

提要: 作者指出了1973年至今世界上50余项地球化学填图计划中普遍存在的缺陷大都涉及分析问题。1988~1992年实施的国际地质对比计划IGCP259项目旨在使全世界地球化学填图方法标准化。在此项目中对分析问题提出了若干规定, 主要是要求今后的填图计划应统一分析71种元素, 痕量及超痕量元素的检出限必须低于相应的地壳丰度值及采用中国的GSD和加拿大的STSD标样系列, 以使全球数据可以对比, 在其后开始延续至今的全球地球化学填图计划IGCP360, 旨在用极低密度采样早日覆盖全球大陆。讨论了正在实行的两种极低密度采样方案, 并提出通过极低密度采集地极少量样品示范性地进行IGCP259项目对分析要求的具体建议。

关键词: 勘查地球化学; 地球化学填图; 极低密度采样

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Global geochemical mapping

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Abstract: The deficiencies in more than 50 national and regional geochemical mapping projects in the world carried out from 1973 to present are all analytical in character. The IGCP259 Project under the aegis of UNESCO's IGCP Program carried out from 1988 to 1992 aimed to standardize geochemical mapping methods used in the world. This project advances several analytical requirements for forthcoming geochemical mapping projects, which mainly include the following: 71 elements should be analyzed in the future mapping projects; the detection limits of trace and ultratrace elements must be lower than the corresponding crustal abundances and the Chinese GSD and Canadian STSD standard sample series should be used for the correlation of global data; the aim of the IGCP360 Project (Global Geochemical Mapping Project) is to use 5000 composite samples taken at very low sampling densities to cover the whole Earth's land surface. Besides social, political and economic problems, the main bottleneck is the difficulties to meet IGCP259 analytical requirements by many countries. The best way to solve this bottleneck is proposed in the present paper.

Key words: exploration geochemistry, geochemical mapping, extremely low density sampling.

晚期成藏对大气田形成的重大作用

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提要: 截至2001年底, 中国发现21个大气田, 累计探明天然气储量 $17953 \times 10^8 \text{m}^3$, 占全国天然气总储量的59.80%。天然气的分子小、重量小、难被吸附而易扩散。成藏早的大气田, 若无继续获得气源, 随扩散时间增长损失气量不断增加, 有大气田演变为中、小型气田, 甚至散失殆尽。因此, 晚期成藏是大气田形成的必要条件之一。中国盆地具有多旋回性, 旋回性往往是后续的旋回损害和降低前旋回聚集气藏的保存条件和储量, 故晚期成藏就避免此弊, 有利于大气田的形成。晚期成藏的大气田的生气高峰期既可是与成藏期同步或基本同步, 以及储集层与气源岩的层位较新, 也可以是成气高峰期比成藏期早, 储集层和气源岩层位老。

关键词: 大气田; 控制因素; 晚期成藏; 中国

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Important role of the formation of gas accumulations in the late stage in the formation of large gas fields

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Abstract: By the end of 2001, 21 large gas fields had been discovered in China, and their cumulative explored reserves of gas in place reached $17953 \times 10^8 \text{m}^3$, taking up 59.80% of China's total gas reserves. Gas molecules are small, hard to be adsorbed and ready to diffuse. Large early-formed gas fields will lose their quantity and become small or medium-sized ones or even be depleted completely owing to long-continued gas diffusion, if no gas source replenishes the supply. Therefore, the formation of gas

accumulations in the late stage is one of the fundamental conditions for the formation of large gas fields. Basins in China are polycyclic in nature. The tectonic cycle of succeeding basin usually reduces or damages the reserves and preservation conditions of gas accumulations in the preceding basins. So, the formation of gas accumulations in the late stage can avoid this defect and is favorable for the formation of large gas fields. The period of peak gas generation of large gas fields resulting from late-stage accumulation is synchronous or nearly synchronous with the period of accumulation, and their source and reservoir rocks are younger. Sometimes, the peak generation period is earlier than the period of accumulation and their source and reservoir rocks are older.

