

## Rock magnetic chronostratigraphy of the Shuram carbon isotope excursion: Wonoka Formation, Australia

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Cui (2017) explores two potential caveats affecting the conclusions of our recent rock magnetic chronostratigraphy of the Shuram Excursion (Minguez and Kodama, 2017). The main conclusion from our study is that the Shuram Excursion was a globally synchronous event that lasted ~8 m.y. Given those chronostratigraphic constraints, certain geochemical models having testable chronostratigraphic parameters were eliminated. Diagenesis was also regarded as unlikely, assuming a post-depositional mechanism as proposed by Derry (2010).

The first potential caveat raised by Cui is the “veracity” of the magnetic signals measured in our study. Specifically, Cui observes that in stratigraphic sections from South China, the primary paleomagnetic signal has been lost either by later thermoviscous remanent overprinting (Gong et al., 2017), or dissolution of magnetite by sulfide reduction (Macouin et al., 2012). And thus, he states that our results are in question. Of course, the geologic factors affecting the preservation of paleomagnetic remanence in China should not be extrapolated to South Australia. Our results show that hematite was the primary remanence carrier in the Wonoka Formation of South Australia. Hematite has a significantly higher unblocking temperature than magnetite (~680 °C versus ~580 °C), and in our samples, a consistent overprint was routinely removed, revealing a stable high unblocking temperature remanence. That remanent magnetization passes the fold test (Schmidt and Williams, 2010), indicating it predates the Late Cambrian Delamerian orogeny. In other words, the directions are ancient. Furthermore, the stratigraphic pattern of directions yields a reversal stratigraphy that is reproducible in Death Valley (California, USA) and, coarsely, in Brachina Gorge which is near our study locale (Schmidt and Williams, 2010). This result further fortifies the conclusion that the directions are ancient and, importantly, record global geomagnetic polarity transitions. In short, the limitations of the paleomagnetic recorders in South China are not an adequate basis to cast doubt on the results from South Australia.

The second potential caveat raised by Cui is that an early diagenetic origin for the Shuram Excursion does not conflict with global synchronicity, or our estimated duration. This may be the case. Cui indicates that a global rise in atmospheric oxygen and/or seawater sulfate concentrations could serve as a trigger for a global diagenetic event. Indeed, we suggested that the former case should be reconsidered (Minguez and Kodama 2017). The specific diagenesis scenario that we consider unlikely is presented by Derry (2010), in which the interaction of meteoric waters and buried carbonate yields a globally synchronous anomaly profile. Derry’s proposed mechanism can match the range of Shuram isotopic values. However, to our knowledge, it has not been demonstrated how such a mechanism would produce an asymmetric isotopic profile that scales chronostratigraphically in multiple, globally separated localities.

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