

# The Cause-Forming Analysis of Shangping Tungsten Deposit

Zhengru Gan\*

*Faculty of Architectural and Mapping Engineering, Jiangxi University of Science and Technology, No 86 Hong Qi Avenue Jiangxi Ganzhou, 341000, China*

**Abstract:** The forming of each deposit has its objective and natural conditions. Different deposits have different types because their conditions and environments are different. This paper analyzed and discussed the cause of Shangping tungsten deposit. Firstly, it is the district background. Secondly, it is the geological characteristics and the age of the deposit. We think that the deposit is the zoning deposit of intermittently reverse precipitation from the pegmatite petrography to the hydrothermal solution stage gradually from the whole developing process. And this is a more complicated high temperature hydrothermal solution deposit of (FeMn)  $WO_4$  and quartz with thin-vein type from the characteristics of the deposit. The cause classification from different was is new and original in the paper. Its aim is to finding out the distribution regulation of the tungsten deposit and to serve for directing mine production and prospecting bitterly.

**Keywords:** Shangping, tungsten deposit, cause-forming, analysis.

## 1. INTRODUCTION

Shangping tungsten deposit locates the reverse composite area of east-west fault zone and New Chinese series uplift belt in the east of Nanling. Its regional structure belongs to Pangushan "mountain" type structure. The short axis anticlines of south-north direction in the south of mineral area make up the spinal column of the "mountain" type structure. The east wing of its front arc is Huangsha anticlines of north-east direction. The west wing of its front arc is Anqiantan anticlines of north-west direction. There are beneficial geology conditions of ore-forming in the area because of the development of folds and fracture structures, frequently magmatic activities.

The deposit was found in 1922 and was mined by migrant workers in the early period. Keqin Xu did the general geological investigation of the ore district and completed a geological map of 1:5000. He treated the deposit generally and wrote a "Shangping tungsten deposit in Yudu". It was nationalized in 1954 and started a mechanization production. Changsha exploring company did the preliminary exploration of the mine in 1954. The company completed the geological survey of 1:2000 and wrote a "the geological exploration report on Shangping tungsten deposit in 1954". The company did the detailed work of the deposit area in 1955 to 1956 and submitted "the geological exploration and summary report on Shangping tungsten deposit in 1957" [1]. This report determines the size of the ore deposit and provides

the system and reliable geological resources and the economic and technical basis for mine construction scale deposit. Jiangxi Bureau of Nonferrous decided Shangping tungsten area to stop mining in 1966 to 1982 for copper not to tungsten. A small amount of production prospecting was done in the process of mining later. But the study about the deep control to the deposit and the depth of tungsten mineralization are not enough. Zhengru Gan, Xiaoyang Zhong etc. did the feasibility analysis and the prediction of the deep exploring ores to Shangping tungsten deposit in 2009 to 2010 [2]. It is necessary to analyze and discuss the cause of the deposit forming for directing mine production and prospecting bitterly.

## 2. THE DEPOSIT GEOLOGICAL CHARACTERISTICS

### 2.1. The Ore Body Occurrence and Distribution

The ore bodies which occur in the area often-present intensive and thin veins. Their strike is  $N80^{\circ}-90^{\circ}E$ , keeping rectangular with strata, inclining to north, steeper dip angle which generally is bigger than  $80^{\circ}$ . But because of the complicated fractures and the interference of structure change squeezing after ore-forming, this usually make veins bigger in part; their strikes are to the north or to the east from time to time, uncertain bending; their inclining is suddenly to the north or suddenly to the south. Their dip angles are sometime big or sometime small.

The vein's strikes in this area are parallel with mountain lodge direction. The veins distribute along mountain lodge. The total length of mine belt has 1300 m. The mineralizing breadth is different, between 110m and 30m, generally 40m or so. Its distribution area is  $0.15km^2$ .