Key words: accumulation; gas field; late stage; China

关岭生物群--世界上罕见的化石库

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提要: 以产保存完美海生爬行动物和海百合化石为特色, 多门类脊椎动物、无脊椎动物共同繁盛, 且夹带有少许古植物化石的关岭生物群是世界上极为罕见的珍稀古生物组合。其化石保存之完美, 类型之多样, 数量之丰富, 堪称世界上少有的晚三叠世“化石库”。在该“化石库”中, 海生爬行动物主要有鱼龙类(ichthyosaurs): Qianichthyosaurus Zhou Li (1999), Cymbospondylus asiaticus Li et You (2002), Panjiangsaurus epicharis Chen et Cheng gen. et sp. nov.; 海龙类(thalattosaurs): Anshunsaurus huangguoshuensis (Liu, 1999), Xinpusaurus suni (Yin et al., 2000), X. bamaolinensis Cheng et Liu sp. nov. 楯齿龙类(placodonts): Sinocymodus xinpuensis Li (2000) 以及某些尚待研究的类型。在所储藏的海百合化石中, 以重新厘定的许氏创口海百合Traumatocrinus hsui (Mu) [?=T. caudes (Dittmar, 1866); ? = T. guanlingensis Yu et al.]为主, 新的发现说明, 此类海百合营假浮游生活方式, 它们以网状或铰接状根簇附着在漂浮树干上而广泛分布。共存的化石还有: 新近发现和重新厘定的Metapolygnathus nodosus带的牙形石, 少量鱼类(Asialepidotus sp. nov.), 大量软骨鱼类(elasmobranch ichthyoliths)鳞片和牙齿化石的新类型, Trachyceras multituberculatus带的菊石, Halobia-“Daonella” bifurcata 组合带的双壳类, 以及腕足类: Koninckina guizhouensis, K. zhengfengensis等以及古植物化石: Equisetites arenaceus, Ctenozamites sarrani等。系统调查、科学发掘和对上述各门类化石时代综合分析后指出, 这个珍稀生物群形成于晚三叠世卡尼期早-中期, 主要产在新铺乡黄土塘、小凹、毛凹、巴毛林和岗乌乡白岩一带小凹组下段, 距底5~11m的地层间隔中, 其分布面积约200km²。构造古地理及层序、生态、化学地层的综合研究说明, 关岭生物群可能是伴随晚三叠世卡尼期早中期的海侵在盘江裂陷槽盆西北角活动外陆棚边缘所形成的“避难所”中形成和发展起来的。随着海侵的扩大, 海水的加深和有机质的过盛贮存所诱发的缺氧和海水的咸化事件, 可能是导致该生物群的集群绝灭, 并形成完好保存埋藏群落的主要原因。

关键词: 关岭生物群; 晚三叠世; 海生爬行动物; 海百合; 牙形石; “化石库”

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The Guanling Biota-A unique “Fossiliferous” in the world

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Abstract: The Guanling biota is characterized by the occurrence of numerous well-preserved Late Triassic (Carnian) marine reptiles and crinoids with ammonoids, bivalves, conodonts, brachiopods, elasmobranch ichthyoliths and a few fossil fishes and plants. Such a rich, diversified and perfectly preserved paleontological assemblage is rarely encountered in the world and can be called, therefore, a unique Late Triassic “Fossiliferous” in the world. Preliminary study indicates that the principal marine reptiles are ichthyosaurs: Qianichthyosaurus Zhou Li (1999), Cymbospondylus asiaticus Li et You (2002), Panjiangsaurus epicharis Chen et Cheng gen. et sp. nov., thalattosaurs: Anshunsaurus huangguoshuensis (Liu, 1999), Xinpusaurus suni (Yin et al., 2000), X. bamaolinensis sp. nov. Cheng et Liu, placodonts: Sinocymodus xinpuensis Li (2000) and some new unidentified taxa. The crinoids are dominated by Traumatocrinus hsui (Mu) (? = T. caudes (Dittmar, 1866), ? = T. guanlingensis Yu et al. 2000) revised in the present paper. New discovery of Traumatocrinus attaching drifting wood fossils by anastomosing or articulated rootlets indicates that the taxa of crinoids are widespread in the world, depending on its pseudo-planktonic living style. Associated fossils comprise conodonts of the Metapolygnathus nodosus Zone redefined by Chen (in press), ammonoids of the Trachyceras multituberculatum Zone, bivalves of the Halobia-“Daonella” bifurcatus Assemblage Zone, brachiopods, Koninckina guizhouensis, K. zhengfengensis, and newly discovered fossil fishes, Asialepidotus sp. nov., shark scales and teeth, plants, Equisetites arenaceus, Ctenozamites sarrani etc. Comprehensive analysis of the above-mentioned various kinds of fossils suggests that the age of the Guanling biota should be Late Triassic early-middle Carnian. Detailed

