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# 中国南方南岭泥盆系层控矿床

曾允孚 刘文均 张锦泉
（成都地质学院沉积地质矿产研究所）

**内容提要** 南岭地区是中国有色金属矿产资源重要基地之一。据不完全统计，位于泥盆系地层中的层控铅锌、黄铁矿、钨、锡、汞、重晶石等矿床，已有大、中型矿床达数十个，小型矿床更是星罗棋布。按成因类型分为成岩矿床、成岩-后生矿床、火山喷气-沉积矿床、岩浆热液叠加矿床和混合热液矿床。相应地建立了四种成矿模式，即与火山作用有关的海底渗流循环喷气-沉积成矿，成岩压实水成矿，热卤水成矿，混合热液成矿。虽然泥盆系层控矿床种类多、成因类型复杂，其控矿因素和分布主要受层、相、位控制，本区绝大多数层控矿床赋存于区域不整合面之上，中、上泥盆统海侵旋回的碎屑岩建造向碳酸盐建造的过渡部位；控矿的主要岩相古地理类型是被台盆分割的台地边缘生物礁和泻湖、潮坪，或古陆边缘的生物礁和局限台地；本区绝大多数层控矿床集中分布于北西向丹池断裂带、北北东向冷水江-龙胜断裂带的交汇处，位于前泥盆系构造隆起边缘或泥盆系构造盆地边缘。混合热液矿床还与燕山期的岩浆活动有关。空间分布上成矿带、构造带和岩相带之间有明显的一致性。

**主题词** 层控矿床 成矿模式 火山活动 岩浆岩侵位 成矿溶液迁移、循环和富集
**第一作者简介** 曾允孚 男 60岁 教授 沉积学

# STRATA-BOUND ORE DEPOSITS OF DEVONIAN IN NANLING AREA, SOUTH CHINA

**Zeng Yunfu Liu Wenjun Zhang Jinquan**
(Institute of Sedimentary Geology and Mineral Resources,
Chengdu College of Geology, Sichuan)

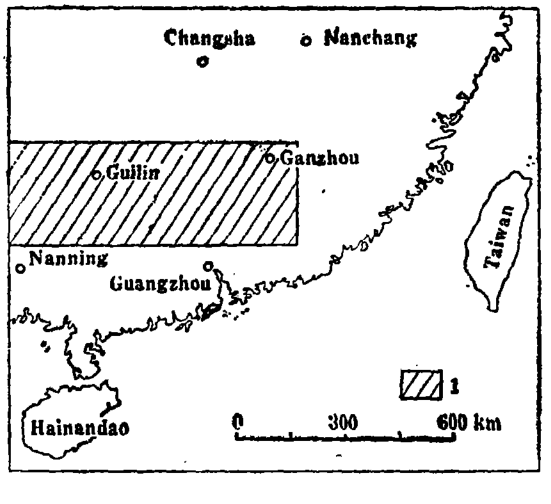
## ABSTRACT

The Nanling of South China is one of the most important areas of nonferrous metal mineral resources. Based on incomplete statistical figures, strata-bound lead-zinc, pyrite, tungsten, tin, mercury, antimony and barite ore deposits have been found in Devonian of this area. There are ten's medium to large scale deposits explorated and numbers of small deposits spread far and wide. According to genetic types, these deposits can be classified into diagenetic, diagenetic-epigenetic,

volcanic exhalation-sedimentary, superimposed and mixed hydrothrmal ore deposits. Four metallogentic models have been established: 1. submarine vadose circulating volcanic exhalation-deposition; 2. basinal diagenetic compactive fluids; 3. basinal thermal brine; 4. mixed hydrothermal metallogenic model. Although these strata-bound deposits are different in types and genesis, many similarities in their ore-controlling factors and distributon may be found. The main controlling factors are stratigraphy (formation), lithofacies and tectonic setting. Thereby, it is considered that any geologic factor controlling the ore formation could not be treated in isolation. The formation of any large scale ore deposit should be considered as the result of the coaction of various geological factors in certain geological settings, and those factors affect and interact commonly each other. The stratigraphic horizon, lithofacies and tectonic setting are thought as main factors for controlling the diagenetic-epigenetic strata-bound ore deposits, and three factors are concordant spatially. When the formation of ttrata-bound ore deposits are related to magmatism, the regional large fault, lithofacies zone, magmatic activity and metallogenesis often show the consistency. That is, the fault controlled early the lithofacies (or volcanic activity), and subsequently controlled the emplacement of magmatic rocks and the migration, circulation and final enrichment of the metallogenetic solutions.

