

# Research Progress in Metallogenic Rules of Gold Ores in Southwestern Guizhou Province

Tao Cui <sup>a</sup>

College of Resources and Environmental Engineering, Guizhou Institute of Technology, Guiyang, 550003, China

<sup>a</sup>cuitao1203@163.com

**Abstract.** After a comprehensive analysis of previous studies, it is known that features, distribution laws, geochemical characteristics and provenances of ores in gold mines of southwestern Guizhou Province have been studied relatively thoroughly, whereas metallogenic epoch and metallogenic paleogeography remain to be further studied deeply.

**Keywords:** Gold Ores, Metallogenic Rules, Research Progress, Western Guizhou Province.

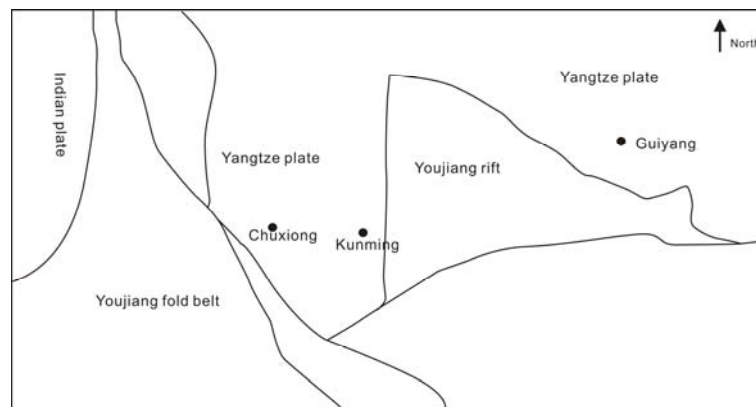
## 1. Introduction

Western Guizhou Province is rich in gold-ore resources, including rocky gold, placer gold and associated gold, among which rocky gold occupies absolute advantages, whereas the other two types of gold are scarcer (Guizhou province geology and mineral bureau, 2014). Lots of experts and scholars have explored gold ores of Guizhou Province (Zhu et al., 1997; Liu et al., 2006; Huang et al., 2008; Liu, 2006; Wu et al., 2013), and achieved considerable outcomes. Based on previous data, studies about metallogenic rules of gold mines in western Guizhou Province are summarized, in order not only to provide basic data for exploring gold ores, but also have certain significance for guiding further research and development of gold ores in western Guizhou Province.

## 2. Geological Backgrounds of Metallogenesis

Sichuan and Yunnan are the most potential provinces for prospecting super-large Pb-Zn ores and gold deposits in China (Tu et al., 2000). In the west of Guizhou Province, the metallogenic province of lead-zinc ores is on the southwestern margin of Yangtze paraplatform and in the east of Xikang Yunnan axis as a upper Yangtze metallogenic sub province in the metallogenic province of Yangtze Para platform, which is an integral part of polymetallogenic ore clusters in Sichuan, Yunnan and Guizhou provinces (Jin, 2006). Listed from the old to new, exposed strata include Sinian Dengying Formation, Cambrian system, silurian, Devonian system, carbonic system, Permian system, Triassic system, Jurassic system, tertiary system and quaternary system, among which Permian Emeishan basalts are extensively distributed across the whole area.





**Fig.1.** Geotectonic map of western Guizhou (modified from Gao, 2002)

### 3. Distribution of Gold Mines

Southwestern Guizhou Province is an area with the richest gold in the “golden triangle” among Yunnan, Guizhou and Guangxi Zhuang Autonomous Region, distributed on both sides of the boundary between Yangtze Continental Block and Youjiang Orogenic Belt, and the triangular area between Hezhang-Luoping and Ziyun-Yadu faults. Horizontally, a considerable amount of gold deposits are County and Xingren County.

### 4. Types of Mineral Deposits and Ore-bearing Strata

In southwestern Guizhou Province, gold ores are mostly micrograined and micrograined, with a small amount of gold sporadic lateritic gold deposits. Micrograined and disseminated gold ores mainly include impure carbonate, pyroclastic and terrestrial siliceous clastic ores (Nie et al., 2007). From the permian Longtan Formation to the first segment of Yelang Formation on impure carbonate ore-bearing strata, there are impure carbonate rocks and fine clastic rocks, relatively rich gold in impure carbonate rocks, pyroclastic ore-bearing strata on the lower part of Emeishan Basalt Formation and basaltic tuffs which are host rocks (Guizhou province geology and mineral bureau, 2014). Lateritic gold deposits occur on the karst surface of unconformity in the permian Maokao Formation, covered by Emeishan Basalt, and their ore-bearing strata are the same as Qinglong sandy anatase.

