MICROBIAL PHOPHATIZATION THROUGH DEEP GEOLOGICAL TIME AND ITS IMPLICATIONS TO SEARCHING FOR LIFE ON MARS. Y. -L. Li and S. Sun, Department of Earth Sciences, University of Hong Kong, Pokfulam Road, Hong Kong (yiliang@hku.hk; sunsi.hku@hku.hk).

Phosphorus is a vital nutrient element for all life forms to sustain their lives and make genetic materials. The biogeochemical cycling of phosphorus governs the primary productivity of aqueous ecosystems, and subsequently influence the environmental changes of Earth. For example, the enhanced input of phosphorus due to the formation of supercontinents (e.g., Superia/Sclavia Supercontinents at 2.75-2.6 Ga) resulted in algae/cyanobacteria blooms, which, in turn, led to atmospheric oxygen increases [1]. The interactions between the living world and geosphere could be archived in sedimentary rocks such as economically scaled phosphorites. Phosphatized fossils well preserved in the phosphorites rich in organics are robust evidence indicating the participant of biological processes.

However, before the onset of phosphorite deposition at ca. 2.2-2.0 Ga, the living world on Earth is an anaerobic world dominated by microorganisms with much lower primary productivities. In addition, the microorganisms are hardly fossilized via phosphatization. As a result, microbial phosphorus cycling before the great oxidation event (GOE, 2.45-2.32 Ga) is now still poorly understood. Phosphate (apatite), the main sequester of phosphorus, could be applied as an alternative proxy to understand biogeochemical cycling of phosphorus as well as microbial activities before GOE by comparison [2-4]. High resolution electron microscopic studies on phosphate (apatite) from Archean to Paleoproterozoic banded iron formations (BIFs) and Proterozoic to Lower Cambrian phosphorites reveal that their apatites are highly similar in terms of chemical compositions, structural patterns, sizes, morphologies and crystal habits. The apatites show micro-sized (4-8 μm) radial-flower patterns with centers made of nano-sized (~30-200 nm) crystals and petals made of apatite rods (Fig.1). The apatite rods are coated and linked by amorphous apatite films, a typical product precipitated in phosphorus-saturated solutions with the mediation of microbes. It can be inferred that the Archean to Paleoproterozoic BIFs probably had undergone a microbial phosphogenesis process similar to that for the younger phosphorites whose deposition was mediated by organisms.

Preservation of these apatites with easily recognizable features through such a deep geological time sheds lights on searching for mineralogical evidence of life on Mars. If microbial life ever existed on Mars, they should be similar to those on the early Earth. Since Martian surface environments much more favor the preservation of apatite due to their much milder dynamic processes, lower radiation damage and lower temperatures and pressures [5], apatite with similar structural patterns and mineralogical features could be found representing past life.

[1] Campbell I. H. and Allen C. M. (2008) *Nat. Geosci., 1,* 554-558. [2] Li Y. -L. et al. (2011) *Geology, 39,* 707-710. [3] Li Y. -L et al. (2012) Ecology & Evolution, 3, 115-125. [4] Sun S. et al. (2014) *Am. Min., 99,* 2116-2125. [5] Weckwerth G. and Schidlowski M. (1995) *Adv. Space Res., 15,* 185-191.

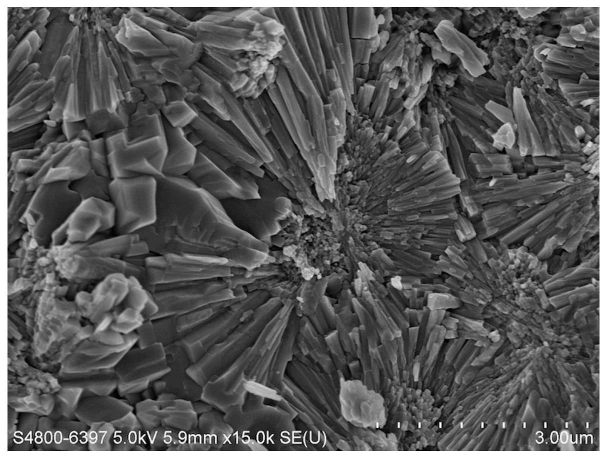

Fig. 1 Scanning electron microscopic image of radial flower-like apatite from the Neoproterozoic Kaiyang phosphorite in South China.