Early Miocene Climate: Investigating the relationships between Earth's orbital cycles and New Zealand's climate in the early Miocene

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During the Early Miocene, atmospheric CO_2 levels were similar to today yet global temperatures were warmer and there were no large, stable polar ice sheets. Geologic records of past climate are needed to better understand the ambiguous climate of the Miocene. Foulden Maar (45.5 °S, 170.2 °E) is a sedimentary deposit formed in a crater lake on South Island, New Zealand. Anoxia in the basin fostered the preservation of a ~100m thick, annually laminated diatomite (the base of which has been dated to 23 ± 0.2 Ma using $^{40}Ar/^{39}Ar$ dating), and allowed for superb preservation of organic materials. Here we examine the hydrogen isotope composition (δD) of leaf waxes in Foulden Maar sediments over a ~100,000 year interval of the early Miocene. Leaf wax δD reflects δD of past precipitation and thus, the hydroclimate at the site. Our record reveals large changes (up to 40 ‰) in leaf wax δD that are most likely driven by orbital scale climate forcing (obliquity and precession). To determine sediment chronology, we used an age model based on varve counts as a starting point. Then, we tuned the δD record to orbital parameters, taking into consideration the positions of sediment gravity flows that may have removed sediment from the section. The orbitally-tuned record will potentially provide a more accurate placement of the diatomite in time and will allow quantification of changes in the hydrology of South Island, New Zealand during the early Miocene.