in hydrothermal stage.

Abundant primary magmatic titanite grains are idiomorphic, ranging ca. 100-400 μm in size, and generally displaying zoned textures. EMPA analytical results indicate that it contains 0.15-1.12 wt.% SnO<sub>2</sub> (the average value is 0.345 wt.% based on 29 data). During the hydrothermal stage, Sn-rich titanite was replaced by mineral assemblage, which includes flourite, ilmenite, rutile, quartz and cassiterite micro-inclusions (Fig. 1a and b). Consequently, such minerals entirely replaced titanite, and preserved the idiomorphic shape of primary titanites (Fig. 1c). Thus, it is inferred that mineral assemblages are products of the primary Sn-rich titanite mediated by fluids:



The reaction allowed tin to activate and transfer from the titanite, and then to accumulate in forming cassiterite. It may be a very important mineralogical criterion for tin exploration.



**Figure 1:** Primary magmatic titanite (Ttn) was (a) partly and (c) entirely replaced by mineral assemblage during the different hydrothermal stages. The mineral assemblage includes ilmenite (Ilm) + flourite (Fl) + quartz (Qtz) + cassiterite (Cst).

This work is financially supported by the National Natural Science Foundation of China (Grant No. 40730423).

## **Analysis of Sr and Pb isotope ratios in wine by MC-ICP-MS**

Q. XIE, N. HASSAN, H. HINTELMANN, D. EVANS AND P. DILLON

Worsford Water Quality Centre, Trent University,  
Peterborough, K9J 7B8, Canada

A method has been developed for high precision analysis of Pb and Sr isotope ratios in wine. The method involves microwave digestion of wine, separation of Pb and Sr from the matrix using a single ion exchange column, and analysis of isotope ratios using a Neptune MC-ICP-MS. We will present the experimental details and preliminary data for an EU wine standard. We will also discuss the precision and accuracy of the isotope ratio measurement. The method has potential applications in areas such as food and beverage authentication. In recent years, more and more faked Canadian ice wines have been marketed overseas, which has become a serious trade issue. Isotope ratios, such as Sr and Pb isotopes, are potentially a powerful tool to distinguish foods and beverages from different geographic regions, due to the differences in soil and water chemistry of the regions, where the produce is grown.

## **Lipid biomarker reconstruction of phytoplankton productivity in the northern Okinawa Trough during the last 92 kyr**

L. XING<sup>1\*</sup>, M.X. ZHAO<sup>2</sup>, H.L. ZHANG<sup>1</sup>, Y.G. LIU<sup>3</sup> AND X.F. SHI<sup>3</sup>

<sup>1</sup>Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, Ocean University of China, Qingdao 266100, China  
(\*correspondence: xinglei@ouc.edu.cn)

<sup>2</sup>School of Ocean and Earth Science, Tongji University, Shanghai 200092, China (maxzhao@mail.tongji.edu.cn)

<sup>3</sup>Key Laboratory of marine Sedimentology and Environmental Geology, State Oceanic Administration, First Institute of Oceanography, Qingdao 266061, China

Biomarkers have been widely used to reconstruct phytoplankton productivity and community structure changes, and this method has been applied in the northern Okinawa Trough of the western Pacific. We report 92 kyr high-resolution molecular records of alkenones, brassicasterol, dinosterol and *n*-alkanols in core CSH-1 (31°13.73'N, 128°43.37'E; 703 m water depth). The alkenone sea surface temperature record shows a glacial-interglacial change of 4°C, consistent with previous results. Haptophyte productivity, as indicated by alkenone content, reveals a general decreasing trend for the last 92 kyr, however, haptophyte productivity was slightly higher during the glacial than during the interglacial, for example, MIS 4 was higher than MIS 3 while MIS 2 was higher than the Holocene. Diatom and dinoflagellate productivities, as indicated by brassicasterol and dinosterol content respectively, generally co-vary and reveal a clear glacial-interglacial pattern with higher values during the glacial. The increased productivity during the glacials was likely caused by the stronger winter monsoon. Also contributing to the higher productivity was increased nutrient supply from terrestrial sources due to lower sea-level, which is consistent with higher terrestrial biomarker (*n*-alkanols) content. Phytoplankton community structure reconstruction, represented by the biomarker ratios, indicates that the haptophyte contribution reached a maximum during MIS 5a and decreased significantly from 80 ka to 60 ka. Phytoplankton community structure remained relatively stable during the last 60 kyr.

