HU Yuzhao, LIU Lu, WANG Pengpeng, 2014. Structure, Ore Fluid and Mineralization in Qinglong Antimony Deposit, Guizhou, China . *Acta Geologica Sinica* (English Edition), 88(supp. 2): 1110-1111.

# Structure, Ore Fluid and Mineralization in Qinglong Antimony Deposit, Guizhou, China

HU Yuzhao, LIU Lu, WANG Pengpeng

*Faculty of Land and Resource Engineering, Kunming University of Science and Technology，Kunming 650093,China*

This comprehensive research is based on ore field structure, geophysics data, ore fluid characteristics, suggesting that Qionglong antimony deposit being formed in a half graben and ramp sag, ore fluid derived from sedimentary basin and normal fault and Dongwu unconformity acted as pathway of ore fluid.

## 1 Geological Setting

Qinglong antimony deposit is located in the handing wall of Qiangshan fault and Dachang fold in Southwestern Guizhou depression. Maokou Fm($P_2m$),Dachang stratum ($P_3d$) and Longtan Fm($P_3l$) outcrop in the deposit which is hosted in volcanic breccias of Dachang Stratum. The ore bodies occur in bedded shape. Stibnite and main alteration minerals such as quartz, flurite, calcite, pyrite and clay mineral are filled in interstice around breccias.

## 2 Structural Style

### 2.1 First order fault

Qingshan normal fault trends ~NE-SW, has ~70 km long with ~60-70°northwestern dip and a separation of ~200-600 meters. Two antimony deposits, Qinglong deposit in Guizhou and Laochang deposit in Yunnan, occur in the handing wall of this fault. In addition, Qingshan fault controls the distribution of volcanic facies which contain antimony ore bodies.

Magnetotelluric data show that there is resistivity difference in AnD,Devonian,Carboniferous~Permian,Triassic system and Qingshan fault has extended in these strata. Seismic profile clearly reveal that Qingshan fault cut the reflection of AnD, Devonian, middle and upper Permian and show characteristics of normal fault.

### 2.2 Dachang fold

Dachang fold also extends ~NE-SW with ~10 km long and ~3-4 km wide. The middle and upper Permian are involved in the fold in surface. Seismic profile neatly show Devonian,Carboniferous~Permian and Triassic system are involved too.There is an angular unconformity (Dongwu unconformity) exits between middle Permian Maokou Fm and upper Permian Dachang Stratum, and paleokarst such as cave and stone forest occur in Maokou Fm beneath unconformity surface. This may indicates that Dachang area was a paleouplift in the end of middle Permian Epoch.

### 2.3 Second order fault

There are several small normal faults in Qinglong antimony deposit, and all most ore bodies occur besides these faults which extend ~NE-SW with ~1-2 km long, ~60-70° northwestern dip and ~several to ~20-30 separation. Few beds such as top of Maokou limestone, Dachang stratum and bottom of Emeishan basalt are involved in these faults. Many conjugate shear joints and sandstone flow rolls are found over NE-SW faults, although Longtan coal measure is not cut by these faults. This indicate that NE-SW normal faults include Qingshan fault may be syngenetic with sedimentation and diagenesis. Stress analysis suggests that shear joints were generated by NE-SW normal faults.

So, we may come to the conclusion that the structure style of half graben and ramp sag exits Qinglong antimony deposit.

## 3 Resource of Ore Fluid

We collected quartz and fluorite minerals intergrowth with stibnite in Qinglong antimony deposit, in which many 2-20μm long inclusions exist and gas-fluid inclusions account for 80%, the rest are fluid inclusions and organic inclusions. Gas compositions measured by

* Corresponding author. E-mail: huyuzhao155@sohu.com

Gas Chromatograph Quad Pole Mass Spectrometer show that $H_2O$ range from 92.98-98.53 mol % with a mean of 95.00 ($n$=9), $CO_2$ from 0.803 to 4.235 mol % with a mean of 2.36 , $N_2$ from 0.114 to 4.426 mol % with a mean of 1.429,$CH_4$ from 0.036 to1.337 mol % with a mean of 0.516 ,$C_2H_6$ from 0.016 to 1.012 mol % with a mean of 0.444, Ar from 0.010 to 0.358 mol % with a mean of 0.146 , $H_2S$ from0.0001 to 0.001 mol % with a mean of 0.001%.

