Flowpaths of groundwater from arsenic contaminated zone to deeper aquifers under development stresses

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Groundwater has been used extensively as the main source of drinking and irrigation water supply in Bangladesh with the coverage of about 98 and 80% respectively. In the early 1990s, high arsenic was noticed in shallow groundwater and about three million tubewells have been detected with arsenic concentrations more than the Bangladesh drinking water standard of 50 μg/l. Pumping water mainly from the lower part of the shallow and upper part of the main aquifers (BWDB-UNDP 1982) during the dry irrigation period, water levels in all three aquifer units upto about 300 m depths response to the pumping stresses. Generally, the water from the shallow arsenic contaminated aquifer has a higher head than water in the deeper zones, and water from the shallow aquifer may move downward into the deeper fresh water zones by leakage and vertical percolation. Still >50% of cultivable land in the country has the potential for irrigation. Increased irrigation abstraction of groundwater in future may enhance arsenic contamination in deeper aquifers.

A three-dimensional modular finite difference groundwater model is used to simulate groundwater flow of multi-layered aquifer system in southeastern Bangladesh focusing flow paths and travel time from recharge areas and arsenic contaminated zone to deeper aquifers. The problem addresses simulation results from computer models of groundwater flow systems, and observes the response of the systems to different development stresses and variations in values of geologic conditions i.e. horizontal (Kh) and vertical (Kv) hydraulic conductivities. The model simulated results indicate that aquifer system in the studied area is generally stable under current development stress and anisotropy is the primary hydrogeologic control on the flowpath length and travel time. Maintaining current trend of installing irrigation wells in lower part of the shallow aquifer may be continued to protect the main aquifer from moving water from the arsenic contaminated zone.

Biogenic sulfur gases, MIF-S, and the rise of free oxygen

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Mass-independent fractionation of sulfur isotopes in Archean sediments implies that (1) sulfur was processed photochemically in the atmosphere by uv light at wavelengths that today are absorbed by ozone, and (2) there was a mechanism for keeping one flavor of fractionated atmospheric sulfur from recombining with its complement before it reached the sediments. UV photolysis of SO_2 or CS_2 can give rise to such fractionations, with one of the flavors preserved in elemental sulfur (S8), which is insoluble in water and hence plausibly kept separate. Photochemical models indicate that efficient S8 production requires: (1) very low levels of tropospheric O_2; (2) a source of sulfur gases to the atmosphere at least as large as the volcanic SO_2 source today; and (3) a sufficiently high abundance of methane or another reduced gas. The widening envelope of mass-dependent sulfur fractionation toward the end of the Archean indicates that the oceanic sulfate pool was growing large. Sulfate reducers outcompete methanogens. Hence we consider the possible role of biogenic sulfur gases such as H_2S, DMS, OCS, and CS_2 at the end of the Archean. To the extent that sulfur gases replaced CH_4 or H_2 as the reduced complement of photosynthetic O_2 they worked to favor the creation of an O2 atmosphere. Atmospheric sulfate hazes generated from the biogenic sulfur gases may have played a part in triggering global ice ages. The ozone shield erected by a weakly oxic atmosphere tends to make atmospheric sulfur gases relatively stable, which raises the possibility that OCS can be an effective Proterozic greenhouse gas.

The effect of magma composition on the genesis of hydrothermal gold and copper ore deposits

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Intermediate to mafic magmas are often suggested to be the source of metals in porphyry and epithermal Cu, Cu-Au and Au ore deposits. In order to evaluate this premise, we conducted experiments to study the solubility of Au and Cu in high-temperature vapors (1000 ºC and 150 MPa) to assess the efficiency of Au and Cu transfer by volatiles exsolving from andesitic to basaltic melts. Our data show that Au hydrosulfide complexes supersede Au chloride complexes at these conditions, and that the stability of gold hydrosulfide complexes is significantly increased by the presence of minute concentrations of KCl or NaCl. For example, at an fO_2 of 0.6 log unit below the Ni-NiO buffer (NNO) and a fixed fH_2S of 13.2 MPa, the addition of 0.5 m KCl to the H_2O - H_2S vapor increases the solubility of Au from 90±20 (1 σ) to 1600±220 μg/g. Therefore, magmatic volatiles that are simultaneously characterized by high H_2S and alkali chloride activities are the most susceptible for Au transfer.

The behavior of Cu contrasts with that of Au at these conditions because of the low stability of Cu hydrosulfide complexes. At an fO_2 of NNO-0.6 log units, the solubility of Cu (at a reduced Cu activity of 0.01) as $CuCl^o$ is higher in dilute chloride-bearing vapors (176±14 μg/g at 0.5 m NaCl), than it is in H_2S-rich, chloride-free volatiles (39±8 μg/g at fH_2S=10.4 MPa). As opposed to the behavior of Au (the solubility of which significantly drops at the H_2S to SO_2 transition), the solubility of Cu significantly increases with increasing fO_2. The relative role of Cu chloride complexes, and Cu complexes formed with oxidized sulfur species at high fO_2 (~NNO+2 log units) is under investigation.

Many of the largest known hydrothermal Au deposits occur in association with alkaline mafic magmas, which are the most likely to release volatiles simultaneously rich in H_2S and alkali-chlorides, while porphyry Cu deposits are typically associated with oxidized magmas. Therefore, a clear link can be established between magma types and the occurrence of hydrothermal Au and Cu deposits via understanding the solubility of these metals in high-temperature vapors.

Formation of humin and humic acids by surface precursor polymerization: Implications to primitive and well-developed soils

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A considerable fraction of mineral-bound organic matter in soils is represented by high molecular weight (50-100 kDa) humic acids and non-extractable humin. The origin of such high molecular weight compounds on mineral surfaces can not be explained simply by adsorption since migration of polymeric material to adsorption sites should be limited by its low solubility. We argue therefore that polymeric humic-mineral compounds are formed *in situ* in mineral soil horizons. One of the possible mechanisms is heterophase polymerization of low molecular weight and thus soluble precursor material on/near the surface of catalytically active solid phases (so-called adsorption or boundary polymerization). In the recent review we have summarized available data supporting this concept and provided an experimental evidence for the key role of immobilized phenol oxidases and solid matrix in accelerating polymerization process [1]. The proposed reactions sequence leading to formation of humic acid-like polymers and non-extractable organic matter (humin) on the mineral surfaces is shown below.

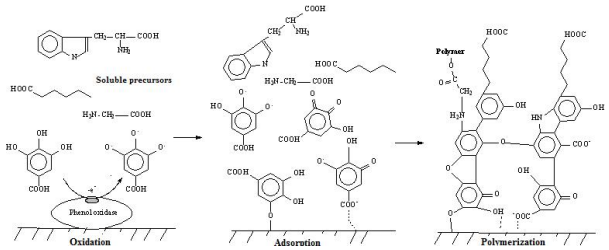

Figure 1: Formation of humic acids and humin by surface/boundary polymerization.

Surface polymerization can be of primary importance for the long-term carbon sequestration in illuvial and surface humus horizons of soils in cold and temperate humid climate. We are going to present experimental data supporting this hypothesis. The special emphasize will be given to lichen-induced humus formation by surface polymerization mechanism.

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Iron minerals formed by the binary culture of alkaliphilic anaerobic bacteria from the soda lake

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Alkaliphilic iron reduction is remarkable by the process which occures in the environment where iron is completely immobilised. Iron minerals formation at pH 9.5 in course of growth of the binary culture containing two new alkaliphilic anaerobic bacteria *Anaerobacillus alkalilacustre* and *Geoalkalibacter ferrihydriticus* [1, 2] isolated from Central Asia soda lake with moderate salts content was studied in laboratory experiments. Mössbauer spectroscopy and scanning microscopy were used for the investigation of solid phase; Fe (II), fermentation products and cell counts were recorded during the bacterial growth.

A. alkalilacustre ferments carbohydrates only and does not reduces amorphous Fe (III) hydroxide (AFH) by indirect action. Fermentation products formed during its growth on mannitol were lactate, formate and acetate. *G. ferrihydriticus* does not ferment carbohydrates, but utilizes acetate and lactate reducing AFH to siderite or magnetite [3]. Mannitol (1 g/l) and AFH were added as electron donor and acceptor during the experiments (initial content of Fe (III) in AFH was 10 or 100 mMol) with combined cultures of two anaerobic alkaliphiles. Reduction depends from the initial content of aceptor. Complete reduction of AFH by the binary culture with mannitol as electron donor leaded to formation of siderite oolites when initial content of Fe (III) was 10 mMol. When initial content of Fe (III) was 100 mMol up to 50 mM of Fe (III) was reduced into the mixture of siderite and non-stoichiometric magnetite. In the control with pure culture of *G. ferrihydriticus* on acetate as an electron donor complete reduction to siderite was observed at 10 mMol of Fe (III) but only 24 mMol of Fe (II) was formed at 100 mMol of Fe (III).

Due to synergistic action binary culture was far more effective in Fe (III) reduction even with subsrates not used by iron reducer.

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Constraints on transient pCO_2 variations based on oceanic calcium, CCD, and terrestrial weathering

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In an earlier paper, Tyrrell and Zeebe developed a method to reconstruct long-term changes in the deep-sea carbonate ion concentration, which provides constraints on atmospheric CO_2 (GCA, 2004). The method was based on CCD- and oceanic calcium records and was designed for long-term reconstructions over millions of years. Can a similar method be developed for shorter time-scales to estimate pCO_2 levels during aberrations such as the PETM? If the contemporaneous pCO_2–weathering relationship was perfectly known, then the CCD overshoot during the recovery phase would constrain the mass of carbon input and thus atmospheric CO_2 levels. However, this requires knowledge of three critical issues: (1) the changes in the ocean's calcium inventory, (2) the amplitude of the CCD overshoot, and (3) the strength of the weathering feedback. We will present new PETM modeling results that adequately constrain changes in oceanic calcium (issue 1). The amplitude of the CCD overshoot can be reconstructed based on sediment core data along appropriate depth transects (issue 2). Finally, variation of weathering parameters will constrain the possible range of atmospheric CO_2 concentrations that are consistent with observations (issue 3).

The role of South Pole-Aitken Basin in understanding impact history and the origin of the lunar crust

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The South Pole-Aitken (SPA) Basin plays a central role in understanding the impact history of the Moon and of the inner Solar System because it predates all other clearly recognized impact basins on the Moon. Determining the absolute age of SPA and the ages of other basins that formed within it will therefore constrain the timing of the heavy bombardment that affected the inner Solar System. The SPA Basin also plays a key role in understanding the makeup of the lunar crust because the formation of the Basin dug deep into the lower crust, and materials within the SPA Basin retain a lower crustal signature in geochemistry and in mineralogy and lithology. Examination of samples from the SPA Basin will allow us to determine the lithologic makeup of the lower crust in this part of the Moon and to test for mantle components that might also have been excavated and mixed into the SPA deposits. These are goals of the New Frontiers MoonRise mission to return samples from the SPA Basin, now in Phase A.

The distinctive geochemical signature of the SPA Basin interior was first demonstrated by results of the 1994 Clementine mission and again by the results of the 1998 Lunar Prospector mission. The Fe-rich interior is consistent with expectations of a lower crust that is more mafic (less anorthositic) than the highly feldspathic upper crust, exposed broadly in the lunar highlands. Modest elevation of thorium, however, indicates that this lower crust differs significantly from the crustal section exposed in the Th-rich Procellarum KREEP Terrane [1]. Without samples, the possibility of mantle components contributing to the geochemical signature [2] is unclear, although the predominance of norite (i.e. orthopyroxene-dominated mineralogy) in remotely sensed data [e.g. 3] favors lower crust. From the makeup of mafic rocks of the lower crust, we can better understand magma-ocean processes and post-magma-ocean modifications. MoonRise will provide direct samples of the SPA substrate through impact-melt-derived crystalline rocks and impact-melt breccias, allowing for identification of crust and mantle components. Samples will also include basalt and volcanic glass as direct samples of the far-side mantle beneath the SPA Basin.

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The geochemical characteristics of early Cretaceous volcanic rocks from Songliao basin, Northeast China, and its tectonic implications

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Early Cretaceous volcanic rocks from Songliao basin, northeast China, are characterized with basic rocks (BRS) which include dorgalite and basalt, intermediate rocks (IRS) which include basaltic andesite, andesite and trachyandesite, and acid rocks (ARS) include trachyte, trachydacite, dacite and rhyolite. The major element, trace element and isotopic data of the early Cretaceous volcanic rocks are reported in this paper. All samples have distinct characteristics with enriched large ion lithophile elements (LILE) relative to high field strength elements (HFSE), enriched light rare earth element (LREE) relative to heavy rare earth element (HREE), relatively low in $(^{87}Sr/^{86}Sr)_i$ and high in ε_{Nd} (t). Additionally, BRS have Ce/Nb=1.92~8.31, Th/Nb=0.08~0.44, $(^{87}Sr/^{86}Sr)_i$=0.7031~0.7047, ε_{Nd} (t)=+1.7~+5.2. IRS have Ce/Nb=3.70~15.80, Th/Nb=0.34~2.58, $(^{87}Sr/^{86}Sr)_i$=0.7040~0.7054, ε_{Nd} (t)= 0~+3.0 and ARS have Ce/Nb=4.29~15.80, Th/Nb=0.11~1.02, $(^{87}Sr/^{86}Sr)_i$=0.7038~0.7066, ε_{Nd} (t)= +1.0~+3.3, respectively. According to their geochemical characteristics, the magmas of BRS were generated partial melting of the depleted mantle which have been enriched, with little contaminated by crust. The generation of IRS magmas origined from melting of juvenile crust components underplated by upwelling of depleted mantle and the magmas of ARS derived from partial melting of juvenile crust components which origined from depleted mantle with contaminated by supracrust. Conclusionally, the dynamic model of stretch and extension in late Jurassic-early Cretaceous in Songliao basin was a result, from partial melting depleted mantle induced by delamination of thickened subcontinental mantle root induced by orogenesis with Okhotsk- Mongolia ocean closure. The rift-extensional tectonic setting of Songliao basin showed active rift characteristics.

Constrains on the timing of partial melting events in the Sulu UHP rocks

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Fertile components in UHP rocks could undergo partial melting at both water-present or –absent conditions during deep subduction as well as early stages of rapid exhumation of continental materials [1, 2, 3]. Petrographic and geochemical observations had shown that the Sulu UHP rocks experienced partial melting at UHP-HP conditions, which led to the formation of quartzo-feldspathic inclusions [4], granitic veins or plutons [5], and substantial geochemical effects [6]. To further constrain the timing of these partial melting events, we have carried out SHRIMP zircon U/Pb dating on UHP metapelite (SYK08) as well as concordant K-rich granitic dike (SYK20) from Yangkou, Shandong Province. Zircon separates from both samples have core-mantle-rim structure. Zircon cores from metapelite yield $^{206}Pb/^{238}U$ ages from 282-633 Ma, which represents different crustal components incorporated into the protiolith of metapelite. The mantle and rim yield $^{206}Pb/^{238}U$ ages of 233±3 Ma and 214±4 Ma, representing the timing of UHP and amphibolite facies retrograde reactions, respectively. Zircon grains from the synkinematic peraluminous granitic dike (A/CNK=1.2) yield similar wide range $^{206}Pb/^{238}U$ ages (483-800 Ma) from the core, implying that it might be derived from metasediments similar to sample SYK08. Except for one spot from the mantle yields $^{206}Pb/^{238}U$ age of 234.6±3.9 Ma, all the other spots yield a concordant $^{206}Pb/^{238}U$ age of 220.8±2.9 Ma. These mantle domains also contain mineral inclusions of Pl+Kfs+Qtz+Ap, typical of granitic composition. Such an association indicates that the Sulu UHP metasediments underwent partial melting at ~221 Ma and prior to the widespread amphibolite retrograde metamorphic events.

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Metastable phase equilibria of the quaternary system KCl + K_2CO_3 + $K_2B_4O_7$ + H_2O at 273 K

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Metastable phase equilibrium and phase diagram play an important role in exploiting the brine resources. The system KCl+K_2CO_3+$K_2B_4O_7$+H_2O is one of a subsystem of Zabuye Salt Lake brines. So far, no report has been found about the metastable phase equilibria of this quaternary system. The present paper covers the metastable equilibria of the quaternary system KCl+K_2CO_3+$K_2B_4O_7$+H_2O at 273 K. The solubilities and the densities of the equilibrated solution were measured.

Figure 1 is the metastable phase diagram of the system at 273 K. The phase diagram of the system consists of three univariant curves, three crystallization fields and one invariant point. This system is of eutonic type, no double salt or solid solution was formed. The three crystallization fields were corresponding to single salt $K_2CO_3 \cdot 3/2H_2O$, KCl and $K_2B_4O_7 \cdot 4H_2O$, respectively. Invariant point E was saturated with salts $K_2CO_3 \cdot 3/2H_2O$, KCl and $K_2B_4O_7 \cdot 4H_2O$. The mass fraction composition of the equilibrium solution corresponding to E is *w* (K_2CO_3)=44.85 %, *w* (KCl)=0.77 %, *w* ($K_2B_4O_7$)=1.25 %, *w* (H_2O)=53.13 %. Results show that the salt KCl has salting out effect to the salt $K_2B_4O_7$.

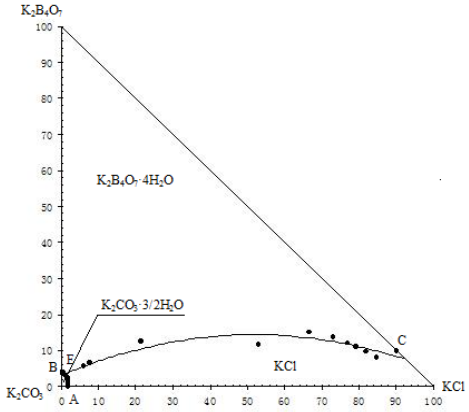

Figure 1: Metastable phase diagram of the quaternary system $K^+//Cl^-, CO_3^{2-}, B_4O_7^{2-}$-$H_2O$ at 273 K

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Phototrophic S oxidation in modern and ancient redox stratified ecosystems: A multiple S isotope perspective

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Phototrophic S-oxidizing organisms are the dominant anoxygenic phototrophs in redox-stratified environments where sulfidic waters intersect the photic zone. These organisms form dense and diverse communities at the redox interface of modern sulfidic systems [1], and sedimentary biomarkers chronicle their existence in ancient microbial communities as old as 1.6 Ga [2]. Despite the abundance and antiquity of these organisms, their past and present importance in carbon and sulfur cycling is not well constrained. We have undertaken a series of multiple S isotope studies of sulfur compounds associated with phototrophic S-oxidizing organisms (in both the laboratory and in the field) to determine: 1) the range of S isotope fractionations produced by this metabolism, 2) the environmental and physiological controls on these fractionations, and 3) the expression of these isotope signatures in modern and ancient redox stratified systems. Pairing of traditional sulfur isotope measurements ($\delta^{34}S$) with minor S isotope analyses ($\Delta^{33}S$ and $\Delta^{36}S$) allows us to constrain and quantify the flow of sulfur compounds at both the metabolic and ecosystem levels, providing insight into the physiology of phototrophic S oxidation and the contribution of phototrophs to biogeochemical sulfur cycling in natural systems.

