The transformation and co-evolution of archaea with its environment assessed by energy quantum

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Archaea are believed as key players in the biogeochemical cycling of basic elements such as carbon, nitrogen, and sulfur in various environments, yet the physiology and functions of many of them remain largely unknown mainly due to difficulties in cultivation and lack of genetic manipulation systems. By the combined utilization of high pressure bioreactors, together with OMICS enabled metabolic potential analysis, synthetic biological technologies, and single cell capturing and sequencing methods, our group aims to reveal the physiology, evolution and functions of some important archaeal groups in the deep-sea environments. As examples, we will highlight our recent progress in the systematic investigation and genetic engineering of piezophilic/thermophilic Thermococcales strains pool from deep-sea hydrothermal vents; and some novel understandings on the physiology, evolution and metabolisms of methane oxidizing archaea-bacteria syntrophic consortia. We propose a "Coevolution and Energy Quantum" (CEQ) theory as a guidance for mathematic model construction to understand the interaction and co-evolution of life and environment.

Skarn Cu-Fe-Au deposits in the East Hubei ore cluster, Middle–Lower Yangtze River metallogenic belt

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The East Hubei ore cluster is one of most important skarn Cu-Fe-Au clusters in the Middle–Lower Yangtze River metallogenic belt(MLYR) because it contains >50 skarn Cu–Fe–Au deposits and over 800 km^2 of igneous rocks, which provides the best sample for studies on the origins of Late Mesozoic igneous and ore-forming event in the MLYR. With respect to mineral systems and metal associations, there are dominantly skarn Cu–Fe, Fe–Cu, Fe and Au deposits, which are all genetically associated with Late Mesozoic granitoids in the East Hubei.Previous studies mainly focused on individual skarn deposits, and comparatively studies among different skarn Cu-Fe-Au deposits have not yet been investigated.

There are similar compositions and mineral assemblages of skarn minerals, such as prograde garnet and pyroxene, among skarn Cu–Fe, Fe–Cu, Fe and Au deposits, and garnets and pyroxenes are dominantly andradite and diopside, respectively. In contrast, obviously differences between sulphur isotope and mineralized-related intrusions in different skarn types have been recognized: (1) The 137–144 Ma skarn Cu–Fe, Fe–Cu and Au deposits are genetically associated with 136–143 Ma diorite and quartz diorite, and the $\delta^{34}S$ of pyrites and chalcopyrites range from -8 to +12‰; while the 132–133 Ma skarn Fe deposits are genetically associated with 127–133 Ma diorite, quartz diorite and granite, and the $\delta^{34}S$ of pyrite range from +12 to +20‰. (2) The intrusions related skarn Cu–Fe, Fe–Cu and Au deposits show relatively high Sr/Y(25.1–201), and $(La/Yb)_N$(8.1–173), and low Yb contents(0.34–1.93ppm); whereas intrusions-related skarn Fe deposits show relatively low Sr/Y(0.66–75.3), and $(La/Yb)_N$(2.3–30.0), and high Yb contents(1.07–5.17ppm). It is proposed that the tionation of Cu, Fe and Au in the East Hubei ore cluster are possible related to different magma sources of intrusion and various evoporitic rocks involved in the formation of these skarn deposits.

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