## INTRODUCTION

The Nanling area of South China includes Guangdong, Guangxi, Hunan and a part of Jiangxi (Fig. 1). It is one of the most important areas for nonferrous metal mineral resources in China. Based on incmplete statistical figures, strata-bound lead-zinc, pyrite, tungsten, tin, mercury, antimony and barite ore deposits have been found in Devonian of this area ten's medium to large scale deposits




1. studied area

**Fig.1 Location map of the Nanling area, South China**

have been explorated and numerous small deposits spread far and wide.

Strata-bound deposits dealt in this paper are referred to as the stratiform (or partially in irregulr form) deposits which are limited in certain stratigraphic horizons and lithofacies within a large area.

In genenral, the characteristics of strata-bound ore deposits are as follows:

1. The orebody is concentrated in certain beds. The metallogenetic material were derived from sedimentary or volcanic sediments and ore deposits were formed by further mobilization and enrichment. Therefore, it is considered as a type of polygenetic ore deposits.

2. Both syngenetic and epigenetic mineralizing features occurring in orebodies suggested a longer minerogenetic epochs.

3. The emplacement of orebodies is usually in surface or near surface. Ore reservoir is in Devonian but the "source bed" could be both in Devonian and deeper strata (metallogenetic materials are transported by deep-circulating thermal brine or hydrothermal).

**Table I Classification of Devonian Strata-bound deposits in Nanling area**

| formation of host rocks | assemblage of metallogenetic elements | examples of ore deposits |
|---|---|---|
| Carbonate rocks | S (in pyrite) | Guangdoong: Hongyai, Makot, Lishuzia<br>Hunan: Putou,Hongshuiping,<br>Qingshuizhong, Jingshiling |
| | Pb, Zn, S, | Guandong: Fankou;<br>Guangxi: Beishan, Sidin;<br>Hunan: Heqing, Baiyunpu, Qingjiang |
| | Sb | Hunan:Xikuangshan;Guangdong:Lejiawan |
| | Hg | Guangxi: Yilan |
| | U | Guangxi: Pinnan |
| | Ba | Guangxi: Xiangzhou-Panchun, Longbao,<br>Puhe |
| Carbonate-clastic rocks | Sn polymetal | Guangxi: Dachang, Mangchang |
| | W(Sn) | Hunan: Caojiaba;<br>Guanxi:Suanhu |
| clastic rocks | w(Mo) | Guangxi: Deminggshan |
| | Pb | Guanxi: Baoan |
| | Cu | Guangxi: Changxu, Haiyangping, Lingli;<br>Jiangxi: Zhankou |
| volcanic-sedimantary rocks | Fe, Cu polymetal | Guangdong: Dabaoshan |

4. The distribution of ore bodies occuring as groups or zonation which may be controlled by stratigraphic horizon, lithofacies and tectonics.

In this paper, strata-bound ore deposits are genetically classified first based on lithology of the host rocks then the source of ore-forming materials, and the stage of the ore formation as well as the evolution of sedimentary basin. In addition, whether the magmatism has presented.

1. Classification based on lithology of mineralized host rocks is shown in table I.

2. The genetic classification is mainly based on the stage of ore-formation and the source of ore-forming materials. The types of ore deposits are as follws:

1) Diagenetic ore deposits, which formed by diagenetic compaction fluids, e.g. Putou pyrite deposits in Chengbu, Hunan Province.

2) Diagenetic-epigenetic ore deposits, which formed by diagenetic compaction fluid and circulating thermal brine in deep setting, e.g. Fankou-lead-zinc-pyrite deposits in northern Guangdong and Beishan zinc, pyrite deposit in northern Guangxi.

3) Epigenetic ore deposits, It was formed by circulating thermal brine in deep setting, e.g, Sidin lead, zinc deposits in northern Guangxi.

4) Volcanic exhalative sedimentary ore deposits, which were formed by vadose circulating fluid related to volcanism, e.g. Dabaoshan iron copper polymetaallic sulphide deposits in northern Guangdong.

5) Hydrothermal superimposed strata-bound ore deposits. This type was added hydrothermal in mineralization process, e.g. Qingjiang lead-zinc deposits, Hunan province.

6) Mixing hydrothermal ore deposits, which generated from the mixing of deeply circulating fluids or mateoric water and magmatic hydrothermal, e.g. Mangchang tin polymetallic deposit in Guangxi.

## GEOLOGIC FEATURES OF VARIOUS GENETIC DEPOSITS

1. Diagenetic ore deposits

The Putou pyrite deposit can be represented for this type, the main characters are as follows:

1) The pyrite deposits occur in carbonaceous biomicritic limestone of Upper Qiziqiao Formation, Middle Devonian. The occurrence of deposit is controlled by stratigraphic horizons and closely related to the local stagnante environment of reef edge in the intraplatform basin facies.

2) Ore bodies occurs as bedded or bedded-like.

3) Many depositional-diagenetic features has preserved in ore fabrics showing as the pyrite with framboid texture, remains from replaced the organic texture and horizontal lamination structure.