## Study on experiment and a mechanism of utilization of calcite in phosphor removal from eutrophic water

HONG XU\*, JING ZHANG AND YIMING GAO

China University of Geosciences, 29# Xueyuanlu, Beijing 100083 (\*correspondence: hongx88@sohu.com)

### Experiment of Dephosphorization of Calcite

Experiment reagents and minerals :  $K_2HPO_4 \cdot 3H_2O$ , NaF,  $CaCl_2$ , Calcite (#160-#200). Firstly, we analyze the P-bearing solution at room temperature in order to study whether calcite has the function of dephosphorization or not, and its effect. Each group is same in concentration but different in additional material kinds. Compared with results of all groups, we can found that P concentration of solution in these groups that had added calcite crystal seed declined significantly. The P concentration could be dropped down to below 2.7mg/l and the lowest value is 0.247mg/l ; However, there is no change in P concentration of solution in the group1-1, 1-2 without addition of calcite. It is obviously that the addition of calcite crystal seed is beneficial to P precipitation in solution. Therefore, results of experiment show that calcite can promote the decrease of P concentration in water bodies. Attenuation rates of P concentration of solution is different: 88.48%, 69.94%, 12.68% when the initial P concentration of solution is 5mg/l, 3mg/l and 1mg/l respectively.

### Discussion and Results

The experimental results conducted by Dietfried Donnert and Manfred Saleker [1] or Li Zuyin, Lv Jialong [2] indicate that calcite can induce the precipitation of phosphorus high P concentration ( $\geq 20$  mg/l or 20-500 mg/l). In above mentioned experiment, initial phosphorus concentration is only 5.26mg/l, far below the P concentration in those dephosphorization experiments. This indicates that calcite still has dephosphorization in a low P concentration of solution. The result of TEM shows that the Ca-P precipitation of experiments is not crystalline and no phosphor precipitation occurs at the surface of calcite.

[1] Donnert & Saleker (1999) *Wat. Sci. Tech.* **40**, 195-202.

[2] Li & Lv (1995) *Soil* **6**,304-310 (in Chinese).

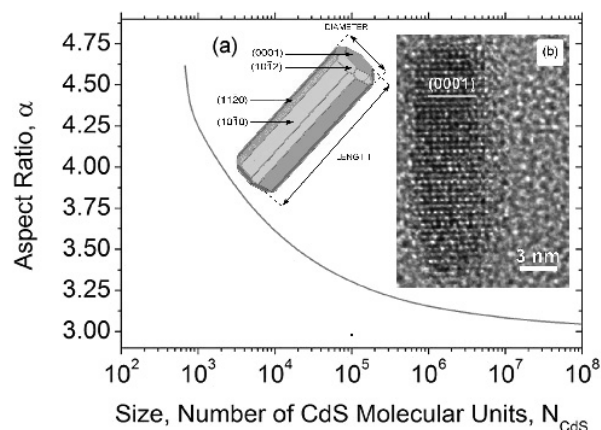
## Nano-minerals: Size-dependent crystal structure, shape and chemical reactivity changes

HUIFANG XU<sup>1</sup> AND AMANDA S. BARNARD<sup>2</sup>

<sup>1</sup>Department of Geology and Geophysics, University of Wisconsin, Madison, WI 53706, USA

