http://www.geojournals.cn/dzxbcn/ch/index.aspx

Abstracts of *Acta Geologica Sinica* (Chinese Edition) Vol. 73, No. 2, 1999

A Comparison between the Tectonic Units on the Two Sides of the Altun Sinistral Strike-slip Fault and the Mechanism of Lithospheric Shearing

XU Zhiqin, YANG Jingsui, ZHANG Jianxin, JIANG Mei, LI Haibing and CUI Junwen (Institute of Geology, Chinese Academy of Geological Sciences, Beijing, 100037)

The Altun strike-slip fault is the largest strike-slip fault in Aisa and defines the northern boundary of the Qinghai-Tibet Plateau. The Altun terrane, bounded by the north Altun thrust fault and the Altun strike-slip fault on the south, consists of the Dunhuang massif, northern Altun Caledonian subduction complex, central Altun massif and southern Altun subduction-collision complex from north to south. Our studies indicate that these tectonic units correspond to the Alxa block, northern Qilian subduction complex, central Qilian block and northern Qaidam subduction-collision zone respectively on the two sides of the Altun strike-slip fault. Especially, the eclogites in the southern Altun and northern Qaidam show strong similarities in geological setting, occurrence, mineral assemblage, geochemical and protolith feature, *P-t* condition of formation, retrograde metamorphism, associated country rock and almost consistent metamorphic age. This suggests the HP-UHP(?) metamorphic zone displaced by a large strike-slip fault be similar to the case of the Dabie-Sulu HP-UHP metamorphic zone which was truncated by the Tanlu sinistral strike-slip fault, and the offsets along the Altun sinistral strike-slip fault is about 400 km.

A seismic tomographic section across the Altun Mountains, established by the natural earthquake experiment, indicates a steep low-velocity anomaly beneath and along the Altun strike-slip fault, and a high-velocity anomaly (implying dense material) beneath the Altun terrane located between the southern Altun strike-slip fault and the northern gently-dipping thrust fault. The two faults may meet at a depth of 80 km, then continue to underthrust steeply southward to 150 km, suggesting that Tarim block has been underthrust southward beneath the Altun Mountains and the Qaidam block. The large magnitude of anisotropy represents the existence of shearing of upper mantle along the Altun strike-slip fault, while the lithospheric shearing may be attributed to the southward subduction of the Tarim block.

Key words: sinistral strike-slip; subduction-collision complex; comparison between tectonic units; lithospheric shearing fault; intracontinental subduction

The Spatio-temporal Framework and Geological Evolution of the Jinshajiang Arc-Basin Systems

WANG Liquan, PAN Guitang, LI Dingmou, XU Qiang and LIN Shiling (Chengdu Institute of Geology and Mineral Resources, Chengdu, 610082)

The research on the spatio-temporal framework and geological evolution of the Jinshajiang arc-basin systems indicates that Jinshajiang junction zone is an important subduction complex belt in the Nujiang–Lancangjiang–Jinshajiang structure zone in southwestern China in the Palaeo–Tethyan back-arc oceainc basin. The Jinshajiang back-arc oceanic basin was formed during the Early Carboniferous–Early Permian and its embryonic form appeared in the late Late Devonian. Early Permian was the summit of oceanic basin spreading; in the late Early Permian it began to subduct toward the west. The Jinshajiang junction zone includes the Ailaoshan–Gajinxueshan–Gongka–Xiaruo–Xinzhu ophiolite melange belt of the oceanic crust consumption (C_1–P_1), Zhubalong–Yangla–Dongzhulin complex belt of the intraoceanic arc consumption (P^2_1–P_2) and Xiquhe–Xueyayangkou–Jiyidu–Gongnong complex belt of the back-arc basin consumption (P^2_1–P_2). Along the west side of the Jinshajiang junction zone are the Jiangda–Weixi volcanic rock belt of continental marginal arc (P^2_1–T_2) and the bimodal volcanic rock belt in the superimposed volcanic rifting basin (T^2_2–T^1_3) and the comsumpina complex belt of the continental marginal rifting basin in the Shimianchang, Deqin. The Jinshajiang arc-basin systems began to grow, develop and evolve on a background of the Early Palaeozoic metamorphic "soft basement" at the end of the Silurian and went through the stages of the back-arc rifting basin (D), the back-arc oceanic basin (C_1–P_1), the oceanic crust subduction-consumption (P^2_1–P_2), the arc-continent collision (T_1–T_2), the superimposed-volcanic rifting basin (T^2_2–T^1_3), the foreland basin (T^2_3–Q) and the intracontinental convergence (E–Q).