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Experimental data and equation of state for modeling of PVTx properties of H_2O-H_2S mixtures

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Knowledge of the properties and behavior of H_2O-H_2S fluid mixtures is of great importance for a number of geochemical and engineering applications. For example, at elevated temperatures, this system has major significance for geological processes in many environments. However, at the conditions encountered in magmatic hydrothermal systems, the equations of state (EOS) and thermodynamic models of vapor-liquid equilibrium are inadequate to reliably predict the properties of H_2O-H_2S fluid mixtures due to a dearth of experimental data. Based on previous measurements of the properties of gas mixtures, we suggested a set of parameters for custom EOS applicable to temperatures <400 °C and high partial pressures of hydrogen sulfide [1]. We now present new experimental data on the PVTx properties of saturated aqueous mixtures of water and hydrogen sulfide which result in a notable improvement of the EOS at vapor-liquid equilibrium conditions.

Vapor and liquid phase compositions were determined at the liquid saturation boundary using a custom designed apparatus permitting direct sampling of the fluid at the temperature and pressure of the experiment. The constant-volume experimental cell was equipped with a sapphire pressure sensor which also allows direct measurement of pressure along the selected isotherms. Titanium oxide coatings of the surfaces which were in contact with the fluids ensured corrosion resistance of the cell. The data obtained from the experiments were used to select the best equation of state, fit the necessary adjustable binary interaction parameters, and facilitate the thermodynamic model describing the PVTx properties of fluids in both homogeneous vapor and vapor-liquid two-phase regions.

The results of this experimental study make it possible to reliably estimate volumetric properties of aqueous fluids containing hydrogen sulfide at temperatures up to 400 °C and high partial pressures of H_2S, i.e. for conditions commonly encountered in volcanic-hydrothermal systems. Using this same experimental method, we are also planning to conduct measurements of vapor-liquid element partitioning, which is one the potentially important applications of the direct sampling of two-phase fluids.

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Twenty-five years of ultrahigh-pressure metamorphism and continental deep-subduction

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Because of its lower density than the oceanic crust, the continental crust was considered to be not subductable in the classic plate tectonics theory. However, this precept has been changed since discoveries of coesite as inclusions in minerals from metamorphic rocks of supracrustal origin. It was 25 years ago that metamorphic coesite was reported to occur in pyrope quartzites from the Dora-Maira Massif in Western Alps [1] and in eclogites from the Western Gneiss Region in Norway [2]. Five years later, coesite was reported to occur in eclogites from the Dabie orogen in China [3, 4]. It was reinforced by discoveries of diamond as micro-inclusions in garnet and zircon in gneisses and associated rocks from the Kokchetav Massif in Kazakhstan [5] and in garnet in marble-associated eclogite from the Dabie orogen in China [6]. The discoveries of coesite and diamond provide the petrological evidence that crustal rocks were subducted to mantle depths of at least 100 km and later exhumed to the surface by tectonic processes. As a consequence, the term ultrahigh-pressure (UHP) metamorphism is coined with reference to those rock types that were formed or embedded in shallow levels of the continental or oceanic lithosphere and subsequently experienced P-T conditions within or above the lower limits of the coesite stability field. Since then, about 25 terranes with metamorphic coesite and diamonds have been reported on the earth. The P-T diagrams of metamorphic conditions in continental subduction zones have been extended to 2.8-4.0 GPa, corresponding to burial depths of about 100-140 km. While almost all disciplines of solid earth sciences in the world have been affected as a result of these studies, the development of China earth sciences has particularly benefited from intensive studies of UHP metamorphism and continental deep-subduction [7]. So far there are 6 terranes in China to contain metamorphic coesite and diamond, with tectonic settings varying from oceanic seduction to continental collision [8]. Among these terranes the Dabie and Sulu orogens have been studied most comprehensively on twelve aspects of continental subduction and exhumation [9], presenting a type example dealing with the geodynamics of continental subduction zones.

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Geochronology and Hf isotopic composition of mafic dykes in Qinling orogen, central China

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The Qinling orogen is sandwiched between North and South China blocks. In which, numerous mafic dykes are outcropped in the Early Palaeozoic meta-sedimentary rocks of the South Qinling belt.

The mafic dykes are diabases. The analysis for the diabases yield a weighted mean $^{206}Pb/^{238}U$ age of 433.3 ± 0.98 Ma and a $^{40}Ar/^{39}Ar$ plateau age of 431.10 ± 4.92 Ma, consistent with the forming age of 431.10 ± 3.03 Ma from the mafic volcanics in the South Qinling [1], indicating an important mafic magmatic event in Qinling orogen during early Silurian.

The ε_{Hf} (t) of the zircons from diabases ranges from +1.25 to +7.87. Based on their OIB-like characteristics [2] and combined new Hf isotopic data with previously published isotopic data [3] from the South Qinling, the mantle source shows a mixture of the DMM and EMII, HIMU as well as minor EMI end members, being resulted from the subducted oceanic crust and terrigenous sediment recycled into depleted mantle. Furthermore, because of long-term consentaneous mantle of South Qinling from Neoproterozoic to Early Paleaozoic, we suggest that the diabases had been formed in a rift environment trigged by the plume activity and derived from the depleted mantle mixed by ancient subducted oceanic crust and continental margin sediments along the northern margin of Yangtze block in the Early Neoproterozoic.

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Low-frequency dielectric spectroscopy measurements on sulfate-reducing bacteria cell suspensions

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Recent biogeophysics research demonstrates the sensitivity of electrical measurements to microbial growth and microbial induced alterations to geologic material. However, the inherent dielectric properties of microbes themselves and how they might directly contribute to the electrical responses observed during bioremediation processes are poorly understood.

To improve the understanding of electrical signals from microbial-mineral transformations in porous media, we studied the low frequency dielectric properties of sulfate-reducing bacteria (*Desulfovibrio vulgaris*) in cellular suspensions. We have acquired precise dielectric dispersion curves of *D. vulgaris* cell suspensions over the frequency range 0.1 Hz to 1M Hz using two-electrode dielectric spectroscopy. We adopted a simple and robust strategy to measure, analyze and remove electrode polarization impedance arising from the interface between electrodes and ionic solutions at low frequencies (< 1000 Hz). This polarization removal technique has been tested on water saturated silica beads. We show that the broadband dielectric response of *D. vulgaris* cell suspensions can be reliably determined using this approach, with the increase of cell concentration being proportional to the increase in dielectric permittivity at low frequencies (alpha regime). The measurements were modeled assuming a dilute suspension of polarizable particles embedded in a non-polarizing medium, with the polarization attributed to the surface charge on the cell walls. Our results suggest quantitative prediction of pore- and nano (cell wall) scale microbe-mineral transformations may be possible from electrical data, and provide insights into the likely contribution of the cells themselves to electrical signals observed during biomineralization processes.

Geochemical signature of felsic porphyries in the western Tianshan Mountains, Xinjiang, NW China

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A porphyry-type Cu (Mo, Zn, Au) polymetallic ore belt extends in an E-W direction for >200 km along the late Paleozoic Kokirqin arc in the western Tianshan Mountains of China, part of the Central Asian Orogenic Belt (CAOB). Petrologic, mineralogical and geochemical study for the Lalisigao'er Mo-Cu, 3571 Cu and Lamasu Cu-Zn deposits, indicated that the ore-forming porphyries are predominantly intermediate-felsic and belong to calc-alkaline and transitional series. They are characterized by similar major element compositions to those associated with giant porphyry copper deposits in the CAOB. They exhibit enrichment of large ion lithophile elements and depletion of high field strength elements and heavy rare earth element coupled with slightly negative Eu-anomalies. These rocks also show high $(^{87}Sr/^{86}Sr)_t$ (0.70722-0.71028) and low ε_{Nd} (t) values (-3.71-++0.17), coupled with depletion of Ba relative to Th and elevated Th/Ce, Nb/Y and Th/Yb ratios, suggesting that the porphyry magma originated largely from partial melting of a subducted oceanic slab, mixed with minor melts produced by partial melting of mantle wedge components and involvement also of lower continental crust. New LA-ICPMS zircon U-Pb dating indicates that the ore-forming porphyries of the Lailisigao'er and 3571 deposits formed at ca. 346-354 Ma. In combination with extensive field investigations, we infer that the porphyries of two of the deposits, the Lailisigao'er and 3571, appear to be co-magmatic and the area beneath the 3571 deposit should be considered as a potential target for prospecting the porphyry Mo deposit.

Compared with the geochronological and geochemical datas of other ore-forming porphyries in the Chinese Tianshan, the emplacement of the ore-forming porphyries occurred mainly in the late Paleozoic, and can be divided into two groups: ca. 390-340 Ma and ca. 300-250 Ma.These three deposits belong to the first metallogenic group in the Chinese Tianshan, which formed from the Middle Devonian to the early Carboniferous in a continental arc environment related to a subducted oceanic slab, which are distinguishable from a second group that formed in the Permian during a late collisional stage, in which regional collisional compression changed to extension.

Abiotic synthesis of disordered dolomite in agar gel medium

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The origin of dolomite is a long-standing enigma in sedimentary geology. It has been proposd that microorganisms can overcome kinetic barriers to facilitate dolomite precipitation [1, 2], although their specific role in dolomite formation and nucleation is still unclear. Microbial cell surfaces and excreted extracellular polymeric substances (EPS), which carry a negative electric charge, are capable to bind and accumulate Ca^{2+} and Mg^{2+} ions, and thus are frequently cited as the sites of carbonate nucleation [3]. Herein we provide a new mechanism to explain the dolomite crystallization associated with microorganisms. Our experiments demonstrate that disordered dolomite can be synthesized abiotically in systems of agar gel medium and aqueous solution mixtures at room temperature. The dehydration / desolvation of hydrated surafce Mg^{2+} has been recognized as a critical kinetic barrier to dolomite nucleation [4]. Dissolving a low dielectric constant solvent in water will lower the dielectric constant of the solution, and thus can reduce the solvation energies of dissolved cations [5, 6]. Therefore, we propose that the agar, which has a low dielectric constant, lowered the solvation energy of strongly hydrated Mg^{2+} ions in solution, and thereby enhanced their dehydration and incorporation into dolomite nuclei. It is possible that EPS may play a similar role as agar does in promoting dolomite nucleation and crystallization in natural environments. Our new findings may shed new light on the understanding of the role of microorganisms in dolomite formation.

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Sedimentary environments and factors of marine organic-rich source rocks in Ordos Basin, China

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On the base of detailed research on sedimentary structure, biological developments, depositional environment, geochemical characteristics and generated hydrocarbon simulation experiment by petrography and organic geochemistry, it is confirmed that marine organic-rich source rocks is developed in Pingliang formation, southwestern Ordos basin. Its organic macerals contain sapropelic group, animal organism and exinoid group. The organic matters are dominated by Type I, and a few samples belong to Type II_1 (Fig. 1).

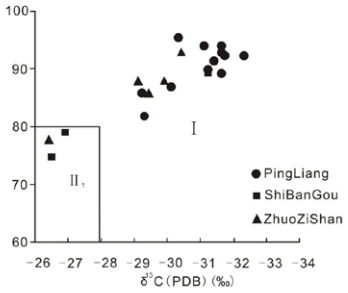

Figure 1: Correlation diagram of $\delta^{13}C$ and Ity

There is a high carbon abundance in the source rocks with a total organic matters (TOC) of 0.2% to 2.0%(Figure 2). According to analysis on the vitrinite reflectance and saturated hydrocarbon gas chromatographic, it is situated in post-mature dry gas phases and has high hydrocarbon generation potential by modeling hydrocarbon generation history. So it is thought as the main source rocks in Ordovician marine strata, Ordos basin. Finally, it is developed in the paleogeographic environment of strong reduction, oxygen deficiency, deep water slope by analyzing trace element geochemical characteristics and petrologic characteristics.

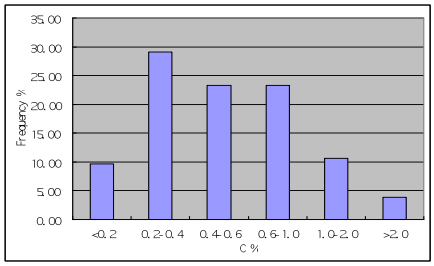

Figure 2: "C" frequency diagram in Pingliang formation.

Silicon isotope fractionation during soil development on basalt in tropical China

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Silicon (Si) is a link of earth surface systems. Soil system is suggested to be a key player of Si^{28}, balancing the enriched Si^{30} in ocean water and sediments [1]. However, which soil components really function is to be determined.

We studied a chronosequence consisting of six basalt-derived pedons in Hainan Island of tropical China, with age ranging from 10Ka to 1.8Ma. We analyzed the biogenic silicon (BSi) content and other related properties of soils, and detected the silicon isotope features of main silicon fractions.

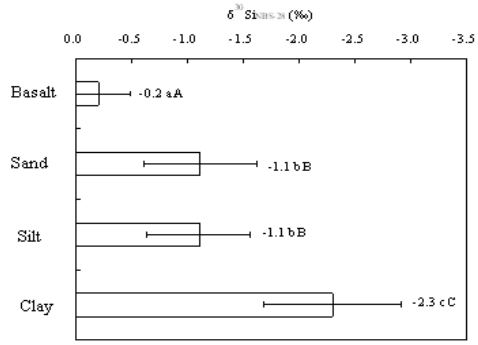

Figure 1: $\delta^{30}Si$ values of soil fractions vs. basalt rock.

The results show that from the weathering basalt to the formation of soils, Si-isotopic fractionation takes place as Si moves to secondary minerals. $\delta^{30}Si_{NBS-28}$ values of different particle size of soils are significantly lower than that in basalt, showing a sequential enrichment of Si^{28} in the finer fractions. Furthermore, by comparing soils of different ages, it is found that with increasing weathering intensity and soil age, weathering and biogenic processes favor ^{28}Si entering into the secondary minerals. Our study illustrates that secondary soil clay minerals contain more Si^{28}, than that of origin rock, which therefore can balance the preferential loss of Si^{30} to the ocean.

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Zr-in-rutile thermometry in HP/UHP eclogites from Western China

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Four Zr-in-rutile thermometry calibrations areapplied to eclogites from Western China. Here, we show that if rutile grows in equilibrium with Qtz and Zrn, and is isolated inside garnet, it preserves its Zr composition and does not undergo compositional change due to cation exchange with the host garnet. It thus preserves the composition for the P–T conditions of its formation and the growth zoning of the host garnet. For the HP/UHP metamorphic temperature, the Tomkins *et al*. [1] calibration yields temperatures that agree well with previous studies, whereas the other three calibrations [2-4], which do not include a pressure correction, give systematically lower temperatures. Zr contents of rutile inclusions within garnet show systematic decrease from garnet core to rim. The rutile inclusions in garnet rims contain the lowest Zr content, similar to that in the matrix. Analyses confirm that the pressure plays a significant role in modifying the primary temperature dependence of the Zr content of rutile. Rutiles trapped in garnets are unable to re-equilibrate easily during retrogression, but those in the matrix can do so, providing retrograde P–T path information.

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Fluid-mobile components in lavas from Eastern Manus Basin, Papua New Guinea: Implication for magma generation in subduction zone

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The east Manus Basin is a newly formed volcanic zone, where lacks well-defined magnetic anomalies and linear tectonic fabric [1]. So lavas there can be used for the study of magmatism during initial subduction. Forty-eight samples are obtained from four dredges in the study area, in which eight are basaltic andesite, twenty-four are andesite and sixteen are dacite. Fluid-mobile components, such as Ba (169-332 ppm), Cl (0.15-1.49 wt%), Pb (2.8-14.6 ppm), Li (1.8-14.2 ppm) and U (0.31-1.25 ppm), and H_2O contents (1.31-9.92 wt%) are enriched and largely variable. These samples have Ba/La ratios of 29-77, which is generally higher than that in other back-arc basin system.

The contents of fluid-mobile elements and H_2O are positively correlated. There are also positive correlation between Ba/La, U/Th, Pb/La, Cl/La, Li/La and H_2O/La, suggesting that the fluids are responsible for the enrichment of Ba, U, Pb, Li and Cl. Furtherly, these ratios are in a general negative relationship with Na_8, Ti_8. It seems that the addition of H_2O has increased the mantle melting degree and led to the enrichment of fluid-mobile components.

We calculated the average value of Ba/La, U/Th, Pb/La, Cl/La, H_2O/La, Na_8 and Ti_8 in each dredge, and found that the ratios of Ba/La, U/Th, Pb/La, Cl/La, H_2O/La decrease and Na_8 and Ti_8 increase with increasing distance from the New Britain Trench. Thus the melting degree and fluid-mobile components are dominated by the release of H_2O of subducting slab.

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Obtaining *in situ* kinetic and speciation information for trace metal complexes in freshwater

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The dynamic technique of DGT (diffusive gradients in thin-films) has been developed to measure speciation and fluxes of trace metals in natural environments. The measurements are sensitive to both the equilibrium state (speciation) and the dynamics of the system (diffusion and dissociation rate of complexes), and are potentially useful in increasing our physico-chemical understanding of natural waters. However, unravelling this information from the measurements can be very challenging. Manipulation of the physical properties of DGT and determination of diffusion coefficients of metals and their complexes in the different materials has enabled the simultaneous derivation of kinetic and speciation information for natural waters. Deployment of multiple DGT devices with a range of diffusion layer thicknesses can provide directly a visually informative kinetic signature for a range of metals, and with more sophisticated interpretation, information on the dissociation rates of complexes. Complementary information on the discrimination between species on the basis of molecular size, as related to their diffusion coefficients, can be obtained by co-deployment of devices with gel layers with different diffusion layer characteristics. With a single suite of measurements, an iterative procedure can be used to obtain both speciation and kinetic information. *In situ* measurements using this approach in a freshwater were consistent with other speciation techniques, while providing new information on the *in situ* rates of dissociation and diffusion coefficients of complexes.

