

Geochronological Constraints from the Ghaub Formation, Namibia: Implications for the Timing of Marinoan Glaciation

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The Neoproterozoic succession of Namibia contains an exceptionally well preserved carbonate and glacial sedimentary record. Two glacial units, the Chuos and the Ghaub formations, have been correlated to the global Sturtian and Marinoan episodes, respectively. These correlations are based on lithofacies similarities of post-glacial cap carbonates, overall physical stratigraphy and positive - negative carbonate C isotopic excursions associated with both intervals. A third positive (up to +11 % VPDB) excursion and subsequent sharp decline in ¹³C values occurs in the post-Ghaub carbonate rocks of the upper Tsumeb Subgroup.

Dropstone-bearing glaciomarine sedimentary rocks of the Ghaub Formation within metamorphosed Neoproterozoic basinal strata (Swakop Group) in central Namibia contain interbedded mafic lava flows and thin felsic ash beds. U-Pb zircon geochronology of an ash layer associated with mafic volcanic rocks within basinal dropstone-bearing strata of the Ghaub Formation provides a reliable age of 635.5 ± 1.2 Ma for the deposition of the glaciomarine

sediments (Hoffmann et al., 2004). We interpret this age as constraining the timing of the Ghaub glaciation, providing an age for what has been described as a “Marinoan-type” glaciation. In addition, this age provides a maximum limit for the proposed lower boundary of the Terminal Proterozoic (Ediacaran) System and Period. Combined with reliable age constraints from other Neoproterozoic glacial units - the ca. 713 Ma Gubrah Member (Oman) and the 580 Ma Gaskiers Formation (Newfoundland) - these data provide unequivocal evidence for at least three, temporally discrete, glacial episodes during the Neoproterozoic. Furthermore, we suggest that the upper Tsumeb Subgroup ^{13}C decline and overlying base Mulden unconformity as a proxy of the 580 Ma Gaskiers glaciation indicates that the interglacial periods, with maximum durations of ~50–80 Myr, were characterized by prolonged positive $\delta^{13}\text{C}$ excursions.

Reference

Hoffmann, K.H., Condon, D.J., Bowring, S.A., and Crowley, J.L., 2004, in press. U-Pb zircon date from the Neoproterozoic Ghaub Formation, Namibia: Constraints on Marinoan glaciation. *Geology*.