Key wards: Jinshajiang junction zone; spatio-temporal framework; geological evoltuion; Palaeo-Tethys

Metallogenic Series and Their Formation and Evolution in Western Tianshan, Xinjiang

WEI Heming, WU Wenkui and XUE Chunji (Xi'an Engineering University, Xi'an, Shaanxi, 710054)

Western Tianshan is one of the most famous metallogenic belt in China, where there are many useful mineral resources, especially the nonferrous and noble metals, and also rich in ferrous metal. The metallogenic series (or minerogenetic series) of western Tianshan has been studied in this paper based on an

analysis is of the main metallogenic types and factors. According to lots of material about the ore deposits and occurences in the western Tianshan, there metallogenic series in the area has been recognized, ① Cu-Fe-Au-Mo-W-Sn-Pb-Zn metallogenic series related to intermediate-acid–acid granite; ② Fe-Cu-Au metallogenic series related to basic–intermediate —acid volcanic formation; ③ Stratbound Cu-Pb-Zn metallogenic series related to the sedimentary rocks and hydrothermal sedimentary rocks. Each series shows its own metallogenic features and background. The division and study of the metallogenic series have revealed some regional time-space distribution characteristics of the ore deposits, which are important for the metallogenic prognosis.

Key words: Western Tianshan; metallogenic belt; metallogenic series; metallogenic evolution

On The Genesis of Gold Deposits in Precambrian Metamorphic Basement, Eastern Liaoning and Jilin

NI Pei and XU Keqin (Department of Earth Science, State Key Lab of Mineral Deposit Research, Nanjing University, Nanjing, 210093)

In eastern Liaoning and Jilin, a large amount of gold deposits are located in the Precambrian metamorphic basement. The gold deposits are located within the Liaonan terrane, and occurring in Paleoproterozoic metamorphic rocks — the Liaohe Group (Gaixian Formation), or the granitic gneiss formed by migmatization and granitization of it. The authors' present study of the geology and geochemical characteristics of gold deposits in this region is concerned with: ① the distribution of gold orebodies; ② the ore-controlling structures; ③ the ore-mineral association; ④ the REE and REE pattern; ⑤ the trace elements; ⑥ the lead isotope compositions; ⑦ the sulphur isotope compositions; ⑧ fluid inclusions data et al. It is suggested that the gold deposits could be divided into three main genetic types: the Proterozoic metamorphic hydrothermal type, the Mesozoic meteoric hydrothermal type and the Mesozoic magmatic hydrothermal type.

After the formation of the Liaohe Group, an extensive Proterozoic regional metamorphism took place. The metamorphic hydrothermal solution, carrying mobile components such as Au, Fe, S, As, H_2O, CO_2 and CH_4 derived from the Liaohe Group, was transported to the ductile shear zone which formed simultaneously with regional metamorphism, and finally, resulted in the formation of Proterozoic metamorphic hydrothermal type gold deposits in the greenschist facies Gaixian Formation, under appropriate physical and chemical conditions.

The circulation of meteoric water, resulting from the Mesozoic tectono-magmatic process, leached some elements (Au, Fe, S, As et al.) out from the Liaohe Group, especially the Gaixian Formation, and formed the ore-forming meteoric hydrothermal solution, which was transported to the ore-controlling structures, such as the fracture zone in the strata, the brittle and ductile shear zone and the zone of nappe structures, causing the metasomatic reaction with the country rocks and formed the Mesozoic hydrothermal type gold deposits.

The Mesozoic syntactic granite caused some elements (Au, Fe, S, As, et al.) to derive from the country rock on one hand and carried partly ore-forming elements such as Au and Sb from the lower part of the Earth on the other hand. The above-mentioned ore-forming elements along with the magmatic hydrothermal solution were transported along the faults in granitic gneiss adjacent to the granite bodies and finally formed the Mesozoic magmatic hydrothermal type gold deposits.

