MINERALIZATION CONTROL EFFECT OF GEOCHEMICAL TECTONIC MACROSCOPIC FRAME OF CHINA

Jin-zhong Gong*

Abstract: Due to the close relationship between rock geophysics and geochemistry, the geochemical distribution of stream sediments in China is closely related to the tectonic framework. Based on the transitional zones of macro element change, we can outline the geochemical tectonic framework of China, and draw the four horizontal, three vertical and one shield, and basically correspond to the geophysical tectonic framework. Four horizontal is: the variation line of Si-K-Na-Mg content in the Tianshan-Yinshan-Yanshan, K-Na content in the Kunlun mountain –Qinling -Dabie mountain, Si-K-Na content in the Gangdise -Nangqingtanggula, Al-K-Ca-Mg content in Nanling. Three vertical is: the variation line of Al-Fe content in Zhang Guangcai ridge - Qianshan, Greater Hinggan Si-Ca-K-Na- Taihang mountains Ca-Mg - Wuling mountain Ca-Mg content, Helan mountain - Minshan Ca content. One shield area is Yunnan - Guizhou plateau - Emeishan basalt rock area Al-Fe-Ti-Mn and the basic element enrichment region. One Knife is: Nanling -Wuyi mountain Jurassic magmatic rock acid element enrichment zone. In mainland China, the macroscopic elemental division line divides 13 geochemical blocks with significant abundance characteristic. The tectonic framework controls the significant chemical abundance of rock and thus restricts the mineralization characteristics. Their final result is that the metallogenic concentration zones of different tectonic frameworks are also different. Its basic law is east-west differences, basin ridge differentiation, banded structure, elemental spatial zonation. That the linear tectonic belt is orogeny, magmatic activity

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frequent areas, becoming the concentrated areas of the distribution of polymetallic deposits, the stable triangle areas is conducive to the accumulation of oil and gas resources.

Key words  Tectonic geochemistry; Geotectonic framework; Geochemical blocks, Mineralization control effect; China mainland


On the basis of the theory of plate tectonics and geosyncline-platform structure, according to detailed observations and comprehensive reflections on the characteristics of China's geological and geophysical fields, Academician Liu Guangding of the Chinese Academy of Sciences combines the global tectonic activity theory with the reality of China's geology, proposed the block structure theory, which provides the basis for studying the tectonic problems and the comprehensive geological and geophysical interpretation. The theory of block tectonics comes China the evolution of land and sea tectonics down to, as one demarcation, two front lines, three transformation formats, four conversion faults, five screens evolution history. China's land and sea tectonic framework is summarized as three horizontals and two verticals and two triangles. Three horizontals are three transverse distribution tectonic belts: A Tianshan - Yinshan - Yanshan, B Kunlun - Qinling - Dabie mountain, C Nanling tectonic belt; Two vertical are D Greater Hinggan - Taihang mountain - Wuling hill cascade zone, E Helan mountain - Longmenshan north and south zone; Two triangles are: F Qaidam area surrounded by Aldjin-Qilian mountain, and G Songpan - Ganzi area. North China, Yangzi and south China block are separated by three horizontal; The two vertical bands gives the Tethys domain, the Pacific Ocean and its transition zone (Liu et al.,1997; Liu et al., 1998; Liu et al., 2007). Zhang pointed out that in the three horizontal, two vertical, two triangular with the vicinity of the band, is concentrated areas of variety of metal deposits; In the stable area between binding zone, is the main target area of oil and gas exploration(Zhang.et.al.,2009; Zhang et. al., 2014).

Based on the latest geological, mineral and geochemical data, this paper has discussed the
mineralization control effect of the tectonic framework.

1. Geochemical response of the tectonic framework

Rock physics and rock chemistry from different angles reflect the rock formation process or the existing state, there is a close relationship between the two (Gong et al., 2001). In space-time evolution, tectonic geochemistry can be unified interpretation combined with geodynamics, tectonic chronology (Sun et al., 2002).

The sedimentation geochemistry of China's stream system shows a close response to the geophysical tectonic framework, the different elemental manifestations are also different.

