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Origin of carbonate platform islands in the Chobe Enclave of northern Botswana: a stable and clumped isotope perspective

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The ubiquitous carbonate deposits in largely siliceous, sandy sedimentary basins of the Chobe Enclave are still a matter of debate [1, 2]. These deposits commonly occur as carbonate platform "islands" of variable sizes, occasionally interbedded with diatomite. They are thought to be of palustrine origin as they are commonly surrounded by ephemeral rivers that may terminate in seasonal lakes flooding with variable frequencies such as Lake Linyanti. Optically stimulated luminescence dating of these continental deposits suggests that they are erosional relicts formed in response to regional paleo-hydrological changes related to Late Cretaceous to Early Pleistocene uplift and large-scale block faulting within the Kalahari Basin. To help constrain their origin, we have measured the C and O stable isotope ($\delta^{13}C_{VPDB}$, $\delta^{18}O_{VSMOW}$) and clumped isotope compositions (δ^{47} and Δ_{47}). The range in C-isotope compositions of -6.7 to +0.8‰ (avg. -3.2‰, 1σ = 1.8‰, n = 54) is compatible with carbonate formation from dissolved inorganic carbon dominated by atmospheric CO_2 with lesser contributions of respired CO_2 from a mixed C_3/C_4dominated vegetative cover. O-isotope compositions have a range between 24.3 and 31.3‰ (avg. 28.4‰, 1σ = 1.3‰, n = 54), while clumped isotope compositions have an average Δ_{47} of 0.701 (1σ = 0.010, n = 24), corresponding to crystallization temperatures of 22.0°C (1σ of 3.1°C), similar to average annual temperatures measured for northern Botswana today. The $\delta^{18}O$ values of water calculated to be in equilibrium with the carbonates have a range between -2.8 and +2.6‰ (avg. -0.8‰, 1σ = 1.5‰, n = 24), similar to groundwaters in the Chobe Enclave today, but where these groundwaters lie on evaporation lines defined by mildly to extremely evaporated surface waters of the present-day Okavango, Chobe, and Zambezi rivers in this area [2]. Evaporated river as well as groundwaters also reach carbonate saturation, supporting a palustrine origin for the carbonate platform deposits under environmental conditions like those of today.

1 Diaz N., *et al*. *Quaternary Geochronology*, 49, 172-176 (2019).

2 Mokatse T., *et al*. In: *F. D. Eckardt (ed.), Landscapes and Landforms of Botswana, World Geomorphological Landscapes, https://doi.org/10.1007/978-3-030-86102-5_6* (2022).