\*Address correspondence to this author at the Faculty of Architectural and Mapping Engineering, Jiangxi University of Science and Technology, No 86 Hong Qi Avenue Jiangxi Ganzhou, 341000, China; Tel: 13576684197; E-mail: GZR1968@163.com

**Table 1: The Content Table of Ore Chemical Composition**

Element	Content (%)	Element	Content (%)	Element	Content (%)
SiO <sub>2</sub>	62.2	WO <sub>3</sub>	0.77	Cu	0.05
Mn	12.7	Sn	0.02	Sb	0.04
Fe <sub>2</sub> O <sub>3</sub>	4.23c8	Bi	0.08	S	0.15
FeAc	6.64	Mo	0.02	As	0.01

## 2.2. The Ore Quality

(FeMn)WO<sub>4</sub> is the main economic mineral of the deposit. The content of W, Mn, Fe among them is respectively 71.114% (WO<sub>3</sub>), 12.7% (Mn), 4.238% (Fe). Its associated minerals are numerous. The main metal minerals among them have more than 30 Species, such as cassiterite, molybdenite, bismuthinite, chalcopyrite, magnetite, zingeline, galena, arsenopyrite, bornite, and lithium iron mica etc. The main nonmetal minerals have quartz, feldspar, topaz, calcite, fluorite etc. Nb, Ta, Sc in the (FeMn)WO<sub>4</sub> beside W, Sn, Bi, Mo and Cu and the elements of Li, Rb and Cs in the lithium iron mica have comprehensive recovery value by mine survey [3].

The ore structure mainly has graphic structure, geode structure, massive structure, granular structure and sheet structure.

The ore texture mainly has massive texture, Shell banding texture, vein alternating texture, residual texture and colloidal texture.

The ore chemical composition: the content of each component such as Table 1.

The ore type is the thin-vein type of wolframite-quartz. The ore quality is better. The crystal of wolframite is bulky. There is not the interference of other harmful component. The ore process is brief and the ore separation is easy

The ore type is the thin-vein type of wolframite-quartz. The ore quality is better. The crystal of wolframite is bulky. There is not the interference of other harmful component. The ore process is brief and the ore separation is easy.

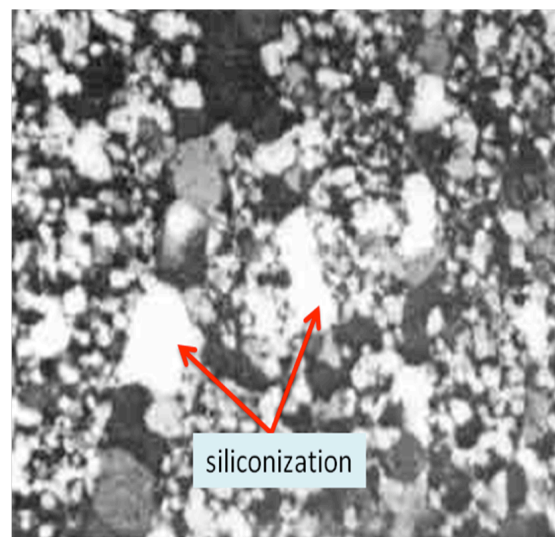
The tungsten grade in this area changes with different areas and middle segments. The general regulation of its grade is that the central is rich and high, the east being second, the west being relatively poor. In the vertical direction, according to the data of the middle segments which already have been

exploited at present, its grade downward has a little bit to lower, but change on its grade is not big.

## 2.3. Alterations of the Surrounding Rock

The surrounding rock alteration is the change of chemistry composition, mineral composition, structure and construct among rounds rock and hot liquid in mineralizing process because of the unbalance thermodynamics of the rounds rock and the hot liquid. The chemical reaction and change of the rounds rock and the hot liquid certainly take place for equilibrium, with the result that new mineral formation and old mineral disappearance.

The deposit surrounding rock alteration main has siliconization (as shown in Figure 1), sericitization, tourmalinization, pyritization, biotitization, fluoritization and carbonatization etc [4].



**Figure 1:** Siliconization in siltstone.

## 2.4. The Ore-Forming Temperature

According to temperature-measuring research to the deposit inclusions, main ore-forming temperature is between 300° and 500°. The deposit is high temperature hydrothermal tungsten deposit of wolframite-quartz with thin-vein type.