4) The components of ore are simply, manly is pyrite, in which the Co/Ni ratio is less than 0.2, S/Se is more than 200,000.

5) Sulfur isotope shows $\delta^{34}S$ extremely negative values over a range from −18.6‰ to −30.16‰.

2. Diagenetic-epigenetic ore deposits and epigenetic ore deposits

The diagenetic-epigenetic ore deposits involve most of strata-bound pyrite deposits, lead-zinc pyrite deposits in carbonate rocks. Most of mercury, antimony deposits in carbonate rocks and lead deposits, copper deposits in clastic rocks are involved in epigenetic ore deposits. This type is characterized by following features:

1) The occurrence of ore deposits is controlled by stratigraphic horizons and lithofacies. Copper deposits mainly occur in clastic rocks, and lead-zinc, pyrite and antimony deposits are mostly in carbonate rocks. Lead, zinc and pyrite deposits of carbonate rocks often occur in the paleocontinental edge or margin of carbonate platform. The ore deposits are generally related to restricted platform and reef-shoal facies. Lead, copper deposits of clastic rocks mainly occured in the shoreline zone of the paleocontinental or edge of paleoislands.

2) The configuration of ore bodies are bedded, bedded-like and lenticular, and with bifurcated, composited, as well as penetrated the bed.

3) The components of ore are mainly pyrite, sphalerite, galena and stibnite. The order of formation of such sulfide minerals of different diagenetic stages is pyrite-sphalerite → galena. Early diagenetic pyrite occurred as framboid aggregates, showing organic remnant texture by replacement and lamination. In late diagenetic stage, the sulfides show as disseminated or dense with massive structures. Epigenetic stage sulfides occurred as metacolloided and in sack-like forms infilled the fracture cavities.

4) The features of minor elements: Co/Ni ratio is less than 1 in pyrite; sphalerite contains more Cd and galena contains less Ag.

5) Sulfur isotopic composition ($\delta^{34}S$) ranges both positive and negative value. "Positive" mostly occured in northern Guangdong and east-southern Hunan, whereas "negative" is in central Hunan and northern Guangxi. The southern Hunan is the transition area of $\delta^{34}S$ value. In generally, the isotopic compositon of sulfides have not reached equilibrium, sometimes can be partial equilibrium.

6) Normal Pb dominated in Pb isotopic compositions, content of redioactive Pb varied with different regions and increasing gradually from central Hunan to northern Guangdong. The soruce of Pb mainly derived from the earth crust. The model age is more than 400 Ma in central Hunan, 250 to 400 Ma in northern Guangxi, and the 300 Ma in northern Guangdong.

7) The features of some solution of inclusions: $\delta D$ is −68∼−143% (SMOW), $\delta^{18}O_{H_2O}$ is 0.4∼−13.4% (SMOW), salinity is 5-12% (wt); inclusion solution is rich in $Na^{+}$, $Ca^{++}$, $Cl^{-}$, $SO_4^{2-}$. All the features mentioned above indicate that the mineralization solution mainly derived from meteoric water or sea water. Average minerogenetic temperature is from 100 to 250℃ (method of uniform reduction).

8) Weak alteration of wall rocks has been found. Dolomitization is dominant

in Pb, Zn deposits, which is characterized by the formation of contorted dolomite. Silicification is commonly in antimony ore deposits.

3. Volcanogenic hydrothermal strata-bound ore deposits

Only Daobaoshan iron, copper polymetallic deposits in northern Guangdong is classified as this type in this area. The geological and geochemical feature of this type of ore deposits is consistent with that of volcanic massive sulfide deposits. The main features are showing in the following:

1) The deposit is situated in volcanic-sedimentary rock sequence of Upper-Middle Devonian. The volcanics belong to calcic-alklic rocks and main ore bodies overlying the dacite (based on measure of U-Pb isotope of zircon, the geological age is $441\pm19$Ma).

2) The metal minerals of ore are mainly consist of pyrite and/or magnetopyrite and minor amounts of chalcopyrite, sphalerite and galena. The ore bodies can be divided into three zones: upper and middle zone mainly consist of massive, stripped and mottled magnetopyrite galena and sphalerite, the siderite intercalation occurs in upper zone, within pyrite the microfossils (bacillus) has been found. Co/Ni ratio is less than 1 and S/Se is more than 300,000. The origin of ore is considered as syngenetic. The lower zone mainly consists of network veined and bracciated sulfide ore. CO/Ni ratio is more than 1, S/Se is less than 200,000. The origin of ore is considered as the products of epigenetic volcano-hydrothermalism.

3) The alteration zone is well developed under the major ore body. The CaO, $Na_2O$ contents of alterated volcanic rocks decrease significantly upwards to the main ore body and the tendency of $K_2O$ and MgO contents increase.