### 5. Provenance Analysis

Provenance analysis has been always a difficulty in studying mineral deposits. As more and more in-depth research is performed, people have realized that many deposits don't arise from a single provenance. For example, bauxites of northern Guizhou Province are composed of clay shale of the silurian Hanjiadian Formation, limestone of the carbonic Huanglong Formation and basalts (Du et al., 2013; Yu et al., 2014; Cui et al., 2014). It is generally acknowledged that Emeishan Basalt is the original source of gold mines in southwestern Guizhou Province and its eruptions have made numerous ore-forming materials available to the formation of gold mines (He, 1992; Nie et al., 2007). Owing to the eruptions, adjacent strata are rich in so much cinerite and Au that they are source beds of ores (He, 1992; Tao, 2009). In southwestern Guizhou Province, the silicon in Sb ores is from the eruption of Emeishan Basalt (Zhang et al., 1999; Zhang et al., 1999), which implies the source of silicon in gold ores (Tao, 2007). Emeishan Basalt might be the main provenance of gold mines in southwestern Guizhou Province. However, the formation of gold mines in southwestern Guizhou Province is an extremely long process. It is hard to say that in this process; certain type of rocks is the mere provenance. In addition to micrograined and disseminated gold ores, there are also lateritic gold deposits, which might come from more complicated sources. Therefore, Emeishan Basalt is considered to be the major provenance of gold mines in southwestern Guizhou Province, whereas other categories of rocks are also provenances of these ores.

## 6. Metallogenic Epoch

In southwestern Guizhou Province, gold mines have developed thorough a long period and vary in their metallogenic time. The formation of micrograined and disseminated gold mines is assignable to intensive eruption of the late permian Emeishan Basalt; the sedimentation with volcanic gas-liquid leads to the formation of source beds for the permian Longtan Formation (Wang, 1994). In the Triassic period, Emeishan Basalt interacts with hot water and sediments to develop source beds of terrestrial siliceous clastic gold ores (Gao et al., 2002; Nie, 2009). In the Yanshanian period, mantle plumes move vigorously on Emei Mountain, and hydrothermal alternation ultimately causes the formation of gold mines (Liu et al., 2001; Nie et al., 2009). For lateritic gold deposits, quaternary period is the peak of gold enrichment into ores and the main metallogenic period of lateritic gold deposits (Wang et al., 2000; Yang et al., 2004; Nie et al., 2015). In southwestern Guizhou Province, the formation time of early source beds is generally the same between micrograined/disseminated gold deposits and lateritic gold deposits. However, the late enrichment and ore formation mainly occur in the Yanshanian period for micrograined/disseminated gold deposits and the quaternary period for lateritic gold deposits. Southwestern Guizhou Province is quite rich in gold-ore resources. Although they are generally divided into three types, it doesn't mean these ores only go through 3 or fewer metallogenic periods. In southwestern Guizhou Province, the gold deposits have never stopped development until the quaternary period. Micrograined/disseminated gold ores mainly develop in the Yanshanian period, but might form across other epochs, or they are enriched in other epochs. Despite that lateritic gold deposits mostly formed in the quaternary period, some mineral deposits might have been enriched in the early period, so the exact metallogenic epochs of different gold deposits in southwestern Guizhou Province remain to be further explored.

## 7. Paleogeography of Metallogenesis

In southwestern Guizhou Province, gold ores form through a relatively long period and their formation is dependent upon paleogeography to certain extent. Late Paleozoic southwestern Guizhou Province is mainly characterized by marine-continental transitional environment, under which frequent regression and transgression contribute to the formation of intertongued marine-and-continental coal measures (Cao, 1991; Wang et al., 1994; Wang, 1994). The macroscopic paleogeographic environment of metallogenesis is not controversial, whereas the impacts of microfacies upon gold mines in different areas remain to be further explored.

## 8. Conclusion

By sorting out, summarizing and analyzing previous data, conclusions are reached as follows: 1) Features, geochemical characteristics, ore-bearing strata, distribution laws and provenances have been studied relatively clearly; 2) Gold mines vary in minerogenetic epochs to certain extent. In spite of the same formation time of their source beds, the micro grained disseminated gold mines were enriched in the Yanshanian period, whereas lateritic gold deposits were enriched in the quaternary period. The minerogenetic epochs of particular deposits remain to be further investigated.

## Acknowledgements

This work was supported by the Key support disciplines of Mineral prospecting and Exploration from Guizhou Province (ZDXK [2014]20), the Startup Projects of High-level Talents of Guizhou Institute of Technology (No. XJGC20140702), Guiyang, 550003, China, and the joint fund of the science and technology department of Guizhou province (No. LH [2014]7358).