### 3. THE CAUSE ANALYSIS OF THE DEPOSIT

For developing the target of the "excellent" engineer's ability in the surveying and mapping engineering, traditional engineering survey teaching obviously has some defects or deficiencies. Their performance is mainly in some respects as follows:

#### 3.1. The Age of the Deposit

The age of the deposit is Mesozoic. On the one hand, from the magmatic rock mass which has a close relationship with the deposit; it is the outcome of Yanshan movement. Because the granite porphyry rock wall related with the deposit is the same homology with the magmatic rock mass of Libangqiao or Xieling, and the granite porphyry rock wall which has intruded into the Permian strata is covered by tertiary strata. On the other hand, from the structure, the EW fault zone in which the deposit exists is the fracture system which was formed by the Strong compressive stress of Mesozoic orogenic movement on the transverse joint of the SN fold in the lower Paleozoic, and it is made deepened and intensified further. Therefore, the activity of the ore liquid which was induced in the fracture system later is necessarily the orogenic period of Mesozoic [5].

#### 3.2. The Nature of the Ore Solution

The solution nature of three -mineralizing function in this area all have respective characteristics, from their composition, temperature, pressure and the speed of going up and down. By discussing the direction problem of total ore solution source first, we preliminarily judge that the ore solution should be from lower part to top in the center and from the center to east or west end, and slightly present a fan shaped status. This can be quoted as proof from following two aspects:

- (1) The attitude and the structure of the granite porphyry rock wall are wider and bigger in the central part of the mining area; especially the mineral structure is bulky (stone base) and presents a phenomenon with phenocryst. The vein width of E-W ends is smaller or they present a phenomenon with branch, and their mineral crystals accordingly become smaller too. Thus this reflects that the central is the part of magma enrichment in which there is the phenomenon of very big capacity, stronger crystallizing and slower diffusing. This phenomenon should be the general features of approaching magma source.

Since the granite porphyry and the deposit are the derivative of the same magma, their source direction is the same too. Therefore, we can judge that the mineral liquid action also is from bottom to top, from inside to outside as well.

- (2) The deposit has experienced a superposition of multi-mineralization events. From the change of metal grade, the deposit grade is lower in the upside and east-west ends, and is relatively high in the centre. This obviously expresses that the central part is the result of repeated mineralization and overlap enrichment. Therefore, the later mineral liquid is judged to be from the central part.

#### 3.3. The Type of Vein

According to the different characteristics of each mineral liquid, the ore-veins can be divided into representative three kinds:

- (1) The vein of feldspar, quartz-iron lithium mica and the vein of iron lithium mica-beryl (pegmatite petrography):

The capacity of this mineral liquid is very big; almost all spaces of the fracture were occupied (especially central and upper part). Main composing materials are feldspar, quartz, iron lithium mica, beryl, W, Sn, Bi, Mo and the many volatile components of H<sub>2</sub>O, F, B, Li etc. Its temperature mostly is between 500 °C and 600 °C. It should belong to pegmatoides petrography. Undoubtedly, at that time, the mineralizing environment was that the pressure was gradually small, and the residual magma which was rising on the way gradually obtained the certain amount ion of oxygen or hydrogen (namely PH is opposite lower), that is, being formed under the function of volatile component and oxide participating. Thus the mineral crystal can be made. Consequently we can say that the minerals of (FeMn)WO<sub>4</sub>, cassiterite etc was born in acidity medium.

On the other hand, because the compositions of feldspar, quartz etc in the lower part continuously precipitated, the volatile components increased and the steam pressures inevitably increased also. Thus this not only lowered the dense degree of mineral liquid and the crystallizing temperature of various mineral compositions, but also helped heavy metal components such as Wu and Bi etc went upward. As a result, this made its active space scope very big, but constituted

extensive and strong tourmalinizing. The proportion of the feldspar which is the typical mineral of this period mineral liquid is very big and is 27% of the vein capacity as a whole according to actually measuring. This mineralizing stage is the main period of w-ore becoming. The characteristics of this period mineral texture are the big granular of various mineral gathering together, the graphic texture and the belt structure of feldspar and quartz.