CaO and MgO, between A-B-D, it is the high background and positive anomalies, other areas mainly with low background and negative anomalies; Na₂O and Sr, in B goes north, it mainly to the high background and positive anomalies, B goes south to low background and negative anomalies; In A goes north, B goes south, C goes east, P mainly with high background and positive anomalies; Mn, B, Be, As, Bi, Ag, in the B, C goes south, mainly high background and positive anomalies; Ti, Nb, Th, U, Zn, Pb, W, Sb, to B as the boundary, showing the south high north low characteristics; In B goes north, Ba mainly high background and positive anomaly, B goes south mainly the background and negative anomalies; Between the C-E, F mainly the high background and positive anomalies; La, Li, Cd, in B goes north, mainly high background and positive anomalies, B goes south mainly low background and negative anomalies; Fe, V, Cr, Ni, Co, Cu, between B-C, mainly high background and positive anomalies; Hg, in B goes south, E goes east, mainly high background and positive anomalies; Mo, between A-D, B goes south, E goes east, mainly high background and positive anomalies; Y, Zr in C goes south, mainly the high background and positive anomalies.

Based on the transition zone of macro element content change, we can outline the figure of
China's geochemical tectonic framework, which summed up the four horizontal, three vertical, a shield a knife, and the geotectonic framework basically corresponding, but also has different. Four horizontal is: the variation line of Si-K-Na-Mg content in the Tianshan-Yinshan-Yanshan, K-Na content variation line in the Kunlun mountains-Qinling-Dabie mountain, Si-K-Na content variation line in the Gangdise-Nangqing Tanggula, Al-K-Ca-Mg content variation line in Nanling.

Three vertical is: the variation line of Al-Fe content in Zhangguangcai ridge - Qianshan, Greater Hinggan Si-Ca-K-Na- Taihang mountains Ca-Mg- Wuling mountain Ca-Mg content variation line, Helan mountain - Minshan Ca content variation line. One shield is Yunnan - Guizhou plateau - Emeishan basalt rock area Al-Fe-Ti-Mn and the basic elements enrichment region. A Knife is: Nanling Wuyi mountain Jurassic magmatic rock acid element enrichment zone.

The general characteristics of the stream sediment geochemical field in China: North and south to K-Na content changes mainly, the east-west direction is mainly Ca-Mg content changes, the elemental enrichment characteristical contrasts strongly between the Yunnan-Guizhou plateau and the southeastern coastal.

2. Geochemical block characteristics
Geochemical block theory is often used to study the relationship between the distribution of trace elements and the deposit concentration zones (Xie, 1995; Wang, 2000; Xie et al., 2002).

Macro elements segmentation line will be the Chinese mainland divided into 13 abundant characteristic significant of geochemical blocks: Si in Gangdise, Nanling and Inner Mongolia plateau for high background distribution; Al east high west Low, Ca, Mg, Na north west high south east low; K north east high south west low; Fe, Ti, P, Mn in Yunnan and Guizhou, Changbai mountain is a strong high background, southeast coastal hills is intense low background. The geochemical distribution of stream sediments in China is the result of the collective effect of crustal evolution and superficial geological effects.
Table 1 Characteristic of Chinese Geochemical Blocks