4) Zonation of the metallic elements is shown obviously. The Cu/Cu+Zn+Pb ratio decrease upwards vertically and in lateral far from the central part of ore body, whereas the Zn/Zn+Pb+Cu ratio may contrary to above mentioned.

5) Sulfur isotope value is positive with large range in upper ore zone, but lower ore zone is around zero, $\delta^{34}S$ of sulfide mineral pairs does not reach the equilibrium. Lead isotope value varied in small range indicating that the source of which may be uniformization. $\delta D$ and $\delta^{18}O$ values showing the mixing metallogenetic fluids dominated by seawater. The source of metal ion derived from deep stratigraphic horizon and the sulfur derived from the reduction of seawater sulfate.

4. Hydrothermal superimposed strata-bound ore deposits

This type of strata-bound ore deposits is related to magmatic rocks in space and origin, for instance, in lead-zinc ore deposits of Xianghualing, Qingjiang, Shexingping in Hunan province. The ore deposits show hydrothermal ore features and with features of strata-bound ore deposits.

1) The occurrence of ore deposits is controlled by stratigraphic horizons and lithofacies.

2) The granite or granite porphyry generated Yanshan movement are found in the ore district. Country rock alteration with zonation is obviously around the magmatic rock body and several strata-bound ore deposits occurring around

ore district.

3) Both bedded and veined ore bodies are existed. some of bedded ore bodies showing the features of diagenetic deposits.

4) Components and fabrics of ore are complicated. But the existence of fine impregnation ore or framboid pyrite indicated the characteristics of diagenetic deposits.

5) Co/Ni ratio less than 1 in early pyrite, but large than 1 in late pyrite The larger contents of silver occur in galena.

6) Sulfur isotope value is far away from zero and well uniformized similar to that of diagenetic-epigenetic deposits. Most of the sulfide mineral pairs have reached to equilibrium.

7) Lead isotope is mainly normal lead. Some model ages are the same as that of granite body and others are older than that of magmatic rock body.

8) δD of inclusions show that the ore solution is dominated by seawater or meteoric water. Na-Ca-Cl brine is the major composition of ore solution and some containing higher $SO_4^{=}$.

5. Mixing hydrothermal strata-bound ore deposits

It is represented by tin, tungsten (or molybdenum), polymetallic ore deposits which may be closely related to the remelted granite, are classified as this type of ore deposits, e.g. cassiterite ore complex in Mangchang of Guangxi.

1) Ore deposits are controlled by stratigraphy horizons, lithofacies and tectonics. Ore body developed in siltstone, mudstone and lenticular limestone in intraplatform basin facies of Devonian. However, high background values of ore-forming elements are found in surrounding rocks and underlying strata.

2) Remelted granite (Yanshan episode) occurs in this ore district. The zonation of alterational mineralization is found around the granite body.

3) The components and fabrics of ore are complicated. Some of the ore bodies developed in bedded-like, fine veins and big veins also existed.

4) $\delta^{34}S$ value of sulfide in the bedded-like ore body deviates from zero and is similar to the sulfur isotope value of diagenetic and epigenetic strata-bound ore deposits.

5) Lead isotope value is that of normal lead dominantly. Most of the model age is older than the age of granite body.

6) The components of inclusion are mainly type of Na-Ca-Cl brine. Salinity varies from 0.5‰ to 46‰, the variation of homogeneous temperature is highly. δD studies suggest that the ore-bearing solution is mixed by magmatic with meteoric water.

These deposits mentioned above have common characteristics in spatial distribution. Their main genetic features such as the shapes of ore body, mineral assemblages, textures and structures of ore, geochemistry, stable isotope components and inclusion features are related to the different genetic types. All of these indicate that the genetic relationships among these different kinds of deposits, i.e. they are separately the products of the different stages of metallogenesis controlled by various factors.

## METALLOGENIC MODELS

Based on the geologic background and geochemical features of the strata-bound ore deposits in study area, there are four main metallogenic models have been established

1. The metallogenic model formed by submarine vadose circulating volcanic exhalation-deposition. The geologic and geochmical features of deposits are similar to volcanic massive sulfide ore deposit, which formed in or nearly discharge passage of sea-floor hydrothermal system.

2. The metallogenic model formed by basinal diagenetic compaction fluids. This model could be found in those ore deposits which showing the diagenetic or diagenetic-epigenetic minerogenic characters.

The metal- bearing complex solution which formed during diagenetic copmaction in Devonian would have migrated to the margin of the basin or along the growth faults approaching the semi-closed environment or tidal flat of paleocontinental margin and connected with the pore water which became reducing gradually during buried. The metal or metal complex in solution combined with $H_2S$ which w as derived from the reduction of interstitial pore water sulfate by bacteria and resulted the precipitation of sulfide.

