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Bone histology of Neogene angulate tortoises (Testudines: Testudinidae) from South Africa: palaeobiological and skeletochronological implications

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Here we examine the tibial microstructure of modern and fossil angulate tortoises to assess the histology and growth from the late Miocene–early Pliocene, Pleistocene through to modern forms. The cross-sections of all the tibiae sampled revealed highly vascularized, uninterrupted, fibrolamellar bone tissue during early ontogeny, which suggests that early growth was fast. However, later in ontogeny, growth was slower, as indicated by the deposition of parallel-fibred bone tissue in the outer cortex, and even ceased periodically, as indicated by lines of arrested growth. Comparative analyses of the growth rates of the tortoises from different time periods showed that the tortoises from the late Miocene–early Pliocene Langebaanweg locality and from Diepkloof Rock Shelter had relatively slower growth rates under less optimal growth conditions. Additionally, these prehistoric specimens show extensive remodelling, and several generations of secondary osteons further suggest functional and/or metabolic stresses on the skeleton. Palaeoenvironmental reconstructions suggest that it was mostly cooler and drier with seasonal fluctuations in late Miocene–early Pliocene, and it is likely that *Chersina* responded to these conditions by having a lower rate of growth as compared with their modern counterparts, which thrive in the current prevailing more favourable Mediterranean type of climate.