

## Study on main sources of the sulfur in acid rain in Jiangxi province, China

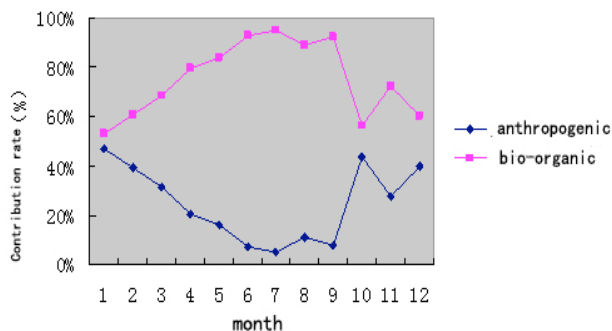
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The main sources of sulfur in rain water include bio-organic sulfur and anthropogenic sulfur in Jiangxi province, China.

We analyzed the sulfur isotopic composition of rain water from Nanchang City in this paper. The results indicated that the sulfur isotopic composition possesses a seasonal variation trend. It is discussed individually that the different sulfur sources of rain water with the principle of mass balance, the relative contribution of the biogenic and the anthropogenic to sulfur source of acid rain in Nanchang each can be calculated quantitatively. In summer and autumn, the sulfur in rain water comes mainly from bio-organic sulfur. In winter and spring, the sulfur in rain water dominantly originates from anthropogenic sulfur (Fig.1). The sulfur in rain water from the sea may be very small in percentage.



**Figure 1:** Two main sulfur sources' relative contribution to the precipitation in Jiangxi province

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## Multistage growth of garnet in UHP metagranite in the Dabie orogen

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Garnet is a common mineral in subduction-zone metamorphic rocks, and its growth and reworking can be linked to metamorphic P-T conditions. We performed a combined study of major and trace elements by means of EMP and LA-ICPMS analyses on garnet from UHP metagranite in the Dabie orogen. Three stages of garnet growth are deduced from the major element zonation based on the assumption that Ca contents and Fe/Mg ratios in metamorphic garnet are indicative of metamorphic pressure and temperature, respectively. The first stage of growth (Grt-I) occurs in the core of skeletal garnets, which is characterized by the homogeneously low  $X_{\text{Grs}}$  values and Fe/Mg ratios, indicative of the highest temperature but the lowest pressure. It is a residue of magmatic garnet that most likely nucleates in the stage of protolith granite formation. The second stage of growth (Grt-II) occurs in the mantle and core of garnets, which is indicated by the increased  $X_{\text{Grs}}$  values and Fe/Mg ratios, corresponding to continuous increase in temperature and pressure till peak pressure and thus garnet growth during the prograde subduction. The third stage of growth (Grt-III) occurs in the rims of all garnets, which is suggested by slightly decreased  $X_{\text{Grs}}$  values and Fe/Mg ratios in response to a pressure decrease but a temperature increase till peak temperature. These rims overgrew subsequent to the peak pressure with continuous heating during the initial exhumation. REE distributions in the three stages of garnets are also different from each other. Both Grt-I and Grt-II exhibit steep MREE-HREE patterns with high HREE contents, with obvious negative Eu anomalies and high REE contents for Grt-I. Grt-III displays obviously lowered REE contents compared to those for Grt-I and Grt-II, with two subtypes of MREE-HREE patterns: steep (IIIa) and flat MREE-HREE patterns (IIIb). Therefore, the garnet from low-T/UHP metagranites displays obvious multiple stages of growth during continental collision. Nevertheless, the highest pressure occurs in the cores or mantles whereas the maximum temperature occurs in the rims, suggesting that the peak pressure did not occur at the peak temperature during the continental collision. Thus the "hot" exhumation is recorded in the garnets from the low-T/UHP granitic gneiss. This provides a thermal condition for dehydration melting of the deeply subducted continental crust.

## Diffusive anisotropy in low-permeability Ordovician sedimentary rocks from the Michigan basin in southwest Ontario

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Diffusive anisotropy and its scale-dependence were investigated using samples from the Upper Ordovician Georgian Bay Formation (shale and thin interbeds or 'hardbeds' of limestone and siltstone) and Middle Ordovician argillaceous limestone from the Michigan Basin of southwest Ontario, Canada. Effective diffusion coefficients ( $D_e$ ) were determined for iodide (I<sup>-</sup>) and tritiated water (HTO) tracers on paired cm-scale subsamples oriented normal (NB) and parallel to bedding (PB). Measurements were conducted using X-ray radiography and through-diffusion methods. The  $D_e$  values range from  $4.8 \times 10^{-13}$  to  $5.3 \times 10^{-12}$  m<sup>2</sup>·s<sup>-1</sup> for shale,  $2.1 \times 10^{-13}$  to  $1.3 \times 10^{-12}$  m<sup>2</sup>·s<sup>-1</sup> for limestone, and  $4.1 \times 10^{-14}$  to  $5.6 \times 10^{-13}$  m<sup>2</sup>·s<sup>-1</sup> for siltstone interbeds within the Georgian Bay shale formation. The sample-scale anisotropy ratios ( $D_{e-PB} : D_{e-NB}$ ) for  $D_e$  values obtained using I<sup>-</sup> tracer are 0.9 to 4.8, and the anisotropy ratios for HTO tracer are in the range of 1.1 to 7.0. A formation-scale anisotropy ratio of 8.0 was calculated for the Georgian Bay Formation from the ratio of the arithmetic to the harmonic mean of  $D_e$  data measured at the sample scale and weighted for the thickness of interbedded siltstone/limestone and shale units.