<sup>2</sup>Department of Chemistry, University of Melbourne, Australia

Nano-phase minerals (or nano-minerals) are common in the earth environments, especially in the critical zone where the fluids meet the solid earth. The behaviors of nano-minerals are different from their macroscopic crystals. The size-dependent property of the nano-minerals is important for us to better understand geochemical processes in the earth system. Integrated experimental study and computer modeling will help us to know nano-crystals' properties and their formation processes. Both shape and size of nano-crystals will affect their stability and reactivity. In CdS (greenockite) nano-crystal system, aspect ratio of the stable crystal shape increases as the crystal size decreases [1]. Growth of the crystals through oriented attachment nano-crystals will result in very long 1-D crystal (nano-fiber) and 2-D nanoplate. In the zirconia system, thermodynamically unstable tetragonal phase becomes stable when the crystal size becomes small ( $< 13$  nm). The sized-dependent phase transition between the tetragonal and monoclinic (baddeleyite) structure also depends on crystal shapes [2].



**Figure 1:** HRTEM image and DFT calculation showing the calculated crystal shape and aspect ratio of CdS as function of size.

[1] Barnard & Xu (2007) *Journal of Physical Chemistry* **111**, 18112-18117. [2] Barnard *et al.* (2006) *Nanotechnology* **17**, 3039-3047.

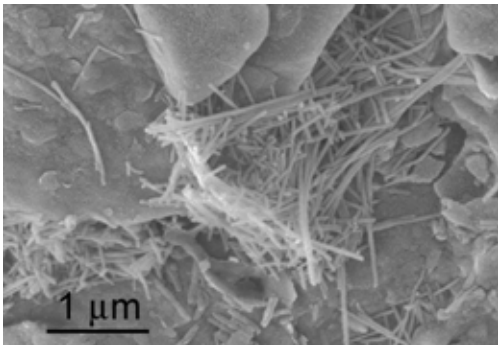
## Microbe-templated calcite nano-fibers in Chinese Loess Plateau: Potential carbon dioxide sinker

HUIFANG XU<sup>1</sup> AND T. CHEN<sup>2</sup>

<sup>1</sup>Department of Geology and Geophysics, University of Wisconsin, Madison, WI 53706, USA

<sup>2</sup>School of Natural Resources and Environmental Engineering, Hefei University of Technology, Hefei 230009, P.R. China

Burning fossil fuels is a major cause for global-warming and long-term climate change. The possibility of abrupt, near-future climate changes have attracted international attention, and resulted in growing interest in the development of carbon dioxide removal from atmosphere and alternative renewable energy resources. Carbonate minerals like calcite are natural buffers for equalizing carbon dioxide in the earth system. After systematically investigating calcite minerals in Chinese loess deposits, we have discovered that the calcite nano-fibers in Chinese Loess Plateau are well preserved in both modern and Quaternary loess deposits. The calcite nano-fibers are even well preserved in late Tertiary loess (red clay layers). Each calcite nano-fiber is a single crystal. The elongation direction is not parallel to *c*-axis. Calcite with unusual morphology is a bio-induced product. We propose that the calcite nano-fibers are formed through the interactions between pore water and nano-fibers of certain dead cell membranes (of cyanobacteria and fungi). Nano-fibers released from the dead cells form templates for controlling the calcite precipitation. The calcite formed through this process in the vast Chinese Loess Plateau area is a stable sinker for carbon dioxide.



**Figure 1:** SEM image showing an aggregate of calcite nano-fibers from modern loess. The associated minerals are clays.

This work is supported by NASA Astrobiology Institute (N07-5489) and Chinese Natural Science Foundation.

