

LI Yiliang and TANG Min. 2014. Microbial Mediated Mineralization in Kamchatka Hot Springs. *Acta Geologica Sinica* (English Edition), 88(supp. 1): 185.

Microbial Mediated Mineralization in Kamchatka Hot Springs

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Materials deposited in low-temperature environments are characterized by their small particle size. The activity of microorganisms in aqueous sedimentary environments may have effective impacts on the geochemical parameters, which consequently change the original mineralogical records. The characterization of the fine environmental materials, especially those related to the microbial mediation are usually overlooked, but are essential for studies in the field of environmental microbiology or records of environmental change. The Kamchatka volcanic hot springs have been extensively studied for their microbiology because of their unique geological setting and applications to our understanding of life in the extreme environments.

In those hot springs, minerals commonly appear with various morphologies. The hot springs have been existed for 40,000 years. Authigenic minerals, such as clay minerals, silica, sulfur, sulfide, and sulfate were characterized. Two types of silica and silicified biota are observed. Elemental sulfur crystals are observed although they are thermodynamically unstable, implies the once existence of geochemical conditions for their stability. Pyrite and gypsum show high diversities in morphologies and crystal sizes. Single forms of pyrite crystals include: cube, pyritohedron, octahedron, and sphericities. Prismatic, prismatic pseudo-hexagonal, fibrous, tubular,

lenticular and twinned gypsum crystals are observed. The co-existence of diverse crystal habits of gypsum implies a long-term interaction between hot spring geochemistry and the metabolisms of the microbial community. The morphology of gypsum in hot springs is compared with that of gypsum with hydrothermal genesis in Lower Cambrian black shale. The crystallization of gypsum in the black shale of the Lower Cambrian was simply controlled by post-depositional hydrothermal fluids. We suggest that the high diversities of the morphology and crystal size of gypsum in those hot springs represent the continuous mediation of microorganism, which could be used as mineral ecophysiological records of life not only on Earth, but also on Mars.

Acknowledgements

This study was financially supported by Research Grants Council of Hong Kong (HKU 703911P).

References

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