

Analysis on Provenance of Lead-zinc Ores in Western Guizhou

Tao Cui ^a

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

^a cuitao1203@163.com

Abstract. Based on previous data, the analysis suggests that the formation of lead-zinc ores in western Guizhou Province is the result of the effects of several phases. Underlying Sinian-Cambrian strata are important provenances, apart from which, there are also other provenances, including Emeishan Basalt and diabase bodies.

Keywords: Lead-zinc Ores, Distribution Laws, Western Guizhou Province.

1. Introduction

In western Guizhou Province, there is a considerable amount of Pb-Zn ores, which have been examined by many experts and scholars (Zhang, 2005; Jin, 2006; Nie et al., 2007, 2014; Li et al., 2012; Wang et al., 2013) and great achievements have been made in their research. Based on previous data, provenances of Pb-Zn ores in western Guizhou Province are analyzed to provide basic data for further studying metallogenic rules of these ores and prospecting and exploration.

2. Geological Backgrounds of Metallogenesis

Lead-zinc ores, which are mostly distributed in northwestern Guizhou Province, which composes the Sichuan-Yunnan-Guizhou metallogenic belt of lead-zinc ores together with eastern Yunnan and Southern Sichuan provinces. From the perspective of its tectonic structure, western Guizhou Province lies on the rift of Youjiang River on the southwestern margin of Yangtze Plate. Sanjiang fold zone is the boundary in the west of the rift in Youjiang River, while the south of the rift adjoins the South China Block (Nie and Kang et al., 2014). In northwestern 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 subprovince in the metallogenic province of Yangtze paraplatform (Jin, 2006).

Listed from the old to new, exposed strata include Sinian Denying 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). Carboniferous carbonate rocks are essential ore-bearing strata and host rocks for lead-zinc ores. This zone has tectonically evolved through Chengjiang orogeny, Caledonian orogeny, Hercynian orogeny, Indosinian orogeny, Yanshanian orogeny and Himalayan orogeny.



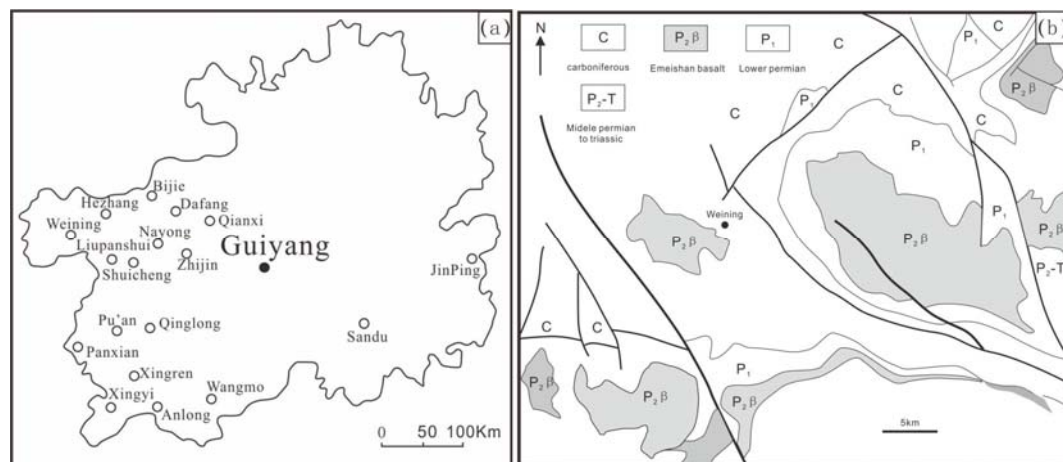


Fig.1. a. map of Guizhou; b. Geology map of western Guizhou (Qi et al., 2016)

3. Characteristics of Gold Distribution

In western Guizhou Province, Pb-Zn ores are mainly distributed in Weining, Hezhang, Liupanshui, Puding County and Qinglong County. On the border between Guizhou Province and Yunnan Province, there are also some Pb-Zn deposits. Relatively typical deposits include Pb-Zn Deposit in Shuichen Cedar Forest, Qingshan Deposit, Pb-Zn Deposit in Boji Bay, Mangdong Pb-Zn Deposit, Maomaochang Deposit, Yadu Pb-Zn Deposit, Tianqiao Pb-Zn Deposit, Yinchangpo Deposit and Yunhuhe Deposit.

4. Analysis on Provenance of Lead-zinc Ores

Pb-Zn ores have distinct features in different areas of western Guizhou Province and provenances of the ores differ among different met allogenic provinces. In Guizhou Province, Pb-Zn deposits mainly include wall-rock deposits, vulcanite deposits with land facies, weathered-residual deposits, carbonate and glutenite deposits. Carbonatite deposits are account for a major proportion in western Guizhou Province.

