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Reply

Reply to the comment by Retallack et al. (2023) on "Stinging News: 'Dickinsonia' discovered in the Upper Vindhyan of India not worth the buzz"

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1. Introduction

We are delighted to learn that Retallack et al. (2023) agree with our conclusion regarding the remains of an *Apis dorsata* nest which they mistakenly identified as the Ediacaran fossil *Dickonsonia tenuis* (Meert et al., 2023; Retallack et al., 2021; Retallack et al., 2023). The *mea culpa* by Retallack et al. (2023) is admirable. The classification of Ediacaran fossils based exclusively on morphology, especially when they cannot be directly sampled, requires caution. A recent submission by Pandey et al. (2023) offers additional support for our earlier conclusion that the purported fossil is of recent origin.

Retallack et al. (2023) dismissed our arguments about the positioning of the 'fossil' noting that *Dickinsonia* fossils sometimes can curve, bend or cross-cut bedding planes (Gehling et al., 2005; Evans et al., 2015; Runnegar, 2022). We accept this observation; however, those arguments are moot in this case because the 'fossil' is positioned on a recent fracture plane where a large piece of rock was detached from the roof. To the best of our knowledge, there is no case of *Dickinsonia* fossils forming along a Neozoic tilted fracture plane. Pandey et al. (2023) later confirmed our observations regarding the positioning of the fossil.

Retallack et al. (2023) mistakenly claim that *Tribrachidium heraldicum* and *Albumares brunsae* were found in the Maihar Sandstone (Upper Vindhyan) referencing the paper by Parihar et al. (2023). That paper focused on the Sonia Sandstone in the Marwar Basin which is located ~ 600 km to the northwest, in a spatially and temporally separate sedimentary basin (Meert and Pandit, 2015). Although the fossils reported by Parihar et al. (2023) are poorly preserved, the Marwar Basin is most certainly of Ediacaran-Cambrian age (Pandit et al., 2001; Kumar and Pandey, 2009; McKenzie et al., 2011; Srivastava, 2012; Meert and Pandit, 2015; Lan et al., 2020; Ansari and Pandey, 2021; Xu et al., 2022). Therefore, it is not at all clear that data from the Upper Vindhyan reveals anything about the connection between India and Australia as claimed by Retallack et al. (2021, 2023). Furthermore, the paleomagnetic pole from the Marwar Basin is significantly different from the Bhander-Rewa pole (Davis et al., 2014).

The formation of Gondwana progressed piecemeal following the breakup of the supercontinent Rodinia. The final assembly of Gondwana took place between ~ 550–520 Ma (Meert and Van der Voo, 1997; Meert, 2003; Meert and Lieberman, 2008; Mitchell et al., 2010; Oriolo et al., 2017). Retallack et al. (2023) repeat their claim of 'close biogeographic links' between Australia and India, based on the occurrence of similar Ediacaran fossils in the Marwar Basin (MB; India), the Flinders Ranges (FR; S. Australia) and Central Australia (CA). We note here that in a fully assembled Gondwana, the regions containing Ediacaran fossils (MB, FR,CA) are separated by ~ 45° (~5000 km). Any proposed biogeographic linkage between India and Australia based on Ediacaran fossils present in the MB, FR and CA is weak since Laurentia, Baltica and Siberia share many similar taxa.

Retallack et al. (2021, 2023) rejected the True Polar Wander (TPW) reconstruction of Torsvik and Cocks (2013), based on a misunderstanding of paleogeographic reference frames. The TPW reference frame (mantle-frame) is used to trace deep-mantle and surface processes, such as kimberlites and Large Igneous Provinces (LIPs) assuming that the Earth's rotation axis is fixed. The paleomagnetic reference frame accounts for shifts in the spin axis (TPW) and plate motion and is therefore used to estimate paleolatitude. As noted by Torsvik and Cocks (2013), the paleomagnetic reference frame MUST be used to ascertain biogeographic or climatic zonation.