3. Basinal thermal brine metallogenic model. General views on the genesis of this type including lead-zinc deposits in Siding, Guangxi and Fankou, Guangdong were thought to be similar to that of lead-zinc ore deposits of Mississippi valley-type. The key to mineralization is that meteoric water or sea water or diagenetic compaction fluid infiltrated into deep formation and formed thermal brine circulation with the dissolution of evaporites or "effect of membrane filtration". The thermal brine migrated upwards and introducing metal ions in chloride form or organic complex form to carbonate. Sulfide would be precipited in carbonate rocks when those metal ions has combined with hydrogen sulfide.

4. Mixing hydrothermal metallogenic model. The tin polymetallic ore deposits of Mangchang, Guangxi was an example. The surrounding rocks with high background value of tin influenced by late remelted magmatism and not only supply the ore-bearing hydrothermal, but also provided a heat source resulted in heat convection, impelling the dissolution of ore-forming elemets in surrounding rocks and finally, the ore-forming solutions derived from mixing magmatic water and meteoric water was formed.

These models are releted to each other and there exists the transition from one of them to another. Their relationship is shown in Fig. 2. These deposits are produced by ore-bearing thermal brine or infiltrating thermal brine which formed in evolutional process of the synsedimentary basin. Sometims, they are associated with magmatic hydrothermal fluid at the different metallogenic stages under the certain tectonic condition.

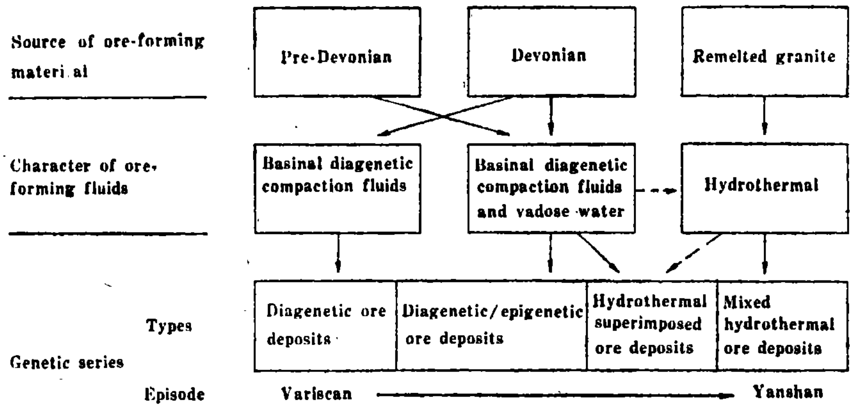



**Fig. 2 Schamatic diagram showing genetic series of strata-bound ore deposits in Devonian of Nanling area, South China**
**——main source, ----secondary source**

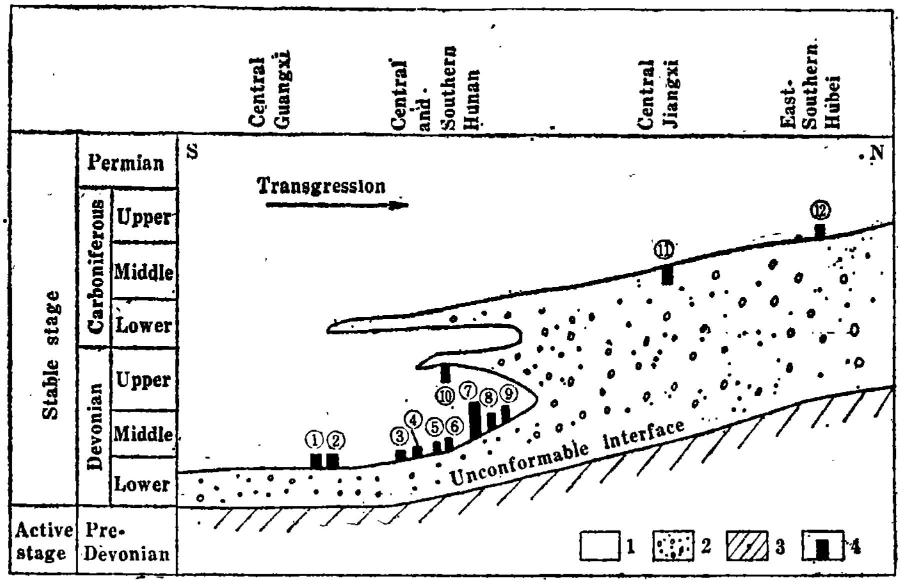
## CONTROLLING FACTORS OF MINERALIZATION

The mineralization of varieties of Devonian strata-bound ore deposits of Nanling region were dominantly controlled by the stratigraphic horizons, lithofacies and tectonic settings. And the spatial distribution of ore bodies are obviously consistent with mineralization zones, structural belts and lithofacies zones.