Qian (2001) think that on Sinian-Cambrian strata, high background values of Pb-Zn make primary sources of materials available to the metallogenesis of this zone. The content of Pb-Zn is relatively high in diabase bodies, so ore-forming materials might be provided for the formation of Pb-Zn ores in southwestern Guizhou Province (Liu, 1995).

In southwestern Guizhou Province, the rate of changes is relatively high, which indicates that there is no unified provenance for lead (Zhao, 1988; Chen, 1993). By measuring age of ores, it is found that Haixi-Yanshan cycle is the main metallogenic period (Mao et al., 1998; Zheng et al., 1994) which is in line with the eruption of basalt and diabase intrusion within the area. This indicates that the metallogenesis of Pb-Zn ores provides some ore-forming materials for magmatic activities within the area (Non-ferrous metals geological exploration bureau of Guizhou, 2009). Mao (1998) and Wang (1993) reported in their research that enrichment of heavy sulphur is the only sulphur source of ores, which is mainly from the reduction of sulphate in sea water, because features of carbon and oxygen isotopes are similar to normally deposited marine carbonate. In northwestern Guizhou Province, the properties of rare earth elements are much poorer than wall rocks, which reveal that wall rocks provide provenances for the formation of lead and zinc (Jin, 2006).

Whether Emeishan Basalt is the provenance of Pb-Zn ores is still relatively controversial among lots of experts and scholars (Liu, 1995; Han, 2001; Huang et al., 2001; Liu, 2002). who consider that Emeishan Basalt is rich in metallic elements such as Pb, Zn and Cu. It is thus clear that distribution of various mineralization phenomena, horizontal and vertical directions determine the distribution of Pb-Zn ores. Their thickness has significant positive correlations with that of ores. Basalt and ores are partially the same or similar in age, which suggests that basalt provides ore-forming materials for the

ores. Some scholars consider that only spatial overlay exists between basalt and Pb-Zn ores (Gu et al., 1997; Zhang, 2005; Zhang et al., 2006). Some other scholars think that Emeishan Basalt provides ore-forming materials from thermodynamic activation and extraction during metallogenesis of Pb-Zn ores as “shields” and “protective layers” (Zhang, 2003; Li et al., 2012).

Ratio of Pb isotopes and related parameters are effective for indicating metal sources of ore-forming fluids (Zhou et al., 2013a, 2013b). In southeastern Guizhou Province, features of Pb isotopes suggest that rocks of ore-forming strata provide some substances for metallogenesis and ore-forming material sources of Pb-Zn ores are relatively complicated (Wang et al., 2014). In fine detrital rocks of lower Cambrian Balang Formation of the southeast or Wuxun Formation, the content of Zn is much higher compared with other strata, which indicates that ore-forming materials of Pb-Zn ores in southeastern Guizhou Province mainly come from these two formations (Wang et al., 1993).

5. Discussions

Pb-Zn ores form through a rather complicated process. In western Guizhou Province, these ores might arise via several phases but not simply come into being at once. Hence, this problem shall be observed dynamically from several phases. All analysis results of ore-hosting features, routine elements, trace elements and isotopes show that underlying strata are provenances of Pb-Zn ores and provide numerous ore-forming materials for these ores, whereas apart from the strata, the complex metallogenesis is also associated with the involvement of other strata or geologic bodies like the intrusion of diabase. Main provenances of deposits vary in different periods. This doesn't mean wall rocks don't provide ore-forming materials. Hence, deposits are expected to be analyzed specifically. Great controversies exist in whether Emeishan Basalt provides ore-forming materials. After a comprehensive analysis, Emeishan Basalt provides basic ore-forming materials for multiple deposits but is not the sole provenance for the formation of all Pb-Zn ores in western Guizhou Province. Although Emeishan Basalt might be a crucial provenance of some deposits, it might not provide ore-forming materials or only a small amount of these materials for other deposits. Comparatively, the provenances of Pb-Zn ores in both western and southeastern Guizhou Province are from underlying strata and multiple sources. Problems with provenance of Pb-Zn ores are so complicated that further systematic research must be performed to accurately identify their provenances.

6. Conclusion

After comprehensive research, conclusions are reached as follows: 1) Pb-Zn ores form through several phases and sources. Underlying Sinian-Cambrian strata are important source beds for Pb-Zn ores; 2) Host rocks are not major provenances of Pb-Zn ores but might provide a minority of ore-forming materials for the ores. 3) Other geologic bodies such as Emeishan Basalt and diabase bodies might provide ore-forming materials for some Pb-Zn ores, which remains to be further confirmed systematically.

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