The influence of porosity distribution on diffusive anisotropy has been investigated using one-dimensional spatially-resolved profiles of I-accessible porosity obtained from radiography experiments, and the use of AgNO<sub>3</sub> for fixation of I<sup>-</sup> tracer in the pores, allowing for SEM visualization of I-accessible pore networks. The porosity profiles generally display greatest heterogeneity in the direction normal to bedding. The SEM imaging suggests that diffusion pathways are preferentially oriented parallel to bedding in the shale, and that diffusion occurs dominantly within the argillaceous component of the limestone but fine clay-filled voids in the limestone are also accessible for diffusive transport.

## Characteristics and prediction of high quality coal measure source rocks in Oligocene Yacheng Formation of Qiongdongnan Basin, Northwestern South China Sea

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The coal measure strata of marine-terrestrial facies in Oligocene Yacheng Formation are the major source rocks of Qiongdongnan Basin. Through comprehensive studies, main characteristics of this set of coal measure source rocks can be concluded as following: (1) they consist chiefly of coals, carbonaceous mudstones and dark mudstones with relatively high organic matter abundance and type II<sub>2</sub>-III kerogen. Among them, coals have been most noticed because of the highest organic carbon abundance (19.9-95.9%) and hydrocarbon-generating potential (14.3-142.8mg/g), (2) the drilling and logging data shows that coals are developed in multiple seams with thin single seam thickness and unstable plane distribution, and their logging responses are high neutron porosity, high acoustic interval transit time, high resistivity, low natural gamma ray, and low lithology density, (3) coal seams in Yacheng Formation mostly form by the gelatification and are deposited in the peat swamp environments of braided river delta plain, fan delta plain, and upper intertidal zone and supratidal zone in tidal flat, and (4) the relatively gentle paleotopography and the approximately equivalent sedimentary rate and subsidence rate are the two key control factors of the development of coal measure strata. According to the above conclusions, three favorable development areas of high quality coal measure source rocks in Yacheng Formation are predicted, including Yacheng area of western Qiongdongnan Basin, northeastern slope and southern slope of the basin.

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## Biogeochemical characteristics and environmental effects of low-molecular-weight organic acids in lacustrine ecosystem

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Low molecular weight organic acids (LMWOAs), are generally considered as the important immediate products during the conversion of anaerobic organic substance (carbohydrates, fats, proteins, etc.) into CH<sub>4</sub> and CO<sub>2</sub>, and closely related to lacustrine regional environmental evolution [1, 2]. In this research, the composition and contents of LMWOAs were determined, temporal-spatial variation trends and their contributions to dissolved organic carbon (DOC) were investigated in overlying waters of two plateau lakes in China: Lake Hongfeng (HF) and Lake Dianchi (DC) where two sampling sections were set as P1 and P2. Total organic acids (TOAs) were on average 6.55 μmol·L<sup>-1</sup> in HF, 7.98 and 6.54 μmol·L<sup>-1</sup> in DC, which can contribute to total DOC approximately 7.47%, 2.67% and 2.48%, respectively. This study identified 5 key organic acids such as lactic, acetic, pyruvic, sorbic and oxalic acid. The results show that pyruvic acid in these two lakes was confirmed as the major component among LMWOAs with the average concentrations of 2.35 μmol·L<sup>-1</sup> in HF, 3.82 and 3.35 μmol·L<sup>-1</sup> in DC. The sources and behaviors of LMWOAs during the photoradiation on lacustrine dissolved organic matter were also discussed. Differential physicochemical parameters indicated that the increasing-decreasing and decreasing-increasing diurnal variation trends of TOAs at two sampling sections in DC were dependent on autochthonous biological and photochemical activity. TOAs in HF decreased with time, mainly due to strong microbial assimilation and mineralization in hypolimnion. LMWOAs' photochemical production from allochthonous humus and consumption in epilimnion of HF basically leveled off with time except for significant increase at 18:00, indicative of their direct terrestrial import. The increase of pyruvic acid in epilimnion in HF at night reflected a photoradiation hysteresis effect, and resulted from great algal decomposition. Various hydrochemical conditions revealed that massive algal cover in DC and thermal stratification in HF primarily controlled the profile behavior of decrease and increase for LMWOAs. This research would benefit for management and eco-regulation of lacustrine aquatic environment.

