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Jurassic ecology: An insight into dietary dynamics using Ca stable isotopes

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Diets of extinct animals are challenging to reconstruct. The best hypotheses for ancient food webs rely on multiproxy inferences (e.g. dental morphology) and thorough sampling of the palaeobiodiversity. The sparse nature of the fossil record, and poor preservation, leaves many fundamental questions unanswered, particularly related to palaeodiet and palaeotrophic levels. Geochemical markers preserved in fossilised tooth enamel provide novel dietary dynamic proxies within ancient ecosystems, which can overcome the challenges of poor preservation. The Elliot Formation of the Karoo Supergroup (South Africa) preserves a Jurassic ecosystem with an abundant and diverse range of vertebrate lineages and body sizes. It is an ideal natural laboratory for understanding palaeodietary dynamics.

Calcium (Ca) is a bio-essential element that is diagenetically stable in tooth enamel and displays isotopic fractionation in plants and animals. We investigated the non-traditional Ca isotopic system to infer aspects of palaeodiet and ecology of dinosaurs in the Elliot Formation. Our study consisted of three sympatric, co-occurring presumed herbivorous sauropodomorph genera (*Massospondylus, Aardonyx* and *Pulanesaura*). Little is known about how these species might have filled different niches. We found that these genera are ^{44}Ca-enriched (-0.15‰ to -0.53‰) in line with their presumed herbivorous diets. We also observe Ca isotopic differences between these species within the same palaeoecosystem. *Massospondylus* specimens have a mean $\delta^{44/42}$Ca value of -0.22 ± 0.02‰ (2 s.d., n=6), while *Aardonyx* has a mean $\delta^{44/42}$Ca value of -0.35 ± 0.03‰ (2 s.d., n=6) and *Pulanesaura* a $\delta^{44/42}$Ca mean value of -0.45 ± 0.02‰ (2 s.d., n=2).

Our preliminary results suggest that these resolvable isotopic differences may be evidence of resource partitioning in sympatric herbivorous sauropodomorphs. These dietary niches and/or foraging habits are supported by anatomical differences like tooth morphology and skeletal anatomy. Another hypothesis is that phenotypic differences may explain Ca isotopic fractionation: e.g. larger body size could imply different digestive and metabolic processes. We are currently examining within-genus fractionation among animals of different body sizes to control for this potential effect. Regardless of this process, this study illustrates how isotopic proxies like $\delta^{44/42}$Ca can be used to better understand dietary dynamics, and ultimately palaeoecology, within past ecosystems.