Geological and geochemical constraints on the origin of the giant Lincang coal seam-hosted germanium deposit, Yunnan, SW China

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The Lincang germanium deposit in Yunnan, SW China, contains at least 1000 tones of Ge at an average grade of ~850 ppm Ge, being one of the largest germanium deposits in the world. The deposit is hosted in coal seams of the Miocene Bangmai Formation deposited on a Ge-rich granitic batholith. The Bangmai Formation is divided into eight units among which three units are coal-bearing. The Ge-bearing coal seams are inter-layered with siliceous rocks and siliceous limestones in the basal coal-bearing unit. The coal seams of the other two coal-bearing units are not inter-bedded with siliceous rocks and siliceous limestones, and are barren. Equant or elongated germanium ore-bodies are mainly distributed at fault intersections, and are located at the top and bottom of coal seams where they mainly contact with the layered siliceous rocks or siliceous limestones. Ge is mainly associated with organic matters of coal seams. The major and trace elements, and O- and C-isotopes of the siliceous rocks and siliceous limestones are similar to those of hydrothermal sediments, indicating formation by hydrothermal sedimentation. Compared with barren coals, Ge-rich coals are notably rich in Nb, Li, Sb, W, Bi and U and show substantial enrichment of HREE which increase with Ge. Ge-rich coals have the vitrinite reflectance generally higher than barren coals. They contain disseminated pyrites with $\delta^{34}S$ from 17.2‰ to 51.4‰, similar to the pyrites in barren coals, and thin vein-like pyrites with $\delta^{34}S$ from 1.9‰ to -5.4‰, similar to the sulfides in granite-related quartz veins. We propose that circulating hydrothermal fluids leached abundant Ge and other elements from Ge-rich granite in the basement, and then discharged into the basin mainly along fault intersections to form layer-like siliceous rocks and siliceous limestones by depositing Si and Ca, and to form germanium deposit through interaction between germanium in the fluids and organic matters in coal seams.

Acknowledgment

This study is supported by by Natural Science Foundation of China (grant 40634020 to Hu).

Oxygen and carbon isotope composition and implication of Early Palaeozoic dolomites in Keping, Tarim Basin

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In order to approach to the formation environment and fluid condition, carbon and oxygen isotopes are analyzed of Early Palaeozoic dolomite sequences in Keping, northwest of Tarim Basin, for the dolomite sequences are important reservoir rocks in the basin.

104 field dolomite samples were collected from the outcrop of Early Palaeozoic in Keping. This outcrop is consisted of algal dolomite, bedding dolomite, calcareous dolomite, and some limestone. Evaporates and many siliceous aggregates were found in the middle Cambrian, which might be related to special environments. In order to figure out variations of the isotopes in the samples with different composition and texture, micro-area sampling was conducted by Hand Grinder with 1mm in diameter. The analysis was performed on CF-IRMS in Nanjing University.

The isotopic result is mainly consistent with ancient seawaters of that age. The $\delta^{13}C$ of the samples ranges from -1.6‰ to 1.6‰, with an average of 0.515‰, and the $\delta^{18}O$ from -12.7‰ to -5.7‰, with an average of -7.23‰. The $\delta^{18}O$ varies larger in different samples than the $\delta^{13}C$, and the $\delta^{18}O$ become depleted with increasing ages. The $\delta^{13}C$ and $\delta^{18}O$ have relatively lower values in middle Cambrian dolomites. But they rise to -1‰ and -7‰, respectively, and become relatively stable in upper Cambrian and Ordovician dolomites. In addition, the obvious variation of the isotopes can be found between different algal dolomite layers in middle Cambrian, but such a variation becomes small in the younger algal dolomites in upper Cambrian and Ordovician.

The depleted $\delta^{18}O$ in middle Cambrian, most less than -10‰, is likely related to hydrothermal activity. On the other hand, evaporation process during middle Cambrian could make the ^{13}C and ^{18}O of the seawaters enriched, and the $\delta^{13}C$ and $\delta^{18}O$ rise in the related dolomites. Because the above two aspects had different constrains on the variation of the isotopes in the seawater, the $\delta^{13}C$ and $\delta^{18}O$ of middle Cambrian dolomites go up and down frequently. There was no effect of hydrothermal fluids and evaporation process in upper Cambrian and early Ordovician, and little variation of the $\delta^{13}C$ and $\delta^{18}O$ can be seen of the younger dolomites, just showing $\delta^{13}C$ of about -1‰ and $\delta^{18}O$ of about -7‰ consistent with the seawaters at that ages.

Acknowledgement

This work is supported by the foundation of the State Key Basic Research 973 Program of China (Grant No. 2005CB422103)