Petrogenesis of Indosinian volcanic rocks in Songpan-Garze fold belt, Western China: New evidence for lithospheric delamination

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In the Songpan-Garze fold belt, an Indosinian lithospheric delamination model has been proposed based on previous investigation on widespread granitoids. This presentation reports U-Pb zircon LA-ICP-MS ages, geochemical and Sr-Nd-Hf isotopic compositions from the Aba and Wasai volcanic rocks in the central Songpan-Garze fold belt. These volcanic rocks are calc-alkaline andesites. Obtained magma crystallization ages are 210±3 Ma for the Aba andesite and 205±1 Ma for the Wasai andesite, which are consistent with magma crystallization ages of the Late Indosinian granitoids in the Songpan-Garze fold belt. They formed in a post-collisional tectonic setting. The Aba and Wasai andesites are distinct in geochemical singnatures. The former has higher Al_2O_3, K_2O, Rb but lower Na_2O, Ba and Sr contents, suggesting their different magma evolution. The Aba andesites have I_{Sr} values of 0.7070~0.7076 and ε_{Nd} (t) values of -3.90 to -5.34, and the Wasai andesites have initial $^{87}Sr/^{86}Sr$ ratios (I_{Sr}) of 0.7075~0.7077 and ε_{Nd} (t) values of -3.55 to -3.92. Zircon Hf isotopic data show ε_{Hf} (t) values of -3.7 to +0.3 for the Aba andesites and -2.7 to +5.5 for the Wasai andesites. Geochemical and Sr-Nd-Hf isotopic compositions indicate that fractional crystallization and crustal assimilation processes are not key roles for their magma evolution, implying that their chemical compositions would be those of primary melts. We suggest that the magma of the Aba andesites were dominantly originated from a crustal source, with minor mantle-derived component. The magma generation location is likely at the boundary between crust and mantle. The magma of the Wasai andesites resulted from partial melting of lithospheric mantle, which was probably metasomatized by amphibole-bearing fluid. The petrogenesis of the Aba and Wasai andesites provides an additional evidence for the lithospheric delamination in the the Songpan-Garze fold belt, indicating that the lithospheric delamination invoked mantle asthenosphere upwelling and resulted in the partial melting of residual lithospheric mantle.

U-Pb zircon dating of coesite-bearing eclogites from the Dulan area of the North Qadiam HP/UHP terrane, northwestern China: New constraints on ages of UHP metamorphism and protoliths

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Coesite- and kyanite-bearing eclogites from the Dulan UHP metamorphic unit, North Qaidam Mountains of western China, contain zircons that record protolith crystallization and UHP metamorphism. Most of the zircons are weakly zoned or unzoned, and some zircons contain CL-dark and oscillatory zoned cores, surrounded by unzoned, CL-grey or -bright rims. SHRIMP and LA-ICPMS U-Pb analyses from zircon cores in coesite-bearing eclogite yield scattered $^{206}Pb/^{238}U$ ages of 436-758Ma with an upper intercept age of 838 ± 50 Ma, and 8 concordant analyses from oscillatory zoned cores in kyanite-bearing eclogite gave $^{206}Pb/^{238}U$ ages ranging from 804 ± 9Ma to 866 ± 7 Ma with a weighted mean age of 832 ± 20 Ma. These zircon cores yield steep HREE slopes and negative Eu anomalies that suggest a magmatic origin. We thus interpret >800Ma as the eclogite protolith age. Unzoned zircons and zircon rims from four samples yield weighted mean ages of 430-446 Ma, flat HREE patterns without Eu anomalies, and contain inclusions of garnet, omphacite, rutile, phengite, and rare coesite. We thus interpret these ages to record HP/UHP eclogite facies metamorphism. These new data suggest that, similar to eclogites in other HP/UHP units of the North Qaidam Mountains and South Altyn Tagh, eclogites in the Dulan HP/UHP metamorphic unit formed in a continental setting during the Neoproterozoic, and then subducted to mantle depth together with continental materials during the Early Paleozoic.

Primary halo anomalies and prospecting in No.77 exploration line of Dashui Deposit in Maqu, Gansu, China

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Dashui Gold Deposit had very unique ore-forming characteristics in West Qinling mountain area. Its mineralization was strongly related to silicification and hematitization. The ore was red, brown and very poor sulfide. It was high economic value for shallowly buried, high grade, simple composition, easy acquisition and sorting. With deep mining, the grade declined sharply. Therefore, research primary halo anomalies had significant meanings on finding new ore bodies in deep. The paper selected No.77 exploration line and every five meters one sample at five levels:3815m, 3795m, 3765m, 3730m, 3690m and 3650m.The results showed that: 1) Au had obvious correlation with Hg, Mo, As; 2) There were two or three of the primary halos overlapping, which might be caused by two little apart ore bodies. It was consistent with the actual geological conditions at ore body's 'lens' shape of output and the 'pinch-out reproduction'. The complex features of the primary halo zoning sequence reflected the multi-stage and complexity in ore mineralization. 3) The zonation features of the eight series of geochemical parameters had verified the existence of three beaded ore body in the lower left No.3 and No.7 ore bodies; 4) The Ag and Zn anomalies in the second beaded tail ore might be the middle-upper position in last beaded ore body. It could be predicted that below 3650m level there was still a certain degree of prospecting perspective.

Distribution characteristics of heavy metals in soil of uncontaminated agricultural products base of Guangyuan city

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Soil heavy metal pollution has become one of the most important environmental problems in the world. Guangyuan city is the key agricultural products base of Sichuan province. In order to make agricultural products base develop in a scaled, high quality and industrialized direction as well as provide a scientific foundation for the construction of national uncontaminated agricultural products base, 145 soil samples from 7 county of Guanyuan agricultural products base were collected and evaluated by the indexes of single contaminants and combined pollution according to the national standard for evaluation of soil environmental quality, finally the soils were divided into different levels and the correlations of the heavy metals in the soil were analyzed [1].

According to the indexes of single contaminants pollution, the results show: heavy metals indexes in the soil of Cangxi, Jiange, Yuanba, Shizhong county are less than 1.0 indicating that they meet the requirements of soil environment for producing uncontaminated food, but Cd, As form Qingchuan and Wangcang county are more than 1.0 as well as Cd, Cr, Cu from Chaotian district.

According to the indexes of combined contaminants pollution, the results show: only 3 heavy metals indexes of the 145 soil samples are more than 1.0, belonging to slight pollution. The others are less than 1.0 indicating that the level of the soil belong to cleanness, so they meet the requirements of soil environment for producing uncontaminated food.

According to Cluster Analysis, the results show: the representative element in soil of Jiange, Wangcang, Cangxi, Shizhong county is Cd, Pb, Hg and As respectively. The heavy metals in soil of Qingchuan, Chaotian, Yuanba district have no representative element. Cr and Cu, Cd and Hg of Chaotian district, Pb and Hg of Shizhong Jiange district have obvious correlation. The heavy metals of Cangxi, Wangcang, Qingchuan county and Yuanba district have unobvious correlation. As a result, the soil of agricultural products base in Guangyuan city is in good condition and it is fit for producing uncontaminated food.

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Reduction of structural Fe(III) in clay minerals by mesophilic and thermophilic methanogens

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The capability of methanogens to reduce structural Fe (III) in clay mineral nontronite was studied. Mesophilic *Methanosarcina barkeri,* thermophilic *Methanothermobacter wolfei* and hyperthermophilic *Methanococcus jannaschii* were used in the experiments. Nontronite NAu-2 has a total Fe content of 23% (w/w), and almost all of the Fe is Fe (III). The NAu-2 size fraction of 0.05-0.2 μm was used in all experiments. The three methanogens were incubated with methanol, acetate, or H_2 as electron donor and structural Fe (III) in NAu-2 (0, 5, and 10 g/L) as electron acceptor. The extent of iron reduction was measured by Ferrozine assay and the 1, 10-phenanthroline method. Methane concentration, solution pH and aqueous chemistry were measured. X-ray diffraction (XRD), scanning and transmission electron microscopy (SEM and TEM) were used to observe any mineralogical changes.

All of the three methanogens reduced structural Fe (III) in NAu-2 to Fe (II) with methanol or H_2 as electron donor. *M. barkeri* reduced Fe (III) in NAu-2, with H_2/CO_2 and methanol, but not with acetate. Using H_2, the extent of Fe (III) reduction reached 5-10% and 7-13% as measured by Ferrozine assay and the 1, 10-phenanthroline method, respectively. For the methanol set, the extent was higher, reaching 18-23% and 25-33%, as measured by the two methods, respectively. Concentrations of Si and Al in solution markedly increased within 3 days accompanied with decreased pH, suggesting that *M. barkeri* reductively dissolved NAu-2. XRD and SEM-EDS of bioreduced materials showed that there was no biogenic illite formation but occurrence of high charge smectite or intermediate phase between smectite and illite, and silica. Methane production was almost completely inhibited by iron reduction with H_2/CO_2 as substrate which highlights the important role of iron in global methane flux. Thermophilic and hyperthermophilic methanogens were also capable of reducing structural Fe (III) in NAu-2, and the extent of Fe (III) bioreduction with H_2/CO_2 or methanol as substrate ranged from 10% to 20% at a 5g/L NAu-2 concentration. Extensive mineralogical changes also occurred as a result of bioreduction.

On the origin of pyroxene exsolution topotaxy in majoritic garnets

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The pyroxene exsolution in garnet after majorite from garnet peridotites of Otrøy and Fjørtoft Islands suggests a very deep origin (>350 km) of the rocks. Microstructures and trace element compositions of the exsolved pyroxenes and garnets indicate that these ultra-deep mantle rocks may have experienced a complex multiple stage exhumation process. The interstitial pyroxenes were exsolved during the Archean upwelling from mantle transition zone. The intracrystalline pyroxene lamellae were exsolved during the isobaric cooling after accretion to deep cratonic roots. We provide here EBSD, EMP and LA-ICPMS analyses of pyroxenes exsolved from the garnets. The EBSD analyses of more than 200 exsolved pyroxenes and host garnets reveal the following exsolution topotaxial relationship: 1) The interstitial milimeter-size orthopyroxenes have no consistent crystallographic relation with the surrounding garnets; 2) There are three different types of intracrystalline exsolutions in garnet (orthopyroxene rods (major exsolved phase), clinopyroxene rods and the rods of intergrowth of CPX and OPX). The majority (80-90%) of exsolutions have a tight topotaxial relationships with the host garnet by $\langle 001\rangle_{px}$ // $\langle 111\rangle_{grt}$ and $\langle 010\rangle_{px}$ // $\langle 110\rangle_{grt}$. 3) Pyroxene rods are elongated parallel to the $\langle 111\rangle_{grt}$ or $\langle 110\rangle_{grt}$. The elongation directions are the $\langle 001\rangle_{px}$ in the former case. 4) The polycrystalline intergrowths of clinopyroxenes and orthopyroxenes have also a tight topotaxial relationships of $\{100\}_{cpx}$//$\{100\}_{opx}$, $\langle 010\rangle_{cpx}$//$\langle 010\rangle_{opx}$ and $\langle 001\rangle_{cpx}$//$\langle 001\rangle_{opx}$. The interfaces between clinopyroxenes and orthopyroxenes are most likely the $\{100\}_{px}$ planes. The $\langle 100\rangle_{cpx}$, the elongation directions for the intergrowth pyroxene rods, are near parallel to the $\langle 111\rangle_{grt}$. The volume ratio of Cpx/Opx varies from nearly pure Cpx to pure Opx suggesting that these exsolutions are exsolved two-pyroxene solid solutions. All exsolved clinopyroxenes show essentially no difference in major and trace element compositions as revealed by EMP and LA-ICPMS analyses. So are the exsolved orthopyroxenes and the host garnets. Based on our results and previous experimental results, we hypothesis that clinopyroxene rods were exsolved firstly from the precursor majoritic garnet, followed by solid solutions of pyroxenes and orthopyroxene rods.

LA-ICP-MS *in situ* trace elements analysis of apatite and magnetite from Taocun iron deposit, Anhui Province, China

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Ningwu volcanic basin located in the easternmost portion of the Middle-Lower Yangtze River metallogenic belt, which is an important Fe-S-Cu-Au mining district. A large number of iron deposits occurred in the Ningwu basin. The Taocun iron deposit is an important large deposit composed mainly of magnetite-apatite-actinolite assemblage that can be well compared with the Kiruna type iron deposits.

LA-ICP-MS data show that magnetite in Taocun deposit have detectible Ti, Mg, Al, V, Ni, Co, Zn, Ga, but the co-genetic apatite contains detectible Mg, Al, Si, K, Ca, V, Cr, Mn, Sr, Th, U and REE. The apatite of the Taocun deposit has a content of 5568-7930 ppm REE with a strong LREE/HREE fractionation and negative Eu anomalies, which is in similar to that of apatite in Kiruna deposit in Sweden (Figure 1). The REE distribution in the host rocks (gabbro-diorite porphyry) of the deposit have a significant difference REE pattern.

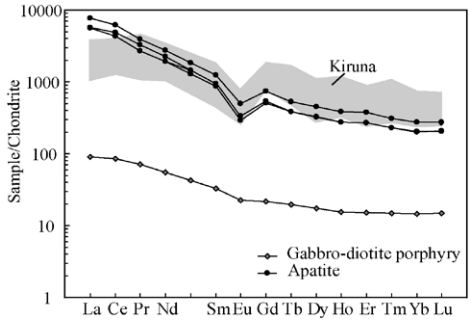

Figure 1: Condorite-normalized REE pattern of hostrock and apatite from Taocun iron deposit.

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Geochemistry and petrogenesis of foliated (garnet-bearing) granites in the Tongbai-Dabie orogenic belt

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Foliated (garnet-bearing) (FGB) granites are associated closely with and are usually the major wall rocks of the high-pressure (HP) and ultrahigh-pressure (UHP) metamorphic rocks in the Tongbai-Dabie region. These granites are rich in Si and alkali with high Ga/Al ratios, and depleted in Ca, Mg, Al, Ti, Sc, V, Ni, Co, Cr and Sr, which are similar to the A-type granite. In conventional discrimination diagrams, these FGB granites belong to A-type granite, with geochemical characteristics affinitive to post-collisional granites. The εNd (230 Ma) values (-15.80–-2.52) and TDM values (1.02–2.07 Ga) suggest that magma for the FGB granites were derived from a heterogeneous crustal source. Therefore, the FGB granites may provide clues for deciphering the formation of post-collisional granites. We propose that the magma of the FGB granites both in the HP and UHP units was formed in an extensional tectonic setting slightly postdating the HP and UHP metamorphism, likely through decompressional partial melting of UHP retrograded eclogites during exhumation.

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Graphitic carbon in the pyrite rods in the sediment of South China Sea as a mineral indicator for gas hydrates

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Gas hydrates are generally considered as a potential energy resource. Most often detected by seismic means such as BSRs and the geochemical anomalies produced by dissociation of gas hydrate.

Authigenic pyrite is the end product of the microbial sulfate reduction in the sediments, which coupled to either the oxidation of methane or the mineralization of organic material. Some chemical anomalies profiles in this site show that pyrite has the connection with methane but not organic material [1]. However, we didn't have the direct evidence.

In order to find some useful evidences from pyrite, we measured pyrite rods in the sediment of South China Sea using SEM and HRTEM. It is located at the junction of the Eurasian, the Pacific and the Indian–Australian Plates. The results show that the pyrite is framboidal. Nanocrystalline graphite occurs with the pyrite. Generally, graphite can be deposited from metamorphic organic matter or natural carbon-bearing fluids such as those containing CO_2, CO and /or CH_4. Temperature has been considered as the major factor controlling the formation of fluid-deposited graphite deposits [2, 3, 4]. However, when C-O-H fluids in the systems are supersaturated and the temperature decreases, graphite can be deposited [2, 3], following the reaction: $CO_2+CH_4=2C+2H_2O$. Therefore, the graphite indicates that the fluids containing CO_2 and CH_4 are saturated in the sediments from which the pyrite deposited, suggesting that there is a methane source under the site.

The finding of graphite associated with pyrite suggest that there is a gas hydrate in this site of South China Sea, and graphite can be used as a mineral indicator to detect methane sources. It also has an implication for the industrial synthesis of graphite.

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Origins of hydrcarbon volatiles in the Earth's mantle rocks

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Hydrocarbon volatiles trapped in the mantle-derived rocks likely record the information about their origins. Two types of fresh mantle-derived rocks: ophiolitic peridotite from Yushigou and mantle xenolith from Damaping, China have been extracted the hydrocarbon volatiles (CH_4, C_2H_6, C_3H_8 and C_4H_{10}) trapped in the minerals by ameliorative stepped-heating method. The results showed that two volatile releasing peaks at ~ 500-600°C and 900-1000°C likely correspond to two types of fluid inclusions which were trapped at different stages of mineral growth, the late-stage fluid inclusion decrepitated at lower temperature than the early-stage one. The majority of data at low temperature falls in the range of methane oxidation in the plot of $\delta^{13}C_{CH4}$ and $\delta^{13}C_{CO2}$, suggesting that CH_4 in the late-stage fluid inclusion mainly originates from organic matter oxidation. In contrast, CH_4 in the early-stage fluid inclusion released at high temperature with $\delta^{13}C_1$ of -25.8 to -20.8‰ suggest its possible abiogenic origin. $\delta^{13}C_{co}$ values of the early-stage fluid inclusion in Damaping mantle xenolith remain constant with increasing temperature, suggesting that hydrocarbons via Fischer-Tropsch (F-T) synthesis reaction from oxidized carbon compounds reduction by molecular hydrogen occurred under a static closed system at deep earth. A reverse carbon isotopic distribution patterns among CH_4-C_4H_{10} hydrocarbons in the early-stage inclusions further supports the formation and preservation of hydrocarbons in both subcontinental lithospheric mantle and oceanic lithospheric mantle by F-T synthesis reaction.

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Experimental study of dissolution rates of some silicate minerals at high temperatures up to 400ºC

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Steady-state dissolution rate measurements of pyroxene, wollastonite, actinolite and albite were carried out in the temperature (T) range from 25 to 400°C at 23 MPa. Minerals used in experiments are collected through microscope, cleaned and analyzed chemically. Most experiments were performed in mixed-flow reactors with Zr liner. Usually, all reactive solutions were undersaturated with respect to the mineral and the secondary product phases on the reacted surface.

The experiments suggest that the measured dissolution rates of the minerals at T ≤300°C coincide with previous experiments published in literatures. The dissolutions are stoichiometric for those experiments, in which cases the release ratio of molar concentrations of metal M_i versus molar concentration of Si in outlet solutions $\Delta Mi/\Delta Si$ is identical to the stoichiometric number N_i in solid. The stoichiometric dissolution of albite in water is present at 300°C. Stoichiometric dissolution of pyroxene in water is at T near 200°C, and that of actinolite is at 300°C. Dissolution rates (r_{Si}) for albite, actinolite, pyroxene, wollastonite in water were found to increase with increasing T from 25 to 300°C, and then decrease with increasing T from 300 to 400°C. The maximum release rates of Si for those minerals are reached at 300°C. But $\Delta M_i/\Delta Si$ varies with T. The different metals of the minerals often behave the different release rates at a fixed temperature. Usually, the release rates of Na, Ca, Mg, Fe, Al of minerals are often higher than Si at T<300°C. In contrast, release rates of Si are higher than others at T ≥ 300°C.

Experiments prove that the hydrolysis of Si-O-Si bond and metal M_i-H^+ exchange reactions at T< 300°C are different with reactions at T ≥ 300°C, 23 MPa. At T range from 300 to 400°C and 23MPa, strong lowering water density and dielectric constant lead to break water hydrogen bond network, and decrease hydration of Si-O-Si bond, thus, dissolution rates of Si decrease.