In $xCO_2/xCH_4$-$xN_2$ / $xCH_4$ chart (Norman and Moore,1999), 4 samples fall into formation water area, and 5 samples into atmospheric water area. In $xCH_4$-$xC_2H_6$- $xCO_2$ chart (Giggenbach et al., 1994), all fall into natural gas area, and have no relationship with magmatic gas. Data of inclusions in authigenic quartz by Zinc Reduction method, show that δD compositions range from -105.8 to -128.1‰ with a mean of -114.2 ($n$=5).The $\delta^{18}O$ values of authigenic quartz range from 3.8 to 6.9 ‰ with a mean of 5.4 tested by method of Bromine Pentafluorine, being converted into $\delta^{18}O$ of water range from -7.8 to -10.2 ‰ with a mean of -8.08.In the δD-$\delta^{18}O$ figure (Taylor, 1974), the data above fall into formation water.

In 2012, a number of asphalt layers were found by five drill holes in Dachang Stratum and Emeishan basalt in Qinglong antimony ore field. Of which eleven layers exceed 1.00 meter in thickness with mean value of 3.30m and the maximum of 11.03m in thickness; and weighted asphalt content (effective plan porosity) averages of 8.66% with a greatest of 20% and a minimum of 2.00%.The reserves of original crude oil are estimated as much as 5.90 million barrels and we call it Shaziling paleo-oil reservoir. The carbon isotope rations ($\delta^{13}C$) of asphalt in Shaziling paleo-oil reservoir vary from -27.7‰ to -28.8‰ with a mean of -28.1‰($n$=9),which is very close to the ration of other Permian paleo-oil reservoir in Nanpanjiang basin(Zhao,2007).The carbon isotope rations also suggest that the maturity of asphalt in Shaziling paleo-oil reservoir is higher. Comparing to the carbon isotope rations ($\delta^{13}C$) of kerogen from Devonian and Permian source rock in Nanpanjiang basin (respectively -26.6‰ and -23.6‰ in average; Zhao, 2007), the carbon isotope rations is closer to Devonian source rock, suggesting that asphalt derived from Devonian source rock. Because of mixture of Permian source rock, carbon isotope ration of Shaziling paleo-oil reservoir become lower.

## 4 Metallogenic Model

As discussed earlier, ore fluid may derive from Devonian. Based on geophysical data, ore fluid is conjectured to flow through Qiangshan fault from Devonian to Dachang Stratum where ore bodies occur. Alteration minerals such as quartz,fluorite, calcite and gypsum are often found in paleocave beneath Dongwu unconformity in southwestern Guizhou.Sometimes,stibnite is found besides the unconformity. This indicates ore fluid may flow along the unconformity while alteration covering an area of ~2000km$^2$ happens in Dachang volcanic rocks in southwestern Guizhou.

Ore bodies of Qinglong antimony deposit mainly distribute besides second order faults and not occur in fractural zone of these faults. Sb contents in ~NE-SW second order faults reach at $133\times10^{-6}$~$499\times10^{-6}$, more than Sb contents with $100\times10^{-6}$~$200\times10^{-6}$ in tuff ($P_3d^3$) and $13\times10^{-6}$~$180\times10^{-6}$ in silicified volcanic breccias ($P_3d^3$).Moreover, some stibnite scatter in joints besides second order faults. This may indicates ore fluid flow through second order faults. In the later, ore fluid flow to interface between volcanic breccias and tuffs and form antimony ore bodies.

## Acknowledgements

We thank Prof.Ran Chongying for carefully reading this paper and suggesting of antimony mineralization. This work is Sponsored by National Science Foundation of China（41362007）,Research Bases of China Typical Metal Deposits(20091107),Innovation Team of Metallogenic Dynamics and Concealed Deposits Prediction of Yunnan Universities.

**References**

Giggenbach, W. F., Sheppard,D. S.,Robinson B W, Stewart, M.,and Lyon, G.， 1994.Geochemical structure and position of the Waiotapu geothermal field，New Zealand, Geothermics,23:599-644

Norman, D.I., and Moore, J.N.， 1999. Methane and excess $N_2$ and Ar in geothermal fluid inclusions. In: Proc.24th Workshop Geotherm Reservoir. Eng：Stanford University, 196-202

Taylor,H.P.， 1974. The application of oxygen and hydrogen isotope studies to problems of hydrothermal alteration and ore deposit. Econ. Geol., 69:843-883

Zhao Mengjun, Zhang Shuichang, Zhao Ling,Zhao Peicu,Da Jiang， 2007.Geochemistry characteristics and genesis of the paleoreservoir bitumen and natural gas in Nanpanjiang Basin. Science in China: Series D, 37: 167-177(in Chinese)