We turn to the assertion that *Cloudina* can be used to test the validity of Gondwana reconstruction (Retallack et al., 2021; 2023). We show two possible paleomagnetically based reconstructions (Fig. 1) using the 547 Ma Sinyai Dolerite (Africa) virtual geomagnetic pole (Meert and Van der Voo, 1996) and the Upper Arumbera (Australia) paleomagnetic pole (Kirschvink, 1978). Superimposed on those reconstructions are the known occurrences of *Cloudina* as summarized in Adorno (2019). Both demonstrate a broad geographic range of *Cloudina* that does not appear to be latitudinally restricted.

The age of the Bhander-Rewa groups, despite claims by Retallack et al. (2021, 2023), remains contentious. We, along with many others, have discussed the Upper Vindhyan age controversy

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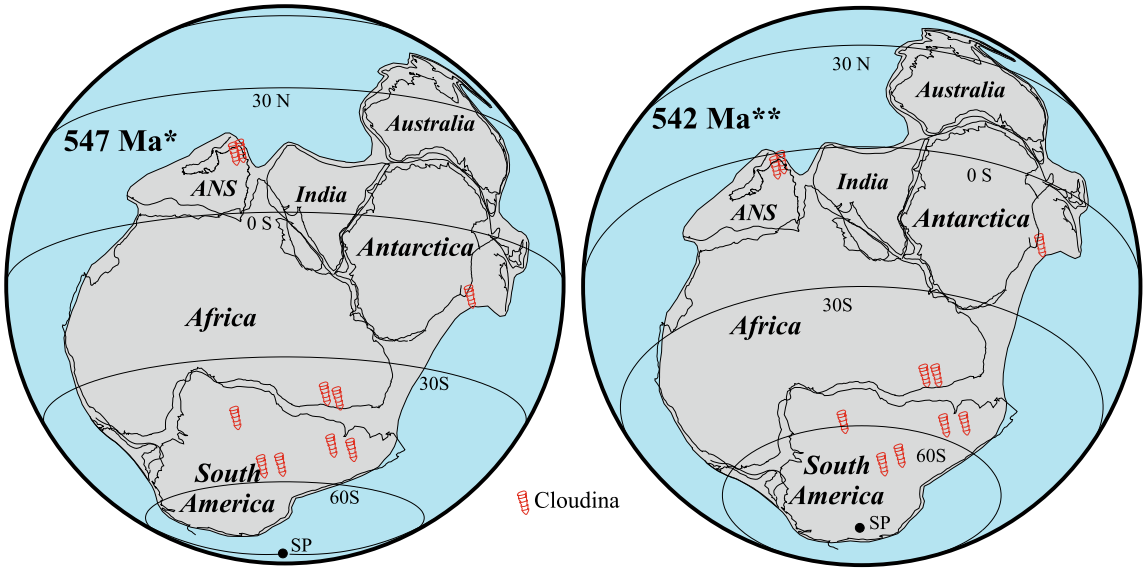

Fig. 1. (a) Gondwana positioned according to the virtual geomagnetic pole from the Sinyai dolerite (Africa, western Gondwana; Meert and Van der Voo, 1996). Documented locations of *Cloudina* are shown based on the data provided in Adorno (2019). Rotation parameters for the Gondwana blocks according to Lottes and Rowley (1990). Gondwana was then rotated through an euler pole located at 0° N, 49° E, +61°. (b) Gondwana positioned according to the virtual geomagnetic pole from the Upper Arumbera (Australia, eastern Gondwana; Kirschvink, 1978) along with occurrences of *Cloudina*. Rotation euler pole for reconstructed Gondwana at 0° N, 62.8° E, +52.1°.

at length and look forward to resolving this long-lived debate (Malone et al., 2008; McKenzie et al., 2011; Turner et al, 2014; Davis et al., 2014, Meert and Pandit, 2015, Basu and Bickford, 2015, Meert et al., 2021).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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