<table>
<thead>
<tr>
<th>Geochemical blocks</th>
<th>Area/km²</th>
<th>Enrichment elements</th>
<th>Depleted elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Jungar - Inner Mongolia - Greater Hinggan</td>
<td>1656000</td>
<td>Si, Ca, Mg(W), K, Na, Fe(W), P(E,W), Mn(E,W), Ba, Sr, V(W), Cu(W), Be(E), Mo, As</td>
<td>Al, Mg (E), Fe(E), P(C), Ti, Mn (C), F, B, Zr, Nb, V, Cr, Ni, Co, La, Y, Th, U, Zn, Cu(C,W)</td>
</tr>
<tr>
<td>2 Northeast plain</td>
<td>574560</td>
<td>K, Na, Ba, Sr, Zr</td>
<td>Mg, Fe, P, Ti, Mn, b, V, Cr, Ni, Co, Nb, La, Y, Th, U, Zn, Cu, Li, W, Sn, Mo, As, Sb, Bi, Hg, Ag, Au</td>
</tr>
<tr>
<td>3 Wandashan - Changbai shan</td>
<td>216000</td>
<td>Al, Mg, Na, Fe, Pt, Mn, F, Ba, Sr, V, Cr, Ni, Co, Nb, La, Y, Th, U, Zn, Cu, Li, Be, Sn, Mo, As, Hg, Ag</td>
<td>K, B, Sb, Au</td>
</tr>
<tr>
<td>4 Tarim - Alashan</td>
<td>1108800</td>
<td>Ca, Mg, Na, Ba, Sr</td>
<td>Si, Al, K, Fe, Pt, Ti, Mn, F, B, V, Cr, Ni, Co, Nb, La, Y, Th, U, Zn, Cu, Li, Be, W, Sn, Mo, As, Sb, Bi, Hg, Ag, Au</td>
</tr>
<tr>
<td>5 Ordos - Shanxi - Shan Gan plateau</td>
<td>518400</td>
<td>Ca, Mg</td>
<td>Al, K, Fe, Ti, P, Mn, V, Co, Nb, La, Y, U, Th, Zn, Cu, Li, Be, W, Sn, Mo, As, Bi, Hg, Ag, Au</td>
</tr>
<tr>
<td>6 Yanshan - North China Plain - Shandong Hilly</td>
<td>806400</td>
<td>Ca, Mg, Na, P, F, B, V, Cr, Ni, Co, Cu, Li, Sb, Au</td>
<td>U, Mo, As, Bi, Ag</td>
</tr>
<tr>
<td>7 Qinghai - Tibet plateau</td>
<td>1850400</td>
<td>Ca, Na, Li, As, Sb</td>
<td>Al, Mg, K, Fe, Ti, P, Mn, f, B, Ba, V, Cr, Ni, Co, Nb, La, Y, Th, Zn, Cu, Be, W, Sn, Mo, Sb, Bi, Hg, Ag, Au</td>
</tr>
<tr>
<td>8 González - Nianqing Tangguilla</td>
<td>151200</td>
<td>Si, Al, Mg, K, Na, Fe, Ti, P, Mn, F, Ba, V, Cr, Ni, Co, Nb, La, Y, Th, Zn, Cu, Li, Be, Sn, Mo, As, Bi, Ag, Au</td>
<td>Ca, B, Sr, Co, U, W, Sb</td>
</tr>
<tr>
<td>9 Himalayas</td>
<td>302400</td>
<td>Ca, Na, P, B, Sr, Nb, La, Y, Th, Li, Be, Sn, As, Sb, Bi</td>
<td>Mg, K, Fe, Ti, Mn, Ba, V, Cr, Ni, Co, U, Cu, W, Mo, Hg, Ag, Au</td>
</tr>
<tr>
<td>10 Sichuan basin</td>
<td>604800</td>
<td>Fe</td>
<td>Si, P, Mn, F, Sr, Nb, Y, Th, Zn, Cu, Be, W, Mo, As, Sb, Bi</td>
</tr>
<tr>
<td>11 Yunnan-Gui zhou plateau</td>
<td>360000</td>
<td>Al, Mg, Fe, Ti, P, Mn, F, B, Zr, V, Cr, Ni, Co, Cu, Li, Be, Nb, La, Y, U, Th, Zn, Sb</td>
<td>Si, Ca, K, Na Ba, Sr, W</td>
</tr>
<tr>
<td>12 Yangtze river middle</td>
<td>252000</td>
<td>Al, Fe, Ti, B, Zr, V, Cr, Ni, Co, Nb, La, Y, U, Th, Zn, Cu, Li, Be, W, Sn, As, Sb, Hg, Ag, Au</td>
<td>Ca, Mg, K, Na, P, Mn, F, Ba, Sr, Mo</td>
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</tbody>
</table>
In addition, by using the characteristics of trace element content changes, we can delineate the north-west linear and circular structures of the next level (Figure 1).

3. The relationship between the distribution of polymetallic deposits and the tectonic lattice

Residual gravity anomaly reflects shallow crustal density and thickness of rocks and hence provides rich information for metallogenic research and exploration forecast (Huang et al., 2002; Tu et al., 2006).