Investigation and systematic exploration indicate that the Guanling biota is distributed mainly in the interval of 5-11 m above the base of the Lower Member of the Xiaowa Formation (former "Wayao Formation") around Huangtutang, Xiaowa, Maowa, Bamaoling of Xinpu Township and Baiyan of Gangwu Township, Guanling County, covering an area of about 200 km². Combined tectono-paleogeographic and eco-, sequence- and chemostratigraphic studies indicate that this rare biota was probably formed and developed in a particular "asylum" situated in the NW corner of the active shelf margin close to the relatively stagnated Nanpanjiang intracontinental rift basin. This basin was surrounded by the Sichuan-Yunnan-Guizhou-Guangxi old land on three sides during the earliest Late Triassic transgression, following the Middle Triassic Ladinian global regression. The anoxic and salted events, caused by subsequent Early-Middle Carnian maximum transgression and sedimentary organic surplus stockpiling, were probably the main causes for the mass extinction of this biota and formation of well-preserved taphocenosis.

Key words: Guanling biota; Late Triassic; marine reptile; crinoid; conodont; "Fossilagerst"

白垩纪黑色页岩与海水含氧量变化--以西藏南部为例

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摘要: 黑色页岩具有特殊的沉积学、古生物学和有机地球化学特征, 主要表现在生物组合和丰度的变化、有机碳含量的增高与碳稳定同位素的偏移等方面。具有丰富有机质来源的高生产力表层水是黑色页岩中富有机碳沉积物形成与埋藏的先期条件。白垩纪中期黑色页岩在全球广泛分布, 是Cenomanian/Turonian期界线事件的最重要标志。在西藏南部的C/T界线处, 浮游有孔虫种一级的绝灭速率达34%, 底栖有孔虫的绝灭速率达50%; 有机碳含量偏高; $\delta^{13}C$ 出现2.74%的正向偏移; 生物扰动几乎消失, 微小钻孔黄铁矿化; 有孔虫房室充填有黄铁矿微球丛; 诸多其他地球化学指标亦存在不同程度的异常。这些特征说明当时海洋不同深度水层处于不同强度的贫氧至缺氧状态, 同时沉积的黑色页岩是缺氧环境中有机碳大量保存的结果。该现象发生的原因是白垩纪中期的海平面上升和气候变化的影响。西藏特提斯海古海洋条件的变化明显受全球和区域性海平面上升的影响, 由此形成的白垩纪中期黑色页岩具有全球一致的特征。

关键词: 白垩纪; 黑色页岩; 含氧量; 西藏

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Cretaceous black shale and dissolved oxygen content ---A case study in southern Tibet

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Abstract: Black shales have special lithological, paleontological and geochemical features, which are mainly represented by changes in faunal assemblage and abundance, an increase of organic carbon content and positive excursion of carbon stable isotopes. High surface water productivity is of paramount importance in organic matter deposition. Black shales were worldwide during the Mid Cretaceous and well marked the Cenomanian-Turonian transition. In southern Tibet, the extinction rates for planktonic foraminiferal species are 34%, and up to 50% for the benthos at the C/T boundary. A short positive $\delta^{13}C$ excursion that shows a maximum value of 2.74‰ occurs at the top of the Cenomanian. The bioturbation almost disappeared; microburrows are pyritized; foraminiferal chambers are filled with pyrite microspherical clusters. Other geochemical indicators also show different degrees of anomalies. These features suggest that different degrees of oxygen-poor to oxygen-deficient states occurred in water layer at different depths of the ocean. The shales deposited simultaneously are the result of preservation of abundant organic carbon in the anoxic environment. The causes for the occurrence of this phenomenon are the influences of the sea-level rise and climatic change in the Mid Cretaceous. The changes of the conditions of the Tibetan Tethys Sea were markedly affected by the global and regional sea-level rises at the Mid Cretaceous black shale formed thus have the features consistent with those of the global shales.

