Volcanic source of phosphorus for Neoproterozoic Doushantuo phosphorites in the Three Gorge area, South China: Constraint from in-situ REE geochemistry

LIU-YI LU[1], DAO-HUI PI[1*], SHAO-YONG JIANG[1, 2*]

[1]State Key Laboratory of Geological Processes and Mineral Resources, Collaborative Innovation Center for Exploration of Strategic Mineral Resources, Faculty of Earth Resources, China University of Geosciences, Wuhan 430074, China. Email: 826397101@qq.com; daohuipi@cug.edu.cn

[2]State Key Laboratory for Mineral Deposits Research, Department of Earth Sciences, Nanjing University, Nanjing 210093, China. Email: shyjiang@nju.edu.cn

Previous studies have speculated that increased continental weathering rates following Neoproterozoic glaciations have promoted an increase in riverine delivery of Ca^{2+} and phosphorus [1]. This process might have led to wide occurrences of cap carbonates and subsequently huge amounts of phosphorite deposition in the shallow seas. However, there remain debates on the source of seawater alkalinity during the deposition of cap carbonates and phosphorites and also the phosphorus source and formation process of the banded structure of phosphorites that widely occurred in the Yangtze Platform of South China.

We used LA-ICP-MS technique to investigate in situ REE geochemistry of phosphatic grains and clay aggregates from both the phosphorite ores and intercalated clay layers from Neoproterozoic Doushantuo Formation in the Three Gorge area, South China. Results displayed a hat-type REE pattern for the phosphatic grains, but a seawater-type REE pattern for the clays. This difference indicated that REEs in the phosphatic grains should have not inherited from the clays, which is in contrast to the traditional view that REEs in phosphorites were sourced from terrestrial detritus through diagenesis. The clays may originate from continental margin volcanism, and get their seawater-like REE features through seawater-rock interaction. The phosphatic grains may gain their REE feature by diagenetic process with the phosphorus supplied from the same volcanism. Combined with a recent study [2], we propose a new genetic model for the Neoproterozoic phosphorites, invloving a shallow-water volcanic activity and subsequent precipitation of the banded phosphorus ores in the Neoproterozoic Doushantuo ocean in South China. [1] Papineau (2010) *Astrobiology* **10**, 165-181. [2] Gernon *et al.* (2016) *Nature Geosci.* **9**, 242-248.