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Mobility of iodine (^{129}I and ^{127}I) species in sediment columns from the Savannah River Site

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^{129}I is a major by-product of nuclear fission and is among the top three risk drivers for waste disposal at the Yucca Mt., Hanford, and Savannah River Sites (SRS). ^{129}I is of major concern because of its perceived mobility in the environment, excessive inventory, toxicity, and long half-life (~16 million yrs). Little research has been carried out at these facilities beyond simple monitoring of groundwater plumes. Different iodine species exhibit dramatically different mobility in aquatic and sediment environments as inorganic and organic species may be hydrophilic, atmophilic and biophilic. In this study, we conducted column experiments to investigate the sorption and transportation of iodine species using a sandy aquifer sediment from the SRS and deionized water with $CaCl_2$ to simulate the SRS ground water ionic strength. This study is unique in that we mimic ambient concentrations of iodide (10^{-8} to 10^{-7} M) in the experiments instead of using artificially high concentrations of iodide (≥ 0.1 mM/L) used in most laboratory analyses. Results demonstrate that iodine mobility varies greatly with iodine concentration, mostly due to covalent binding of iodine to organic carbon moieties in soils and aquifer sediments. At the ambient concentration, significant retardation of iodide in the sediment was found, while there was no retardation at the artificially high concentration of 0.1 mM/L. The data from this study supports findings from sediment and ground water slurry experiments on SRS samples [1] and Swiss Glattfelden samples (unpublished).

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Continental accretion by arc-continent collision during the Columbia assembly in South China

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A Paleo-Mesoproterozoic supercontinent, Columbia, has been proposed to exist on the Earth, with its assembly mainly at 2.0-1.8 Ga. However, it is unclear how South China behaved during the Columbia assembly before it became part of supercontinent Rodinia in the Neoproterozoic. A combined study of geochronology and geochemistry of ancient continental fragmentss in question is expected to provide a genetic link to their geotetconic affinity and thus to the relationship between South China and Columbia. In doing so, it is intriguing to know how the middle Paleoproterozoic tectonothermal event in South China is link to the Columbia assembly and if the continental accretion proceeds by arc-contient collision.

A combined study of zirconology and whole-rock geochemistry was carried out for metamorphic rocks in Yangtze Gorge, South China. Zircon U-Pb dating gave concordant ages of 1.97 ± 0.03 Ga with low Th/U ratios of 0.01 to 0.14 for migmatite, metapelites, amphibolite. The similar U-Pb ages were also obtained from zircons from igneous and metamorphic rocks elsewhere in South China, providing the geochronological record of middle Paleoproterozoic metamorphic event in South China. Nevertheless, this period of metamorphic event and subsequent magmatic activity occurred in the north, but only magmatic activity in the south. Both metamorphic and magmatic activities are associated with formation of a unified basement responsible for cratonization of the Yangtze Block due to assembly of supercontinent Columiba.

Zircon ε_{Hf} (t) values of about −6.5 and model Hf ages of about 3.0 Ga were obtained for the metapelites, suggesting that their protolith is ancient Archean crust. $\delta^{18}O$ values of 11‰ and 8‰ were obtained for quartz from the metasediments and garnet from the amphibolite, respectively, indicating that their sources experienced supracrustal recycling. Whole-rock analyses show arc-like distribution of trace elements in the 2.0-1.8 Ga rocks, suggesting their derivation from reworking of arc-sourced rocks. Thus, the continental accretion around the Yangtze continental nucleus was realized by arc-continent collision orogeny during the Columbia assembly. This provides a geodynamic link between the Yangtze cratonization and the global tectonothermal event in the middle Paleoproterozoic.

Ubiquitous and expanding biosphere in deep sediments: Inferred from a microbial profile of Quaternary terrigenous deep deposit, Qaidam Basin, China

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In extreme environments such as hot springs, thermophiles can survive at 121°C, even at 360°C. However, the knowledge on the distribution of the deep biosphere in normal deposits is limited due to objective reasons, such as the difficulty in obtaining deep samples [1].

The present paper investigated a profile (from 200 m to 2400 m) located in the Sanhu region of the Qaidam Basin, Northwestern China, a world famous biogas-producing area in the Quaternary. The results showed that as anticipated, abundant bacterial populations occur from the shallow (100 m) to deep (2400 m, T-101 °C; P-27 Mpa). The number of microorganisms remains between $6.9\times10^3 \sim 4.4\times10^5$ /cm^3 even in the depths of 2396 m ~ 2400 m. The bacterial populations do not decrease with increasing depth, bacterial populations in the depth of 1596 m (71.6 °C, 18.3 Mpa) and the layer below are obviously more than those in the two upper layers (± 600 m and ± 1100m). The nutrient substrate produced by thermal stress could explain this phenomenon [2, 3]. Affected by the lithology of the deposit itself, the number and types of microorganisms vary a lot even over tens of centimeters. All these characteristics demonstrate that the nutrient is the key to the deep biosphere, and that relatives high temperatures of normal deep sedimentary environments does not regulate the survival of microorganisms. The wide distribution of microorganisms during weakly diagenetic stage gives us a novel view of the total number of microorganisms in the deep biosphere. The discovery of commercial biogas accumulations in the Sanhu region of Qaidam Basin, to a certain extent, reflects that the role of microorganisms is much greater than we can imagine.

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The molecular level mechanisms of quartz dissolution at coupled electrolyte-pH conditions

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Both different pH conditions and electrolyte types have profound influence on the dissolution mechanisms of quartz. This study provides molecular level mechanisms related to the quartz dissolution at coupled electrolytes vs. pH conditions. Under acidic, neutral or basic conditions, with either Ca^{2+}, Mg^{2+} or Na^{+} cations, the dissolution mechanisms of Q1 (Si) and Q2 (Si) sites at quartz surface, representing the major dissolution story of quartz, have been carefully studied by high-level quantum chemistry calculation. Large cluster models are used to represent the surface structures of quartz. The M05-2X/6-311+G** level and QST3 method are used to estimate the energy barriers of bond breaking occurring at Q1 (Si) and Q2 (Si) sites under those coupled situations.

Many very interesting points have been found in this study. Electrolytes will largely enhance quartz dissolution for the whole pH range. However, whether electrolytes bond to bridging oxygen (BO) or non-bridging oxygen (NBO) of quartz surfaces is the key factor leading to different quartz dissolution mechanisms. At acidic condition, due to the intensive surface protonation, electrolytes are difficult to attack the oxygen atoms of quartz. The dissolution increase is not directly caused by electrolytes but by water which is prone to be electrolyzed at such situations. At neutral conditions, the electrolytes can directly bond to the BO, let a weaken Si-O_{br} bonding and lead to the increase of dissolution. The Ca-O_{br} and Mg-O_{br} bonding are stronger than that of Na-O_{br}, leading to the dissolution rate differences of these electrolytes. At basic conditions, electrolytes cannot link to BO but rather link to NBO, which also cause the dissolution increase. The energy barrier data suggest that the present of electrolytes at neutral or basic conditions will directly and dramatically enhance the quartz dissolution, such as E_{Ca}=16, E_{Na}=20, E_{Mg}=48kJ/mol at neutral condition and E_{Ca}=11, E_{Na}=8, E_{Mg}=21kJ/mol at basic condition.

Photodegradation of methylmercury is enhanced by complexation with thiol-containing natural organics

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Monomethylmercury (MeHg) is a neurotoxin that poses significant risks to human health due to its persistence in aquatic ecosystems and bioaccumulation in food webs. Sunlight demethylation is an important component of the mercury cycle that maintains MeHg at low concentrations in natural waters. Rates of photodemethylation, however, can vary drastically between different bodies of waters for reasons that are largely unknown. Here, we show that photodegradation of MeHg occurs through sunlight sensitization of dissolved natural organic matter (NOM) and that the rate of degradation depends on water composition and constituents that bind CH_3Hg^+ ions. We demonstrate that singlet state oxygen ($^1O_2$), which is generated by sunlight sensitization of chromophoric NOM, is capable of demethylating MeHg at rates similar to field observations. However, these rates apply only to MeHg species bound to thiol-containing organic ligands such as glutathione, mercaptoacetate, and humic substances. In contrast, CH_3HgCl complexes are unreactive towards $^1O_2$. Photochemical experiments indicate that binding of CH_3Hg^+ to electron-dense thiolates lowers the excitation energy of the C-Hg bond, making the bond susceptible to attack by electrophiles such as $^1O_2$. Our results provide an explanation to why photodemethylation is rapid in NOM-rich freshwater lakes, and relatively slow in coastal marine waters where CH_3HgCl complexes dominate methylmercury speciation.

The responding of carbon isotopic compositions of the organic sediments to environmental change since Holocene in the Bosten Lake, Xinjiang, China

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Bosten lake (86°40′~87°26′E, 41°56′~42°14′N) with a large water area 1002.4 km^2 is located in the northwestern part of China. The lake level is about 1048.75m as the hydrological records in 1955. The lake average depth is 8.2m, the highest depth is 17m. The annual average temperature is 6.3°C, and average rainfall is 68.2mm, annual evaporation is 1800 to 2000mm.

The core BSTC2000 was sampled at 2-cm intervals and the analyzed items include organic matter content (TOC), C/N of organic matter, carbon isotopic compositions and n-alkane of organic sediments. As the results of carbon isotopic compositions of organic sediments, it is shown that carbon isotope of terrestrial plants, floating and submerged plants were lighter below to -26‰. But that of merged aquatic plants were heavier over than -26‰. At the same time, when the lake became depth, merged plants with a heavy carbon isotope bloomed. Otherwise, with the raising of the temperature, the lake became shallow. Terrestrial plants, floating and submerged plants with light carbon isotope bloomed, and merged plants degenerated during this time. From the results of organic matter content (TOC), C/N of organic matter, carbon isotopic compositions and n-alkane of organic sediments, the temperature and lake level raised from 8060aB.P. to 3830aB.P. at the Bosten Lake. During this interval, merged plants bloomed. The paleoclimate condition was warm-wet and cold-dry controlled by the East Asian Monsoon mainly. After 3830aB.P., the palaeoclimatic condition changed greatly. With the rising of temperature, the lake level fall. The paleoclimate was warm-dry and cold-wet controlled by the westerly.

Catalytic effect of the combination of catalysts on bioleaching of low-grade Chalcopyrite ore

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Chalcopyrite is the most important copper mineral. It is, however, relatively recalcitrant to chemical and bacterial oxidation because of its special crystal structure and electrochemistry in contrast to many other copper minerals. It is essential to find some desirable methods to enhance chalcopyrite bioleaching.

The low-grade chalcopyrite ore used in this study was obtained from Yongping Copper Mine, SE-China. The particle size was less than 5mm. The chemical composition is as follows: 0.40% Cu, 14.12% Fe, 13%S. The chemical phase analysis showed that chalcopyrite is 0.38%and the other copper minerals 0.02%. The mixed *Acidithiobacillus ferrooxidans* and *Acidithiobacillus thiooxidans* used in this study were isolated from acid mine drainage at Yongping Copper Mine. Leaching experiments were carried out in 250 mL elenmeryer flasks with 80ml 9K + S medium without Fe^{2+} and 20ml inoculation at initial pH 1.20 (pH values were controlled within 1.50 during the bioleaching) and 25%(W/V) pulp density. The activated carbon, Ag^{+} and Fe^{2+} concentrations were added as need. The flasks were incubated in a rotary shaker at 130 rpm and 30°C.

The combination of activated carbon, Ag^{+} and Fe^{2+} can greatly enhance the copper dissolution during the bioleaching of low-grade chalcopyrite ore. The best bioleaching results can be achieved under the combination of 3.0 g/L activated carbon, 2.0 mg/L Ag^{+} and 8.0 g/L Fe^{2}, in this case, the bioleaching rate of copper reaches 93.5% after 310 h bioleaching. When the combination of 3.0 g/L activated carbon and 2.0 mg/L Ag^{+} is used, the bioleaching rate of copper reaches 84% after 450 h bioleaching. The bioleaching rates of copper is only 79% after 600 h bioleaching when only 3.0 g/L activated carbon is added. It is found that it is more favorable to the bioleaching of copper from low-grade chalcopyrite ore if the low redox potential is controlled at 550 ~ 650 mV.

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Mathematical model and factors of source and sink of uranium migration

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The precipitation from the mountain areas supplies water to the target layer of the sandstone uranium deposits stably, uniformly and continuously. They are always under the state of equilibrium in the destination layer for uranium exploration and the dissolution process of minerals in groundwater is carried out in the uniform constant flow field [1].

The x direction is in accord with flow direction, Vx = V = C, $D_{XX} = D_d T + \alpha_L V = D_L$, then the mathematical model is:

$$\begin{cases} \dfrac{\partial c}{\partial t} = D_{XX}\dfrac{\partial^2 C}{\partial X^2} - V\dfrac{\partial C}{\partial X} - c\left(\lambda - \dfrac{nF}{RT}\dfrac{\partial Eh}{\partial t}\right) \\ c(x,0) = 0 \,\|\, 0 < x < \infty, t > 0\| \\ C(0,t) = c_0 \,\|\, 0 < x < \infty\| \\ c(\infty,t) = 0 \,\|\, t > 0\| \\ \dfrac{\partial Eh}{\partial T} = q \,\|\, q \ is \ \text{constants}\| \end{cases}$$

The t_{max} can be obtained at x point under the condition of ($\partial C / \partial t \,|_{t = tmax} = 0$), at the same time, the maximum concentration appeared. When $t_p / t_{max} < 0.07$, $t_{max} \approx x / v + 0.5 t_p$, then

$$c_{max} = 0.5\left[erf\frac{vt_p}{\sqrt[4]{D_L(X/V + 0.5T_P)}} + erf\frac{vt_t}{\sqrt[4]{D_L(X/V - 0.5T_P)}}\right]$$

The main factors [2] of sources and sink are adsorption of solute by aquifer particles, solute precipitation, ion-exchange between surface of solid-phase particles and the solution, dissolution of certain substances in the solid-phase particles, the chemical reactions in solution, radioactive element decay, crop roots absorption of solute.

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New high-temperature and-pressure granulites in Amdo basement, central Tibet

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High-temperature and-pressure granulites containing garnet, clinopyroxene, hornblende and quartz have been first found in Amdo basement along Bangong-Nujiang suture in central Tibet (Figure 1).

Fine grained symplectites composed of orthopyroxene + plagioclase ± spinel/hornblende + plagioclase ± orthopyroxene developed during the decompressing stages in the granulites. A metamorphic evolution of the largest granulite lens is determined from careful analyses of reaction textures. It shows a peak condition (860-920°C and 14.6-15.6kbar), which retrogressed from post-peak condition (820-890℃ and 8.8-11.5kbar) to Amphibolites facies condition (550-670℃ and 5.2- 6.5kbar). The three stages define a near-isothermal decompressional clockwise P-T path for Amdo granulites, suggesting that Amdo basement underwent initial subduction to lower-crust level, subsequent rapid exhumation or extensional faulting, and fast cooling and retrogression.

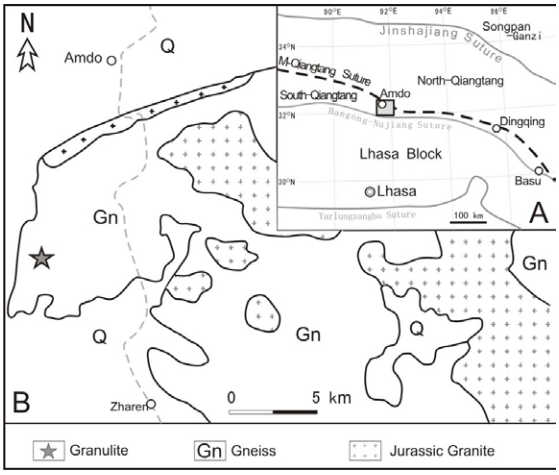

Figure 1: Location of the new granulite, Tibet

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Experiments of olivine reacted with aqueous solutions at high temperatures and its implication for MOR hydrothermal reactions

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Scientists reported that the reaction of olivine- and pyroxene-rich rocks with water—produces magnetite, hydroxide, and serpentine minerals, and liberates molecular hydrogen, a source of energy and electrons that can be readily utilized by a broad array of chemosynthetic organisms. The reaction has implications for life in early earth, and at MOR. Modern MOR investigations found H_2 bearing hydrothermal fluids at the vent, e.g. Lost City. Here, we report kinetic experiments of olivine and femic minerals (pyroxene) – aqueous solutions at temperatures (T) from 25 to 400°C and at 23MPa with a purpose for simulating the reaction between olivine and water at MOR vents. The mineral samples used in these experiments are obtained from nature and have been analyzed chemically. The olivine mineral contains a little pyroxene. Their compositions and structure are also analyzed through SEM and TEM before and after reactions. All dissolution experiments were performed using a flow through reactor (mixed-flow reactor with Zr metal liner). Put 5 g in Ti network sample bag in 196 ml vessel, and flow rate ranges from1to 3mL/min. The experiments were conducted at far-from-equilibrium conditions. As usual, steady state dissolution experiments found that Na, Mg, Fe, Ca dissolve faster than Si at T <300°C. In contrast, at T≥ 300°C, Si release rate is higher than other metals, so that the dissolution product is often not stoichiometric. The maximum dissolution rates (Si) are observed at 300°C, 23MPa. As we collected effluence fluids sample (room air was not interfused), and analyzed. Then hydrogen was found in the effluence particularly at 300°C. H_2 concentration is 0.5-0.8μm in the effluent solution in flowing system (flow rate: 1-3mL/min). Proved the reaction occurring:

$$3Fe_2SiO_4 + 2H_2O = 2Fe_3O_4 + 3SiO_2 + 2H_2$$

SEM and TEM study found: as T ≥ 300°C, the surface layers is a light Fe-rich and little Si deficient after femic mineral reacted with water, serpentine were often found at surface.

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Note. A pinhead is mounted at the outlet tube. As the pinhead is inserted into the plastic cover of the sample bottle, the H_2 bearing fluids pass through the pinhead into the bottle. Dissolved H_2 in fluids were determined by a gas chromatography.

The dynamic effects of sedimentation rate on the gas hydrate system

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It is generally suggested that the high sedimentation rate is favorable to gas hydrate depositing. Gas hydrate in sediments is strictly controlled by temperature, pressure and the saturation of methane, when the fast sedimentation happens, how the temperature and pressure and the fluid flow migrate with sediments remains a question. We design a 2-D transient numerical model, which considers the processes of sedimentation and the adjustment of thermal field and fluid flow and the formation and dissociation of gas hydrate, using the Arbitrary Lagrangian-Eulerian FEM method, to quantitatively address the dynamic effects of sedimentation rate on the gas hydrate system. The ALE method can well simulate the spatial changing of the model. We consider about the methane flux at the model base and *in situ* biogenic gas and there is no gas hydrate initial. The results suggest when there is no obvious continue sedimentation, the profile of gas hydrate saturation should like figure 1. a, which is as the case of the steady state model. However, when the fast sedimentation (0.0505 mm/a) is considered, the highest saturation of gas hydrate would occur just above the base of gas hydrate stability as a thin zone and the shape of the profile of gas hydrate saturation would like figure 1. b, after time evolving to 2.8 Ma. This result corresponds well with the drilling result of Northern South China Sea gas hydrate expedition, which has the fast sedimentation and thin strip of high saturation (up to 48%) gas hydrate just above the base of gas hydrate stability zone.