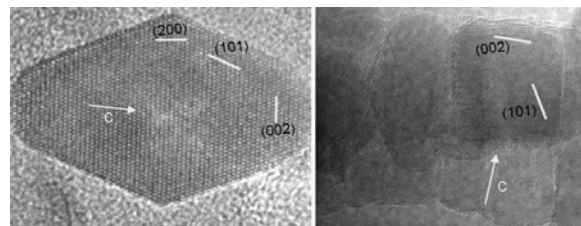
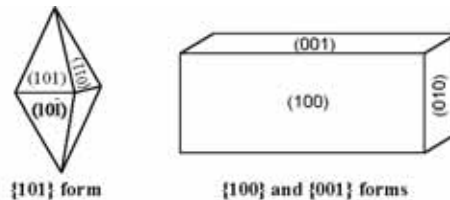
## Smart minerals for hydrogen production and environmental clean up using renewable solar energy

HUIFANG XU AND R.R. YEREDLA

Department of Geology and Geophysics, University of Wisconsin, Madison, WI 53706, USA

Energy and environment are two challenge issues we are facing today and will face in future. Production of hydrogen can be enhanced dramatically by intergrading photocatalyst titania with tourmaline micro-crystals that have electrical polarity. The electrical field produced by tourmaline can reduce the band bending, increase the chemical potential (EF) of the electrons in titania, and enhance the separation of photogenerated electrons and holes. All these factors promote hydrogen production from water [1].

In one crystal system, shape-controlled anatase crystals dominated by {001} and {100} forms display enhanced reactivity for both photosplitting of water and photocatalytic oxidation of organic pollutants (such as volatile organic compounds in air) using renewable solar energy [2]. The results have important implications for enhancing the photocatalytic activity of titania for environmental remediation, increasing the quantum efficiency in photo-voltaic (PV) solar cells and other photo-assisted processes.



**Figure 1:** Normal anatase crystal with tetragonal dipyrramids (left image and diagram). The elongated anatase crystal synthesized through topological replacement of titanate display shoebox-like shapes with crystal forms of {100} and {001} (right image and diagram).

[1] Yeredla & Xu (2008) *Journal of Physical Chemistry C* **112**(2), 532-539. [2] Yeredla & Xu (2008) *Nanotechnology* **19**, 055706.

## Impact of microbial activity on the fate of arsenic in offshore sediment

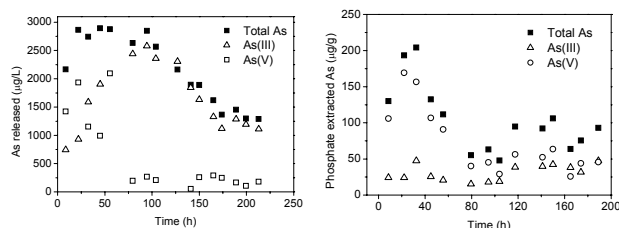
LIYING XU, Y. JIA\*, X. ZHANG AND R. PAN

Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, Liaoning, China, 110016

(\*correspondence: yongfeng.jia@iae.ac.cn)

The fate and bioavailability of the arsenic in offshore sediments are affected by microbial activities. The objective of this work was to study the impact of microbial activities on the fate of arsenic in offshore sediments.

The sediment sample was collected from Jinzhou Bay in Northeastern China. This bay is heavily polluted by a variety of toxic heavy metals due to the operation of a zinc smelter. The concentration of arsenic in the sediment was determined to be 718.5 µg/g. The sediment was dispersed in sea water spiked with lactate as carbon source at liquid/solid ratio of 100/1 (120 ml of sea water, 1.2 g of sediment). The slurry was incubated under anaerobic condition at 30°C. The concentration of released arsenic (total As, As(III) and As(V)) in aqueous phase was monitored with incubation time (Fig.1). The concentration of phosphate-extractable arsenic in solid was also determined (Fig. 2).



**Figure 1:** Concentration of released arsenic in aqueous phase.

**Figure 2:** Concentration of phosphate-extractable arsenic in solid.

There was a remarkable release of arsenic from the sediment as a result of incubation. The concentration of total As reached ~2900 µg/L after about 1 day, implying that about half of the arsenic in the sediment was released. Both As(V) and As(III) were released, but As(V) was microbially reduced to As(III) as showed in Fig.1. However, after ~4 day incubation, where nearly all aqueous arsenic was present as As(III), arsenic concentration decreased greatly indicating that arsenic was re-immobilized. Arsenic sulfide was probably formed since H<sub>2</sub>S was detected in the atmosphere of the incubation vials. The amount of phosphate-extractable As also decreased sharply with incubation time, suggesting that the adsorbed arsenic was largely transformed to less soluble arsenic minerals and/or released to aqueous phase due to microbial activities.

