Poster

Reservoir effect in pre-historic shell midden humans (Western Cape, SA) detected by ^{14}C differences in bone collagen and bioapatite

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Abstract

Radiocarbon dating represents the most widely used method for the establishment of absolute chronologies, often relying on the dating of human bone material. Reservoir effect is the expression used to denote the presence of a radiocarbon-depleted signal within an aquatic reservoir. Humans with an aquatic diet will incorporate a reservoir effect signal. Radiocarbon dating of this bone material results in apparently older chronologies.

The main organic fraction of bone, collagen, is usually preferred for radiocarbon dating. In contrast, bone's inorganic fraction, bioapatite, is less often radiocarbon dated due to its high susceptibility to diagenesis and contamination. Bioapatite carbonate is in equilibrium with blood bicarbonate, which is derived from respired CO_2 (Jim et al. 2004). Thus, bioapatite carbon is routed from the entire dietary mix (Froehle et al. 2010), mostly represented by carbohydrates. In contrast, bone collagen will reflect primarily protein intake. As fish is particularly rich in protein and depleted in carbohydrates, collagen-bioapatite radiocarbon age differences should be observed in fish consumers and provide an estimate of reservoir effect.

Based on recently published compiled results of controlled feeding experiments of animals (Froehle et al. 2010), a simple algebraic model is presented establishing the routing of dietary protein and energy (carbohydrates and lipids) towards bone collagen and bioapatite.

This model was applied to recently published data (Cherkinsky 2009), consisting of stable isotope analyses ($\delta^{13}C$) and radiocarbon dates of both collagen and bioapatite, on well preserved human remains found in pre-historic shell middens in the Western Cape Province of South Africa. The model was capable of establishing a clear linear relationship between dietary energy intake and bone collagen and bioapatite ^{14}C differences. These differences were of the expected magnitude considering the local marine reservoir effect during the period. Finally, the model also correctly predicted the local C3 isotopic signal.

These results provide the first evidence for collagen-bioapatite radiocarbon age differences linked to reservoir effect, and open the possibility of using the presented model to improve radiocarbon-based chronologies.

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Jim, S., Ambrose, S.H., and Evershed, R.P., 2004, Stable carbon isotopic evidence for differences in the dietary origin of bone cholesterol, collagen and apatite: implications for their use in palaeodietary reconstruction, *Geochimica et Cosmochimica Acta* **68(1)**, 61-72

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