Key words: gold deposits; genetic type; geochemistry; eastern Liaoning and Jilin areas

The Solubility of Coexisting Minerals and Its Calculating Theory and Method and Ore-forming Processes of Sulphide Metal Minerals

CEN Kuang (China University of Geosciences, Beijing, 100083)

The concept of the solubility of coexisting minerals and its calculating theory and method are put forward. With the Tianmashan Cu and Au deposit as an example, the solubilities of coexisting minerals of pyrite and chalcopyrite with quartz (sandstone environment) or calcite (limestone environment) are calculated. The results show the mechanism that the ore-forming fluid flowed through the sandstone, dissolved the original pyrite in the sandstone, and then pyrite was precipitated again at the interface of sandstone and limestone.

Key words: coexisting minerals; solubility; ore-forming processes; Cu and Au sulphide deposit; Tianmashan, Anhui Province

Expermental Study on the Transformation of Amphibolite-Amphibole Eclogite-Coesite Eclogite in Zhujiachong, Dabie Mountains

LIU Xiaochun, QU Wei (Institute of Geomechanics, Chinese Academy of Geological Sciences, Beijing, 100081)
XIE Hongsen, ZHANG Yueming and GUO Jie (Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, 550002)

The recrystallization of amphibolite from Zhujiachong in the Dabie Mountains was experimentally investigated at 750～1200 ℃ and 1.0～4.5 GPa, and the relationships of mafic rocks in high- and ultrahigh-pressure regions are briefly discussed. The results show that the progressive evolutionary process of mafic rocks with increasing pressure at 750 ℃ underwent five stages, i.e. amphibolite (Ga+Amp+Ep+Bi+ Pl+Qz, 1.0～1.5 GPa), amphibole eclogite (Ga+Cpx+Amp+Ep+Ph+Qz, 1.75～2.25 GPa), quartz eclogite (Ga+Cpx+Zo+Ph+Qz, 2.5 GPa), coesite eclogite (Ga+ Cpx+Zo+Ph+Cs, 3.0～3.5 GPa) and lawsonite eclogite (Ga+Cpx+Law+Ph+Cs, 4.0～4.5 GPa),

eclogite (Ga+Cpx+Law+Ph+Cs, 4.0~4.5 GPa), in which phase relationships can be restricted by some specific metamorphic reactions. Amphibole is a major coexisting mineral at pre- and post-eclogite stages and can be regarded as an index mineral because its upper stability limit is less than 2.5 GPa. The occurrence of zoisite+kyanite+coesite assemblage indicates that the upper pressure limit of eclogite in the Dabie Mountains does not reach the stability field of lawsonite, and therefore could not exceed 4.0~4.5 GPa. The progressive evolution of hydrous minerals in eclogite suggests that a portion of surface water may be carried deep into the mantle in a subduction zone, and that the continuous dehydration of water-bearing eclogite provides a H_2O source for the partial melting of the subducting slab.

Key words: amphibolite; eclogite; lawsonite; phase transformation; Dabie Mountains

Sm-Nd Ages of the Panxi Layered Basic-Ultrabasic Intrusions in Sichuan

ZHANG Zongqing (Institute of Geology, Chinese Academy of Geological Sciences, Beijing, 100037)
LU Jiren (Institute of Mineral deposits, Chinese Academy of Geological Sciences, Beijing, 100037)
TANG Suohan (Institute of Geology, Chinese Academy of Geological Sciences, Beijing, 100037)

The intrusive complex zone in the Panxi area, Sichuan province, China, consisting of layered basic-ultrabasic intrusive rocks, syenites and aikali granites, is know in the world for their containning large vanadium-titaniferous magnetite deposits and rare earth element deposits. The rocks and deposits have been investigated and a lot of data have been accumulated over the past forty years. However, their formation timing is still in dispute. Most geologists consider that the rocks and deposits originated in the Variscan-Indosinian period about 300~200 Ma ago and are closely related with the Emeishan basalts, covering an extensive area in south-western China, but some believe that they formed in the Proterozoic or earlier. Sm-Nd dating of layered intrusions in the zone has been performed, and their ages obtained are as follows: the Upper Panzhihua body has a whole-rock age of 210±43 Ma, the Lower Panzhihua body has a whole-rock age of 282 Ma and a mineral age of 209±32 Ma, the Baima body has a whole-rock age of 197±60 Ma, and the Hongge body has a whole-rock age of 283±38 Ma and a mineral age of 261±45 Ma.

