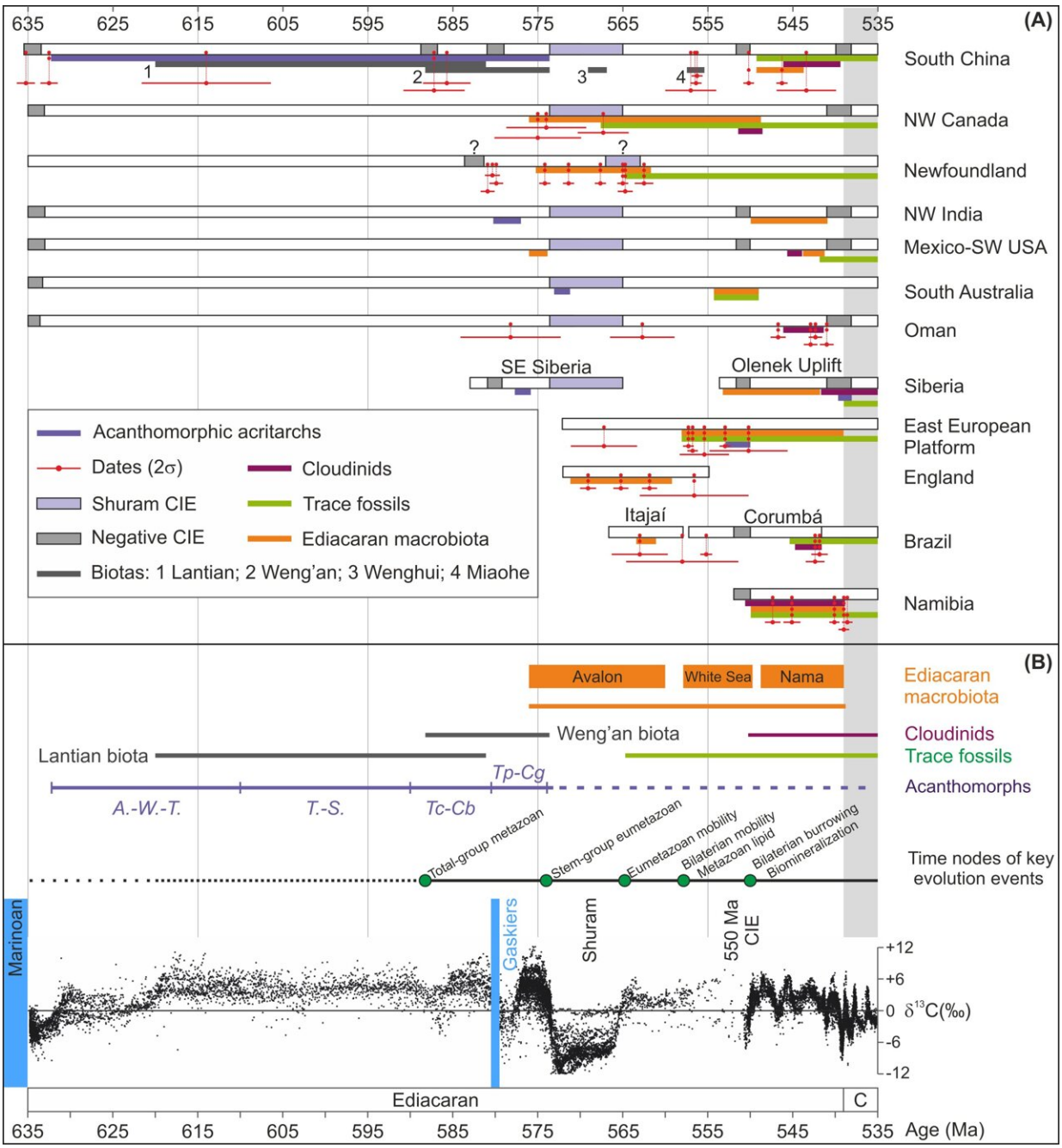
High-precision geochronology reveals high-resolution Ediacaran timescale

November 3 2021



Integrated radioisotopic dates, fossil ranges, and carbon isotopic profile of the Ediacaran Period. Credit: NIGPAS

Researchers led by Prof. Zhu Maoyan from the Nanjing Institute of Geology and Palaeontology of the Chinese Academy of Sciences (NIGPAS) and their collaborators from the UK, the USA, and Russia have proposed new radioisotopic dates for Ediacaran successions in South China and the White Sea area.

The new dates provide age constraints for both the Ediacaran fossil assemblages and the carbonate carbon isotope perturbations.

Their study was published in *Science Advances* on Nov. 3.

The Ediacaran Period is a pivotal period in Earth history, archiving the rise of complex macroscopic life. This evolutionary milestone occurred in the aftermath of extreme climate perturbations, the Cryogenian snowball Earth events, and amid dramatic changes in the global carbon cycle and ocean redox conditions.

These perturbations, including the Shuram event, which is the largest magnitude negative carbon isotope excursion in Earth history, have been documented worldwide, and are commonly employed to establish regional to global stratigraphic correlations.

However, there is a lack of a chronostratigraphic framework at sufficient resolution for testing hypotheses related to the tempo, magnitude/duration of the events (especially the Shuram), their global expression, and their co-relationship with biospheric evolutionary

innovations.

The Upper Ediacaran is characterized by typical Ediacara-type fossils. Three assemblages of fossils have been recognized: the Avalon, White Sea, and Nama.

The age ranges of the Avalon and Nama assemblages have been constrained at 575–560 Ma and 550–539 Ma, respectively. New dates from the study indicate that the White Sea assemblage spans a time interval starting earlier than 557 Ma and ending later than 553 Ma. The age constraints on these three fossil assemblages can facilitate our understanding of evolution in the Late Ediacaran.

New dates from South China also provide age constraints for the Doushantuo acanthomorphic acritarchs, Weng'an biota, Wenghui biota, Miaohe biota, and Ediacara-type fossils in the Dengying Formation.

The terminal timing of the Shuram event was constrained at 551 Ma. However, the lack of high precision radioisotopic dates and the complexity of local stratigraphy have given rise to much debate about the number of negative carbon isotope excursions in the late Ediacaran and the age of the Shuram event.

The new dates indicate that there are two negative carbon isotope excursions in the 575–550 Ma period. The older, long-lasting one is the Shuram event, and the younger, short-lived one occurred 550 Ma.

The researchers also compiled a global Ediacaran geochronology database and suggested that the Shuran event occurred between 575 Ma and 565 Ma, with an uncertainty on the order of a few million years. Another short-lived negative carbon isotope excursion, which is locally called WANCE in South China and is older than the Shuram event, is dated at ~587 Ma.

The proposed Ediacaran age model for the carbon cycle perturbations and fossil records provides the necessary chronometric context to test causal relationships, if any, between them. At the current resolution, these transitions in the fossil record coincide with the carbonate carbon isotope excursions, suggestive of a potential causal relationship between environmental perturbations recorded in the carbon cycle and biological turnovers.

More information: Chuan Yang et al, The tempo of Ediacaran evolution, *Science Advances* (2021). DOI: 10.1126/sciadv.abi9643. www.science.org/doi/10.1126/sciadv.abi9643

Provided by Chinese Academy of Sciences