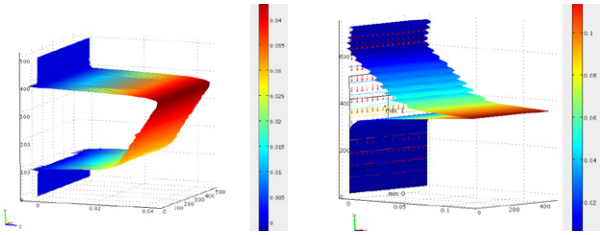

Figure 1: The saturation of gas hydrate when no obvious continue sedimentation(a); and has fast sedimentation (0.0505 mm/a); (b), at 2.8 Ma, respectively.

Evaluation on the denudation of the Hadamengou and the Liubagou gold deposits in Inner Mongolia, China

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Located at the northern margin of North China Craton, the Hadamengou and the Liubagou gold deposits are hosted by Archean medium-high metamorphosed rocks, controlled by EW trend tectonic faults, and may be related to magmatic hydrothermal fluids. They are characterized by widespread K-feldsparthization, accompanying silicification, chloritization and epidotization [1]. Multi-methods are used here to evaluate the denudation extent of the two gold deposits.

In the Liubagou deposit, the vertical zoning is Zn-Bi-As-Ag-Cu-Ba-Au-Hg-Pb-W-Sb-Mo in its western part and Sb-Hg-Ba-Cu-Zn-As-W-Bi-Mo-Ag-Au-Pb in its eastern part; while it is Mo-Pb-Au-Cu-W-Cr-Ni-Ba-Bi-Zn-Co-V-Mn-As-Ti in the Hadamengou deposit. The cell parameter (a_0) values of quartz show a good positive correlation (0.89) with altitudes. The elevation of ore bodies from the Hadamengou deposit is about 300 ~ 900 meters lower than the one from the Liubagou deposit, and its a_0 values are obviously less than the ones of the Liubagou deposit. The average homogenization temperature of the Liubagou deposit roughly decreases from west to east (289°C→268°C→257°C); its overall average temperature (268°C) is slightly lower than the one of the Hadamengou deposit (286°C). The $\delta^{34}S$ values of pyrite from deep to shallow areas in the Hadamengou deposit change from large to small [2]. The average $\delta^{34}S$ values of pyrite in the western section (-7.44‰, 8.73‰) higher than the ones in the eastern part (-9.60‰, 10.03‰) at both the Hadamengou and the Liubagou deposits; the overall average $\delta^{34}S$ value of pyrite in the Hadamengou deposit (-8.59‰) is relatively higher than the one in the Liubagou deposit (-9.25‰). The primary halo, genetic mineralogy, fluid inclusions and sulfur isotopic geochemistry provide strong evidences for the denudation level of the Hadamengou and the Liubagou gold deposits whereby their western parts are less denudated than the eastern ones, while there is a less degree of denudation and a better ore prospecting potential for the Liubagou gold deposit.

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Oxygen diffusion in hydrous silicate melts

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Oxygen is the most major constituent in silicate melts. Quantifying oxygen diffusion is critical to understanding oxygen isotopic exchange, rates of reactions involving oxygen, and general mass transport in silicate melts. In anhydrous silicate melts, ^{18}O diffusivity is often found to be similar to Eyring diffusivity [1]. However, in hydrous silicate melts, ^{18}O diffusivity is often higher than the Eyring diffusivity by orders of magnitude, and is predictable quantitatively by assuming ^{18}O is carried by molecular H_2O [2, 3] and assuming isotopic equilibrium between hydrous and anhydrous oxygen species [4]. Recently, H_2O diffusivity in several melts has been determined as a function of temperature, pressure and water content [5-7]. From such relations and H_2O solubility (e.g. [8]), we can now compare ^{18}O diffusion flux in natural magmas due to anhydrous oxygen (such as nonbridging oxygen and free O^{2-}) mobility estimated from Eyring diffusivity, and ^{18}O diffusion flux due to $H_2{}^{18}O$ flux. We estimate that in rhyolitic melts at 1200 K, H_2O diffusion would dominate oxygen transport at ≥100 ppm total H_2O; in dacitic melt at 1200 K, H_2O diffusion would dominate oxygen transport at ≥500 ppm total H_2O; in basaltic melt at 1600 K, H_2O diffusion would dominate oxygen transport at ≥1.0 wt% total H_2O. Because natural rhyolitic to dacitic melts contain more than 500 ppm H_2O, oxygen diffusion in these melts is dominated by H_2O carrier. On the other hand, H_2O contents in mid-ocean ridge and ocean island basaltic melts are often less than 1 wt%, oxygen diffusion in these melts is mostly due to its own mobility. However, in island arc basaltic (IAB) melts that often contain wt% level H_2O, oxygen diffusion in IAB melts is often due to H_2O mobility. Quantitative relations between oxygen diffusivity in hydrous natural melts as a function of temperature, pressure and H_2O contens will be presented.

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Atomic structure at the quartz (101) – water interface by X-ray scattering method

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Knowledge of the atomic level structures at the quartz water inteface will be essential to understand the dissolution/precipitation processes at such interface. In a previous study [1], the interfacial structure of quartz (101) and (100) surface in water was probed along the surface normal direction. In this study, the single crystal quartz (101) – deionized water interface structure was measured with high resolution surface X-ray scattering (i.e. crystal truncation rod). The 3D interfacial structure, including the relaxations of the atoms in the near surface region and the distribution of the interfacial water molecules, were determined. This is the first step in determining the interfacial structure during the dissolution/precipitation processes when the quartz surface is exposed to aqueous solutions at various conditions.

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Characteristic of tourmaline in Xiazhuang Uranium ore-field, South China

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Tourmaline is a common accessory mineral in many igneous and metamorphic rocks. Xiazhuang uranium ore-field was one of the most important granite-type uranium deposits in China. Previous studied revealed that tourmaline was one of the most important alteration minerals with the mineralization of uranium [1]. So the study on the characteristics included the paragenetic association and the formation conditions would be helpfully to understanding the mineralization of the Uranium in this field. Therefore this paper we focused on the characteristic and the formation conditions of tourmaline in Xiazhuang Uranium ore-field by using microscope and electron probe microanalyser (EPMA) methods.

There were two kinds occurrence of tourmalines in Xiazhuang uranium ore-field. One kinds of tourmaline occurrence in tourmaline-quartz vein, tourmaline often radiated or lumped distributed in quartz vein and some of grains size reached 3 cm, pitchblende was distributed at the astillen of this kind of vein by exploitation. The other kind of tourmaline dispersed in tourmalinization granite or Maofeng Pluto, which was one of the most important host granite pluto in Xiazhuang uranium ore-field.

EPMA analysis revealed that all the tourmalines were lack of the interior girdle and the composition of the tourmaline were located in the schorl areas. In the distinguish diagram between the composition of tourmaline and formation environment, which used by Henry & Guidotti [2], most of the tourmaline located in the granite genesis, few of them located in the quartz-tourmaline and metamorphose mudstone zone. Most of the tourmaline has the same REE pattern with the host granite; but some of them especially those occurrences in quartz vein differ from the granite type, and lack of the Europium-depletion, which might infer that the REE in tourmaline were not derive from granite. Due to the tourmalines in Xiazhuang uranium ore-field had different attitude and similar chemical composition but varied REE pattern and lack of interior girdle which might infer that tourmaline not the product of the autometamorphism but the products of the B-riched fluid.

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Extremely higher Gallium content of the Xuanwei black shale in the Upper Permian, West Guizhou, China

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The Xuanwei Formation of Upper Permian is widely occurred in western Guizhou, unconformably overlying Emeishan basalt, and mainly consists of black shale. It is ~170 m thick in the Cuyudong village, Weining County, West Guizhou, China, where the samples of black shale and sandy shale analyzed here are collected. The shale mainly consists of SiO_2, 18.9%–44.1%, Al_2O_3, 14.8%–52.8%, Fe_2O_3, 1.0%–41.2%, LOI, 3.2%–21.1%, TiO_2, 1.0%–6.7%, and MgO, 0.2%–2.5%. The content of all other major elements are lower than 1.0%. These show that the black shale had higher contents of Fe_2O_3 and LOI than that of normal shale. The siderites occurred in the black shale with higher contents of Fe_2O_3, which may be from hydrothermal activity on seafloor. The all analyzed shale samples had extremely higher Ga, 47.8 ppm–109.9 ppm (70.5 ppm in average), higher than the industrial mining standard of Ga Resource Industry Standard (China Mineral Resources Reserves Committee, 1987). The total content of rare earth elements (REE) of 9 black shale samples varies from 213 ppm to 1460 ppm, suggested that these black shale was enriched in REE. The shale-normalized REE patterns display both positive and negative Ce anomalies (Ce/Ce* from 0.5 to 1.7), revealing that the Xuanwei shale precipitated under oxic and anoxic conditions. The Rb-Sr chronological diagram of 6 shale samples in the Xuanwei formation shows that the age is 255 Ma ± 12 Ma. Strontium isotopic ratios ($^{87}Sr/^{86}Sr$)t0 range from 0.70635 to 0.70711, suggested that these Xuanwei black shale might be derived from the chemical weathering of Emeishan basalts.

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Geological characteristics and genesis of Dachang Gold Deposit in Qinghai Province, China

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Dachang gold deposit is located in the North Bayan Har orogenic belt, which is an important metallogenic belt in Qinghai province. The deposit is formed during the late stage of regional Indosinian orogenic process and Au-Sb mineralization related closely with the evolution of the Bayan Har Ocean. All gold ore bodies are hosted in the Middle Triassic sandstone interbedded with slate of Bayan Har Mountains Group and controlled by fracture zone strictly. All ore bodies are presented by vein, vein-like and lenticular. Mineralization can be divided into two stages, for example, gold mineralization and antimony mineralization. The depth of gold mineralization is 6.9km and the depth of antimony mineralization is 5.9km, the antimony mineralization is less shallow than the gold mineralization. The ore-forming fluids belong to NaCl-H_2O-CO_2 type characterized by rich CO_2, low-moderate temperature, low salinity, low density and strong reductibility.The characteristics of geology and geochemistry is similar to the standard orogenic deposit, the gold mineralization is the mesozonal orogenic mineralization and the antimony mineralization is the epizonal orogenic mineralization. The ore-forming fluids of Dachang gold deposit were mainly derived from the formation water and mixed with a small amount of the mantle source magmatic water and meteoric water. Fluid immiscibility and existence of organic matter play important role in gold mineralizing processes. As for its geological setting, ore-hosted rock, mineral and element paragenesis, or metallogenic mechanism, the gold deposit is pretty similar to the Muruntau gold deposit and can be contrasted completely [1].

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Nb and Ta in the rutiles from eclogite in the Yuka of the North Qaidam UHP belt, NW China

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Using LA-ICP-MS, we analysed the Nb, Ta concentrations of 14 rutile grains from four eclogite samples in Yuka, the North Qaidam UHP belt, NW China.

Analyses results show that both Nb, Ta concentrations and Nb/Ta vary dramatically, not only in different samples but also in different grains in the same sample, and even within individual grain. 03QH20 is a phengite eclogite containing some melting quartz-phengite veins and conglomeration. Rutiles in this sample have relative the highest concentrate and largest variation in Nb, Ta and Nb/Ta. In which, rutiles coexisting with garnet and omphacite have lower Ta and roughly chondritic Nb/Ta ratios of 16.41-19.65 with average of 17.93. Wheras rutiles in retrograde region and veins coexisting with Phen, Amp, and Qtz have lower but fluctuant Nb, Ta and overall subchondritic Nb/Ta of 4.38-13.67 with average of 9.08. And the lowest Nb/Ta in a grain occures at the core and increase towards the rim. 02QH15 is garnet rich massive eclogite, Omp mostly been altered into Amp or Chl. Rutiles in this sample have relative the lowest Nb, Ta concentrate but overall suprachondritic Nb/Ta ratios of 18.76-24.31 with average of 20.05. Differing from 03QH20, the highest Nb/Ta in a grain lie at the core and decrease from core to rim. Sample 08QH93 is a retrograde eclogite containing lots of Phen veins. Grt and Omp mostly overprinted by Amp, only fewer Grt left. Analyzed rutile grains all from veins coexisting with Phen. They show lower Ta, medium Nb and overall suprachondritic Nb/Ta ratios (Nb/Ta=19.33-23.43 with average of 21.56) and Nb/Ta decrease from core to rim. 08QH92 also a retrograde eclogite and rutiles coexist with Amp and Qtz. These rutiles have medium Ta and Nb content and roughly chondritic Nb/Ta ratios ranging from 15.82 to 18.52 with average of 17.26.

Our studies suggest: 1) Nb and Ta were highly fractionated in UHP rocks; 2) Nb/Ta characteristics in rutile cannot be changed remarkably during retrograde metamorphism; 3) Rutiles of 03QH20 and 08QH93 all from Phen vein but exhibit distinct characters, implying that dehydration melting during subdution resulted in subchondritic Nb/Ta and high concentrate Nb and Ta (e.g. 03QH20), whereas, during exhumation resulted in suprachondritic Nb/Ta and lower Nb, Ta concentrate (e.g. 02QH15 and 08QH93).

Integration of stream sediment geochemical and aeromagnetic datasets for mapping target areas for mineral exploration of iron deposits in eastern Tianshan, China

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Previous researches proposed that most of the marine volcanic-sedimentary iron deposits in the eastern Tianshan ore district were formed within intermediate-mafic and intermediate-felsic volcanic rocks, and exhibit positive anomalies in aeromagnetic data [1].

From stream sediment geochemical data, principal component analysis (PCA) allows recognition of element assemblages (e.g. Fe_2O_3, K_2O, Na_2O, SiO_2, CaO, MgO, Al_2O_3, etc.) associated with ore-forming volcanic rocks. However, stream sediment geochemical data only reflect surface or near-surface distribution of elements, which are inadequate for mapping sub-surface ore-forming volcanic rocks. Nevertheless, aeromagnetic data can show magnetic differences between geo-bodies buried at depth. Since most of the iron deposits in the study area exhibit high positive anomalies in the aeromagnetic map, such anomalies can be considered to be among the most important diagnostic ingredients in mapping of mineralization targets.

Spatially weighted principal component analysis (SWPCA) method [2] was used to integrate the geochemical and aeromagnetic data sets. In the process of deriving ore-forming element assemblages from the geochemical data, the aeromagnetic data can be assigned as a spatially weighting factor to highlight areas containing more magnetic materials. The result shows favorable areas for iron mineral exploration.

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Heterogeneous carbonation in the $MgO-H_2O-CO_2$ System

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Carbonation of natural brucite is carried out in aqueous environments at room temperature and moderate CO_2 pressure to examine the product mineral phases and reaction kinetics. Two sets of initial conditions are examined: brucite in pure H_2O v. s. in diluted (1%) HCl. Time-dependent XRD analysis shows that carbon fixation process begins within 30 min of the experiments irrespective of the original makeup of the slurry. XRD and FT-IR reveal that nesquehonite is by far the dominant C-bearing species in the mineral product assembly with minor components being basic Mg-carbonate hydromagnesite and dypingite in water and chloride-bearing artinite in HCl. However, thermodynamic calculation suggests that such assembly is most likely kinetically favored becasue the experimental conditions are more saturated with respect to hydromagnesite and magnesite than to nesquehonite. A pseudo first-order rate law is found to best describe the time-dependent measurements for both settings. Moreover, fitting the rate expression yields a higher rate constant for the experiments performed in HCl solutions. The faster kinetics implies that the carbonation reaction may be a multi-stepped process, involving first the dissolution of brucite and CO_2 to generate Mg^{2+} and CO_3^{2-}, followed by precipitation of magnesium carbonate phases from aqueous solutions. This leads to our proposition that direct heterogeneous reaction between CO_2 and solid phase Mg $(OH)_2$ is probably not the pathway for the overall carbonation process. Assuming the upper limit of carbon content Cmax = 8.7% (based upon that of nesquehonite), measured total carbon in the product Ctot show a carbonation rate of 83.9% and 94.3% for brucite in HCl and DDW at the end of 2.5 hr experiments. However, significant amount of brucite (~ 30 to 40%) remains unreacted in HCl, sharply contrasting to < 5% in DDW. Solution chemistry analysis indicates that most CO_2 stays in aqueous phase in both media; however, the concentration of HCO_3^- and pH in HCl dip below those in H_2O after about 2 hr, suggesting lower saturation may be repsonble for the inferior carbonation extent in HCl.

Origin of diagenetic fluid: Constraints from *in situ* analyses of stable isotopes and trace elements in carbonate veinlet and wallrock from the Ediacaran system in South China

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To retrieve the original signatures of sedimentary geochemistry in carbonates requires chemical and isotopic separation of precipitation fluid from diagenetic fluid. However, it is a challenge to trace the origin of diagenetic fluid in sedimentary limestone and dolostone that suffered the influence of freshwater and terrigenous weathering. In order to constrain the origin of diagenetic fluid in postglacial carbonates, *in situ* analyses of C-O isotopes and trace elements were carried out on carbonate veinlet and wallrock from the Upper and Lower Units of the Lantian Formation in South China, which is equivalent to the Doushantuo Formation elsewhere in South China and to the upper part of the Ediacaran system elsewhere in the world.

In the Upper Unit, $\delta^{13}C$-$\delta^{18}O$ values and REE+Y patterns for veinlet are similar to those for wallrock, indicating the internal origin of diagenetic fluid from pore water and thus precipitation water. In the Lower Unit, however, the geochemical features of veinlet are highly different from those of wallrock, suggesting an external origin of diagenetic fluid. The REE+Y patterns for both veinlet and wallrock in the two units differ from those for normal marine carbonates, suggesting incorporation of terrigenous weathering by freshwater into the depositional basin.

There are negative and positive correlations between the $\delta^{13}C$ and $\delta^{18}O$ values for the Upper and Lower Units, respectively. This indicates that the isotopic compositions of wallrocks in the two units were influenced by different origins of diagenetic fluid. Both veinlet and wallrock in the Upper Unit are similar to each other with unusual depletion of ^{18}O, indicating their deposition from continental deglacial meltwater. The variation in $\delta^{18}O$ values are probably caused by different proportions of mixing between meltwater and seawater during carbonate precipitation in addition to precipitation temperature. On the other hand, the high $\delta^{13}C$ and $\delta^{18}O$ values for the wallrock of the Lower Unit suggest that the precipitation water is similar to the seawater, whereas the low $\delta^{13}C$ and $\delta^{18}O$ values for the veinlet that are consistent with those for the Upper Unit indicate the action of diagenetic fluid derived from the continental deglacial meltwater.

