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The reliability of radiocarbon dates of different carbon fractions in the Australian tropical savannas: A case study from Sanamere Lagoon, northeast Australia

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The selection and pre-treatment of a reliable organic fraction from which to acquire radiocarbon dates is fundamental to obtain accurate chronologies. Sampling from tropical lakes is particularly challenging given the adverse preservation conditions and diagenesis in these environments. Our research is the first to examine and quantify the differences between the radiocarbon date results from different carbon fractions and pretreatments from the same depths from a tropical lake sediment core (1.72 m long) located in north Australia to assess which one(s) are more reliable. Six different organic fractions (bulk organics, pollen concentrate, cellulose, stable polycyclic aromatic carbon (SPAC), charcoal >250 µm and charcoal >63 µm), for a total of 27 radiocarbon dates, were compared in six different depths along the core. Acid-base-acid (ABA), modified ABA (30 % hydrogen peroxide + ABA), 2chlorOx (a novel cellulose pre-treatment method) and hydrogen pyrolysis (hypy) were used to pre-treat the correspondent organic fractions. The oldest date is 31,295 calibrated years before present (cal yr BP) and the youngest is 2,048 cal yr BP, spanning 29,247 years. The smallest offset between the minimum and the maximum age in a given depth was found to be 975 years (between SPAC and charcoal >63 µm) and the largest 16,527 years (between pollen concentrate and SPAC). The SPAC fractions pre-treated with hypy consistently yielded older ages compared to all other fraction in most cases, while bulk organics yielded consistently younger ones. The magnitude and consistency of the offsets and the physical and chemical properties of the tested organic fractions suggest that SPAC is the most reliable fraction to date in tropical lake sediments and that hypy successfully removes contamination sourced from exogenous carbon.