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Ca isotope variations in modern dietary systems and their potential to assess the importance of dairying in past cultures

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Previous studies have suggested a trophic level effect on Ca isotopes, which fractionate at a fixed value from the dietary sources during bone formation (e.g. Skulan and DePaolo, 1999). Mammals acquiring a large fraction of their dietary Ca from milk are therefore expected to have systematically lighter Ca isotopes than those acquiring Ca from water and vegetable sources, because of the addition of an extra trophic level. Ca isotope compositions of bones could provide significant information about past dairy consumption in Neolithic and other communities. Such information would complement that derived from occasional finds of milk residues in pot shards, and might provide more quantitative information about the importance of dairying. To test the capability of this new proxy, we have established suitable analytical approaches for these organic matrices and used them to measure Ca isotopes in food sources (water or vegetation), lactating milk, hair tissues and excretions of modern herbivores. These analyses allow a complete Ca isotope budget to be assessed for the animal, and provide further information about the extent and source of Ca isotope fractionation. We have also assessed the Ca isotope composition of bones from four groups of modern deer bones at different locations across UK plus one in Poland. Preliminary results indicate that Ca isotopes in bioapatite do not show significant geographical variations ($<$0.6 per mil), despite various types of weathering and plant processes in catchments of these locations. This suggests that the trophic-level effect will not be obscured by significant spatial variation. Continuing work is to investigate dairy changes (i.e. weaning) in modern and past diets from measurements in human teeth enamel.

Reference:

Skulan J. L. and DePaolo D. J. (1999) Calcium isotope fractionation between soft and mineralized tissues as a monitor of calcium use in vertebrates. *Proceeding of the National Academy of Sciences* **96**(24), 13709-13713.