News and Highlights

Separation Technology of the World’s Only Chambersite Deposit Has Achieved A Big Breakthrough

HAO Ziguo1,2,*, FEI Hongcai1,2, HAO Qingqing3 and LIU Lian1,2

1 Chinese Academy of Geological Sciences, Beijing 100037, China
2 Editorial Office of Acta Geologica Sinica, Geological Society of China, Beijing 100037, China
3 Editorial Office of Geology and Exploration, Institute of Mineral Resources Research, China Metallurgical Geology Bureau, Beijing 101300, China

Chambersite is a rare mineral worldwide, a manganese chloride borate (Mn₂B₂O₇Cl), which was first discovered in the recovered brine from a salt dome at Chambers, Texas, USA. This rare mineral has been proven to have a great utilization value in anti-nuclear radiation, high-temperature friction materials, medicine and stealth materials, and can be used in aerospace and aviation fields. China has the world’s only mineable chambersite deposit in Jixian County, Tianjin.

There is a complete record of Meso-Neo-proterozoic strata in Beijing, Tianjin and Hebei Province in north China, which was referred to the Gaoyuzhuang Formation in 1934 (Kao et al., 1934). In 1954, primary sedimentary manganese ore deposits were discovered in these strata, followed by medium-sized lead-zinc and pyrite deposits. In 1971, the original Hebei Geological Brigade No. 11 first discovered abundant chambersite during the exploration of manganese ores in Dongshuichang Village, Jixian County, and considered to be manganese boron deposits. Because of its great hardness and transparency, this mineral was once ranked with the gem minerals.

Regionally, manganese boron ore occurrences have a wide distribution, which range from Pinggu County in Beijing, extending eastward through Jixian County to Qianxi, Lulong and Qinglong counties in Hebei. The ore-bearing rock series extends for 200 km intermittently, with a stable horizon, and rhodochrosite occurs in the margin of the surrounding ore-bearing belt.

Spatially, the rich orebodies encompass areas up to as large as 14.5 km, generally 1–4 km, averaging 2–2.6 km, with an average thickness of 0.25 m. The ores are poor in manganese and rich in boron, and occur as chambersite, with small amounts of boracite or borax. The chambersite often occurs at the bottom of the manganese seams (Fig. 1), and is white or light yellow in color. The ores tend to be oxidized into black psilomelane and pyrolusite, and therefore they need to be saved in a sealed condition. The ore minerals mainly include rhodochrosite and chambersite, followed by pyrite, hematite, magnetite, chalcopyrite, psilomelane, pyrolusite and limonite. The ore types include manganese oxides, rhodochrosite, chambersite-rhodochrosite, rhodochrosite-chambersite and chambersite. The chemical composition of the ores is: the average Mn grade is 16.37 wt%, as high as 31.01 wt%, and the average grade of B₂O₃ is 9.29 wt%, reaching up to 25.74 wt%. The ore amounts are 0.038 million tons of oxidized ores at an average Mn grade of 23.62 wt%, and 0.242 million tons of primary ores (chambersite ores) containing 14.11 wt% Mn and 9.39 wt% B₂O₃. The total ores amount to 0.38 million tons (equivalent to 333 class), and the prospective Mn and B reserves (equivalent to 334 class) are 1.10 million tons.

* Corresponding author. E-mail: haoziguo@126.com

© 2015 Geological Society of China
Previous researches have suggested that the Jixian County chambersite does not have a wider distribution than manganese, and that it generally occurs in areas with underlying volcanic rocks. The rhodochrosite and chambersite in Jixian County did not form in the same environment; the former deposited in a shallow sea, while the latter resulted from hydrothermal deposition due to volcanic eruption.

During recent years, relevant researches have been carried out on chambersite separation. The chemical method was first used to recover manganese and boron, but it had a low recovery and rate and a consequent poor economic effect. During 2014 to 2015, the Zhengzhou Institute of Mineral Comprehensive Utilization from the China Geological Survey has researched high-efficiency separation of chambersite. Based on the technological mineralogical characteristics of chambersite, the project first discarded a regrinding return through selective crushing, improving the grade of the primary ores from about 30% to greater than 50%, and sieved the ores into fine-grained, medium-grained, and coarse-grained ones by size sieving. The ores were then recovered based on grain size to avoid traditional grinding operations and save the dressing cost, i.e., fine-grained ores adopted flotation process, medium-grains adopted gravity sorting, and coarse-grained ores used scouring-sieving process. The fine-grained ores had a recovery rate up to 74.68% after sieving, and were then separated by flotation using different medicaments and dosages, with the grade of chambersite concentrates reaching as high as 91.52. The grade of chambersite concentrates for coarse-grained ores was 91.79%. The final mineral processing indices of chambersite are as follows: the grade of chambersite concentrates is 91.54%, and the overall recovery rate is 73.33%.

The success of this separation technology will provide strong technical support for the large-scale development and utilization of chambersite.

Acknowledgement

Thanks are given to Susan Turner for her improvement of English.

Reference