The 26°S hydrothermal field located at South Mid-Atlantic Ridge (SMAR) was firstly found by Chinese scientists in RV “Dayang Yihao” Cruises 22. Hydrothermal polymetallic sulfides sampled from the 26°S was rich in pyrite, morphology and composition characteristics of pyrites will be discussed in this research.

1 The Morphology of Pyrite

The pyrite in 26°S can be classified into four distinct types:

Type-I occurs as colloform texture and show banded and circled characteristics. It has the lowest reflectivity, and always co-existing with Type-II.

Type-II occurs as anhedral texture with poor crystallization degree and porous. They all show aggregate structure and assemble with Type-I.

Type-III occurs as subhedra l-euhedral cubic crystals, always occupy in the margin of the aggregation of Type-I and Type-II. Its’ optic character was similar to Type-II.

Type-IV occurs as euhedral cubic crystals with larger grain than Type-III and co-existed with chalcopyrite. These pyrites always occupy in the fissures and pores of the aggregation of Type-I and Type-II.

Type-I → Type-II → Type-III represent the different crystallinity of the same hydrothermal mineralization stage. Abundant pores and fissures can be found in the aggregate of first stage pyrite. Type-IV, occupying in these fissures and pores and co-existing with chalcopyrite, represents the later hydrothermal mineralization stage.

2 The Composition of Pyrite

Chemical composition of representative pyrites was analyzed, the analysis results were listed in Table 1.

All the pyrites are characterized by depletion of S; S/Fe (atomic ratio) of Type-I, II, III and IV is 1.962, 1.971, 1.979, 1.955, respectively. From Type-I to Type-III, the S/Fe increased, this indicated that the S gradually enriched with enhancement of euhedral degree. Moreover, the lowest S/Fe in Type-IV suggested that they were formed during another hydrothermal mineralization stage. Four types’ S+Fe content is 97.84, 99.13, 98.76, 98.93 (wt%) respectively; the lowest S+Fe content in Type-I pyrites indicated that Cu, Zn and Ni decreased with the enhancement of crystallization.

3 The Temperature of Fluid

Previous studies of the TAG hydrothermal area (Chu et al., 1995) and Edmond area (Wang et al., 2011) documented that the S/Fe were increased and the S+Fe content were decreased from cubic euhedral pyrite → subhedral-euhedral pyrite → colloid form pyrite, it indicated the temperature of fluid from high to low. But this study has an opposite results.

The Cu-rich pyrite always be concerned with the high temperature hydrothermal activities, and the Zn-rich pyrite responsible for the low temperature fluid (Tivey et al., 1995). Type-I have the highest Cu, Zn content from others in this study, especially several times Cu higher than others. The Type-I’s high Cu content is similar to the pyrite from the high temperature vents of TAG area(Tivey et al., 1995), so the Type-I’s pyrite may be concerned about the high temperature fluid. Furthermore, the Zn content of all pyrite in this study much low than the pyrite of TAG high temperature vents, this indicated that Zn content in this study was low range, Type-I’s higher Zn content than others is not the cause of the fluid temperature, but mainly affected by Ph (Lydon , 1988).
The four types’ Cu/Zn ratio is 1.389, 0.233, 0.238, 0.583, respectively. The Type-I’s highest Cu/Zn ratio could indicate the higher temperature than Type-II and Type-III. The disequilibrium texture of colloform pyrite reflects rapid crystallization with undercooling caused by mixing between hot vent fluid and cold ambient seawater (Xu et al., 2005). So Type-I’s pyrite precipitated from rapid cooling environment when high temperature fluid mixing with seawater. Type-II and Type-III have similar chemical composition (such as S/Fe, Cu/Zn) indicated they were formed in similar environment, and the lowest Cu/Zn ratio of Type-II and Type-III point out the lowest fluid temperature. Type-IV’s Cu/Zn ratio is little higher than Type-II and Type-III, but the temperature of later stage fluid is medium-high from it co-existed with chalcopyrite.

4 Conclusions

The morphology, texture and chemical composition of pyrite in this study show that: high temperature fluid entering the seawater and mixed with it, the quickly reduced temperature lead to Type-I’s pyrite precipitated. Subsequent the Type-II and Type-III’s pyrite precipitated when the temperature of mixed fluid decreased to the lowest. And Type-IV’s pyrite precipitated in the fissures and pores of the Type-I and Type-II’s aggregation with chalcopyrite from the later fluid, the temperature of later fluid is medium-high.

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References