## References

- [1] Guizhou province geology and mineral bureau. Mineral resources of Guizhou. China university of geosciences press, 2014.
- [2] Zhu Laimin, Hu Ruizhong, Liu Xianfan et al. Some aspects of understanding in genesis of the fine-disseminated gold deposits in Southwestern Guizhou province. Mineral resources and

- geology, 1997,11(5):296-302.
- [3] Liu Ping, Li Peigang, Li Keqing et al. Geological characteristics of the Hubadong gold occurrence and its regional implication in Guizhou province. *Guizhou geology*, 2006,23(2):83-97.
  - [4] Huang Jianguo, Hao Jiaxu, Zhang Min et al. Study on relationship between Permian longtan coal system and Southwest Guizhou gold deposit. *Gold*, 2008,8(29):10-14.
  - [5] Liu Yuanhui. Geological characteristics and prospecting direction of the gold deposit in Guizhou province. *Guizhou geology*, 2006,26(3):162-169.
  - [6] Wu Xiaohong, Cheng Penglin, Xiao Chenggang et al. Metallogenic geologic characteristics of Damaidi gold deposit in basalt distribution area of Western Guizhou. *Guizhou geology*, 2013,30(4):283-288.
  - [7] Tu Guangzhi. Super large deposits, Science press, 2000,350-390.
  - [8] Jin Zhongguo. Research on the ore-controlling factors, metallogenic regularity and prediction of lead-zinc ore district in Northwest, Guizhuo, Central south university, 2006, 79-111.
  - [9] Gao Zhengmin. The formation and exploration of major gold in Yunnan and Guizhou province, Geology Press, 2002:78-96.
  - [10] Nie Aiguo, Qin Dexian, Guan Daiyun, Huang Zhiyong, Zhang Zhuru. A research on regional metallogenic contribution to gushing Emeishan basalt magma in western of Guizhou province *Geology and prospecting*, 2007,43(2):50-54.
  - [11] Du Yuansheng, Zhou Qi, Jin Zhongguo, Lin Wenlin, Zhang Xionghua. Advances in basic geology and metallogenic regularity study of bauxite in Wuchuan-Zheng,an- Daozhen area, northern Guizhou, China. *Geological science and technology information*, 2013, 32(1):1-6.
  - [12] Yu Wenchao, Du Yuansheng, Zhou Qi et al Provenance of bauxite beds of the lower Permian in Wuchuan-Zheng,an- Daozhen area, northern Guizhou province: evidence from detrital zircon chronology. *Journal of paleogeography*, 2014,16(1):19-29.
  - [13] Cui Tao, Jiao Yangquan, Du Yuansheng et al. Mineral and geochemical characteristics of bauxite in northern Guizhou. *The Chinese journal of nonferrous metals*, 2013, 23(10):2905-2920.
  - [14] He Saolin. A preliminary explanatijon of Au formation in Southwestern Guizhou by using geological and geochemical data. *Geology of Guizhou*, 1992,9(2):150-160.
  - [15] Tao Ping, Xiao Xudong, Zhang hui. The Au-bearing sedimentary sequences and their impact on the gold deposits in light metamorphic rock in the boundary of Hunan, Guizhou and Guangxi regions. *Geological science and technology information*, 2009,28(2):110-114.
  - [16] Zhang Zhijie. Some remarks on the ore formation laws of stibine(antimony) in Yunnan, Guizhou and Guangxi province. *Guizhou geology*, 1985,3:193-204.
  - [17] Zhang Qihou. On the silicon source of host rock of Dachang antimony deposit in Southwestern Guizhou province. *Guizhou geology*, 1999,16(2):111-116.
  - [18] Tao Ping, Ma Rong, Lei Zhiyuan et al. Review of gold mineralization system in the southwestern Guizhou Province, Yangtze block. *Geology and prospecting*, 2007, 43(4):24-28.
  - [19] Wang Liting. lithofacies paleogeography and mineralization of north China in Permian. Geology press, 1994.
  - [20] Nie Aiguo. The study on the genetic mechanism of carlin-type gold deposit which caused by activity of Emei mantle plume in southwestern Guizhou. *Guizhou technology press*, 2009.
  - [21] Liu Xunfeng, Tao ping. Geological features and significance in prospecting of volcanic tuff in Guizhou. *Geophysical and geochemical exploration*, 2008,32 (5):461-464.
  - [22] Wang Yangen, Chen Lvan, Li Xingzhong et al. Laterite of gold deposits in southwestern Guizhou. *Guizhou technology press*, 2000.
  - [23] Yang Yuangen, Liu Shirong, Jin Zhisheng. Laterization and its control on gold occurrence in Laowanchang gold deposit, Guizhou province. *Geochemica*, 2004,33(4):414-422.
  - [24] Nie Aiguo, Zhang Min, Zhang Zhuru. An original mechanism of anatase deposits at Shazi

- region of Qinglong area in Guizhou. Science press, 2015.
- [25] Cao Hongshui. A discussion on the genetic environment and minerogenesis of “Dachang strata” in southwestern Guizhou. Guizhou Geology, 1991,8(1):5-13.
- [26] Wang Yangen, Suo Shutian, Zhang Mingfa. Structure of southwest Guizhou and carlin-type gold deposit. Geology press, 1994