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XFM analysis of marsupial teeth - insights into life, growth and reproduction

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Mammal species vary in how much time and energy they invest in growth, reproduction and development throughout their lifetime, summarised collectively as their 'life history'. Knowledge of such differences among species helps us understand how they trade off these factors of their life history, yet, due to variability between populations, the logistical challenge of multi-year observational studies and extinction these data can be very difficult or impossible to collect. Elemental indicators of life history, environment and diet are mineralised into an animal's hard tissues as they develop incrementally. Our research, using the X-Ray Fluorescence Microscopy (XFM) beamline of the Australian Synchrotron, focuses on unlocking biological information from the teeth of Australian marsupials. We have analysed the sectioned teeth of a range of living (e.g. *Macropus giganteus*, *Notamacropus eugenii* & *Vombatus ursinus*) and extinct (e.g. *Macropus giganteus titan* & *Diprotodon optatum*) marsupials. Our novel results indicate that strontium is a particularly powerful indicator of life history in marsupials. A gradual rise in strontium concentration tracks the progression of weaning, with subsequent oscillations following a likely seasonal dietary signal. Furthermore, calcium reflects the varying degree of mineralisation of tooth enamel and dentine, while zinc is preferentially deposited in the outer enamel layers. These results, applicable to both living and extinct marsupials, indicate that trace element mapping can provide unique insights into the life history of Australia's living marsupials and extinct marsupial megafauna.

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