According to the information of eastern Hebei, we can find that there is a good spatial distribution relationship between structural magmatic rock belts, gravity step belts, elemental aggregation belts, and polymetallic ore concentrate areas (Figure 2).

From the spatial distribution relationship, China's tectonic framework the control of mineralization is very obvious. Due to mineralization and process differences, for different minerals, its manifestations are also different (Figure 3).

From the distribution map of 13 metal element deposits in China, we can find the following characteristics.

（1）East-West differences: The distribution density of deposits is significantly higher in the eastern region than in the west. This is due to the fact that the neotectonic movement resulted in the strong uplift of the Qinghai-Tibet Plateau, the climate was dry and cold, the ice and snow deserts cover a wide range, the population was sparse, and the degree of work was generally low.

（2）Basin ridge differentiation: There are no metal deposits in the main large faulted basin, but it is most important distribution area of oil and natural gas.

（3）Banded structure: The spatial distribution of metal deposits is very uneven. Among them,
the seabed rift zone, fault folds, plate suture zone and tectono-magmatic rock belt are densely distributed, showing the northeast, northwest and north-south directions. The intersections of the tectonic belts in different directions can form ore deposit clusters, such as the southern and northern margins of the North China Block, South China, and Kangdian district.

(4) Elemental spatial zonation: Controlled by elemental geochemistry, the types of wall rocks and magmatic rocks, the temporal and spatial distribution of the deposits has a tendency of zonality. Among the blocks with more tectonic activity periods, the metallogenic metal element combinations are more complex and diversified. The ancient base is mainly composed of iron, chromium, nickel, cobalt, vanadium, titanium, gold. The young orogenic belt on the southeast coast is dominated by lead, zinc, tungsten, tin and molybdenum. The plate suture zone is mainly copper and gold, and the young Yangtze platform is dominated by antimony and mercury. Silver is a cut-through element and all various plots are distributed. Yanshan and Qinling obviously enriched molybdenum deposits.

The above distribution rules of the deposits fully reflect the control effect of the geotectonic framework..

Table 3 Mineralization control effect of China geotectonic framework

<table>
<thead>
<tr>
<th>Geotectonic framework</th>
<th>Length/km</th>
<th>Distribution of Mineralization Concentration Areas</th>
</tr>
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<tbody>
<tr>
<td>A Tianshan - Yinshan - Yanshan tectonic belt</td>
<td>3480</td>
<td>Pb-Zn, Ag, Au, Cu, Mo, Sn, W, REE, Ni, V, Cr, Fe, coal</td>
</tr>
<tr>
<td>B Kunlun - Qinling - Dabie mountain tectonic belt</td>
<td>3720</td>
<td>Hg, Sb, PbZn, Au, Cu, Mo, Sn, W, REE, Ni, Cr, Fe</td>
</tr>
<tr>
<td>C Nanling tectonic belt</td>
<td>1800</td>
<td>Sb, Pb-Zn, Ag, Au, Cu, Mo, Sn, W, REE</td>
</tr>
<tr>
<td>D Greater Hinggan - Taihang - Wuling mountain Tectonic belt</td>
<td>3600</td>
<td>Hg, Pb-Zn, Ag, Au, Cu, Mo, Sn, W, REE, V, Fe, coal</td>
</tr>
<tr>
<td>E Helan mountain - Longmen</td>
<td>2160</td>
<td>Pb-Zn, Ag, Au, Cu, Ni, V</td>
</tr>
</tbody>
</table>
This study of the relationship between block structure and mineralization is deeply analyzed, will to play an important role in finding oil and gas resources in China's deep prospecting and marine carbonate distribution.

Synopsis of the author

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References


• **Zhang Xunhua, Meng Xiangjun, Han Bo.** 2009. Block and block structure theory [J]. Marine geology and Quaternary geology, 10, 29 (5), p. e 59-64

Figure 1 Tectonic geochemical map of North China Landmass

The inellae is centerline of a series of beaded geochemical anomalies, and the annular area is a planar geochemical anomaly range.
Figure 2 Plate tectonics granite composition polarity and endogenic mineralization in east Hebei
Figure 3 Geochemical tectonic zones mineralization control in China
Figure 4  Main elemental Geochemical maps in mainland China