[1] Boschker *et al.* (2001) *FEMS Microbiol Ecol* **35**, 97-103

[2] Xiao *et al.* (2009) *J Hydrol* **365**, 37-45

## Redefine Bulunkuole group in eastern Pamirs syntaxis and its signification – From the evidence of LA-ICP-MS isotope dating of detrital zircon

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The Bulunkuole Group is riching in iron ore Paleoproterozoic mesometamorphic rock series distributing in the eastern Pamirs syntaxis. According to sedimentary formation, metamorphism, ore-bearing potential and isotope dating, we disassemble these high pressure rock association (metamorphosed in 220Ma) which is composed of granulite, spinel olivine, garnet pyroxenolite from Bulunkuole Group, belong to the part of Kangxiwar tectonic mélangé; The rock series of alterative volcanic rock folding alterative detrital rock (age is 522Ma) belongs to Ordovician. In fact, the Bulunkuole Group is composed of alumina rich gneiss and schist, gneiss and schist folding quartzite and grotte, schist and calc-silicate rock folding metavolcanite and iron ore deptsits from bottom to top, and it is intruded by early Palaeozoic (506-542 Ma) acidic to intermediate rocks. There are four peak values of age region: 2.7-2.1Ga, 1700-554Ma, 536-344Ma and 302-230Ma in age frequency diagram according to 127 isotope data of detrital zircon (Fig 1). The zircons of the first peak value (2.7-2.06Ga) show the characteristic of magmatic origin, the others were metamorphic origin(or recrystallization). In consequence, the Bulunkuole Group should formed in Paleo-Mesoproterozoic (from 2.14-2.06Ga to 1.14Ga).

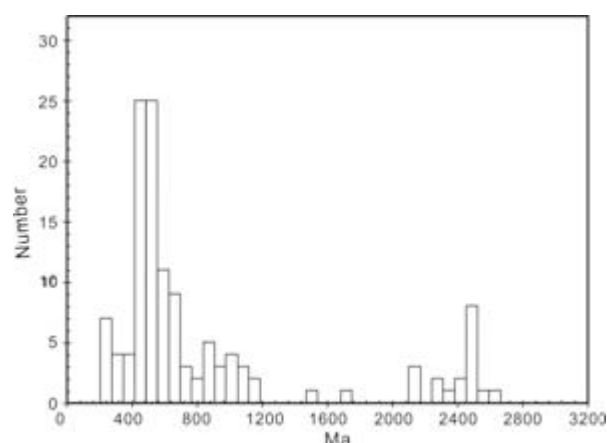


Figure 1 Age frequency diagram of detrital zircons from the Bulunkuole Group

## Effects of melt percolation on platinum group elements and Re-Os systematics of peridotites from the Tan-Lu fault zone, eastern North China Craton

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Concentrations of PGE and Re-Os isotopic compositions were determined for a suite of variably metasomatised peridotite xenoliths from Cenozoic Beiyuan volcanoes within the Tan-Lu fault zone, eastern North China Craton. The majorities of Beiyuan peridotites have flat chondrite-normalized PGE patterns whereas their total PGE contents range between 0.97 and 61.4 ppb, which was reduced by more than 90% from lherzolite, cpx-rich lherzolite to wehrlite, probably because intergranular sulfides were completely removed by silicate melt. Meanwhile, Beiyuan peridotites have low and variable Re (0.0002-0.5118ppb) and Os (0.194-10.4ppb) abundances and high  $^{187}\text{Os}/^{188}\text{Os}$  (0.12167-0.14978) ratios. The  $^{187}\text{Os}/^{188}\text{Os}$  ratios in some wehrlites are much higher than the value of the primitive mantle. The high  $^{187}\text{Os}/^{188}\text{Os}$  ratios have also been observed in peridotites found in other localities within the Tan-Lu fault zone such as Shanwang and Nüshan. This could be the result of the addition of radiogenic Os during the melt percolation. Extremely low Os abundances in Beiyuan peridotites suggest that Os may behave as an incompatible element during melt percolation and could mobilize with the dissolution of sulfides. The suprachondritic  $^{187}\text{Os}/^{188}\text{Os}$  ratios in peridotites within the Tan-Lu fault zone relative to those away from the Tan-Lu fault zone indicate that the Tan-Lu fault zone as a melt infiltrating channel had played an important role in the radiogenic Os enrichment induced by the melt percolation. This could be the reason for the Os isotopic heterogeneity observed in eastern NCC.

## Octanol-water partition coefficient ( $K_{\text{OW}}$ ): Is it a good measure of hydrophobicity of nanoparticles?

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Hydrophobicity, as one of the key properties of NPs, plays a significant role in the fate, transport and bioavailability of NPs. Octanol-water partition coefficient ( $K_{\text{OW}}$ ) is a traditional measure of hydrophobicity of organic compounds, and has been recently applied to NPs. However, due to the larger size, NPs may not diffuse freely between the phases, which may undermine the fundamental assumption of the application of  $K_{\text{OW}}$ . Based on thermodynamic models, we hypothesize: (1) partitioning of NPs is controlled by both hydrophobicity and size; (2) amphiphilic NPs with larger size are more likely to stay at the liquid-liquid interface rather than in the bulk phase.

