

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

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The Ediacaran Shuram Excursion represents the largest carbon isotope negative anomaly in Earth history (Grotzinger et al., 2011). However, its duration still remains poorly constrained. Recently, Minguez and Kodama (2017) constructed magnetic chronostratigraphy for the Wonoka Formation in Australia and proposed an estimate of ~8 m.y. for the Shuram Excursion. Based on their results, the authors argued that the Shuram Excursion cannot be formed by diagenesis in marine environments. Minguez and Kodama provide interesting insights through a paleomagnetic perspective, which represents an important contribution in the study of the Shuram Excursion. Based on this study, I would like to stress some of the critical yet undiscussed aspects to help readers better understand the origin of the Shuram Excursion.

First, the primary magnetic signals of the carbonates within the Shuram Excursion may have been lost during early diagenesis, therefore the veracity of the measured magnetic signals by Minguez and Kodama remains questionable. An increasing number of studies have reported that carbonates within the Shuram Excursion are mixed with methane-derived authigenic carbonates in different proportions by microbial sulfate reduction (MSR) and anaerobic oxidation of methane (AOM) during early diagenesis (Macouin et al., 2004; Ader et al., 2009; Macouin et al., 2012; Kaufman et al., 2015; Furuyama et al., 2016; Cui et al., 2017). Based on these important sedimentological observations, the Shuram Excursion may represent a globally synchronized early diagenetic event in basins along the continental margins (Schrage et al., 2013; Cui et al., 2017; Li et al., 2017). The timing of such authigenic mixing is debatable, which can be either primary in water columns (Fike et al., 2006; Kaufman et al., 2007; Bjerrum and Canfield, 2011), or during early diagenesis via syndeposition (Ader et al., 2009; Schrage et al., 2013; Husson et al., 2015; Kaufman et al., 2015; Cui et al., 2017). Notably, paleomagnetism studies of the Shuram Excursion in South China have already reported that alteration of primary geomagnetic signals occurred due to early diagenetic dissolution of magnetite by sulfide via MSR (Macouin et al., 2012) or a late-stage remagnetization event (Gong et al., 2017). Therefore, studies that use the measured geomagnetic signals of the Shuram Excursion to directly infer primary paleomagnetism should be taken with great caution.

Second, Minguez and Kodama precluded the diagenetic origin for the Shuram Excursion based on a global synchronicity of the Shuram Excursion. It should be noted that an early diagenetic origin for the Shuram Excursion does not inherently conflict with the global synchronicity and their estimate on the duration of the Shuram Excursion. If the trigger of such diagenetic event was initiated at a global scale, then the Shuram Excursion can be both locally expressed and globally synchronized (Grotzinger et al., 2011; Schrage et al., 2013; Kaufman et al., 2015; Zhou et al., 2016; Cui et al., 2017; Li et al., 2017). Such a trigger may be a global rise in atmospheric oxygen (Fike et al., 2006) and/or seawater sulfate concentrations (Fike et al., 2006; Cui et al., 2017). Therefore, we suggest that Minguez and Kodama reconsider the role of diagenesis, particularly early diagenesis during syndeposition, in generating the Shuram Excursion.

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