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Geochemistry and high-precision zircon U-Pb geochronology of the Nama Group reveal foundational uncertainties in terminal Ediacaran chronostratigraphy

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The late Ediacaran Nama Group of southern Namibia and northwestern South Africa hosts the most well-dated mixed carbonate-siliciclastic Proterozoic succession and is key for resolving the chronology of early metazoan evolution. Important outcrops of the upper Nama Group are found in the Swartpunt area, where an allochthonous sequence is preserved across a series of thrust plates. Here, numerous silicified volcanic tuff interbeds are present, but different interpretations regarding the fidelity of associated tuff bed ages result in different regional stratigraphic correlations. We use geological mapping, integrated with lithostratigraphy, carbonate carbon isotope ($\delta^{13}C_{carb}$) chemostratigraphy and high-precision radioisotope geochronology from outcrop and recently acquired drill core from ICDP GRIND-ECT (Geological Research through Integrated Neoproterozoic Drilling – Ediacaran-Cambrian Transition) in an attempt to address this issue. A compilation of new and published zircon U-Pb ages from the Swartpunt area shows systematic age repetition within the upper Nama Group, that either reflects pervasive zircon reworking or points to the presence of a cryptic décollement. We investigate the evidence for and against both scenarios, and consider their implications for stratigraphic and $\delta^{13}C_{carb}$ correlations between the Swartpunt area and coeval autochthonous exposures along the Orange River border with South Africa.

The first scenario implies that some published ash bed ages may be >1 Myr older than their depositional age, increasing the uncertainty of the chronostratigraphic correlation between these two areas by up to 0.22% of the age compared with an analytical uncertainty as low as ±0.02% derived from the youngest coherent zircon populations. If this scenario is preferred, then a cautious approach would be to consider all ash bed zircon U-Pb ages to reflect maximum depositional ages, thereby highlighting an insidious complication for calibrating rates of paleoenvironmental change and biotic innovation at the dawn of the Cambrian explosion. Given that these issues are revealed in an area that benefits from numerous silicified ash beds and extensive exposure, the inability to confidently discount either scenario highlights a level of compounding uncertainty in stratigraphic correlation that must be carefully considered when constructing global chronostratigraphic frameworks in any interval of the geologic record.