We conducted the  $K_{\text{OW}}$  measurement using shake-flask method for seven different NPs in aqueous suspensions, including aqueous  $\text{C}_{60}$  (aqu- $\text{C}_{60}$ ), tetrahydrofuran- $\text{C}_{60}$  (THF- $\text{C}_{60}$ ), fullerol, nano-gold coated with citrate (Au-Ci), nano-silver coated with PVP (Ag-PVP), citrate (Ag-Ci) and gum arabic (Ag-GA). The hydrophobicity of these NPs was determined in Rose Bengal adsorption experiments. According to our results, the NPs that exhibited greater hydrophobicity showed larger  $K_{\text{OW}}$ . We also measured the  $K_{\text{OW}}$  of Au-Ci and aqu- $\text{C}_{60}$  NPs aggregates with different size (10 ~ 100 nm). Our results showed that as size increased,  $K_{\text{OW}}$  of aqu- $\text{C}_{60}$  increased, however,  $K_{\text{OW}}$  of Au-Ci was not dependent on size. Dark field microscopy revealed that Au-Ci NPs with size less than 30 nm mainly remained in bulk water phase; while the majority of Au-Ci NPs with size around 100 nm were accumulated near the water-octanol interface. These results may be due to the amphiphilic property ( $K_{\text{OW}}=0.38$ ) and larger size of Au-Ci NPs, which might elevate the attachment energy of particles to the interface and consequently the attachment became irreversible. Overall, our study demonstrated that size, in addition to hydrophobicity, is an important factor to determine the partitioning of NPs. The current application of  $K_{\text{OW}}$  as a measure of hydrophobicity for NPs is inherently flawed and needs further investigation.

## Li isotopic composition of subduction-related leucogranites: Source tracking and tectonic implications

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We report lithium (Li) elemental and isotopic data for a suite of leucogranitic and gneissic rocks (presumed protolith of the leucogranites) from the boundary between the North China craton (NCC) and the South China plate (SCP), which represents an important repository for understanding the Mesozoic thinning processes of the NCC. The leucogranites have very low Li concentrations (around 1-8 ppm) but extremely heavy isotopic compositions (from 8.6 to 16.1). Overall, Li concentrations and isotopic compositions of the leucogranites are different from those of associated rocks from adjacent areas, including granites ( $\delta^7\text{Li} = 2.7-3.8$ ) and gneisses ( $\delta^7\text{Li} = 0.8-6.5$ ) from North Dabie, garnet-bearing gneisses ( $\delta^7\text{Li} = 2.2-4.2$ ) from South Dabie, as well as those of their host rock—the Archean gneisses ( $\delta^7\text{Li} = -0.6$  to 0.0), but are similar to those of garnet-bearing gneisses ( $\delta^7\text{Li} = 1.2-22.5$ ) from the Sulu area. Based on Li isotope data, with the combination of mineralogical (e.g., garnet) and other geochemical data, we suggest that the leucogranites resulted from the partial melting of the subducted gneisses from the Sulu area. Such an observation is very important for providing constraints on the subduction direction of the SCP during the Triassic UHP metamorphic event.

## Trace element redistribution in oceanic crust during subduction-zone metamorphism – Evidence from Western Tianshan, China

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Constraining the geochemical consequences of subduction-zone metamorphism (SZM) is important for understanding subduction-zone magmatism, crustal growth and the origin of mantle compositional heterogeneity. For this purpose, we have conducted a detailed trace element study on ultra-high pressure metamorphic (UHP) rocks of both basaltic and sedimentary protoliths from Western Tianshan, China using *in situ* LA-ICP-MS.

We found that during SZM, phengite, and to a lesser extent, paragonite, are major hosts of all the Ba, Rb and Cs. Paragonite also hosts some Sr and Pb. Epidote group minerals host 95% of LREEs, Th, U, Pb and Sr, 60% of MREEs and 30% of HREEs. Garnet preferentially hosts HREEs relative to progressively lighter REEs. Rutile and titanite host essentially all the Ti, Nb and Ta. Titanite also hosts some Sr, Pb and REEs. Retrograde albite can host some Sr and Ba. Glaucofanite and (sodic-)calcic amphiboles, omphacite and chlorite contain very low contents of these incompatible elements (except Li). In addition, analyses of coexisting paragonite and clinozoisite, preserved as lawsonite pseudomorphs in garnet, show  $K_d^{\text{clinozoisite/paragonite}}$  for Pb and Sr to be ~ 20 and 4-10 respectively.

Because lawsonite, epidote, garnet, titanite and rutile are stable over a large P-T range during SZM and can exchange REEs, Th, U and HFSEs among each other, these elements are largely redistributed in the newly-formed minerals without significant loss from the system, explaining their relatively immobile nature. Sr and Pb may have been mobilized as shown by their decrease towards rims of prograde clinozoisite, which is also consistent with the insignificant correlations of bulk-rock Sr and Pb with immobile HFSEs. Ba, Cs and Rb are mobile in rocks of basaltic protolith and could have been re-enriched by late infiltrated fluids (e.g., some retrograde mica crystals have very high Ba, Cs and Rb), whereas these same elements may be immobile in rocks of sedimentary protolith, reflecting stronger protolith controls on elemental behavior.

