School of Biological, Earth and Environmental Sciences

Summer Vacation Research Project

Unearthing Australia's climate history: Sampling and radiocarbon dating subfossil Tasmanian huon trees

Supervisors:

Professor Chris Turney (UNSW), Dr Jonathan Palmer (UNSW), Professor Patrick Baker (UMelb) and Professor Lukas Wacker (ETH Zurich)

Project Description:

The timing and impacts of past, and future, abrupt and extreme climate change remains highly uncertain. A key challenge is that historical records of change are too short (since CE 1800) and their amplitude too small relative to projections for the next century (IPCC, 2013), raising concerns over our ability to successfully plan for future change. While a wealth of geological, chemical, and biological records (often referred to as 'natural archives' or 'palaeo') indicate that large-scale and often irreversible (centennial to millennial in duration) shifts in the climate system took place in the past, chronological uncertainties preclude high-precision correlation of records of palaeoenvironmental change. A major focus has been on the late Pleistocene (11,650 to 50,000 years ago; henceforth 11.65-50 ka) where contrasting Greenland and Antarctic temperature trends show millennial-scale warming (Greenland interstadial) events in the north leading cooling in the south (WAIS, 2015); thought to have driven by imbalances in the rate of formation of North Atlantic and Antarctic Deep Water (the 'bipolar seesaw') (Broecker, 1998; WAIS, 2015). Recent models have associated major phases of genetic extinction with rapid warming events during this period (Cooper et al., 2015, Science; Metcalf et al., 2016, Science Advances). However, multi-centennial uncertainties in the phasing of climate trends in ice core sequences and a poorly defined radiocarbon (14C) calibration curve (Reimer et al., 2013) have precluded the high-precision alignment of terrestrial, ice, marine and palaeofaunal records until now. Accurate reconstructions of past changes in atmospheric and ocean circulation on quantified, absolute-dated and robust timescales are therefore urgently needed to better understand the global driver(s) and environmental impacts of abrupt and extreme change. While past changes in atmospheric 14C offer the potential to undertake high-precision correlation between terrestrial and marine records, no contiguous record of global atmospheric radiocarbon concentration is available across the full timescale (Turney et al., 2016).

Building on a major ARC Discovery Project awarded to Professor Chris Turney and Dr Jonathan Palmer entitled 'Testing the mechanisms and impacts of abrupt and extreme climate change'

(DPDP170104665) and working with colleagues in the University of Melbourne, we have uncovered an extensive (250 trees) collection of subfossil huon pine in Tasmania. These trees were collected from river gravels up to several metres depth nearly 20 years ago but have not been studied. These trees offer considerable potential for providing detailed (annually-resolved) multicentennial records of atmospheric 14C. Unfortunately there is no current age control on any of these trees. Previous field expeditions have demonstrated that subfossil huon pines from river gravels may be only a few centuries old or can be up to 40,000 years old. To provide rangefinder ages on these archived trees we have set up a project with Professor Lukas Wacker (ETH Zurich) to radiocarbon date all 250 trees. Success in this project will allow us to target the trees of late Pleistocene age and undertake more detailed (continuous) 14C measurements for high-precision alignment of terrestrial, marine and ice records. For this UNSW Summer Vacation Research Scholarship, a student will be required to visit Tasmania to systematically sample all the archived trees and prepare them for 14C dating at UNSW. The student will also be required to spend 2 weeks in ETH Zurich to help run the samples on the MICADAS AMS 14C system. No previous experience is required but a passion for using the past to understand the Earth system is crucial.

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