Controlling factors and oil-gas geological significance of the high-quality reservoir of volcanic rocks: An example from Songliao Basin

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The volcanic rocks of Yingcheng formation in Lower Cretaceous are the major reservoirs for the deep-buried gas in Songliao Basin. The comprehensive studies of features of volcanic rocks and their physical properties suggest that the formation of the high-quality reservoir of volcanic rocks is controlled by lithofacies, lithology, eruptive phase, fracture and post reformation in Songliao Basin. The volcanic lithofacies controls the primary pores and fractures, which are the basement for the formation of good reservoirs. The explosive facies is the best favorable zone for reservoirs. There are gas-pores built up on the top (belting) of volcanic rocks of the flood facies, which is the best favorable zone for reservoirs. The physical properties for reservoirs of volcanic rocks are usually good when they are more acidic rocks, which have well developed gas pores and corroded pores. The rhyolites or rhyodacites are suggested to be the best type of reservoir rocks. Besides, the more eruptive phases (recycle), superposed lithology and lithologic types, the better physical properties of reservoirs. The high-angle fractures developed inside the volcanic rocks contribute to not only the reservoir space but also the important role of connecting the pores, which are the key factors to the formation of high-yield wells. The deep fluids migrate through the high-angle fractures and then make the corrasion to the host rocks, therefore the area where the high-angle fractures are densely developed are easy to form the favorable reservoir zones with the assemblage of high-angle fractures and corroded pores. The hypergene diagenesis such as the gas dissipation, condesation, corrasion and solution, cataclasis, hypergene weathering and leaching *et al*. have the constructive reformation to the reservoirs, being favorable to the development of reservoirs. So, the high-quality reservoir of volcanic rocks are characterised by the explosive facies, the top of the flood facies, poly-eruptive recycles, fracture-developed rhyolitic volcanic rocks, which are the major production formation of deep buried gas in the Songliao Basin.

A riebeckite alkaline granite related to subduction setting in Chinese Altay Mountain

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The Burgen riebeckite alkaline granite is the oldest late Paleozoic alkaline granite with zircon U-Pb age of 338±1Ma and 358±4Ma in north Xinjiang. Geochemistry of trace elements and Sr-Nd-Pb-Hf isotopes have revealed a subduction-related tectonic setting for this alkaline granite generation. 1. High alkaline contents (K_2O+ Na_2O=8.56-10.62%), Eu strong depletion (Eu/*En 0.03-0.30), relatively rich in HREE ($(La/Yb)_N$0.82-1.69) and HFSE are typical. High positive ε Nd (t) (+6.78-+7.74) and ε Hf (t)(+9.86-+12.54), younger model ages of Nd (T_{DM} = 469-548Ma) and Hf (T_{DM}546-718Ma) and high zircon saturation temperature (880-1025℃) suggest the alkaline granite originated form high temperature depleted mantle.2. Diorite, quartz monzonite, monzonite and K-feldspar granite (about 350Ma)are closely distributed with the Burgen alkaline granite and composed of an association of I- with A-type granites. Middle Devonian and early Carboniferous basic-intermediate volcanic rocks and early Permian alkali-rich intrusions (300-280Ma) are wide distributed, but there lack of late Carboniferous (318-300Ma) magmatic activities. The association of I- with A-type granites and nearly 20 Ma gap of magmatic activities both suggest the alkaline granite was generated in a slab window. Ridge subduction or break off or roll back of the subducting oceanic slab may be responsible for the slab window generation and then asthenosphere upwelling leads to generation of high alkaline magma.

Remelting of subducted continental lithosphere: Petrogenesis of Mesozoic magmatic rocks in the Dabie-Sulu orogenic belt

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The Dabie-Sulu orogenic belt formed by the Triassic continental collision between the South China Block and the North China Block. There is a large area of Mesozoic mgmatic rocks along this belt, with emplacement ages mainly at Late Triassic, Late Jurassic and Early Cretaceous. The Late Triassic alkaline rocks and the Late Jurassic granitoids only crop out in the eastern part of the Sulu orogen, whereas the Early Cretaceous magmatic rocks occur as massive granitoids, sporadic intermediate-mafic intrusive and volcanic rocks throughout the Dabie-Sulu orogenic belt. Despite the different ages for their emplacement, the Mesozoic magmatic rocks are all characterized not only by enrichment of LREE and LILE but depletion of HFSE, but also by high initial Sr isotope ratios, low ε_{Nd} (t) values and low radiogenic Pb isotope compositions. Some zircons from the granitoids contain inherited magmatic cores with Neoprotozoic and Triassic U-Pb ages, respectively. The Neoproterozoic ages also have been found in some inherited zircon cores from the Cretaceous mafic rocks. Most of the mafic roks have zircon $\delta^{18}O$ values either lower or higher, and whole-rock $\delta^{13}C$ values lower, than those for the normal mantle. A systematic comparison with adjacent UHP metaigneous rocks shows that the Mesozoic granitoids and mafic rocks have elemental and isotopic features similar to the UHP metagranite and metabasite, respectively. This indicates that these magmatic and metamorphic rocks share the diagnostic features of lithospheric source that has a tectonic affinity to the northern margin of the South China Block. Their precursors were derived from reworking of arc-type crust in the Proterozoic. They underwent the UHP metamorphism and the post-collisional anatexis at different times and depths, respectively. Therefore, the Mesozoic magmatic rocks were derived from anatexis of the subducted continental lithosphere itself beneath the collision-thickened orogen. The geodynamic mechanism of post-collisional magmatisms is tectonic collapse of the orogenic roots in response to lithospheric extension. We advocate that reworking of the orogenic lithosphreic mantle and crust is a basic process for petrogenesis of continental igneous rocks.

Study on determination of Lead isotopes ratio in oil shale by Inductively Coupled Plasma Mass Spectrometry

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Oil shale resources are abundant in the world. As an important substitute of energy resource, has caught people's great attentions for its large resource and multi-purpose utilizations.

A method for the determination of Lead Isotopic Rations in oil shale was proposed by Iductively Coupled Plasma Mass Spectrometry (ICP-MS). The instrumental fluctuation from sampling system and plasma that induce the low precision can be avoided by optimizing the operating parameters.For the accuracy results, the ratios acquired should be corrected with the dead time and internal standard mass bias. The ICP-MS (Agilent 7500a) running conditions: RF power 1250W; Carrier gas flow rate 0.4L/min; makeup gas flow rate 0.8L/min, Spray chamber temp 2°C; Sample flow rate 0.1ml/min; Sample depth 7mm.

In the determination of the method, we analyse ^{206}Pb ^{207}Pb ^{208}Pb. Because the contents of oil shale of ^{204}Pb are too low, wo don't analyse ^{204}Pb. The sample was dissolved in mixed acids with pressurized sample digestion and an appropriate amount of mannnitol was added to prevent boron from volatilization..Analytical mass number were carefully selected and the instrumental operating conditionswere optimized.

The major parameters affecting the acccurate and precise measurement of lead isotope ratios by ICP-MS were studied. The analytical precisions of lead isotope ratios for SRM 981 of repeat measurements at lead concentration of 5 μg/L were about 0.1% for $^{206}Pb/^{207}Pb$, 0.12 for $^{206}Pb/^{208}Pb$, respectively applied to the analysis of oil shale samples. The method of ICP-MS, with the merits of high sensitivity and precision, is suitable for the measurement of lead contents in plants.

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Mass independent isotope fractionation of mercury during its photochemical reduction by low-molecular-weight organic compounds

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Photochemical reduction of Hg (II) by various low-molecular-weight organic compounds (LMWOC) was investigated to evaluate the effect of specific functional groups that are typically encountered in natural dissolved organic matters (DOM) on the photo-reactivity and isotope fractionation of Hg. LMWOC with reduced sulfur functional groups (e.g. cysteine, glutathione) resulted in slower photochemical reduction of Hg (II) than those without reduced sulfur groups (e.g. serine, oxalic acid). Reduction rate constants were specifically determined for two contrasting LMWOC: DL-serine (0.640 h^{-1}) and L-cysteine (0.047 h^{-1}). Different mass independent isotope effects of Hg were induced by the two types of LMWOC. S-containing ligands specifically enriched magnetic isotopes (^{199}Hg and ^{201}Hg) in the product (Hg (0)) while sulfurless ligands enriched ^{199}Hg and ^{201}Hg in the reactant (Hg (II)), suggesting that opposite magnetic isotope effects (MIE) were produced by different type of ligands. The direction of MIE depends on the initial spin multiplicity of the radical pairs generated as intermediates of primary photochemical procedures. Nuclear field shift effect was also observed in the photochemical reduction by serine. These isotope effects are related to specific functional groups and reduction mechanisms. Therefore, they are used to distinguish between the primary and secondary photochemical reduction mechanisms of Hg (II) and to explain the isotope fractionation during the photochemical reduction of Hg (II) by natural DOM, which provides a mixed bonding conditions.

Evaluation of water quality from deep wells in Bangladesh

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Deep wells, usually installed at depth > 150 m, emerged as the dominant safe water option to mitigate the wide spread arsenic problem in Bangladesh. At present, there is a scarcity of water quality data for deep groundwater. This knowledge is needed to guide further development of the deep aquifers for safe water provision.

Concentrations of arsenic, fluoride, nitrate, manganese, and iron of 211 water samples from deep wells from 19 upazilas of 9 districts were measured in the field. The WHO guideline values for drinking water for arsenic, fluoride and nitrate are 0.1, 1.5 and 50 mg/L, respectively. The Bangladesh drinking water standard for arsenic, fluoride and nitrate are 0.5, 1.0 and 10 mg/L, respectively. WHO has guideline values for manganese (0.4 mg/L) but not for iron based on taste. We found that 57% of samples contained > 1 mg/L iron and 19% contained > 0.1 mg/L manganese, the respective Bangladesh drinking water standard.

Arsenic: Concentrations ranged from < 0.01 mg/L to 0.18 mg/L, with 6% (n=12) exceeding 0.5 mg/L and 26% samples (n=55) above 0.1 mg/L. The highest ten values were from Dharmopasha upazila of Sunamgonj district.

Fluoride: Concentrations ranged from below detection to 21 mg/L, with 18% (n=38) exceeding 1.0 mg/L and 6% samples (n=16) above 1.5 mg/L. Eight wells from Comilla and Rangpur districts contained > 10 mg/L fluoride.

Nitrate: Concentrations ranged from below detection to 31 mg/L, with 3% (n=7) exceeding 30 mg/L and none above 50 mg/L. Seven wells containing > 10 mg/L nitrate were from Raipura, Narshingdi (n=6) and Banchrampur, Brahamanbaria.

The reasons for geographic patterns are under investigation. The subsidence rate in Northeastern Bangladesh is high resulting accumulation of a thick sequence of Holocene sediment. This may explain why As is high at 150 m and belwo in Sunamgonj.

Geochemical insights into reworking of juvenile and ancient crustal rocks in arc-continent and continent-continent collision zones

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With the development of plate tectonics, significant differences have been recognized in subduction-zone metamorphism during plate convergence. This is indicated by contrasting geological occurrences, mineral assemblages, and physico-chemical conditions of peak metamorphism. Thus subduction zones can be categorized into Pacific and Alpine types based on the geochemical nature of subducted crust. The Alpine-type subduction involves the possible closure of backarc basins, arc-continent, continent-arc-continent or continent-continent collision without syn-subduction magmatism. Thus, the Alpine-type collision reworks preexisting terranes, resulting in reworking of preexisting crust rather than growth of juvenile crust. Whole-rock Nd and zircon Hf isotope studies enable distinction between different ages of the continental crust. While the juvenile crust is indicated by positive ε_{Nd} (t) and ε_{Hf} (t) values with young Nd and Hf model ages close to timing of magmatism, the ancient crust is characterized by very negative ε_{Nd} (t) and ε_{Hf} (t) values with very old Nd and Hf model ages.

Although the two types of plate convergence can be distinguished from tectonic observations, there are a number of transitions between them. Thus, continental collision zones are further classified into two types also based on the geochemical nature of subducted crust. One is the Himalaya-Tibet type that starts from the Alpine type arc-continent collision with contemporaneous metamorphism and magmatism. Ultimately, it evolves into continent-arc-continent collision orogens, with or without HP to UHP metamorphism. This leads to broad intercontinental orogens with reworking of juvenile crust. The other is the Dabie-Sulu type in which the subduction of one granitic crust-capped continental plate beneath the other continental plate to bring about UHP metamorphism during continent-continent collision, with no juvenile arc between the collided continents. This results in narrow intercontinental orogens and reworking of relatively ancient crust. While variable ε_{Nd} (t) and ε_{Hf} (t) values for continental igneous rocks suggest mixing between different ages of crustal materails, reasonable identification of endmember component holds a key to the hypothesis about crust-mantle interaction during magmatism of interest. In particular, positive ε_{Nd} (t) and ε_{Hf} (t) values for them do not mean that their magma source is the asthenospheric mantle.

Role of morphology in the aggregation kinetics of MeO nanoparticles

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The aggregation kinetics of two types of ZnO nanoparticles has been investigated under various conditions. Distinct differences in aggregation kinetics were observed between the two ZnO particles. The aggregation of the nearly spherical ZnO (denoted as Me ZnO) exhibited strong dependence on the ionic strength (IS) of the solution; while minimal influence of IS was seen on the irregularly shaped ZnO (mixture of slab-like and rod-shaped particles, denoted as Mk ZnO) in the IS ranged tested. It is postulated that the Mk ZnO possesses a critical coagulation concentration (CCC) below the lowest electrolyte concentration tested (1 mM NaCl) due to the interactions between various surfaces. The CCC of ZnO was found to be a function of pH; the CCC increased significantly as the pH was further away from the point of zero charge. Natural organic matter (NOM) was found to substantially hinder the aggregation of both types of ZnO particles (above 10 mg/L for the Me ZnO and above 1 mg/L for the Mk ZnO). To our knowledge, this is the first study to report the effect of particle morphology on nanoparticle aggregation kinetics, which outlines the importance of accounting morphology into nanoparticles' environmental transport assessment. Current ongoing work is to further investigate the role of morphology under more controlled condition. TiO_2 nanoparticles with rod, sphere, and wire morphology are being studied for the difference among their aggregation processes.

Effect of model organic macromolecules on calcite mineralization and implication for biomineralization

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Crystal morphology control is one of the hallmarks of biomineralization. Organisms can employ some of functional macromolecules to produce crystals with one special mineral type and a uniform morphology at the particular tissue sites. The control biomacromolecules associated with biogenic calcite are commonly an array of extracellular proteins, which are characteristically acidic and usually glycosylated in nature. At present, a general consensus is polyanionic macromolecules, such as proteins, induce nucleation of special polymorph and control unique morphogenesis of biogenic calcium carbonate with their carboxylate groups. Herein, a model organic macromolecule with massive –C-O-C- groups was used to influence crystallization and growth of calcium carbonate. Such model additive can mimic some nonionized functional groups, such as glycosidic group in glycosylated proteins associated with biomineralization. Indeed, the elongated calcite prisms, which are similar to the calcite spine of sea urchin or the calcite prisms in mollusk shell in shape, could be obtained by mimetic mineralization with the model additive. Another intriguing result in current experimental conditions is that model additive also initially induces and stabilizes an otherwise unstable amorphous calcium carbonate (ACC) phase notwithstanding the stabilization is transient and the unstable ACC eventually transforms into stable prismatic mesocrystals of calcite, displaying all of features of $CaCO_3$ biomineralization. In fact, the formation of biominerals from an amorphous precursor phase is a common phenomenon in biomineralization, and the elongated calcite within the mollusk shell prisms and sea urchin spines is a key feature of biomineralization, our results may provide another pathway towards a full insight into biomineralization mechanism.

Molybdenum isotope and geochemical evidence for palaeoenvironmental change at the Ordovician-Silurian boundary, South China

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Molybdenum isotopic composition from the Ordovician–Silurian transitional graptolite-bearing black shale intervals, the upper Wufeng Formation and the lower Lungmachi Formation in West Hubei on the Yangtze block of South China have distinctive ranges of $\delta^{98/95}$Mo values, respectively, whereas a prominent more similar and positive $\delta^{98/95}Mo$ values occurs in the interval of the lower Lungmachi Formation, with $\delta^{98/95}Mo$ values up to about +0.79~+1.21‰, more positively than that of the upper Wufeng Formation, approach to $\delta^{98/95}Mo$ for the anoxic conditions. This seems to indicate that a long of the anoxic conditions presented after the interval of the extinction boundary due to the possibility of the rise of sea-level in the lower Lungmachi Formation, caused by the melting of ice sheets on the Gondwana ice cap, and pushing an already poorly oxygenated ocean over a threshold into an anoxic state. The upper Wufeng Formation have a slightly positively $\delta^{98/95}$Mo signature (exception of a maximum of +2.14‰ in $\delta^{98/95}$Mo at the -50cm of the boundary), it is likely related to the physical disturbance, such as strong upwelling setting and glacial-interglacial transitions occurs multiple times during late Ordovician period.

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Glaciochemical evidence of a transitional site of atmospheric circulation in East Antarctica

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Chinese Antarctic Research Expedition has since 1996 conducted several inland traverses from Zhongshan Station toward Dome Argus in interior East Antarctica. Our glaciochemical research suggests a transitional site of atmospheric circulation (76°32.5′S, 77°1.5′E, 2800m. a. s. l., designated at DT263) exists on the glacial investigation traverse along the route of the third Chinese Antarctic Inland Expedition. The spatial distribution of chemical compositions indicates the area closer to the coast is influenced by the proximal short-distance sea marine mass. In the inland area, materials in atmosphere are mainly from the long-distance transported high latitude atmosphere [1]. The distribution is attributed to local features (topography, wind speed *et al.*) in either inland area or coastal area. For the whole profile, it reveals the general influence of distance from sea and elevation. An 82.5m ice core was drilled at the transitional site which provides especially strong evidence of a LIA (Little Ice Age) type neoglacial episode approximately from 1450 to 1850 [2, 3]. LIA has been found to be a common neoglacial episode in numerous Northern Hemisphere locations and in a few places in the Southern Hemisphere. Compared with ice cores in other Antarctic areas, this information recorded at DT263 is more obvious, indicating special regional information about climate and environment variation and the regional differences in Antarctic climate variation. The temporal distribution here suggests evident regional characteristics. Associating with the spatial distribution of chemical compositions, we suggest the interaction of both oceanic climate and continental climate is the main factor in constituting the typical regional characteristics of the area approximating the transitional site.

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Study on the pollutant transport in unsaturated sand using CT

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In order to study the landfill leakage in unsaturated sand above groundwater level, the computerized tomography (CT) is applied to obtain CT images at different depth of the stable unsaturated zone in silica sand and yamazuna sand, the CT images are transformed into mean CT values by J-Image software, saturation is measured, the heights of capillary rise are 23.5cm and 38.0cm separately, the relationship is established between the saturation and the mean CT value. Then the pollutant potassium iodide (KI) solution is injected by continuous interval method with the rate of 0.69g/s, which the density is 1.1g/cm^3 and the pore size of injector is 0.1mm with the constant head pressure. After scanning at different depth and time interval, the results of KI pollutant transportation are shown as Figure 1.

