

Problems on the Neoproterozoic ice ages: working hypotheses and their testing

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Many enigmatic features are associated with the Neoproterozoic glaciations. The problematic features include global occurrence of glaciogenic deposits, paleomagnetic data suggesting their low-latitude depositions, the deposition of thick carbonate sequences just above the glaciogenic deposits (so called cap carbonates), large negative excursions of carbon isotope ratios within the cap carbonates, and occasional association of banded iron-formations within the glaciogenic deposits. These features have been postulated to be reasonably explained by the snowball Earth hypothesis. On the other hand, students who could hardly imagine the entirely ice-covered Earth have proposed alternative hypotheses such as oddball Earth, slashball Earth or the upwelling of the stratified ocean. According to the snowball Earth hypothesis, the ice ages were synchronous over the globe. This suggests that the hypothesis could be tested by the improvement of geochronological studies of glaciogenic deposits or overlying cap carbonates. This hypothesis also could be tested by the geochemistry and sedimentation rates of cap carbonates. On the other hand, according to the slashball Earth, massive dissolution of submarine methane hydrates should be responsible for the negative excursion of the carbon isotope ratios printed in the cap carbonates. The sedimentological and geochemical studies of the cap carbonates with unique gas-escape textures should provide critical data for discussion on the origin of the cap carbonates. The above hypotheses would be discussed on the basis of our previous data and those newly obtained by the field study conducted in the Otavi area, Namibia in summer, 2001.