1. Stratigraphic horizon control

Most of strata-bound ore deposits of Nanling region occur in Middle and Upper Devonian above the unconformity interface, which are the upper part of transgressive clastic formation and the lower part of transgressive carbonate formation. In addition, there are less ore deposits found in lower Devonian (Fig. 3). Owing to the transgression of Devonian is from south toward north, which resulted in mineralized horizon gradually higher level. Thus, the mineralized horizons in Wuxuan and Guiping of central Guangxi occur in Tangding Formation or Xianebiao Formation of Lower Devonian. The mineralized horizons in the northern Guangdong, central and southern Hunan occur in Dongganling Formation (or Qiziqiao Formation) of Middle Devonian. It should be noticed that the mineralized horizons occur in the top of Middle Devonian or base of Upper Devonian in basinal or paleo-island margin. Since the carbonate deposition of the margin area was usually later than that in central region of the basin, e.g. Fankou (Northern Guangdong), Siding and Baishan (Northern Guangxi) mining districts.

Other, the character of stratigraphic horizon control is also indicated by obvious vertical zonation of metallogenetic elements distribution. The regional lithologic sequence consists of clastic rocks of lower part and carbonate in upper part. The




1. carbonate formation, 2. clastic formation, 3. flysch formation, 4. number of strata-bound ore deposits: ① Pengcun; ② Guli; ③ Xiniu; ④ Hongyai ⑤ Heqing; ⑥ Baiyunpu; ⑦ Fankou; ⑧ Beishan; ⑨ Sidin; ⑩ Xikuagshan; ⑪ Qibaoshan; ⑫ Huangmei

**Fig. 3 Schamatical diagram showing the relationships between sedimentary formation and strata-bound ore deposits of upper paleozoic of South China.**

zonal distribution of metallogenetic elements is shown by copper and lead occuring in lower clastic rocks; tungsten and tin mineralized layer in transitional zone between clastic rocks and carbonate; lead, zinc, pyrite mineralization in lower carbonate and antimony mineralization in upper part of carbonate rocks (Fig. 4).

2. Lithofacies-paleogeography control

The main types of lithofacies-paleogeography controlling the ore deposits are as follows (Fig.5):

1) Marginal reefs of carbonate platform and tidal flat-lagoon facies separated by intraplatform basins.

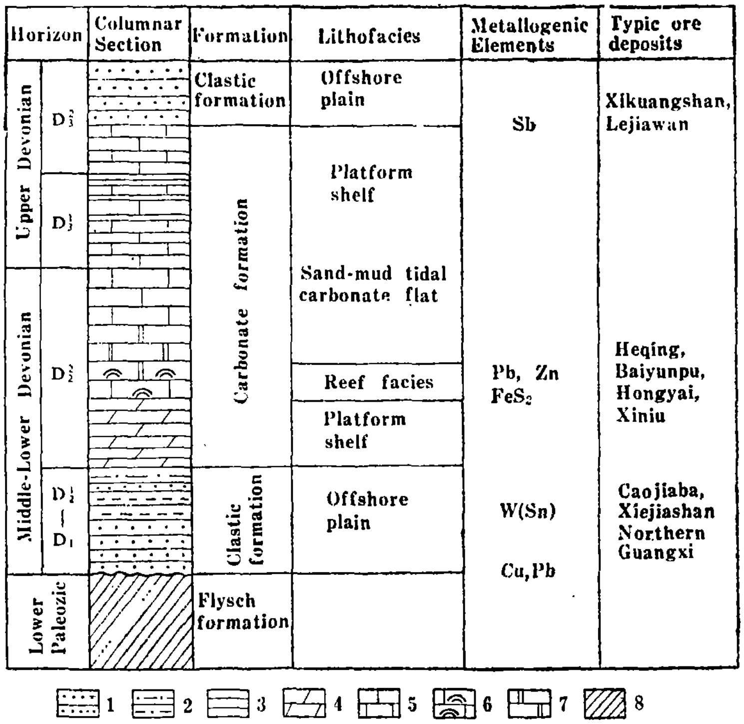
2) Organic reefs and restricted platform facies of paleocontinantal margins.

3) Restricted platform facies occurring in carbonate side of transition zone between carbonate and clastic rocks.

4) Intraplatform basin facies and reef facies in basins.

The favorable lithofacies for controlling mineralization are considered as following:

(1) Normal platformal sequence (upwards): shoreplain and offshore plain clastic lithofacies→platform shelf facies→reef facies→restricted platform facies (controlling mineralization)→open platform facies→platform shelf facies.




1. sanstone; 2. silty sandstone 3. shale; 4. marlite, muddy limestone; 5. limestone; 6. reef limestone; 7. dolomite rock 8. low rank metamorphic rock

**Fig. 4 The vertical zonation of metallogenetic elements and lithofacies of Devonian, Hunan and Guangdong**

(2) Overlapping platform sequence (upwards):

Shore (offshore) plain facies→restricted platform facies (controlling mineralization) →open platform facies→platform shelf facies.