## Mobilization and re-distribution of major and trace elements during extreme weathering of basalt in Guangzhou Province, South China

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Chemical weathering is one of the most important processes that change the chemical composition of the Earth's surface. Weathering products are easily carried out of weathering profiles and deposited in lakes and oceans as the main lithogeneous component in sediments. Therefore, the mobilization and re-distribution of elements during chemical weathering may influence the chemical composition of sediments. Generally, sedimental compositions can be used to trace the provenance of sediments and to reconstruct paleoclimate record [1]. Comprehensive understanding of the behavior of elements during chemical weathering may help to better explain the records found in sediments (Ma et al, 2007; Wei et al, 2004)

Major elements of a laterite profile developed on Neogene basalts in Guangzhou Province, South China were reported in this study. The results indicate that most of the elements have been mobilized and transferred downwards along the profile by aqueous solution. conservative elements during incipient chemical weathering, such as Fe, Ti, Zr, Hf, Nb and Ta, the removals are up to 25–43% in the upper profile. Al, Mn, Ti were significantly enriched in the middle (2–3m) profile, this may indicate there has an paleo-water level. All the REEs are remarkably enriched in the middle and the lower profile.

All the characters of the major and trace elements are similar as it in the weathering profile of basalt in Hainan island mentioned in Ma *et al.* (2007). These may indicate that the basalt in south China underwent the same process of weathering conditions.

[1] M. Zabel *et al.* Late Quaternary climate changes in central Africa as inferred from terrigenous input to the Niger fan, *Quatern. Res.* **56** (2) (2001), pp. 207–217.

## Impact of water-level fluctuations on concentration trends of petroleum contaminants in pipeline leakage area

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### Overview of Case Study

Monitored natural attenuation is one of the most commonly used remediation technologies which means that groundwater contamination was reduced to safety range by the effect of natural degradation and dilution. In typical area of certain oilfield of china, after the leakage oil cleaning up most of the high level contamination areas of groundwater are at pipeline leakage site and sewage infiltration area. Detected from continuous 12 months monitoring, the TPH Total petroleum hydrocarbons concentration of groundwater show two types of correlation with water-level fluctuations. Firstly, at the border of pollution plume, water-level fluctuations are positive correlation with TPH concentrations that as the water level raises, The TPH concentration increases in January to June. Secondly, at the middle of pollution plume, water-level fluctuations were always positive correlation with TPH concentrations during the whole monitoring period.

### Discussion of Results

The monitoring results show that attenuation of petroleum hydrocarbon contamination did not show a simple exponential or linear law with water-level fluctuations [1]. These results demonstrate that the TPH concentration at the high level (0.1–0.2mg/l), convection-dispersion is main process of monitored natural attenuation, and it is affected by water-level fluctuations significantly. Meanwhile at the low level (0.1–0.2mg/l), adsorption and biodegradation are the main process, which shows Linear attenuation characteristics. All the results indicate that in the study area, if the petroleum hydrocarbon contamination is higher than threshold (0.1–0.2mg/l), it would be appropriate to apply active remediation projects to local groundwater remediation, when lower than the threshold monitored natural attenuation will be more suitable.

[1] Alan E. Kehew, Patrick M. Lynch. *Environ Earth Sci.* Published on line :08 June, 2010.

## Granitic porphyry dykes in the Qitianling batholith, Hunan Province, South China: Evidence for the multistage mineralization

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The Qitianling Sn deposit, Hunan Province, China, is famous for its super-large reserves. Two granitic dykes enriched in Sn at Qitianling are subvolcanic counterpart of Sn-bearing granites. Textural relationships provide evidence for a quenched silicate melt with phenocrysts, consisting of albite, quartz, K-feldspar, and zinnwaldite. The porphyry tin deposit arises from abundant cassiterite and rutile enriched in W and Nb. An affinity with Qitianling (amphibole-) biotite granites arises from the geochemistry and their compositions are quite similar to each other. It is highly evolved, strongly peraluminous and enriched in W, Sn, Nb, Ta, Li and F. The melt belongs to the residual melt throughout the fractional crystallization. Analyses of zircon proved the high evolution of the source. Different textures of cassiterite grains provided the magmatic and hydrothermal process. The result of geochronological work shows the zircon U-Pb age of the dyke of  $147.15 \pm 0.45$  Ma, providing that it belongs to the third stage of Qitianling magmatism. The formation of a porphyry tin deposit is believed to be one of the last events at Qitianling. This super hypabyssal intrusive mass contains cryptoexplosive breccia. The occurrence at depth of a hidden granitic body could be the source of the granitic dykes. Therefore the fine-grained Qitianling felsic dykes is appropriate recorder for the concealed granitic body and mineralization. The late-stage mineralization related to the fine-grained granitic dyke is believed to be distinguished important in the multi-stage mineralization.