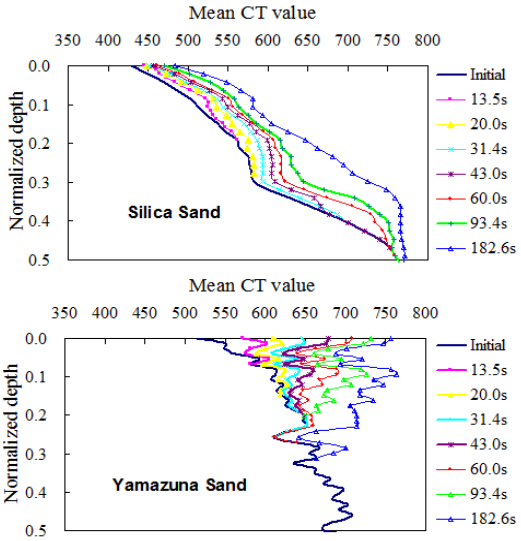

Figure 1 Mean CT value of unsaturated sand and with depth

The pollutant plume in silica sand at low saturation is obviously smaller than that of yamazuna sand. As the saturation increases, the pollutant plume expands and CT value increases gradually as well. But after reaching a certain depth, with the increase of saturation, the pollutant is diluted and diffused gradually, the sensitivity of CT value decreases gradually.

Natural gas characteristics and origin in the Central and Eastern Junggar Basin, NW China

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There is abundant natural gas resources occurred in the northwestern, southern, central and eastern area of the Junggar basin. Based on previous studies, natural gases in this basin are mainly derived from Carboniferous, Permian and Jurassic source rocks. In this study, 14 natural gas samples from 5 oilfields located in central and eastern part of this basin have been collected and analyzed for gas components and carbon, hydrogen and noble gas isotopic compositions.

Main constituents of the gases in the central area of Junggar Basin are methane (80.0–94.6%) up to pentane with traces of carbon dioxide and nitrogen. Compared with central area, natural gases in the east part of basin contain more nitrogen and C_2+ heavy hydrocarbons, and less CO_2. Natural gases in Luliang oilfield demonstrate dry gas characteristics, but gases from giant kelameili gasfield in eastern part are wet gas.

The methane carbon isotope compositions range from -35.2‰ to -37.7‰ and methane hydrogen isotope data range from -177‰ to -192‰ in Shinan, Mobei and Mosuowan oilfield in central part of this basin. In the meantime, their $\delta^{13}C_2$ values range from -26.1‰ to -28.2‰; $\delta^{13}C_3$ values range from -24.7‰ to -26.6‰, all these show that gases are main coal-derived gases with Ro in 0.8-0.9%. The isotopically lightest $\delta^{13}C_1$ and δD_1sample was obtained from Luliang oilfields coexist with biodegraded oil, thus gases of this oilfield are secondary microbial gases. But Kelameili gasfield had higher $\delta^{13}C_1$, mostly ranging from -30.0 ‰ to -31.5‰, while $\delta^{13}C_2$ values range from-27.3‰ to -28.6‰, It is showed that natural gases of this gas field are generated from Carboniferous coal-bearing strata.

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Sm-Nd dating of whole rock and mineral separates from Dangqiong Gabbro, Yarlung–Tsangpo Suture

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Dangqiong ophiolite is one of the main massifs of the Dangqiong-Xiubugabu ultramafic complexes exposed within southern offset in the west segment of the Yarlung–Tsangpo suture zone. Sm–Nd isotope data of plagioclase and clinopyroxene separates and whole rock samples yield an internal isochron age of 373±28 Ma (MSWD =1.5), and an initial εNd (t) value of +3.3. So far most data show Yarlung–Tsangpo ophiolite are remnants of Mesozoic oceanic lithosphere that became trapped along the suture, although there are various kinds ophiolite in age and tectonic setting along different parts of the suture. Except the rather old formation age, Dangqiong ophiolite also shows relatively low Rb concentration and Rb/Sr ratio and OIB-type isotopic affinity in εNd (t)-$(^{87}Sr/^{86}Sr)_i$ space, indicating a distinct geodynamic setting from main Yarlung–Tsangpo ophiolite. In addition, exotic limestone blocks of Permian, Triassic, Jurassic and Cretaceous ages have been found recently in the west segment of the Yarlung–Tsangpo suture zone [1, 2]. Most of these studied rocks show little deformation with slight alteration, and are in fault contact with wall rocks. These rocks, combined with the gabbros, represent a magmatic offspring during an episode of lithosphere extension. This suggests that the Dangqiong ophiolite represents a fragment of Late Devonian Paleo-Tethyan oceanic lithosphere, on top of which are Jurassic-Cretaceous sequences. All these suggest that the geologic assembly including the northern Himalaya block used to be a part of paleo-Asia ocean during the Paleozoic (NSFS No. 40572048, 2009CB421002).

Discussing the metallogenic conditions of sandstone uranium ore at pull-apart tectonic setting

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Tectonic Setting Analysis

After the basalt macroelement analysis results were handled graphically with TAS [1, 2], K_2O-SiO_2 [3] and AMF graph [1], the all graph spots locate at shoshonite zone, so it could be taken the conclusion that the Bayinggebi basin is a pull-apart tectonic setting during Cretaceous period.

Depositional System Analysis

After the field investigation and drill hole data analysis, there are alluvial fan deposit, pebbly braided river deposit, braided deltaic deposit, alluvial deltaic deposit and lake deposit in Baiyinggebi basin.

Uranium Metallogenic Conditions

According to sandstone uranium metallogenic conditions, the braided deltaic deposit has the characters of stratiform, permeability, connectivity in Baiyinggebi Cretaceous sedimentational basin, and its sand-body contained rich in organic element such as carbon dust, plant fragments, low coal seam and pyrite reducing matters. There are full of rocks with abundant uranium source at the basin provenance. So, there are better uranium metallogenic conditions.

Uranium Metallogenic Prediction

Analyzed basin structural setting, sedimentary facies distribution and drill hole geologic data, the sandstone uranium ore forecasted could be find among braided deltaic sand-body in Tamusu district of Bayinggebi basin.

Discussion

The sedimentation of basin is mainly rapid-accumulation at pull-apart tectonic setting, and it could be taken as the target stratum of uranium ore that the braided delta sand-body has the uranium metallogenic conditions.

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Early episodic crust growth of North China Craton: Inferred from U/Pb age, Hf and O isotopes of detrital zircons from Proterozoic sediments, Jixian Section

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To clarify the pattern and rates of continental crust growth in North China Craton (NCC), the clastic sediment samples have been collected for each stratigraphic unit of Neo-Mid Proterozoic Jixian section, which covers over 1.0 Ga sidementation history (0.8 Ga to 1.8 Ga) in nothern margin of NCC. 554 detrital zircons have been separated for analysis of U-Pb age, Hf and O isotopical compositions. The U-Pb age spectrum show two major groups around 2.3-2.5 Ga and 1.6-2.3 Ga, with a minor peak at 3.0-3.3 Ga. It is also characterized by lack of zircons younger than 1.5 Ga while the youngest sedimentary record dated as 0.8 Ga. The two-stage Hf model ages constitute a continuous spectrum from 2.6 Ga to 4.4 Ga, with major peaks at 2.8 Ga - 3.3 Ga and 3.9 Ga, This is consistent with that the majority of zircons show mantle-like values as ε_{Hf} (t) > -8 and $\delta^{18}O<6.5$, especially for those older than 2.7 Ga. The above observations would support an early episodic crust growth in the region studied. Previous study on sediment Nd isotopes for the same section has indicated a Proterozoic crust growth event at ca. 1.7 Ga (Zhou and Goldstein, 1990) and mixing between juvenile and recycled crustal components may cause an oscillation feature of the crust evolution. Based on zircon U-Pb dating, Hf and O isotopic compositions, the generation rates of continental crust have been estimated. It has been suggested that up to 80% and 95% of the present crustal volume was formed by 2.5 Ga and 1.0 Ga, respectively, in the region studied. This work would provide a case study for comparison between sediment - Nd isotope approach and detrital zircon - multiple isotope approach. The preliminary results have demonstrated that the former would manifest the coeval crust growth history while the later would reveal the early history of crust formation for a given region.

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Study on determination of rare earth elements in multi-mineral phase soil by inductively coupled plasma mass

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Soil is a basic construction unit in terrestrial ecosystem, and also is the junction of the matter energy circulation in ecosystem. It is not only the most acitive environment factor on earth, but also is the cherishable renewable resource. But If the system is polluted, not only the plants outputs and qualities will be affected, but the atmosphere and the water circumstance will also be affected.

The soil's main components is mineral substances, organic contents, live organic bodies, moisture, atmosphere and etc. The mineral substances weihgt occupy the solid phase weight (soil dry weight) of 90%~95%,. So the main components in soil is mineral suvstances. In deposit diggings, That make pollution in the soil around the diggings. because of the exploitation, around soils were unavoidable polluted. It make soil have more Multi-mineral. So The Multi-mineral phase soil is the main polutting soil in diggings.

Using inductively coupled plasma mass (ICP-MS), we can exactly analysis the content in multi-mineral phase soil. In the determination of the method, we analyse 30 elements including trace elements and rare earth elments. The sample was dissolved in mixed acids with pressurized sample digestion and an appropriate amount of mannnitol was added to prevent boron from volatilization. Analytical mass number were carefully selected and the instrumental operating conditionswere optimized. The detection limits of the method for the elements were 0.0001-0.003mg/L. The method has been applied to the determination of these elements in National Standard Reference Materials including GBW 07105-GBW 07108. The results obtained were in agreement with the certified values with recovery of 90.3%-110% and precision of less than 5% RSD (n=3).

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The study of Quaternary groundwater recharge in Turpan Basin, NW-China

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Turpan Basin is located in NW-China which belongs to continental arid zone. On the northern and western edge of the basin is Tianshan Mountain. The Quaternary groundwater is the main water source for drinking, agricultural and industrial uses. In this paper, the recharge of Quaternary groundwater is studied using isotopic techniques.

The δD of Quaternary groundwater in the Turpan Basin ranges from -56 ‰ to -60 ‰ (SMOW) and the $\delta^{18}O$ varies from -8.7 ‰ to -9.2 ‰. Since the local meteoric water line of the Turpan Basin is still unknown, the local meteoric water line$\delta D = 7.2\delta^{18}O + 10.6$ of the Junggar Basin which has similar geographic and climatic conditions with the Turpan Basin is applied. The measured data are showed in Figure 1.

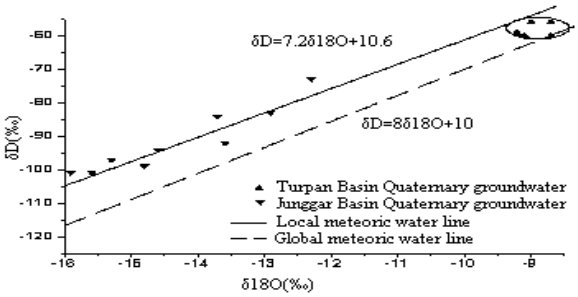

Figure 1: The δD-$\delta^{18}O$ correlation for Quaternary groundwater in the Turpan Basin

It is clear from Figure 1 that the measured isotopic data points of Quaternary groundwater in the basin lie between the global meteoric water line and the local meteoric water line, which indicates that the Quaternary groundwater in the basin is of meteoric origin. So we can draw a conclusion that the precipitation from the Tianshan Mountain is the major source of Quaternary groundwater in the Turpan Basin.

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Variations in composition and size of dissolved and colloidal organic matter in the Bay of St. Louis estuary

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The Bay of Saint Louis (BSL) estuary receives high organic loads from rivers and discharges into the northern Gulf of Mexico, where hypoxia has been linked to nutrient enrichment and organic inputs. To investigate the variation of DOM composition, size-distribution, and transport processes, water samples were collected along a salinity gradient from the BSL for size fractionation using ultrafiltration and flow field-flow fractionation techniques, and for the measurement of DOC concentration, UV-vis absorbance, and fluorescence excitation emission matrix (FluoEEM). Both field and mixing experimental results show that optical properties (a_{355}, fluorescence index, and biological index) behaved conservatively during estuarine mixing along the salinity gradient and correlated significantly with DOC. While DOC concentration decreased ~2.5 fold from the river to coastal seawater, values of a_{355} varied 19 fold, suggesting that marine DOM is less optically active and/or that optically active DOM is preferentially removed during estuarine mixing. The percentage of colloidal organic carbon (>1 kDa) in the bulk DOC decreased from 67% in river waters to 38% in coastal seawater. Higher UV absorbance, lower biological index and lower spectral slope were found in the colloidal fraction, indicating HMW-DOM contained more optically active but less microbially derived materials, with increasing humification index from low to high salinity waters. All samples had the largest population of UV-absorbing and humic-fluorescent colloids in the 0.5-4 nm size range, suggesting chromophores and humic-type matirials are associated with the same organic macromolecules, which are hypothesized to be fulvic acids in nature. Protein-type DOM was found to associate with not only the 0.5-4 nm but also the 3-8 nm and the >20 nm colloidal fractions. The relative proportion of medium and large colloidal sized protein-type DOM appeared to increase with increasing salinity, suggesting sources from freshly produced organic matter in the lower estuary and coastal waters. A removal of mid-size (8-20 nm) protein-type materials was observed in low and mid salinity (0-20) water, indicating possible salt-induced flocculation. Size fractionation techniques, coupled with chemical characterization could provide new insights into DOM transport and transformation in estuarine environments.

Groundwater isotope characteristics of the potential site of a high-level radioactive waste repository in the JiuJing Area in China

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The site knowledge of hydrogeological conditions is extremely important In the high-level radioactive waste repository site because any radioactive material released from the repository will be migrated to the environment or biosphere of human through the groundwater. Beishan area is located in northwestern Gansu Province in northwest China, which is one of the important pre-selected area of China's high-level radioactive waste repository. In order to know the hydrogeological conditions of pre-selected area, and the site suitability as a high-level radioactive waste repository from the hydro-geological point of view evaluation, according to groundwater isotopic data and the available geological, hydrological data and information, this paper, taking the pre-selected area Beishan Jiujing as an example, analyzed the origin, formation, evolution and cycle characteristics of bedrock groundwater in the study area through experiments and hydro-geochemical model simulation. Studies show that, in pre-selected area Beishan Jiujing, deep groundwater and shallow groundwater both derived from the recharge of precipitation in popularity. It also tells us low water-bearing, low permeability, low-flow rate are the main hydro-geological characteristics of this area.

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Implications of the new hypothesis on the apparent discrepancy between field – lab feldspar dissolution rates on modeling reactive transport in the critical zone

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Recently, we have proposed and tested a new hypothesis that appears to resolve part of the apparent discrepancy between lab – field feldspar dissolution rates [1, 2, 3]. The slow secondary mineral precipitation results in a quasi-steady state, at which dissolution proceeds at rates that are orders of magnitude slower than the rates measured at far-from-equilibrium. The quasi-steady state is determined by the relative rate constants, and the function of Gibbs free energy in the rate laws. Therefore, slow clay precipitation effectively reduce feldspar dissolution rates by orders of magnitude, in a fashion consistent with lab rates at conditions far from equilibrium, the control of dissolution rates by the Gibbs free energy of the reaction, and many field observations.

To explore the potential effects of fluid flow rates on the coupling of reactions, we extrapolate a batch system to open systems and simulated 1D reactive mass transport for oligoclase dissolution and kaolinite precipitation in a homogeneous porous media. Different steady states were achieved at different locations along the 1D domain. The time-space distribution and saturation indices (SI) at the steady states were a function of flow rates for a given kinetic model. Regardless of the differences in SI, the ratio between oligoclase dissolution rates and kaolinite precipitation rates remained 1.626, as in the batch system case. Therefore, our simulation results demonstrated coupling among dissolution, precipitation, and flow rates.

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Geochemistry of the Early Tertiary salt lake in the Dongying Depression, Bohai Bay Basin of Eastern China

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A sequence of evaporite and dark-colored mudstones, stratigraphilly belonging to middle-upper part of the fourth Member of the Shahejie Formation (Es_4), Lower Tertiary, is more than 1000m in thickness deposited in central area of the Dongying Depression, Bohai Bay Basin. In the sequence, the thickness of anhydrites is about 200m, while that of argillaceous rocks being 800m. Some scholars thought that depositional environment of evaporite was not favorable to source rocks, so they seldom paid enough attention to evaluating their hydrocarbon generation potential [1]. Having investigated the evaporite sedimentation, the authors believe that lacustrine evaporites are not only deposited with source rock, but also deposited with purely itself.

Geochemical evidence and sedimentary system showed that the saline lacustrine was in an under-filling situation during the geological period of mid-upper Es_4, and a deep-water salt lake was formed. In the salt lake, the salinity of surface water was different from that of bottom water, which resulted in a delamination of the lake water for a long time. As vertical circulation of the lake water being limited, the bottom lake water was in an absolutely stagnant state and appeared in anoxic environment, which prohibited the activity of benthos and led to the preservation of deposited organic matter as much as possible. This environment and sedimentation can be described by geochemical characteristics of dark-grey mudstone and shale interbedded with layered evaporite. In conclusion, super-saline lacustrine water is beneficial not only to accumulation and preservation of organic matter, but also to superior source rocks, such as those developed in the mid-upper Es_4 Formation of the Dongying Depression. A great deal of oil and gas has been generated the source rocks. Meanwhile, it is noticeable that anhydrites are developed in the Es_4 in the Dongying Depression and are buried below 3500m with subsurface temperature over 120°C; H_2S is also generated due to the thermochemical sulfate reduction (TSR).

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The pathways of selenium poisoning in Enshi, China

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Enshi Prefecture became notorious as a Se-rich area in China when a sudden incidence of human selenium poisoning occurred in 1963 at Yutangba, located in the northern part of Shuanghe town about 81km SE of Enshi City, Hubei Province. During a field-screening study to investigate the distribution of Se in soils and rocks in Yutangba, anomalous levels of Se were found in cropland soils at different sites, which ranged from 346 to 2118 mg/kg with an average of 899±548 (n=11), significantly greater than the average of 3.5 mg/kg Se in soils. Selenium speciation in these samples and baked soils as the reference were studied to evaluate relative abundances of bioavailable and insoluble species. Results showed that elemental Se and Se associated with organic materials were dominant fractions, accounting, on average, for 75% and 20% of total Se, respectively. SEM observations showed that native Se crystals occurred in these samples, which are very similar to reported Se crystals derived from natural burning of stone coal and abandoned stone coal spoils. These results showed that the source of Se in croplands was different from that of uncultivated soils, and confirmed that the presence of native Se crystals indicates the process of Se enrichment. Local villagers customarily baked soil on fires fueled by the local Se-rich stone coal and dispersed baked soil as a fertilizer. This practice, commonly used by villagers in Yutangba and other places, introduced into croplands a large amount of Se that further accumulated suddenly in their food chain. The occurrence of native Se crystals in Yutangba croplands explains the reason why the sudden incidence of human Se poisoning occurred in some places like Yutangba but not throughout high-Se areas in Enshi. This finding suggested that high-Se areas in Enshi should be divided into 1) sites with acute, chronic Se poisoning and 2) high-Se, low-toxicity sites, in which different measures to prevent selenosis should be taken by the local government.