(3) Intraplatform basin sequence (upwards):

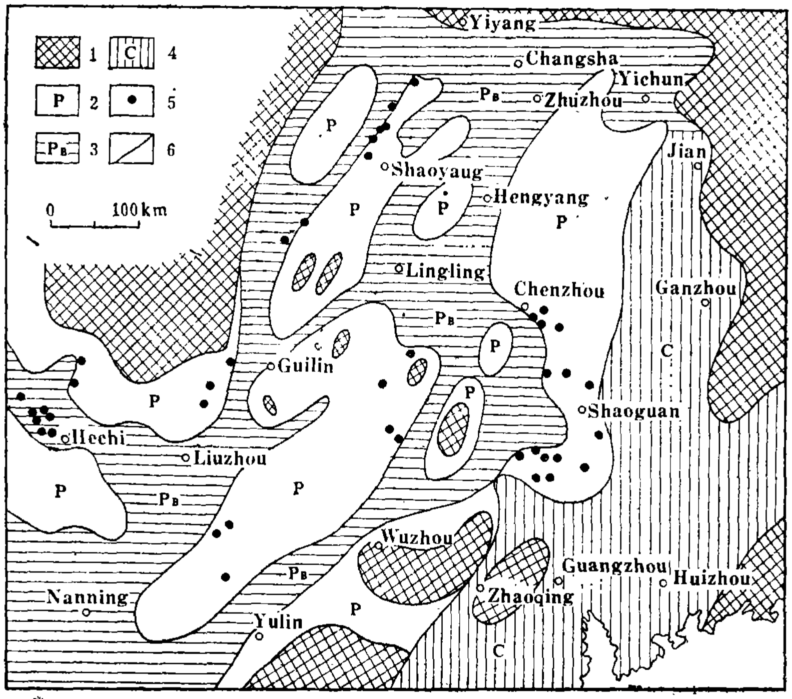
Shore and offshore plain facies→platform shelf facies→intraplatfom basin (sometimes reefs controlling mineralization) →platform shelf.

This sequences involving dolomite intervals with good porosity and permeability or accompanied with source bed, reservoir bed and covering layers could be more favorable to formation of ore deposits.

3. Tectonic control

The paleotectonic characteristics of Devonian in this area succeeded the direction of the fundamental structural lines of basement which was predominantly north-northeast, northeast and northwest during Caledonian movement; on other hand, the tectonism pattern transferred from compression at the end of Caledonian into the extensional strike-slip activity during Devonian.

The results of the synsedimentary process along those faults during Devonian represented by several linear structual-lithofacies zones which directly controlling the lithofacies-paleogeographic outlooking of Devonian. The terrigenous detrital

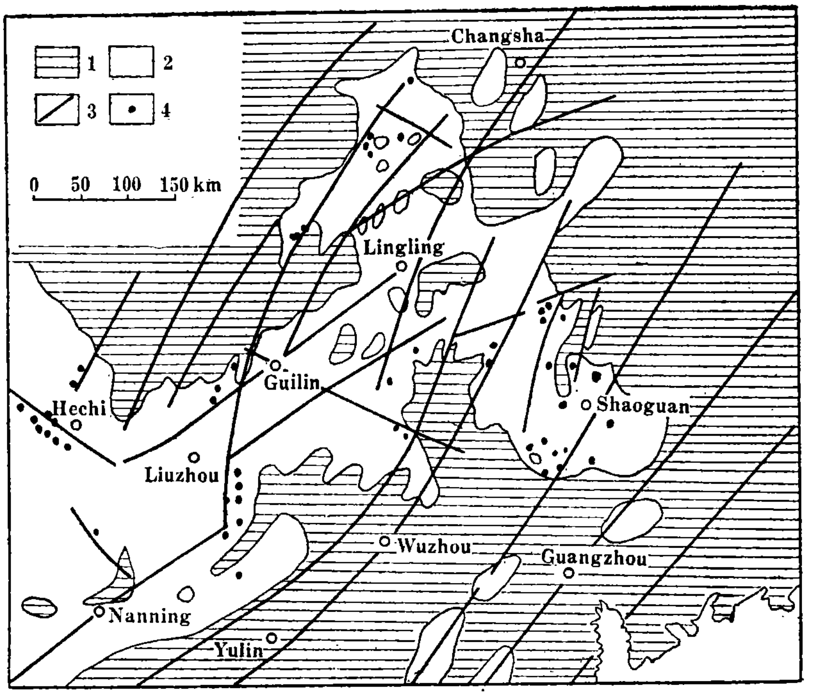



1. palaeocontinent; 2. carbonate platform facies; 3. intraplatform basin facies; 4. clastic shore facies; 5. main ore deposit; 6. boundary line between the lithofacies zone

**Fig. 5 Schamatic map showing the relationships between distribution of strata-bound ore deposits and palaeoenvrionment of Devonian, Nanling area of South China**

rocks and volcanism mainly occur to the east of Wuchuan-Sihui fault zone and carbonate rocks dominantly to the west. Three depression zones with north-norteast trend are developed along the great faults respectively, including the Shenzheng-Meixian, Wuchuan-Shaoguan and Qingzhou-Lingling depression zones. Whereas the another Danchi depression zone with north-west trend has been found. Deepwater intraplatform basins developed in the depression and seperating the platform into several parts, lead to a complex pattern in which the platform are interchangeable with basins.