## Response of Antarctic Intermediate Water to weaker Atlantic Meridional Overturning Circulation during the last deglaciation

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The modes of ocean circulation in response to climate change have been a subject of intense interest. During the last deglaciation, cold periods such as the Younger Dryas (YD) and Heinrich 1 (H1) are thought to be coincident with significant reductions in North Atlantic Deep Water (NADW) formation. Yet, the role that Antarctic Intermediate Water (AAIW) played during these cold events is still poorly constrained. Benthic Cd/Ca data from sediment cores in the Florida Straits suggest a reduced contribution of AAIW in the North Atlantic western boundary current during the YD [1]. However,  $\epsilon_{Nd}$  evidence in sediment cores from Tobago basin and Brazil margin suggests a greater influence of AAIW in the North Atlantic during YD and H1 [2].

In this study, we measure Nd radiogenic isotope ratios of the authigenic Fe-Mn hydroxides in two sediment cores, KNR166-2-26JPC (546 m water depth) and KNR166-2-31JPC (751 m water depth), within the Florida Straits in an effort to investigate the waxing and waning of AAIW during the last deglaciation. Both cores are located within the Florida Current, which under modern conditions represents a mixture of recirculated North Atlantic subtropical gyre water and Southern origin waters. Our preliminary results for both cores show significantly less radiogenic  $\epsilon_{Nd}$  values during the YD than during the Holocene ( $\sim 1$  epsilon unit for 26JPC and  $\sim 0.6$  epsilon units for 31JPC). We interpret the lower  $\epsilon_{Nd}$  during the YD as signifying a decreased input of Southern-sourced waters arriving at these sites, in agreement with the study of Came et al. [1]. Additional high-resolution Nd isotope analyses of Florida Straits sediments deposited during earlier Heinrich Events and the Last Glacial Maximum will be presented in an effort to constrain the role of intermediate waters during periods of reduced NADW formation.

[1] Came et al. (2008) *Paleoceanography* **23**, PA1217 [2] Pahnke et al. (2008) *Nature Geoscience* **1**, 870-874

## Study on decision support system for water pollution control of ShaYing River

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According to the survey on water quality, hydrology, geography of ShaYing River, water pollution situation is analyzed. Aiming at this serious problem, the present situation of water pollution is analysed, the decision support system of ShaYing River water pollution control is analyzed completely and studied. From the standpoint of development process, functional design, framework and modularization design, using GIS technology and object-oriented programming language Visual Basic, the system with visual interface is exploited with MapObjects of GIS and database. Intelligent management of ShaYing River water pollution control come true, the system achieves functions of inputting information, treating data, searching information, thematic maps, water quality evaluation and water quality prediction, which can help data management, searching and assistant decision for water environment. It will provide a powerful tool and intelligent decision information for ShaYing River's water environment management in the future.

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## The geochemical characteristics of the Mashan complex, Guangxi, and its geological implications

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Previous Nd isotope studies about the Mesozoic granitoid intrusions in South China suggested that some bodies formed a southwest-northeast belt with low Nd model ages ( $T_{DM}$ ) in range of 1.7-1.2 Ga, lower than those of adjacent intrusions. It is also suggested that their magma sources and formation progresses should be related to the crustal extension and asthenosphere upwelling.

The detailed geochemical and geochronological studies about the Mashan complex, Guangxi suggest one possibility that the magma source of the low  $T_{DM}$  intrusions was derived from the partial melting of the Neoproterozoic juvenile mantle. The complex includes diabase porphyrite, diorite porphyrite, syenite porphyry, quartz-syenite porphyry and granite porphyry. Their zircon SHRIMP U-Pb ages are in range of 154-148 Ma, indicating that the complex was formed in a short time. The major and trace element compositions of these rocks suggest that they were derived from one mantle source without Nb, Ta negative anomaly. The  $\epsilon_{Nd}(t)$  of diabase is +2.3,  $T_{DM}(II)$  is 0.7 Ga, those of diorite and syenite are +5.9~-+2.6 and 0.7~0.5 Ga, those of quartz-syenite are +0.4 and 0.9 Ga, and those of granitic rocks are -0.3~-2.4 and 1.1~1.0 Ga. The zircon  $\delta^{18}O$  of diabase is 6.2‰, that of diorite is 5.7‰, which are close to the mantle value of 5.6‰, however, those of granitic and quartz-syenite are 7.2‰ and 7.5‰, respectively, suggesting that the quartz-syenite and granites were slightly contaminated by crustal rocks. The zircon Hf model ages of the grains with ages in 160-140 Ma are mainly in range of 1500-600 Ma calculated by felsic crust, and form a peak value at 1000 Ma.

It is concluded that the complex was derived from the partial melting of juvenile lithosphere mantle formed in the Neoproterozoic, triggered by the lithosphere extension and asthenosphere upwelling. After that, the magma was experienced strongly fractional crystallization. However, the granitic magma was contaminated by crustal materials, which may differentiated from the mantle during the Neoproterozoic and remelted in about 175-160 Ma. It should not be ruled out the contribution of the asthenosphere to the basic rocks.

