Paleohydrological reconstruction using plant compound isotopes from the Neogene of Antarctica

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Until recently, stable isotope analysis of tree ring cellulose had only infrequently been applied to fossil wood from deep time, largely due to the scarcity of suitable wood samples. However, it is potentially a very useful tool for investigating past hydrological changes in the geological record. Here, we present the results of a study applying this technique to a unique set of fossil wood samples from the Transantarctic Mountains, Antarctica.

In recent decades the East Antarctic Ice Sheet (EAIS) has been the subject of a somewhat controversial debate over whether it has been a stable or dynamic feature between 14 and 3 million years ago, a period in Earth's history when the climate was several degrees warmer than today. The question remains; has the ice-sheet remained stable over the past 14 million years, or did it collapse in response to brief warming periods?

A suite of exceptionally well-preserved fossil wood fragments, identified as *Nothofagus beardmorensis*, has been recovered from paleosol deposits in the Sirius Group sediments at Oliver Bluffs in the Beardmore Glacier region, Transantarctic Mountains, Antarctica (85° S). The fossils are thought to be 3-14 million years old, possibly representing the last vestiges of woody vegetation on Antarctica at a time when the EAIS was considerably smaller than today. Analysis of plant compound isotope ratios from these fossils – namely, cellulose and leaf waxes – provide unique insight into global climate during this vital part of Antarctica's history, and is the first time this technique has been applied to the Antarctic continent.

Initial results from $\delta^{18}O$ analysis of tree ring cellulose suggest the plants had access to surface water that was significantly enriched (~10‰) relative to precipitation at similar latitudes today. We also use leaf wax δD to further interrogate this. Our results imply that atmospheric circulation patterns were markedly different as a result of warmer temperatures and smaller ice sheets during this time period. We discuss shorter water vapour pathways and increased precipitation at lower southern latitudes as possible mechanisms for such a change.