Most of strata-bound ore deposits in this area distributed mainly in Danchi fault zone with north-west trend, Lengshuijiang-Longsheng fault zone with north-northeast trend and Wuehuan-Sihui fault zone with northeast trend and the intersections of two fault zone, related to certain strutural-lithofacies zone. The strata-dound ore deposits are subjected not only controlled by basement rifts, but also by Devonian tectonic pattern. The favorable position of tectonics are the margin of Pre-Devonian uplift, the margin of Devonian tectonic basin and the margin of local submarine uplift (Fig.6).




1. Pre-Devonain; 2. Devonian; 3. fault belts; 4. main ore deposits

**Fig. 6 Tectonic setting of the strata-bound ore deposits in Devonian of Nanling area, South China**

In short, the consistency of distribution of basement rifts, lithofacies and the metallogenetic zones in spatial since the lithofacies are controlled by early activity of Caledonian basement rifts and the metallogenetic zones are controlled by the later activity of those faults.

4. Related to magmatic activities

Dabaoshan polymetallic deposit was directly controlled by Devonian volcanism. Some facts indicated that the source of the metallogenetic materials of Fankou, Yingde ore deposits in North Guangdong and Danchi in North Guangxi might partially be related to the volcanic activities of Devonain. The strong magmatic activities took place during Yanshan movement in this region, and therefore, some strata-bound ore deposits are usually associated with Yanshan granite and granite-porphyry in the types of hydrothermal superimposed ore deposits or mixing hydrothermal ore deposits, such as tungsten-tin, lead-zinc ore deposits of Dongpo, Qingjiang, Xianghualing in south Hunan, and Danchi, Fuhuzhong in north Guangxi. But it is noticeable that the emplacement of the small granites relative to the metallizaton also occurs at the great faults or the intersection of those faults which controlling Devonian deposition. For examples, the ore bodies of Xianghualing ore district is located at the intersection of Lingshan fault zone and north-northeast faults zone; Dongpo ore district is situated at the intersection of Zhixin fault and Zhixin-Linwu fault; Fuhuezhoug ore district is located at the intersection of Linshan fault zone and north-west Guiling-Fuchuan faults; the ore body in Danchi basin may be relative to the north-northeast fault zone.

Thereby, it is considered that any geologic factor controlling the ore formation could not be treat in isolation. The formation of any large scale ore deposit should be considered as the result of the coaction of various geological factors in certain geological settings, and those factors commonly affect and interact each other. The stratigraphic horizon, lithofacies and tectonic settings are thought as main factor for controlling the diagenetic-epigenetic strata-bound ore deposits, and three factors are concordant spatially. When the formation of strata-bound ore deposits are related to magmatism, large fault, lithofacies zone, magmatic activity and metallogenesis usually showing the consistency. That is, the earlier (activity of the basement fault) controlled the lithofacies (or volcanic activity), the later faulting controlled the emplacement of magmatic rocks, and the migration, circulation and last enrichment of metallogenetic solutions.

## CONCLUSIONS

The mineralization of a variety of strata-bound ore deposits in Devonian of Nanling area are dominantly controlled by the stratigraphic horizon, lithofacies and tectonic setting. And the spatial distribution of ore deposits are obviously consistent with mineralization zones, tectonic-lithofacies belts.

1. Most of strata-bound ore deposits in Nanling area occur in Middle and Upper Devonian above the unconformity interface.

2. The main types of the lithofacies controlling the ore deposits are marginal reef of carbobate platform, tidal flat-lagoon facies.

3. Most of the strata-bound ore deposits in this area distributed mainly in Danchi fault zone with north-west trend, Lengshuuijiang fault zone with north-northeast trend and Wuchuan-Sihui fault zone with northeast trend and the intersections of two fault zones. The favorable position of palaeotectonics are the margin of the Pre-Devonian uplift and the margin of local submarine uplift during Devonian period.

4. The stratigraphic horizon, lithofacies and tectonic setting are thought as main controlled factors for diagenetic-epigenetic strata-bound ore deposits, but apart from these factors the magmatic activity during Yanshan movement for hydrothermal superimposed and mixed hydrothermal ore deposits is also important.

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