Key words: Cretaceous; black shale; oxygen content; Tibet

北祁连山奥陶纪弧后盆地火山岩浆成因
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摘要: 本文对北祁连山早古生代弧后盆地熔岩的岩石地球化学研究结果加以报道。样品的分布将南部弧后盆地拉伸最早阶段发育的岛弧裂谷化区和北部的弧后海底扩张区联系起来。熔岩的岩相学和地球化学特点反映了拉伸方式的改变, 北部是典型的弧后盆地基性熔岩, 向南则逐渐向岛弧熔岩过渡。海底扩张区以玻质(现已脱玻化)、少斑基性熔岩为特征, 长英质熔岩和斑状基性熔岩产于南部岛弧裂谷化区。成熟岛弧部分($Y < 20 \times 10^{-6}$, $TiO_2 < 0.60\%$, $Th/Yb > 0.60$)和弧后扩张区($Y > 20 \times 10^{-6}$, $TiO_2 > 1.0\%$, $Th/Yb < 0.60$)在地球化学上相互有别。从由海底扩张形成的弧后盆地基性熔岩, 向南经过逐渐与岛弧岩石相似的熔岩, 直至裂谷区最南部的岛弧熔岩, 它们的地球化学成分显示逐渐的变化。这种变化反映了弧后盆地形成过程中弧后盆地之下地幔对流方式和熔体产生作用的改变: 从初始岛弧裂谷之下由消减板片俯冲引起的地幔下沉, 转变为弧后海底扩张带之下的地幔上隆。早期岛弧裂谷阶段, 裂谷轴捕获了岛弧岩浆流, 从而使得喷出的熔岩在成分上与岛弧熔岩无法区分; 随着弧后拉张继续, 弧后盆地变宽, 岛弧岩浆流逐渐离开裂谷轴, 最终产生一个似洋中脊的减压熔融统一弧后盆地岩浆系统。

关键词: 弧后盆地熔岩; 岛弧熔岩; 岩石地球化学; 岩浆成因; 北祁连山

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Magma genesis of Ordovician back-arc basins in the Northern Qilian Mountains

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Abstract: This paper reports the results of a petrogeochemical study of lavas in lower Paleozoic back-arc basins in the Northern Qilian Mountains. The distribution of samples links regions of back-arc seafloor spreading to the north with regions farther south where a progression of island arc rifting styles occurred in the earliest stage of back-arc basin extension. Petrographic and geochemical characteristics of lavas reflect the change in style of extension, with typical back-arc basin basic lavas in the north passing southward to arc lavas. Glassy (devitrified now), minor-porphyrific basic lavas characterize regions of seafloor spreading. Felsic lavas and porphyritic basic lavas occur in the southern, island-arc rifting regions. Geochemically, mature arc portions ($Y < 20 \times 10^{-6}$, $TiO_2 < 0.60\%$, $Th/Yb > 0.60$) are distinguished from regions of back-arc spreading ($Y > 20 \times 10^{-6}$, $TiO_2 > 1.0$, $Th/Yb < 0.60$). Samples show progressive marked changes in geochemical compositions, from back-arc basin basic lavas formed by seafloor spreading southward through lavas that increasingly resemble arc lavas to arc lavas that are indistinguishable from arc lavas encountered in the southernmost portion of the rift. These changes reflect the changes in the mechanism of mantle convection and processes of melt generation beneath the evolving back-arc basin in the Northern Qilian Mountains: from mantle downwelling beneath incipient island arc rifts caused by slab subduction to mantle upwelling beneath zones of back-arc seafloor spreading. The rift axis captured the arc magmatic flux in the early island arc rift stage, so that the lavas erupting from this part of the rift cannot be compositionally distinguished from arc lavas. As back-arc extension continued and the back-arc basin widened, the arc magmatic flux moved progressively away from the rift axis, finally generating a mid-ocean ridge-like decompression melting system-back-arc basin magmatic system.

