Positive carbon isotopes of synglacial carbonate from the Cryogenian Talisay Formation (northwestern China) suggesting synglacial active marine productivity

Jiajun Wang*[1], Shihao Fu[1], Ruiming Wang[1], Tianzheng Huang[1], and Bing Shen†[1]

[1]Key Laboratory of Orogenic Belts and Crustal Evolution, MOE, School of Earth and Space Science, Peking University, Beijing 100871, China. – China

Abstract

The canonical Snowball Earth hypothesis argues that the Earth has been frozen globally for tens of millions of years, while the Slushball or Waterbelt hypothesis suggests incomplete freezing with the presence of a water belt in tropics. These two scenarios can be tested by synglacial (bio)chemical depositions, e.g., carbonate, which record the marine geochemical compositions during the global glaciation. The freezing over of the ocean, as proposed by the Snowball Earth hypothesis, prevented or dramatically retarded the surface ocean productivity, and thus the marine dissolved inorganic carbon (DIC) would have the carbon isotopic composition (δ13CCarb) of the mantle value (-5‰). As such, carbonate within glacial deposits, if not detrital or diagenetic, with higher δ13CCarb values would imply synglacial marine productivity and organic C burial, which is unlikely to have occurred in a Snowball Earth condition. In this study, we report bedded dolostone from the Talisay Formation in the Guozigou area of Xinjiang, northwestern China. The Talisay Formation is the youngest glacial deposition among the three glacial records in this area. Traditionally, it was interpreted as an Ediacaran glaciation, but a U-Pb zircon age of 642 +/- 5 Ma from an intrusive granite-porphyry vein in the top of Talisay Formation confirms a Cryogenian, likely the Marinoan glaciation instead. A _˜4-m thick carbonate layer is discovered within massive diamictite in the upper part of the Talisay Formation. Unlike Cryogenian cap carbonate, this carbonate layer within glacial diamictite has positive δ13CCarb values ranging from 0‰ to 1‰. It is suggested that the synglacial ocean might have sustained primary productivity as well as substantive organic C burial. Thus, our study strongly argues for the presence of open ocean during the Cryogenian global glaciation.

Keywords: Cryogenian, Marinoan ice age, snowball Earth, Guozigou, carbonatite carbon isotopes, biological activities

*Speaker

†Corresponding author: bingshen@pku.edu.cn