## Mesozoic lithospheric mantle of the Central North China craton: Evidence from peridotite xenoliths

WEN-LIANG XU<sup>1,2</sup>, D.B. YANG<sup>1</sup>, S. GAO<sup>2,3</sup>, Y. YU<sup>1</sup> AND F.P. PEI<sup>1</sup>

<sup>1</sup>College of Earth Sciences, Jilin University, Changchun 130061, China (xuw1@jlu.edu.cn, yangdebin@jlu.edu.cn, yuyangsmart2@163.com, peifp@sohu.com)

<sup>2</sup>State Key Lab of Continental Dynamics, Northwest University, Xi'an 710069 (xuw1@263.net, sga0@263.net)

<sup>3</sup>State Key Lab of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan 430074, China (sgao@263.net)

Peridotite xenoliths entrained by the early Cretaceous (125Ma) high-Mg diorites (Mg# = [Mg/(Mg+Fe<sup>2+</sup>)], 51-64) in the Taihang Mts provide insight into the nature of the Mesozoic lithospheric mantle in the central North China Craton (NCC). The peridotite xenoliths consist of chromite-bearing dunite, spinel-bearing harzburgite and lherzolite with tabular and metasomatic textures. Secondary amphibole and phlogopite can be found in them. Spinel (Cr# = 27-33) contacted with amphibole and phlogopite was replaced by chromite (Cr# = 41-65), while chromites in dunites have the highest Cr# (73-81). Mg# of olivines in dunite, harzburgite and lherzolite is 88-91, 92-93 and 91-93, respectively. CaO contents of olivines are less than 0.10%. The estimated equilibration temperatures for the dominant peridotite xenoliths range from 812 to 939°C (except for one sample, 1097°C) [1]. The peridotite xenoliths have low Al<sub>2</sub>O<sub>3</sub> (0.15-1.20%) and CaO contents (0.31-1.06%) and are characterized by enrichment in light rare earth elements and large ionic lithophile elements as well as Pb and U. Taken together, these results indicate that the peridotite xenoliths represent the residues remaining after the extraction of large degrees of polybaric melting and be late subjected to late modification by the infiltration of a hydrous melt. The harzburgite and lherzolite xenoliths have olivine Mg# similar to the Archean lithospheric mantle from the eastern block of the North China craton. We therefore suggest presence of Archean mantle beneath the central belt of the North China Craton in the Early Cretaceous.

[1] Wood & Banno (1973) *Contrib. Mineral. and Petrol.* **42**, 109-124.

## Exsolved magnetite and clinopyroxene in olivine from Haladala gabbro, west Tianshan, NW China

YUNXING XUE

School of Earth and Space Sciences, Peking University,  
Beijing 100871, China (yfzhu@pku.edu.cn)

Exsolution textures found in ophiolites and eclogites [1-4] are significant in understanding the geodynamics. The studied Haladala gabbro has intruded carboniferous volcanic strata. Obvious lithological zoning could be observed in planform; the inner is troctolite-olivine gabbro and the outer is gabbro. Both troctolite and olivine gabbro show cumulate textures, with olivine and plagioclase as cumulate minerals; whereas post cumulate minerals are pyroxene, phlogopite, amphibole and opaque minerals. Cumulated olivine contains one group of magnetite exsolved rods. The width of these rods is  $<2\mu\text{m}$  and the length is  $<10\mu\text{m}$ . In some cases, magnetite rods may intergrowth with exsolved clinopyroxene in olivine. These Cpx,  $3\mu\text{m}$  in width, are euhedral-subhedral generally.

