Is Milankovitch Cyclicity Recognisable in Carbonate Sequences? Numerical Experiments Using the Forward Model CARB3D+

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Many workers have suggested that stacking patterns in platform carbonate sequences can be interpreted in terms of stationary Milankovitch-driven cyclicity in sea level. Indeed, this assumption often underpins conceptual models of many sub-surface carbonate sequences. Others have suggested that such patterns are illusory or related to auto-cyclic processes. Recently, Burgess (2008) has suggested that 29 % (16 out of 56) of platform sequences in a large data set of measured bed thickness data exhibited a Poisson distribution indicating that they were essentially random in nature. However, 50 % (28 out of 56) showed non-random behaviour which could indicate they were driven by deterministic, or a combination of both deterministic and stochastic, processes. Here we have used CARB3D +, a numerical forward modeling programme, to generate synthetic stratigraphies for isolated carbonate platforms using both stationary Milankovitch cyclic and random sea level drivers. The synthetic lithological successions generated were tested using two approaches, the exponential distribution test for Poisson related distributions used by Burgess (2008), and the layer thickness inventories (LTI) test devised by Bailey and Smith (2005). The synthetic bed thickness data generated using strictly stationary Milankovitch cyclic drivers showed both exponential and non-exponential distributions indicating that this technique is not capable of reliably identifying stationary cyclic behaviour. Furthermore, some of the non-cyclic simulations also yield non-Poisson distributions, suggesting some ordering was present. In contrast, the LTI technique generally detected cyclicity in the Milankovitch cyclic successions, and given a timescale calibration, the frequency of the main drivers.