Forum Reply

doi:10.1130/G37740Y.1

Mesoproterozoic Tasmania: Witness to the East Antarctica-Laurentia connection within Nuna

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Our detrital zircon U-Pb-Hf isotopic data and paleocurrent indicators from the lower-middle Rocky Cape Group (RCG) of northwest Tasmania, a >10-km-thick package of marine sedimentary rocks, are consistent with a provenance including basement terranes in the southern Mawson continent (East Antarctica) and southwest Laurentia, supporting a SWEAT-like configuration for the supercontinent Nuna between 1.45 and 1.3 Ga (Mulder et al., 2015). Moore and Betts (2016) challenge our proposed paleogeographic position for Tasmania within Nuna. Instead, they champion an alternative position for Proterozoic Tasmania that they claim better fits elements of Tasmanian geology outside of the RCG (Moore et al., 2015). From the outset, we would like to reiterate that the data and paleogeographic reconstruction presented us were discussed in the context of the Nuna supercontinent and based on the most recent reconstruction by Pisarevsky et al. (2014). We specifically addressed the interval 1.45–1.3 Ga, which encompasses the period in which Nuna started to rift and break apart. Nowhere do we address the reconstructed position of VanDieland—a microcontinent that includes rocks as young as Cambrian, and represents Tasmania (and central Victoria, South Tasman Rise, and East Tasman Plateau) just prior to incorporation into Gondwana (Cayley, 2011). Although most of the points raised by Moore and Betts are not directly relevant to the dataset and reconstruction in our paper, we welcome the opportunity to elaborate on our ongoing research on the Proterozoic tectonics of Tasmania by addressing the issues they have raised.

Moore and Betts claim that we have "failed to recognize the significance of Grenville-age orogenic and sedimentary events" in our reconstruction. Not only is this statement incorrect (see the final sentence of Mulder et al., 2015) but the magmatism and metamorphism known from the east South Tasman Rise post-dates the time period considered by us by 200–300 m.y. and therefore cannot be used as a direct constraint on Tasmania's position within Nuna.

Similarly, whether the youngest detrital zircon population in the Jacob Quartzite of ca. 1.2 Ga or 1 Ga is favored, the maximum depositional age of the upper RCG (and the <900 Ma Wings Sandstone) post-dates the 1.45–1.3 Ga time frame considered by us. There is limited evidence to suggest that these strata are related to the Grenville orogenic cycle, as claimed by Moore and Betts. Only once minimum depositional ages for the upper RCG and Wings Sandstone are better understood can a source for the <1.3 Ga detrital zircons they contain be offered within the context of time-appropriate plate reconstructions. This is a current focus of our work on Proterozoic Tasmania.

Moore and Betts propose that an inferred middle to late Paleoproterozoic age for the basement of the RCG is inconsistent with our proposed reconstruction. They follow Black et al. (2010) who interpret an excess of 1.6–1.63 Ga inherited zircons in Paleozoic granites in western Tasmania relative to the overlying RCG as reflecting the age of the underlying basement. However, the most recent data (compiled in Mulder et al., 2015, our figure 4) demonstrate that 1.6–1.63 Ga detrital zircons are common in the RCG, and therefore inherited zircons of this age in Paleozoic granites do not necessarily reflect the age of the underlying basement. We agree "too few Sm-Nd model ages of the basement [of Tasmania] have been determined to make statistically valid comparisons with other regions" (Moore et al., 2015). However, contrary to their assertion, we do not place Tasmania near the USA–Canada border. Our preferred position is close to modern-day Arizona in the USA, and the Miller Range in Antarctica, which is in fact consistent with a Paleoproterozoic basement age for the RCG. Given the uncertainties in the age of the basement to the RCG and hence the position of Tasmania along the margin of the Mawson continent at 1.45–1.3 Ga, we also chose to speculate on an alternative position for Tasmania (Mulder et al., 2015, our figure 2) to highlight geochronological commonalities in the RCG and Belt-Purcell basins (Halpin et al., 2014).

In summary, Moore and Betts refute the reconstructed position of Tasmania in Nuna at 1.45 Ga presented by us primarily because it is not constrained by geology younger than ca. 1.1 Ga. They suggest that the reconstruction of Moore et al. (2015) depicting Tasmania's position at 780 Ma is a more suitable model for "Nuna/Rodinia." While we consider the schematic position of Tasmania in Moore et al. (2015) as being plausible for Rodinia, their reconstruction lacks any constraints on Tasmania's position within Nuna at 1.45–1.3 Ga. We conclude by highlighting a key question arising from this discussion: why do reconstructed paleogeographies for Tasmania at both 1.45–1.3 Ga (Mulder et al., 2015) and 780 Ma (Moore et al., 2015) appear to be so similar? Answering this question will provide important insights into the tectonic transitions during the supercontinent cycle between Nuna and Rodinia, and is a subject of our ongoing work on the Proterozoic of Tasmania.

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