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Seasonality during deposition of the classical Homo erectus bearing succession at Trinil, Java, based on bivalve shell geochemistry

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Climate change and especially changes in seasonality probably affected the environment and hence the colonization of southeastern Asia by Homo erectus, but are not well known. In a first attempt, we aim to reconstruct past seasonality at the time of deposition of the classical H. erectus bearing site of Trinil (Java, Indonesia) by measuring the stable carbon (δ13C) and oxygen (δ18O) isotopic and trace elemental (Na/Ca, Mg/Ca, Mn/Ca, Sr/Ca and Ba/Ca) composition of a single Hippopus hippopus valve from the Pliocene Kalibeng Formation. This marine formation unconformably underlies the Hauptknochenschicht that yielded the H. erectus fossils. The isotopic and trace elemental records show regular variations on different scales along the growth axis of the shell. Since length along this axis can be translated to time, assuming a regular growth rate, to identify the origin of the cyclicity in these records, time series analysis was applied. Comparing the relative frequencies detected shows that the various cycles are likely related to annual, monthly to fortnightly, and daily variations. Clear annual variations in δ13C are interpreted as related to primary productivity and/or fresh water outflow as the nutrient like element Ba co-varies with δ13C. Although the interpretation of the cyclic isotopic and trace elemental signals is potentially complicated due to the various non-environmental factors involved (e.g. vital-, ontological- and kinetic effects), it offers a promising new avenue of research in the study of H. erectus and its palaeoenvironment. Future studies on this shell will include clumped isotope analysis to independently reconstruct temperature. This method will also be applied to the freshwater mollusc shells from the Hauptknochenschicht itself, and the overlying deposits.