Mineralogical evidence for intermittent shallow ocean oxygenation in the aftermath of the Marinoan glaciation

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The Doushantuo Fm (ca. 635-551 Ma) in South China is one important object to study the oxidation events in Ediacaran ocean [1,2]. Lack of mineralogical record makes it difficult to confirm timing and meaning of these ocean oxidation events [3]. Here we report a flower-like structure (Fig. 1) with pyrite as core, marcasite as petals, several minerals as filling materials, that are hereon referred to as Pyrite-Marcasite Rosettes (PMRs), occurring in the lower part of Doushangtuo Fm (Weng'an, South China). As pyrite generally forms from aqueous solutions with pH of 6~7, whereas marcasite growth is favored at pH of 4~5 [4], considering that the aqueous pyrite oxidation can lead to drop of pH [5], the formation of the PMRs is interpreted as a result of pore water acidification caused by pyrite oxidation. Pulsed oxygenation of the phospogenic shallow ocean likely has resulted in rises of O_2 in the bottom water and surfacial sediments, which in turn led to the oxidation of previously formed pyrite [6]. The Doushantuo PMRs thus provide evidence for intermittent shallow ocean oxygenation events after the Marinoan glaciation.

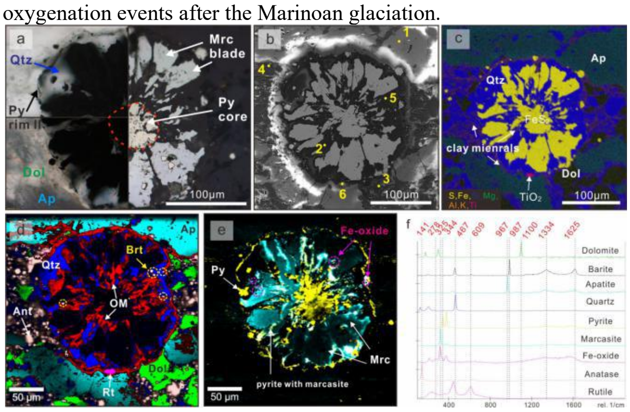

Figure 1: Correlative Raman-SEM analysis on the typical PMR. a), Plane polarized transmitted light image (left) and reflected light image (right) of the target. b), BSE image; c), EDS map; d), Raman map showing different mineral phases; e), Raman map showing the Fe-bearing phases; f) Raman spectra of the minerals in (d) and (e).

Py, pyrite; Mrc, marcasite; OM, organic matter; Dol, dolomite; Brt, barite; Ap, apatite; Qtz, quartz; Ant, anatase; Rt, rutile.

[1] McFadden et al. (2008) *PNAS* **9** 3197-3202. [2] Sahoo et al. (2012) *Nature* **489** 546-549. [3] Shields-Zhou & Och (2011) *GSA Today* **21** 4-11. [4] Schoonen & Barnes (1991a,b,c) *GCA* **55** 1495-1514, 3491-3504. [5] Chandra & Gerson (2010) *Surface Science Reports* **65** 293–315. [6] Schieber (2011) *JSR* **81** 447-458.