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## REE deposits in China

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Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. China, the United States, Russia, India, Malaysia and Brazil constitute the largest percentage of the world's rare earth economic resources. The REE deposits in China are mainly related with carbonatite-alkaline complexes, weathered granite and placer (Fig. 1). The Bayan Obo is largest LREE deposit in the world, and its reserves are more than 13500 Mt. LREE deposits in carbonatite-alkaline complexes from Panxi region (West China) and Miaoya (Central China) are also large. The weathered granite-type REE deposits in South China are characterized by REE, especially HREE adsorption in clay minerals. The origin of Bayan Obo deposit is disputed, including carbonatite magmas, sediment, and carbonatite-derived fluid mixing sediment [1]. Studies suggested that the anomaly high REE compositions in mantle source and mineral fractional crystals and carbonate cumulate processes are key cases for the REE deposit formation related with carbonatite-alkaline rocks [1, 2]. The weathered REE deposits in South China were formed by leaching granites, and REE adsorbed by clay minerals. The precondition requires the granites contain abundant REE minerals. But how the granite can produce the primary REE minerals is not clear. Granite is quite normal rock in world, but not all of them can supply sufficient REE for mineralization. It is necessary to study the primary granite magma type REE deposits.

[1] Xu et al. (2008) *Lithos* **106**, 12-24. [2] Xu et al. (2010), *Lithos* **118**, 145-155.

## Re-Os geochronology of black shale from the Barents Sea: Refining the Triassic time scale

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Stage boundaries in the currently accepted Triassic time scale differ by as much as 8 Ma from those in a proposed "alternate" Triassic time scale [1]. Re-Os isochron ages combined with biostratigraphy for black shales from Kong Karls Land, Spitsbergen, and Svalis Dome in the Barents Sea help resolve these differences.

Drill core samples of black shales of the upper Ladinian Botneheia Formation next to the Kong Karls Land (easternmost Svalbard archipelago) [2], inferred to be near the Ladinian-Carnian boundary, yield a precise Model 1 Re-Os isochron age of  $239.2 \pm 0.4$  Ma. Another section from 8 meters deeper in the same drill core yields a less precise but nominally younger age of  $237.1 \pm 2.3$  Ma, though the two ages overlap within uncertainty. The black shale section from a nearby drill core [2], inferred to be the Carnian Tschermakfjellet Formation, yields a Model 1 age of  $228.9 \pm 1.4$  Ma. In a previous study at Svalis Dome in the Barents Sea [3], a Re-Os isochron age of  $239.3 \pm 2.7$  Ma was determined for the Botneheia Formation, shown by palynology to be uppermost Anisian. Together these results suggest a very short duration for the Ladinian Stage (a few million years), and support the "Alternate Time Scale for the Triassic" proposed by Ogg et al. [1], where the Ladinian Stage is from 240.5 to 236.8 Ma.

Our results affirm the utility of the Re-Os chronometer for dating black shales and correlating paleogeographically separated regions in absolute time.

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[1] Ogg et al. (2008) *The concise geological time scale*. Cambridge University Press, 177 pp. [2] Riis et al. (2008) *Polar Research* **27**: 318-338. [3] Xu et al. (2009) *EPSL* **288**: 581-587.

## Structure and stability of nickel hydroxide at high T-P conditions

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Nickel hydroxide, Ni(OH)<sub>2</sub>, belongs to the CdI<sub>2</sub>-type, layered hydroxide family M(OH)<sub>2</sub> (M = Mg, Ca, Ni, Co, etc.) and is of interest from the crystal-chemical viewpoint, as it provides a model structure for studying hydrogen-mediated interatomic interactions. M(OH)<sub>2</sub> phases are also interesting for studying Earth's deep water cycle. Though uncommon in the deep Earth, they are present as component units in the structures of many hydrous minerals (such as hydrous magnesium silicate phase E), which are potential hosts for water in the mantle. In addition, Ni(OH)<sub>2</sub> is a cathode material in Ni-based rechargeable alkaline batteries. Thus studying the structure and stability of Ni(OH)<sub>2</sub> at various conditions is of significance both geologically and for its practical applications.

In this study, using *in situ* time-of-flight neutron and energy-dispersive synchrotron X-ray diffraction, we have examined the structure and stability of nickel hydroxide at temperatures up to 623 K and/or pressures up to 8 GPa. To avoid the large incoherent scattering of neutrons by hydrogen, a deuterated sample Ni(OD)<sub>2</sub> was synthesized and used for neutron experiments. For synchrotron experiments, both Ni(OH)<sub>2</sub> and Ni(OD)<sub>2</sub> were measured, allowing studying the H/D isotopic effects. Rietveld analysis of neutron data and peak fitting of synchrotron patterns allowed determination of coefficients of thermal expansion, bulk moduli and other thermoelastic parameters. Moreover, the atomic positions and atomic displacement parameters, particularly of D, have been obtained, and the role of hydrogen-mediated interatomic interactions in the mechanisms of compression, thermal expansion and phase stability of nickel hydroxide are discussed. These results are also compared with those of other M(OH)<sub>2</sub> phases to determine the structural and stability systematics of the M(OH)<sub>2</sub> family.

