Combined $\delta^{88/86}$Sr and ^{87}Sr/^{86}Sr in bones and teeth: A toolbox for diet and habitat reconstruction

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Strontium is non-essential in diet, substituting for Ca in enamel and bone bioapatite. Stable Sr isotopes (^{88}Sr/^{86}Sr) vary in the environment, with $\delta^{88/86}$Sr decreasing along the food chain as a result of plant nutrient uptake and biomineral formation [1]. This is in the same sense as $\delta^{44/42}$Ca [2] and opposite to that observed for δ^{26}Mg [3].

We report $\delta^{88/86}$Sr in modern mammal and bird bones (n=56) from different feeding categories and ecosystems. $\delta^{88/86}$Sr (relative to NIST SRM-987) was analysed by TIMS using a ^{87}Sr-^{84}Sr double spike to ±0.02‰ (2σ). A trophic level spacing of ~0.18‰ is observed between mammal herbivores (-0.30±0.17‰) and carnivores (-0.48±0.11‰). $\delta^{44/42}$Ca measured in the same bones [2] display a trophic level effect of ~0.4‰ and are strongly correlated with $\delta^{88/86}$Sr. In contrast, ant/termite feeders have the highest $\delta^{44/42}$Ca and $\delta^{88/86}$Sr (-0.11±0.10‰), potentially a proxy for insectivory. $\delta^{44/42}$Ca and $\delta^{88/86}$Sr together are promising tools for assessing trophic niches in extant and fossil vertebrates.

While bone $\delta^{88/86}$Sr can be used to determine the animal´s diet, ^{87}Sr/^{86}Sr differentiates between sources of strontium and thus habitat. Extant birds of prey (sparrow hawk, kestrel, buzzard, long-eared owl) from around Ludwigshafen, Germany, have distinct $\delta^{88/86}$Sr (-0.29±0.08‰ to -0.49±0.05‰) which might reflect contrasting prey species. Similarly, ^{87}Sr/^{86}Sr vary from 0.7087 to 0.7129, indicating that their hunting grounds differed. Combining $\delta^{88/86}$Sr with ^{87}Sr/^{86}Sr thus allows assessment of trophic and spatial niche partitioning, as well as predator-prey relationships, in ecology, archaeology, and palaeontology.

[1] Knudson et al. (2010) *J. Arch. Sci.* **37,** 2352-2364 [2] Broska et al. (2011) *Min. Mag.* **75(3),** 585 [3] Martin et al. (2014) *Geochim. Cosmochim. Acta* **130,** 12-20.