Key words: back-arc lava; arc lava; petrogeochemistry; magma genesis; Northern Qilian Mountains

河北阜平平阳片麻状奥长花岗岩的地质和岩相学特征

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摘要: 平阳片麻状奥长花岗岩位于河北阜平县平阳镇一带, 围岩为包括混合岩和片麻岩在内的变质表壳岩, 层位上相当于阜平群的下部。研究表明平阳地区空间上存在高级变质作用、混合岩化作用和深熔作用的“三位一体”, 因而由变质岩到花岗岩显示了系统的岩石学、岩相学以及产出关系上的渐变过渡特点。花岗岩中的变质表壳岩以及部分包体不仅在岩性上可和外围的同类岩石对比, 而且也显示了明显的深熔作用改造的痕迹。有较为充分的证据表明平阳片麻状花岗岩总体上为原地深熔的奥长花岗岩, 局部发生了一定尺度的位移。平阳地区变质表壳岩的深熔作用经历了以流体活动占主导地位、以矿物的溶解和重结晶为主要特点的早期阶段, 演变为以部分矿物的熔融占主导地位的高级阶段。平阳片麻状奥长花岗岩的形成代表了阜平岩群变质表壳岩深熔作用的高级演化阶段, 对于客观认识阜平岩群的组成和地质演化具有重大意义。

关键词: 平阳片麻状奥长花岗岩; 阜平岩群; 变质表壳岩; 高级变质作用; 混合岩化作用; 深熔作用; 岩石学; 岩相学

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Geology and petrography of the Pingyang gneissic trondhjemite, Fuping, Hebei

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Abstract: The Pingyang gneissic trondhjemite is located in the vicinity of Pingyang Township, Fuping County, Hebei Province. Its country rocks are supracrustal rocks including migmatites and gneisses, stratigraphically equivalent to the lower part of the Fuping Group. The high-grade metamorphism, migmatization and anatexis have close spatial relationships in the Pingyang area, showing the 'trinity'; thus the change from metamorphic rocks to granites show the gradational features with respect to systematic petrology, petrography and occurrence relationships. The metamorphosed supracrustal rocks and some inclusions in granites can not only be correlated with their equivalents in the surrounding areas but also show signs of modification by anatexis. Ample evidence indicates that the Pingyang gneissic trondhjemite is generally autochthonous anatectic trondhjemite, which has been displaced to some extent locally. The anatexis of metamorphosed supracrustal rocks in the Pingyang area progressed through the early stage characterized mainly by dissolution and recrystallization of minerals and the late stage when melting of some minerals predominated. The formation of the Pingyang gneissic trondhjemite represents the higher evolutionary stage of anatexis of metamorphosed supracrustal rocks of the Fuping Group-complex, which has great significance for the objective understanding of the composition and geological evolution of the Fuping Group-complex.

Key words: Pingyang gneissic trondhjemite; Fuping Group-complex; migmatites; migmatization; meta-supracrustal rocks; high-grade metamorphism; anatexis; petrology; petrography

云南巍山-永平矿集区流体地质填图的理论与实践

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提要: 流体地质填图是一种全新的地质调查及找矿方法。本次研究选择云南巍山-永平矿集区进行流体地质填图试验, 研究了矿集区的控矿地质要素、各种主要的矿床(点)特征、成矿流体子系统及流域、流体的盐度与均一温度、流体的气液相成分、微量元素含量、稳定同位素特征及成矿流体的浓集中心。得到的流体地质图基本反映了本区成矿流体的性质与状态, 反映了两个成矿流体子系统的基本特征, 圈定了2个成矿流体子系统的流域范围及7个成矿流体浓集中心。这些浓集中心与已知矿化点分布、化探异常及有利的地质条件基本吻合, 成为该区进一步找矿预测的重要依据之一。本项目的实践证明, 流体地质填图不失为一种有效的找矿手段。

关键词: 流体地质填图; 地质调查; 成矿流体; 流体包裹体; 巍山县; 永平县; 云南省

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Fluid-geological mapping in the Weishan-Yongping mineralization district, Yunnan-theory and practice