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Simultaneous analyses of major and trace elements in fused rock powders using hermetic vessel heater and LA-ICP-MS

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An improved method of directly making homogeneous fused glass using a hermetic vessel heater was developed to simultaneously determine major and trace elements of whole rock powder by LA-ICP-MS. Unlike the fused glasses prepared using the iridium strip heater [1], losses of volatile elements (i.e. Cs, Ge, Sn, Pb) was not found in the fused glasses prepared using an hermetic vessel heater.

Major and trace elements in basalt and andesite glasses prepared using an hermetic vessel heater were simultaneously analyzed by LA-ICP-MS. Calibrated against mulitiple reference glasses (BIR-1G, BCR-2G and BHVO-2G) without applying an internal standard [2], the results generally agree with the preferred values within uncertainty at the 95% confidence level. Our results demonstrate that the hermetic vessel heater provides a simple and rapid way to directly make fused glasses for determining major and trace elements in basalt and andesite.

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Quartz nanoparticles in 2461-2495 million years old banded iron formation from Dales Gorge, Hamersley, Western Australia

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The 2461-2495 million year old banded iron formation (BIF) from Dales Gorge Formation, Hamersley, Western Australia contains hematite, magnetite, Fe (II)-silicate, quartz, carbonates and apatite [1]. Massive hematite were observed to contain quartz nanoparticles with size ranged from <100 nm to 400 nm. Electron dispersive spectroscopic (EDS) measurements indicated their chemical compositions are close to quartz. Fourier infrared probe also showed a Si-O composition. Some quartz crystals were observed on the surface of massive aggregates of hematite (Figure 1), more quartz nanoparticles could be found inside the etching cavities bigger than quartz in hematite aggregates with a few etching cavities contain two quartz nanoparticles. All those quartz nanoparticles have euhedral faces. Those quartz nanoparticles are common in the anhedral hematite aggregates, but different from quartz crystals in the BIF assemblage which were bigger. Quartz nanoparticles are the only mineral that can be observed in the etching cavities, and they were the only mineral observed in hematite. This implied their formation was short after the precipitation of hematite, but earlier than magnetite, iron-silicates and carbonates. Those particles on the surface of hematite appeared tightly fixed in the etching cavities indicated undisturbed hydrological condition, while the crystals in bigger etching cavities implied a poppling hydrodynamic condition. We suggest that those quartz nanoparticles fell on the just precipitated hematite iron-gel in the shallow oxidized sea environment with an exogenesis. It implied that hematite was the only chemical phase at the early stage of banded iron deposition.

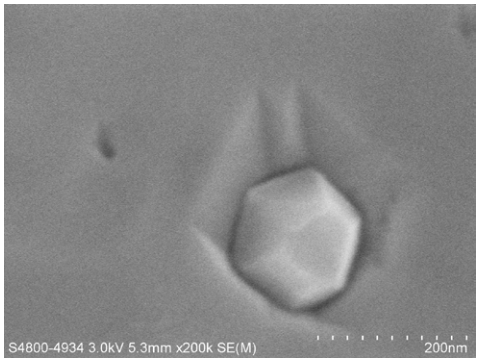

Figure 1: Quartz nanoparticle fell on the just precipitated hematite iron-gel and made a pit.

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Copper isotope fractionation by higher plants

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Transition metals such as Fe, Cu and Zn are present as trace elements in organisms, but are essential for life. Thus variations in transition metal isotope composition may be important in tracing the interaction between geosphere and biosphere, to trace the pathways of these elements into and within biological system. A prerequisite for these applications is an adequate understanding of the mass fractionation of these isotopes during steps of biological uptake and translocation. Here we report the result of a case study for Cu isotope fractionation by higher plant using a Cu accumulator *Elsholtzia splendens*.

Elsholtzia splendens growth-experiments were carried out in green house and in soils with different chemical properties, namely: copper contaminated soil collected from natural environment (denoted as CK), CK with addition of sulphur powder, CK with addition of EDDS, and CK with addition of both EDDS and sulphur. Soils, roots, stems and leaves were measured for Cu isotope ratios using Nu Plasma HR MC-ICPMS after digestion and chemical purification. The results display some prominent features: 1) relative to soils, the plants show overall lighter isotope enrichment, implying significant isotope fractionation occurred during Cu uptake of the root from the soil and light Cu isotope were taking preferentially; 2) from soil to root to stem, Cu isotope composition become progressively lighter, indicating stepwise mass fractionation during Cu uptake and translocation; 3) relative to stems, leaves enrich heavy Cu isotope by *ca*.0.3‰, suggesting a change in Cu transport mechanism from stems to leaves, and showing that heavy Cu isotope can be preferentially taken at some stage during biological processes; 4) the extent of light isotope enrichment of the plant relative to soil varies with the chemical property of the soil, and the light Cu isotope enrichment is enhanced by the addition of EDDS.

The results presented above enhance our knowledge about mass fractionation processes of transition metal isotopes in higher plants significantly.

Co-analysis of $\delta^{18}O$ values of cellulose and carbonate from lake sediments: A new indicator for temperature reconstruction?

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Stable oxygen isotope composition of cellulose and carbonate from lake sediments have been commonly applied to deduce the evaporation/precipitation balance in arid and semi-arid region, although the paleotemperature equation have been well empirically eatablished by numerous researchers. Due to the complex of $\delta^{18}O$ values of lake water, the temperature reconstruction by combination with $\delta^{18}O$ values of lake water and carbonate is not feasible, especially at low latitude, where the amount of precipitation is the dominant factor to control $\delta^{18}O_{precipitation}$. However, $\delta^{18}O$ values of organic matter cellulose gave a direct insight into variations of $\delta^{18}O$ values of lake water in the past. Co-analysis of $\delta^{18}O$ values of cellulose and carbonate may be, therefore, a promising indicator as temperature variations. Here, we quantitatively reconstructed $\delta^{18}O$ values of lake water on the basis of $\delta^{18}O$ values of cellulose. According to $\delta^{18}O$ values of cellulose and carbonate, temperature variations series have been established during the past 500 years at Lake Caohai, southwest China. The result showed that there were four obvious coldest intervals at Lake Caohai during the past 500 years, namely 1550-1610AD, 1670-1730AD, 1770-1870AD and 1890-1920AD coldest periods. The former three coldest intervals were observed during the Little Ice Age. Furthermore, the reconstructed temperature seires is well synchronous with the North Hemisphere temperature variations. Such a relationship suggests that co-analysis of $\delta^{18}O$ values of cellulose and carbonate is the effective approach for temperature variations reconstruction, and may play an important role in reconstructing past temperature variations at low latitude, thus also providing the evidence of the existence of Little Ice Age in southwest China.

Organic matter preservation due to pore-scale interactions between organic matter and water in soil microaggregates

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This study focuses on the influence of pore-filling OM on the hysteretic soil water characteristic, which has been largely ignored in previous studies on water-OM relations. The main drying and wetting branches of the water retention curve were measured using a water activity meter on water-stable microaggregates (53-250 mm), which were collected from surface soils (0-15 cm) subject to different management practices: tallgrass prairie restoration on a Mollisol and tillage with and without nitrogen fertilization on an Alfisol. By taking advantage of differences in x-ray scattering contrast between soil minerals, organic matter (OM), and air, which were measured using ultra-small angle x-ray scattering (USAXS) before and after combustion of microaggregates at 350°C, we evaluated the distribution of the total- and OM-filled porosity within microaggregates. Results show that the OM preservation arose from the evolution of the architectural system of microaggregates during their formation and stabilization. Land-use options (conversion of soils from long-term cultivation to perennial vegetation through restoration of native tallgrass prairie) and agricultural treatments (conventional tillage versus no-till at two levels of N inputs) with increasing OM in microaggregates were associated with encapsulation of colloidal OM by minerals, that creating protected OM-filled pores at the submicron scale within the microaggregate structure. Our water retention measurements show that the OM encapsulation in $<5\ \mu m$ diameter pores increases water retention in microaggregates, while management practices that either increased or decreased the abundance of OM-filled pore volume in the microaggregates promoted hysteresis of water retention characteristics due to changes in soil pore structure.

Characteristics of the abiogenetic gas reservoir in Xujia abyssal fault depression of Songliao basin, China

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Many sets of low-angle faults in supracrust of the Songliao basin were detected, and the complex seismic phases indicated existence of complicated structures in its midcrust and lowercrust. The earth crust of the basin has both concentric circle structures and blocky structures, and boundaries of the fault blocks might serve as the channel for thermal fluid migration in the depth [2]. In this area, the distribution of volcanic massif was controlled by the basement deep faults of NNW to nearly SN direction. The volcanic rocks were mainly intermediate-acid rocks formed in the tectonic environment of an active continental margin, and originated from the crust and mantle.

The gas-bearing formation was buried under 3km~4.5km. According to analyses of natural gas samples taken from 26 wells, the alkane carbon isotope δ13C presents characteristics of the reverse sequence, and the hydrogen isotope δD, characteristics of the positive sequence, which reflects their abiogenetic source [3].

The lithology of volcanic gas reservoir mainly consists of rhyotaxitic clasolite of explosive or pyroclastic flow phases, most of effective reservoir beds are the upper phase or external phase of volcanic belts, usually being layers or thin layers of 10-20m.

The pores of volcanic gas reservoir could be classified into four types: 1) primary pores of original rocks, 2) diagenetic pores, 3) diagenetic fractures, 4) secondary tectoclases and weathered fractures. Types 2 and 3 are the most effective reservoir space which were formed in volcanic eruption process of cooling and aftercooling.

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Combining geochemical zonality coefficient values with weights of evidence to evaluate patterns of mineralisation

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The geochemical zonality coefficient (ν_z) of elements and their spatial associations with particular geological, geochemical and structural factors are critical aspects of mineral distributions that must be considered in exploration and understanding ore geometry [1]. Spatial relationships between mineral occurrences and geological features can be quantified by the weights of evidence (WofE) method which considerably depends on the contrast value [2]. This paper presents a new approach by combining the strenghts of the ν_z and WofE in evaluating mineral occurrence distributions. This new approach was tested on copper occurrences in the NW and SW Iran. The results suggest that the proposed method is more successful than any existing method for the identification of such occurrences. Investigations were carried out for a major lithostratigraphic sequence in the SW Iran (Jabal-Barez). The ν_z determined for the Kerver copper occurrences in the Jabal-Barez area suggests the significance of this area for further exploration. The most important novelty of this article in mining geochemistry is to extend the model proposed for a local scale to a regional scenario.

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Common Os in Molybdenite: How negligible is negligible?

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An oft-touted benefit of molybdenite Re-Os geochronology, in addition to ppm level Re, is 'negligible' common Os [1]. As such, Re-Os model ages prove robust and geologically meaningful. But we find, in certain geologic settings, that common Os in molybdenite is far from negligible, and thus, this default assumption should not go unchecked. The question is 'How can we track, quantify, and correct for common Os in molybdenite?' With Re-Os ages for hundreds of molybdenites derived from fully constrained geologic contexts, the AIRIE Program has the sample archive to test for and track common Os in molybdenite.

We have explored several methods for quantifying and correcting for common Os using various spiking techniques, most notably a mixed-double spike (^{185}Re-^{188}Os-^{190}Os [2]). For ^{187}Re-^{187}Os age determinations, the impact of common Os in molybdenite is dependent on the Re/Os ratio on crystallization and the sample age. The most serious impact is derived from moderately young molybdenites (e.g. Phanerozoic) with low Re concentrations. Sub-ppm and even ppb level Re combined with low ppb level initial Os yields 'apparent' molybdenite ages that are markedly older than the 'true' age of the sample. That is, the initial ^{187}Os present will be erroneously counted as radiogenic ^{187}Os. This situation is far more common than workers realize, and has led to convoluted interpretations by some groups challenging the integrity of this mineral.

Additionally, molybdenites with notable common Os provide insight into geologic settings and unique processes not afforded by high Re molybdenites.

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Plutonium-humic acid stability constant determination and subsequent surface complexation studies

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Plutonium has been released to the environment through a variety of intentional and unintentional mechanisms; including atmospheric testing, disposition from weapons manufacturing processes, and subsurface disposal. Therefore, a thorough understanding of the chemical, physical, and biological processes affecting plutonium transport is imperative. It has been shown that humic acid (HA) (a refractory component of natural organic matter (NOM)) can effectively solubilize plutonium [1]. Increased solubility may result in enhanced subsurface transport, due to the higher concentration of Pu in the aqueous phase. In contrast, the formation of ternary surface complexes may hinder actinide transport. Solution pH is likely to affect the dominance of one species over another. For these reasons, a better understanding of binary Pu-HA and Pu-mineral and ternary Pu-HA-mineral systems is essential for accurately predicting plutonium fate and transport.

The primary objective of this research was to determine the conditional stability constants for Pu-HA complexes using a hybrid ultra-filtration/equilibrium dialysis ligand exchange (EDLE) technique from pH 4 to 6.5. Ethylenediaminetetraacetic acid (EDTA) was used as a reference ligand to allow the aqueous chemistry of the Pu-HA system to be probed at increased pH, without appreciable metal hydrolysis. Partitioning of Pu between HA and EDTA indicated that the Pu-HA complex is favorable. Comparisons with Th (IV), as an chemical analog of tetravalent actinides, indicated that Pu was primarily present in the tetravalent state.

Preliminary sorption studies were also conducted to evaluate the effects of Pu-HA complex formation on Pu sorption behavior. Enhanced Pu sorption was observed in the presence of HA. Notably, enhanced sorption was observed at low pH (pH 4) which is indicative of ligand promoted sorption. Therefore, despite observations of increased solubility of Pu in the presence of HA, the formation of ternary surface complexes may prevent enhanced subsurface transport. The data from these studies will aid in modeling the fate and transport of Pu in the environment and inform the development of conceptual models describing the influence of ternary surface complex formation on Pu sorption.

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Formation conditions and geological and geochemical characteristics of the largest tight gas area in central China

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The central China mainly consists of two gas-bearing basins, i.e. Ordos and Sichuan basins, which have been the two ever-found largest tight gas areas in China. They are tectonically located in the transition area between the eastern extensional tectonic area and the western reducing extruding tectonic area, and are characterized by stable structure, gentle paleo-geomorphology, vertical movements, and weak hydrodynamic intensity. It develops large-scale delta sedimentary system and the sediment separation is poor. Coal measure gas source rocks and sandbodies are widely distributed. The formation of large-scale heterogeneous tight sandstone reservoirs is due to the sour water medium of coal measure strata in the two basins, burial depth more than 4000 m during the early stage, and selective dissolution resulting from the integral uplift of 1000-2500 m of the basin in the late stage. Sedimentary reservoirs are slightly different in the two basins.

The Upper Paleozoic strata in the Ordos basin belong to marine-terrestrial depositions after craton. Coal measures with relatively high maturity are widely developed. The Upper Paleozoic strata of the Ordos basin are tight sandstones with low permeability (averagely <8%) and low porosity (averagely $<0.5\times10^{-3}\mu m^2$). However, effective reservoirs with porosity of 8-14% and permeability of $0.5\sim10\times10^{-3}\mu m^2$ are also developed under such background. Tight gases from different strata are all of typical coal-derived gas, while there exist some differences of the geochemical compositions.

The Upper Triassic Xujiahe formation in the Sichuan basin is a gentle large slope of the foreland basin. The effective source rocks are coal measure dark mudstones with low maturity. The source rocks and reservoirs are distributed with a type of 'sandwich' and the distribution area is more than $10\times10^4 km^2$. The tight sandstone reservoirs have porosity of 3~% and permeability less than $0.5\times10^{-3}\mu m^2$. It is determined as coal-derived gas with relatively low maturity.

Both basins have great potential of tight gas resources and are becoming of important large gas areas with rapid development of natural gas in China.

Paleoclimate, nutrient supply and lacustrine source rocks formation in Songliao Basin, China

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The Songliao Basin is the biggest terrestrial oil-bearing basin in China. The oil source rock is the Upper Cretaceous lacustrine mudstone and oil-shale with a thickness of ~ 120m through the Member 1 (K_2qn^1) into the lower Member 2+3 (K_2qn^{2+3}) of Qingshankou Formation, underlaid by the fluvial-delta red-green silty mudstone and sandstone of the Upper Cretaceous Quantou Formation.

Maturity parameters show that the source rocks are matured with litlle variation. The ratios of C_{21}-/C_{22}+ and $(C_{21}+C_{22})/(C_{28}+C_{29})$ are greater than 1.2 and 2.0, respectively, indicating the organic matter mainly from algal input. However, TOC (1-6%) is gradually decreased from the bottom of K_2qn^1 to the lower K_2qn^{2+3}, coinciding with the variation trend of nutrient elements (e.g. Fe^{2+}). The black carbon concentration is higher within Quantou Formation than Qingshankou Formation, indicating paleoclimate during Qingshankou Formation depositing is relatively warm, arid and might have more wildfires. The compound-specific stable carbon isotopic compositions of leaf-wax HC (*n*-C_{27}, *n*-C_{29}, *n*-C_{31}) demonstrate a heavy carbon isotope plateau within Quantou Formation and a less heavy long-term trend with a short-tern positive excursion torwards the lower Member 2+3 of Qingshankou Formation, suggesting that during Qingshankou Formation deposition, the stable carbon isotopic composition of atomospheric CO_2 is heavy and very like to be associated with the Cenomanian-Turonian Oceanic Anoxic Event (OAE2).

The oil source rock in the Songliao Basin is deposited at post-OAE2 stage during the decreasing atmospheric CO_2 under relatively humid paleoclimate condition. The weathering under relatively warm and less humid climate of Quantou Formation supplys much nutrient for lacustrine algal bloom, TOC is decreased as nutrient is consumed.

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Application of neutral loss tandem MS and time-of-flight MS to identify anthropogenic compounds in fulvic acids

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The interactions of contaminants with dissolved organic matter (DOM) highly determines their transport, fate, and bioavailability in the aquatic environment. The main part of DOM in water can be attributed to fulvic acids (FA) and humic acids (HA) on an operationally-defined basis. Contaminants associated with or behaving like humic substances are a concern for groundwater because they are highly mobile and may not be completely removed during drinking water treatment. Furthermore those contaminants can be transformed by oxidation or disinfection steps to form further products of toxicological importance.

Beside for highly selective and sensitive analysis tandem mass spectrometry can be used for non-target screening to get a more comprehensive picture of a sample. For that purpose neutral loss scans can be used to reveal compounds with common structural moieties, e.g. acidic functional groups.

The objective of the presented work is to characterize FA fractions with respect to their anthropogenic contributions in isolated material from both a contaminated groundwater and a natural surface water [1, 2]. Neutral loss screening at the mass losses 44 (CO_2) and 116 (C_2H_4 $(CO_2)_2$) revealed aromatic and heterocyclic acids and succinic acids, predominantly in the contaminated sample. The further identification of the compounds was based on a combination of the sum formulae from accurate mass measurements with a Q-TOF instrument, information on the original contamination and the prevailing degradation processes in the aquifer [3]. Predominantly the FA fraction from the contaminated groundwater shows a considerable 'anthropogenic' content which has implications for its use for drinking water treatment.

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