1 Geological Setting

The Pb-Zn deposits in Nanjiang-Mayuan area on the north margin of Sichuan Basin chiefly occurred in dolomites of Sinian Dengying Formation. Host rock of deposits distributed both on the two wings of composite anticline of Micangshan, the Mid-Late Proterozoic Huodiya group and Jinning-Chengjiang period magmatic rock located in the cores of the composite anticline. The Dengying Formation in the study area could be divided into four lithologic Member: the first Member (Zd1) was mainly made up of rhythm of several botryoidal dolomite →snowflake dolomite →microlitic-minicrystal dolomite; the second Member (Zd2) consisted of the interbed of hoary-gray microlitic dolomite, gray algal-laminated dolomite and dolarenite; sandstone, siltstone mingled with blue gray mudstone constituted the third Member (Zd3); the fourth Member (Zd4) chiefly included microlitic-finely crystalline dolomite, dolarenite and algal dolomite. The geological and geochemical evidences suggested that there existed two obvious paleo-karst interfaces between Zd2 and Zd3, between Cambrian and Zd4. The Pb-Zn deposits often occurred in layers; the ore mineral mainly consists of blende and/or galena, and gauge minerals mainly consist of dolomite, pyrite, quartz and bitumen. Sometimes zebra structure was formed among galena, blende and dolomite. Pb-Zn deposits, fluorite deposits and barite deposits can adjacently occurred and form independent cystic or stratified ore body respectively. The galena, blende, fluorite and barite etc. mainly infilled in fissure, dissolved pores or karst cave formed by supergene karstification, which indicated that dissolved pore and karst cave were both the channel of metallogenic hydrothermal migration and the room for metallogenic elements accumulation and deposit. Meanwhile, the distribution of Pb-Zn deposits, fluorite deposits and barite deposits were controlled by paleo-karst landform and metallogenic elements only concentrated and deposited on karst highland in the paleo-karst belts selectively.

Study showed that paleo-karstification played a significant role in the mineralization of Pb-Zn deposits, fluorite deposits and barite deposits, and all these deposits developed under the paleo-karst interface between Cambrian and Zd4. The Pb-Zn deposits often occurred in layers; the ore mineral mainly consists of blende and/or galena, and gauge minerals mainly consist of dolomite, pyrite, quartz and bitumen. Sometimes zebra structure was formed among galena, blende and dolomite. Pb-Zn deposits, fluorite deposits and barite deposits can adjacently occurred and form independent cystic or stratified ore body respectively. The galena, blende, fluorite and barite etc. mainly infilled in fissure, dissolved pores or karst cave formed by supergene karstification, which indicated that dissolved pore and karst cave were both the channel of metallogenic hydrothermal migration and the room for metallogenic elements accumulation and deposit. Meanwhile, the distribution of Pb-Zn deposits, fluorite deposits and barite deposits were controlled by paleo-karst landform and metallogenic elements only concentrated and deposited on karst highland in the paleo-karst belts selectively.

Research indicated that MVT Pb-Zn deposits were superimposed with the paleo hydrocarbon reservoirs of the Dengying Formation with each other in the space. Based on investigation of bitumen distribution dimensions, a grand-scale paleo-hydrocarbon reservoir has been identified in Dengying Formation. This reservoir experienced two stages accumulation and destruction, and significant transformation from paleo-oil reservoir to paleo-gas reservoir (Wang et al., 2014). The hydrocarbon reservoir of the first phase was destroyed at the end of Silurian and the reservoir of the second phase was formed in Triassic. With continuous deep burial and increasing temperature, thermal cracking occurred in second paleo-oil reservoir to form thermal cracking bitumen and paleo-gas reservoir. The paleo-gas reservoir was destroyed thereafter during the tectonic uplift in Yanshan-Himalayan
period and then large quantity of thermal cracking bitumen was left over in all dissolved pore and karst cave in Zd4 and some in Zd1 and Zd3. The distribution dimensions of bitumen exhibited that the distribution range of paleo-hydrocarbon reservoir was far larger and wider than that of MVT Pb-Zn deposits.

The mineralized spot or representative MVT Pb-Zn deposits discovered on the surface were investigated and it can be found that the ore mineral composition of MVT Pb-Zn deposits displayed an obvious differentiation both horizontally and vertically. Galena was dominant in the hydrothermal deposits located in the west and middle of paleo-hydrocarbon reservoir and blende in the east. Meanwhile, the differentiation of hydrothermal deposits assemblage also can be found. The hydrothermal deposit assemblage from west to east of paleo-hydrocarbon reservoir was as follows in order: galena deposit + barite deposits → galena deposits + fluorite deposits → blende deposits. The vertical differentiation of paleo-hydrocarbon reservoir, hydrothermal minerals and ore minerals in MVT Pb-Zn deposits were also very distinct. Pb-Zn deposits, fluorite deposits and barite deposits chiefly developed on the top of paleo-hydrocarbon reservoir; bitumen on the top and the upper part; the hydrothermal minerals such as dolomite and quartz on the bottom. The differentiation of ore mineral in Pb-Zn deposits was presented by dominant galena in the upper and blende in the lower (Hou et al., 2007). The differentiation of paleo-hydrocarbon reservoir and hydrothermal deposits might be ascribed to different condition between mineralization of ore deposit and hydrocarbon accumulation. The vertical and lateral differentiation of hydrothermal deposit assemblages and ore mineral might be caused by the metallogenic elements differentiation during metallogenic fluids migration.

3 Conclusions

The symbiosis and differentiation of MVT Pb-Zn deposits and paleo-hydrocarbon reservoir hinted that there existed a close genetic relation between these hydrothermal deposit mineralization and paleo-hydrocarbon reservoir accumulation. Paleo-karstification and paleo-karst landform played a fundamental controlling role in the mineralization of galena, blende, fluorite and barite in Dengying Formation.

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Reference