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Abstract: Fluid-geological mapping is a new method employed for geological investigation and mineral exploration. The first test of fluid-geological mapping in China was carried out in the Weishan-Yongping copper-gold-polymetallic mineralization district, Yunnan. The authors studied mineralization-controlling geological factors, characteristics of various major deposits (occurrences), ore fluid subsystems and its drainage area, salinities, homogenization temperatures, gas-liquid phase compositions of fluids, trace element contents and stable isotope features of ore fluids, and concentration centers of ore fluid system in the mineralization district. The fluid-geological map shows the nature and state of ore fluids in the area and the basic characteristics of two ore fluid subsystems. The drainage area and seven concentration centers of the two ore fluid subsystems have been delineated. The distribution of these concentration centers essentially coincides with the distribution of the known mineralization occurrences, geochemical anomalies and favorable geological conditions; therefore they are thought to be an important basis for mineral exploration. This study suggests that fluid-geological mapping is an effective means for mineral

exploration.

Key words: fluid-geological mapping; geological survey; ore fluid; fluid inclusion; Weishan County; Yongping County; Yunnan Province

火山活动与金矿床
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提要: 火山活动不仅对铁、铜多金属矿床的形成具有重要意义, 而且对金矿形成也是至关重要的。笔者多年在火山岩分布区的工作和整理大量国内外大型超大型矿床矿田地质资料, 深切地认识到火山作用在金矿形成过程中的重要意义。本文将从金矿床地质成因类型划分及其规模和资源量、各类型矿床的地质条件分析来说明这一认识, 并初步总结了找矿工作中应注意的问题和标志, 试图来推动火山岩地区金矿找矿工作。由于陆相火山岩金矿较为直观, 因此本文着墨较少, 而着重说明海底火山活动与金矿形成的内在联系。

关键词: 火山活动; 金矿床; 绿岩带; 绿片岩相; 兰德型金矿
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Volcanism and gold deposit

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Abstract: Volcanism has great significance not only for the formation of Fe and Cu-polymetallic deposits, but also for gold mineralization. The authors have deeply realized the great significance of volcanism in the formation of gold deposits through many years of work in areas of volcanic rocks and arrangement and analysis of geological data of large and superlarge gold deposits at home and abroad. This paper elucidates this understanding from the genetic types of gold deposits and their sizes and reserves and analyses of geological conditions of various types of gold deposits and preliminarily summarizes the problems meriting attention and indicators in gold prospecting with an attempt to improve gold prospecting in volcanic areas. The paper focuses on the internal relation between submarine volcanism and formation of gold deposits, while gold deposits related to terrestrial volcanism are scarcely discussed because they are more directly perceived.

Key words: volcanism; gold deposit; greenstone belt; greenschist facies; Lande-type deposit

南京老虎山黄土剖面中铷锶地球化学和磁化率与古气候变化的关系
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提要: 宁镇地区的下蜀黄土记录了古气候变化的丰富信息。作为中国北方风尘堆积的南部边缘相, 下蜀黄土在全球环境变化研究中占有重要的地位。本文以10cm间距系统分析了老虎山剖面的Rb、Sr含量和频率磁化率。结果显示, 磁化率和Rb/Sr量可以较好地指示东亚冬季风强度变化; Rb/Sr比可以作为下蜀黄土化学风化强度的替代性指标; 剖面的Rb/Sr比由下至升高是南京地区12万年以来化学风化作用增强的结果。

关键词: 铷锶地球化学; 磁化率; 黄土-古土壤; 古气候变化; 南京老虎山
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Rubidium and strontium geochemistry in the Laohushan loess section, Nanjing, and relation between magnetic susceptibility and paleoclimatic change

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Abstract: The Xiashu loess in the Nanjing-Zhenjiang area records abundant information of the paleoclimatic change. The Xiashu loess, as a facies at the southern margin of eolian and dusty accumulations innorthern China, occupies an important position in the study of the global environmental change. The authors systematically analyzed the Rb and Sr concentrations and magnetic susceptibility at

the Laohushan section at 10 cm intervals. The results show that the Rb concentration and magnetic susceptibility may better indicate the variations in intensity of the East Asian monsoon and that the Rb/Sr ratio may server as a substitute proxy for chemical weathering of the Xiashu loess. The increase of the Rb/Sr ratio at the section from below upward is the result of intensification of chemical weathering over the last 120 ka.