(2) The veins of quartz, iron lithium mica (high temperature hydrothermal solution phase):

This period crystallizing out went up later, but the Volatile components of H<sub>2</sub>O, H<sub>2</sub>S, and F etc still had a huge function in mineralizing process. The main components mostly were the sulfide minerals such as quartz, lithium mica, wolframite, molybdenite, chalcopyrite etc, and a little amount scheelite. This neutral medium was beneficial to sulfide crystallizing. This period characteristic is the typical feature which is many sulfide minerals. From them we can judge that the mineral liquid is neutral medium. According to the existence of lithium mica, W and molybdenite, and the Phenomenon of crystallizing out about chalcopyrite and magnetic pyrite, chalcopyrite and sphalerite under common meltdown. On above base we can launch that the liquor temperature was between 300 °C and 500°C. Its main active scope was limited to the overlap of the deposit in middle-late and the earlier pegmatite veins. This mineral liquid resulted in the strong silicon and chalcopyrite infecting. Because the hydrothermal solution contained calcium and interacts with the surrounding rock (that is calcium sodium feldspar in the earlier veins) each other, the scheelite appears. The overlap of this composition with W and the former W composition constituted rich area. This mineralization features are that its products cemented early brecciated ores or alternated early veins.

(3) The veins of quartz, calcite and the veins of calcite, fluorite (the hydrothermal solution phase).

This area is the end outcome of the liquid activity according to observing. Its characteristic is lower temperature minerals and simple mineral combination. The main component is quartz, calcite, chalcedony, scheelite and a small amount of mica. These minerals mostly contain calcium as its characteristics from the composition, so we can judge that the nature of the hydrothermal solution was alkaline and on above base we can inference that the hydrothermal solution

temperature approximately was between 100 °C and 200 °C. Its main active scope was limited to the overlap of the lower part of the ore deposit and the two above narrated stages. In this active segment, the main mark of the surrounding rocks near ore body is carbonation. The characteristic of this period ore-texture is colloidal texture of chalcedony.

#### 3.4. The Mineralization Characteristics

By integrating above mentioned we can generalize a few characteristics as follows:

- (1) The existence of the different nature veins in the same space clearly shows that the mineralizing in this area has the characteristic of interruption in a continuous process.
- (2) Since the direction of each hydrothermal solution source tends unanimous, the complex evolution of hydrothermal solution nature should be the result of the same magma pulse separation. As a result, they have respective characteristics.

#### CONCLUSIONS

By above analysis and discussion, the conclusion we comprehensively obtained that this deposit is the zoning deposit of intermittently reverse precipitation from the pegmatite petrography to the hydrothermal solution stage gradually from the whole developing process. And the deposit is a more complicated high temperature hydrothermal solution deposit of (FeMn)WO<sub>4</sub> and quartz with thin-vein type from the characteristics of the deposit [6].

#### THE PROJECT

The science and technology project of Jiangxi province ((GJJ14418).

#### REFERENCES

- [1] The 203 team of Changsha exploring company. the geology exploring summary report on Shang Ping tungsten mine in Yu Du county of Jiang Xi province[M].Changsha: Changsha exploring company,1957. (In Chinese)
- [2] Gan Z, Zhong X. The Prediction of the deep exploring ores in mine in Shangping [J]. *Metal Mine* 2009; (11): 86-88. (In Chinese)
- [3] Jia M, Wang M, Li Y, Sun C. Characteristics of Chinese Tungsten Ore and the Problems in the Tungsten Resource Utilization [J]. *Mining and Metallurgy* 2013; (3): 90-94. (In Chinese)
- [4] Tan Y, Tong Q, Pi J, Deng G. Geological geochemical Features of Ore-near Hydrothermal Alteration Rocks in Pangushan Tungsten Deposit [J]. *China Tungsten Industry* 2002; (10): 21-26. (In Chinese)

[5] Hua R, Chen P, Zhang W, Lu J. Three major metallogenic events in Mesozoic in South China [J]. *Mineral Deposits* 24(2): 99-105. (In Chinese).

[6] Gan Z, Yang C. Causes Analysis of Tungsten Mine and Calculation of Ore Storage in Lei Gong Di [J]. *Metal Mine* 2009; (4): 84-86. (In Chinese).

---

Received on 07-12-2016

Accepted on 19-12-2016

Published on 20-03-2017

DOI: <http://dx.doi.org/10.15377/2409-5710.2016.03.02.2>

© 2016 Zhengru Gan; Avanti Publishers.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.