## Recycling of lower continental crust in an intra-continental setting: Mineral chemistry and oxygen isotope insights from websterite xenoliths in the North China Craton

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A suite of websterite xenoliths entrained by the Early Cretaceous Feixian basalts in the eastern North China Craton provide direct evidence for recycling of dense lower continental crust in an intracontinental setting. Petrographic observations indicate that olivines within the xenoliths are replaced by orthopyroxenes, which in turn are replaced by clinopyroxenes. The δ<sup>18</sup>O values of olivines from websterite xenoliths vary from 7.1 ‰ to 7.6 ‰ (±0.4‰, 2SD). The Ni contents of the orthopyroxenes and clinopyroxenes in the websterites are much higher than those of mantle-derived harzburgite and lherzolite xenoliths within the Early Cretaceous high-Mg diorites, and of phenocrysts within the Late Cretaceous basalts. Clinopyroxenes in the websterite xenoliths have high <sup>87</sup>Sr/<sup>86</sup>Sr ratios (0.70862–0.70979). These findings, together with high initial <sup>86</sup>Sr/<sup>87</sup>Sr ratios (0.70977–0.70990) and low Nd(t) values of the host basalts (–13.1 to 13.4) [1], indicate that the melt, which modified the lithospheric mantle, could be derived from partial melting of the delaminated eclogitic continental crust. Therefore, our study shows that the intracontinental recycling of lower continental crust is a key factor not only to result in chemical and isotopic enrichment in the subcontinental lithospheric mantle [2], but also to result in compositional variations of intracontinental basalts [1, 3].

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## Geochemistry and petrogenesis of the Carboniferous-Permian granitic magmatism in Tianshan, Northwestern China

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The Carboniferous-Permian granitic magmatism developed strongly in Tianshan orogenic belt, which are composed of various rock types in diversified geodynamic settings. It not only concludes diorite, monzogranite, tonalite, plagiogranite of calc-alkaline series, but also syenite, quartz syenite, albitophyre of alkaline series. Via comparison of petrogenesis, geochemistry, and magma- processes of granitic rocks, the granitic rocks related to different tectonic units can show that the granitic rocks formed during the period of Carboniferous-Permian are mainly calc-alkali series. The Carboniferous-Permian granitic rocks developed in Eastern Tianshan and Bogda rift zone, containing more MgO, TiO<sub>2</sub>, Na<sub>2</sub>O and less K<sub>2</sub>O, Nb, and Th than the granitic rocks developed in ancient micro-terrain and its edge, means a different source. The granitic rocks in the rift zone formed by the mixing processes of the crust and mantle, containing different degrees of crust-derived components, usually are closely related to intermediate-acid volcanics. However, the granitic rocks developed in ancient micro-terrain mainly show strong information about crust source. The chemical composition of granitic rocks formed in the same tectonic settings but developed in different regions also is different. For example, the Tomor Peak granitic rocks developed in Western Tianshan, and the Kuruktag granitic rocks developed in the south of Central and Eastern Tianshan are all formed by crust source. But the former rocks possesses more Mg, K, Nb, Sr and less Zr, Ba than the latter. This shows some differences of crustal components added in Eastern Tianshan and western sections. Moreover, the positive  $\epsilon$ Nd value of granitic rocks developed in the study region may be caused by partially melting of mantle-derived volcanic rocks.

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## Geochemical characteristic contrast of heavy metals between sulphide mines and oxide mines

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Sulphide mines have always been the concerns of people because of their various forms and the resultant environmental problems, whereas oxide mines are paid less attention and not studied much because they do not cause obvious environmental problems. However, the potential environmental problems caused by oxide mines can not be ignored. The author chooses Panzhihua V-Ti-Magnetite, a famous oxide mine in China, as the subject of research. The geochemical characteristics of heavy metals in various environmental media (such as water, soil, and atmosphere) during the process of mining are systematically studied by using the above media as research carriers and employing the analyzing methods of ICP-MS and ICP-AES.

The results show that the geochemical characteristics of heavy metals in the sulphide mines and oxide mines have both similarity and difference. The biggest differences are: the content of chalcophile elements in environmental media of sulphide mines is far higher than that in oxide mines; the worst pollution of oxide mines is caused by atmosphere dust and heavy metals, while the worst pollution of sulphide mines is caused by acid mine drainage. The similarity between the two mines is that their morphological features are same.

Moreover, compared with the sulphide mines, the geochemical characteristics of the oxide mines are: it is mainly polluted through atmosphere circulation; its primary pollution medium is lithometeor; its most remarkable environmental problem is heavy metal pollution and geologic disasters. The oxide mine has potential geochemical hazards, which always break out with change of physical and chemical conditions.