Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16142

# More than just an age - U-Pb dating of Neoarchean carbonates

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The >2.5 Ga Campbellrand platform (South Africa) is one of the best-preserved carbonate archives for studying Neoarchean marine environments. These carbonates contain abundant evidence of early microbial life forms, such as microbialites encased in herringbone calcite or dolomitized stromatolites. The latter are fabric-retentive dolomites that preserve stromatolitic meso-structures and fine micro-textures (e.g., peloids) and have been considered as products of early dolomitization. Herringbone calcite textures were interpreted as a syndepositional marine precipitate that filled primary voids in the microbialite framework. Due to its apparent primary origin and unique petrographic characteristics, geochemical signals measured in herringbone calcite are often thought to reflect Precambrian marine environments. However, the ability of herringbone calcite to retain primary compositions is based mainly on petrographic evidence, and post-depositional alteration of geochemical signals in these fabrics remains a possibility.

Here we use fabric-specific laser-ablation ICP-MS U-Pb dating of carbonate minerals from two outcrops in the Campbellrand platform: the ~2580 Ma Reivilo formation (section W1) and the 2521±3 Ma Gamohaan formation (section W2). U-Pb ages of dolomite fabrics from both sections scatter between 1569±214 to 3032±295 Ma and 1636±315 to 2513±235 Ma, respectively. Most dolomite ages are younger than their expected stratigraphic age, suggesting that the U-Pb system in these dolomites was reset long after deposition. In contrast, herringbone calcite fabrics from the same hand samples as W2 dolomites yield U-Pb ages that cluster around a mean of 2402 (±84) Ma. These ages demonstrate that despite the expected sensitivity of calcite to alteration, herringbone calcite has remained closed with respect to the U-Pb system throughout most of its history. Our results support previous interpretations of herringbone calcite being a primary recorder, emphasizing its exceptional value as a window to the shallow marine environments of the Neoarchean.