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The rise of non-traditional isotopes for studying present, and reconstructing past, biology, and environments

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In living systems, metals are involved in a myriad of cellular functions and biochemical pathways. Metals are provided by the external milieu where their concentration can be variable depending on the local environment, but in cells, their concentration is modulated by homeostasis to lie between deficiency and toxicity thresholds. Consequently, metal concentration in soft, and by extension in mineralized tissues, cannot convey any biological or environmental information. However, biochemical reactions involved in metals homeostasis can lead to stable isotope fractionation, so that metal isotope composition can convey biological or environmental information. In this presentation, I will review the current knowledge on non-traditional isotopes (Li, Mg, K, Ca, Fe, Cu, and Zn) systematics in vertebrates, the study of which mineralized tissues (bone and teeth) opens perspectives for paleobiological and paleoenvironmental reconstructions. A multi-isotopes approach is interesting for deconvoluting complex trophic relationships and is possible from a single fossil aliquot using sequential extraction by ion-exchange chromatography. Using bone and enamel from single specimen allows to study ontogenic processes. The sensitivity of non-traditional isotopes to diagenesis will be discussed.