Exsolution of clinopyroxene + magnetite from olivine is due to the  $f_{\text{O}_2}$  rise and temperature drop [5]. The exsolved magnetite contains lots of  $\text{Fe}^{3+}$ . All three rocks have crystallized magnetite at late magma process, which also support the uprising of  $f_{\text{O}_2}$ .  $\text{Fe}^{3+}$  formed in olivine with  $f_{\text{O}_2}$  increase during cooling and magnetite exsolved from olivine. Clinopyroxene formed around magnetite via diffusion in this process. The observed exsolution texture is significant to understand the crust evolution of west Tianshan, which is a key issue of geodynamic [6-12].

[1] Zhu YF, Ogasawara Y (2002) *Inter. Geol. Rev.* **44**, 831-836. [2] Zhu YF *et al.* (2005) *Acta Petrologica Sinica* **21**, 405-410. [3] Zhu YF *et al.* (2006) *Acta Petrologica Sinica* **22**, 2833-2842. [4] Zhang LF *et al.* (2005) *Amer. Miner.* **89**, 180-186. [5] Markl *et al.* (2001) *Amer. Miner.* **86**, 36-46. [6] Zhu YF *et al.* (2007) *Acta Petrologica Sinica* **23**, 1785-1794. [7] Zhu YF, Zeng YS, Gu LB (2006) *J. Asia Earth Sciences* **27**, 61-77. [8] Zhu YF, Zhou J, Zeng YS (2007) *Ore Geology Reviews* **32**, 337-365. [9] Zhu YF (2007) *Geological Bulletin of China* **16**, 510-519. [10] Zhu YF, Song B (2006) *Acta Petrologica Sinica* **22**, 135-144. [11] Zhu YF, Xu X (2006) *Acta Petrologica Sinica* **22**, 2833-2842. [12] Zhu YF *et al.* (2005) *Chinese Science Bulletin* **50**, 2201-2212.

## Preliminary investigation on the economic mineralization in listwaenites from Sahl-Abad Area, Southeast Birjand, Iran

A. YAGHUBPUR<sup>1</sup> AND A. ABEDI<sup>2</sup>

<sup>1</sup>Department of Geology, Tarbiat Moalem University, 49  
Mofateh Av. Tehran, Iran

<sup>2</sup>Department of Geology, Shahroud University, Iran  
(ayaghubpur@yahoo.com)

An important type of gold mineralization is hosted by listwaenite-beresite that is the alteration products in the ophiolite zones. The listwaenite-beresite alteration is typical in the late stage of fold belt development, and/or tectonic and magmatic activated terrains. It indicates a low-to-moderate temperature range in metasomatic rocks and it may be associated with gold, silver, arsenic, uranium, antimony, mercury, zinc and lead mineralization. This type of alteration also seems to be a good indicator for Au, PGE and Hg mineralization.

The listwaenite investigated through the study area cropping out in the vicinities of Jannat-Abad, Ali-Abad and Gazdez villages located about 100 km southeast of Birjand, in the state of South Khorasan, Iran. The rock units cropping out in the Sahl-Abad area include ophiolitic mélange with the age of emplacement of upper Cretaceous, flysch of Cretaceous-Paleogene age, Neogene's conglomerate and younger age volcanic rocks.

Several samples of listwaenites were collected and geochemical analyses of these samples using emission spectrometry for 40 major elements, atomic absorption analyses for mercury, ICP-MS for 70 major elements were carried out in the laboratories of IGEM and IMGRE Institutes, Russian Academy of Sciences.

Mineralogical investigations indicate that the listwaenites of Ali-Abad and Jannat-Abad area are carbonaceous and siliceous listwaenite, respectively.

Using geochemical modeling for listwaenites in the study area on the basis of As-Ag/Cu-Sn and As-Sb-Ag/Co-Cu-Ni ratios indicate that the listwaenites of Ali-Abad area is actually a barren type rocks, while the Jannat-Abad rocks could be considered as an anomalous area with possibility of deep seated mineralizations. In the present study Zn-Ni-Cr-B-Mn-Ca/Co-V-Mo-Ti-Ba-Si ratios is used to separate different types of economically important listwaenite in the Sahl-Abad area.