Key words: rubidium and strontium geochemistry; magnetic susceptibility; loess; paleosol; paleoclimatic change; Laohushan, Nanjing

陇西民和黄土CaCO₃和有机碳总量的含量变化及其气候指标的局限性

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提要: 民和黄土地处黄土高原与青藏高原东北缘的交接部位, 对气候反应较敏感。对该黄土1.87~0.70 Ma BP段进行了CaCO₃和有机碳总量(TOC)的采样分析。民和黄土CaCO₃含量在5.89%~18.63%之间变化, 平均11.41%; 有机碳含量较低, 在0.007%~0.452%之间, 平均0.088%。民和黄土中的CaCO₃含量明显高于兰州、洛川和西安等地, 而有机碳含量则远低于上述地区。黄土中CaCO₃和有机碳含量变化反映了该区1.87 Ma BP以来气候变干冷的趋向。分别受复杂的CaCO₃来源与类型、困难的采样、地区上的差异对比等和有机碳保存条件、沉积速率以及“埋藏效应”的影响, 黄土中的CaCO₃和有机碳的波动变化作为气候变化的替代性指标存在一定的局限性。文章最后指出, 在实际应用中, 黄土(特别是黄土高原西北部)中CaCO₃和有机碳气候指标应结合其他环境指标共同使用, 才能从中提取正确的古气候信息。

关键词: 民和黄土; 青藏高原; CaCO₃; 有机碳; 局限性

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Variations of the CaCO₃ and total organic carbon contents in the Minhe loess and their limitations as climatic proxies

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Abstract: Situated in the intersection area of the Loess Plateau and the northeastern margin of the Qinghai-Tibet Plateau, the Minhe loess is sensitive to the climate. Analysis of the CaCO₃ and total organic carbon (TOC) contents in the 1.87~0.70 Ma interval of the Minhe loess shows that the content of CaCO₃ in the Minhe loess ranges from 5.89 to 18.63%, averaging 11.41% and that the content of TOC is lower, ranging from 0.007% to 0.452% with an average of 0.88%. The CaCO₃ content in the Minhe loess is notably higher than those in Lanzhou, Luochuan and Xi'an, but the TOC content is much lower than those in the aforesaid areas. The variations of the CaCO₃ and TOC contents in the Minhe loess indicate that the climate in the area had a trend of becoming cold and dry since 1.87 Ma BP. The variations of CaCO₃ and TOC in loess as substitute proxies of climatic changes have certain limitations due to influences of complex sources and types of CaCO₃, difficult sampling and differential comparisons among areas, as well as preservation conditions, sedimentation rates and "burial-effect" of TOC. At last, the paper points out that in actual applications the climatic proxies of CaCO₃ and TOC in loess, especially loess in the northwestern part of the Loess Plateau, must be used together with other climatic proxies, and then correct paleoclimatic information can be extracted.

Key words: Minhe loess; Qinghai-Tibet Plateau; CaCO₃; TOC; limitation

西藏冈底斯东段成矿系列区域地球化学预测

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提要: 西藏冈底斯东段优势矿床成矿系列预测是当前需要解决的重要问题。文中研究了成矿系列矿源场特征, 以及地球化学靶区与矿床成矿系列的联系, 揭示了矿化规模的地球化学控制因素, 计算了因素耦合系数。预测冈底斯构造带是4种类型矿床成矿系列的密集区。

Regional geochemical prediction of the minerogenic series in the eastern section of the Gangdise Mountains, Tibet

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Abstract: The prediction of preponderant minerogenic series in the eastern section of the Gangdise Mountains, Tibet, is a key problem that needs to be solved currently. The authors studied the provenance characteristics and relations between geochemical targets and minerogenic series, revealed the geochemical constraints of mineralization scale and calculated factors coupling coefficients for predicting potential resources. It can be concluded that four different minerogenic series are concentrated in the eastern section of the Gangdise Mountains.

Key words: minerogenic series prediction; constraint; factors coupling coefficient; Gangdise Mountains