These data suggest that the layered rocks and deposits were formed possibly in the late Variscan-Indosinian period about 280~200 Ma ago and were related to closing of the Palaeo-Tethyan ocean.

Key words: Sm-Nd geochronology; layered basic-ultrabasic intrusions; Panxi area; China

The Immobile Elements Identification and Mass Transport in the Geochemical Process of Wall-rock Alteration
——A Case Study of the Gold-Antimony-Wolfram Deposit at Woxi in Hunan Province

GAO Bin, MA Dongsheng and LIU Lianwen (State Key Laboratory for Research of Mineral Deposits, Nanjing University, Nanjing, 210093)

The main purpose of this paper is to introduce a new method to study the immobile elements and mass transport of in geochemical process of wall-rock alteration. A linear regression model is established based on Grant's equation (Grant, 1986) and the Overlap Cone method (Baumgartner et al, 1995). For every immobile element, it is a straight-line equation with a zero intercept and an unspecified slope. We first introduce a set of experimental data of major elements concentration into the equation followed by variance and influence analysis to identify immobile elements. Finally, we use the immobile elements to fit the slope. When the concentration of every element is substituted in the fitted straight-line equation, its mass transport and mass changes are calculated. As a study case, this method is used to discuss the mass transport of the major elements in the bleached alteration in the gold-antimony-wolfram deposit at Woxi, Hunan Province, China. The calculation indicates that about 8 percent mass of the amaranthine slate from the deposit was overall lost during the alteration. The numerical result agrees well with either the geological observations or the geochemical literature. In addition, this paper discusses the geochemical behaviour of many elements, titanium, manganese and phosphorus in particular. The study also suggests that the element titanium shows some mobility under given conditions of the wall-rock alteration in the Woxi deposit, so sometimes it might not be suitable to arbitrarily take titanium as an immobile element to evaluate mass transport in a wall-rock alteration process.

Key words: mass transport; geochemistry; immobile elements; water-rock interaction; wall-rock alteration; Woxi, Hunan

A Study of the Deep-Source CO_2 Release of the Hot Springs System in Kangding, Sichuan Province

YANG Lizheng, WEI Jia and SUN Jinyu (Environmental Science and Engineering Department, Chengdu Institute of Technology, Chengdu, 610059)

In hot water of the hot springs in the Kangding area, the highest CO_2 content is 1840.16 mg/l, and the average 1060.53 mg/l, which shows that the hot springs contain rich deep-source CO_2.

The data of stable carbon isotopes of the hot water, CO_2 gas in hot springs and limestone in Kangding, indicate that the deep-source CO_2 is of the mantle origin or metamorphic origin or a mixture of the two. The $\delta^{13}C$ values of CO_2 in the hot

springs of Kangding range from −4.3‰ to −5.4‰, typical of the mantle origin; the $\delta^{13}C$ value in the Erdaoqiao area is −5.4 ‰, but the $\delta^{13}C$ value of CO_2 in hot water lie between 0.0‰ and 2.8‰, all exceeding 0‰, so that the dissolved CO_2 should come from metamorphosed carbonate rocks; the $\delta^{13}C$ value of CO_2 in the Yulingong area is −4.3‰, but those of dissolved CO_2 range from −3.6‰ to −0.1‰, mixture of mantle-derived and metamorphic CO_2.

The discharge amount of deep-source CO_2 refers to the amount of CO_2 discharged from the depth of the Earth into the atmosphere and hydrosphere along with the hot water. The discharge amount of CO_2 of 12 hot springs in Kangding is 1766.43 t/a. When the hot water flows to the surface, the pressure is lowered, so that part of dissolved CO_2 is changed into the gaseous state and released to the atmosphere. With the flow distance increased, the releasing amount decreases, showing a tendency of gradual diging out. Field measured data in the Kangding area reveal that the released amount is 40% at least of the discharged amount, while the remaining enter the hydrosphere with the hot water. It seems that the numerous hot springs in western China serve as one of the important channel way for the release of the deep source CO_2.

Key words: hot spring; carbon dioxide; carbon isotopes; discharge; release