Oxygen isotope fluctuations of pollen fossils from Lake Suigetsu, Japan

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Interactions of atmospheric, marine, terrestrial, and cryospheric realms are important factors in considering mechanisms of climate change (Lowe et al., 2008). Pollen analysis widely used methods to reconstruct past climate changes. However, comparing pollen data with other geochemical proxies, especially stable isotope signals, is not straightforward due to the non-linearity included in the conventional pollen composition signals. On the other hand, pollen grains are composed of sporopollenin and potentially provide isotopic signals which can be more directly compared with key palaeoclimatic records from across the world (Loader and Hemming, 2004). In this study, we first established a method to extract fossil pollen grains from sediment matrix by “cell sorter”. Then we applied that new method to the varved sediments obtained from Lake Suigetsu, Japan (in particular, transition from the Lateglacial to the early Holocene) in order to test if the isotopic signals of pollen grains are keeping meaningful palaeoclimatic information or not.

Lake Suigetsu (35˚35'N, 135˚53'E, 0 m a.s.l.), Fukui prefecture, is one of the Mikata Five lakes, which measures 3 km east-west by 3 km north-south, with the maximum water depth of ca. 34 m. Lake Suigetsu preserves annually laminated sediments over the last ca.70 kyr with a significant number of event layers that allows precise correlation among parallel cores. Two long cores (SG93, SG06) have previously been recovered from the centre of the lake. An exceptionally precise age model has been established for the cores through a combination of over 800 radiocarbon (^{14}C) dates and high precision varve count (Staff et al., 2011; Marshall et al., 2012; Schlolaut et al., 2012; Bronk Ramsey et al., 2012). In this study, we used well-dated SG06 cores and extracted pollen fossils using cell sorter.

Cell sorter is able to characterise particles using optical parameters (mainly fluorescence), and separate specific particles using electrostatic deflection. Pollen fossils can be isolated by cell sorter without fluorescent dyes using cell sorter because sporopollenin constituting pollen grains is naturally auto-fluorescent (Tennant et al., 2013). After chemical and physical pre-treatments, pollen-enriched suspension was introduced into the cell sorter and extracted half a million pollen fossils from each sample. After drying and weighing, δ^{18}O value of the high-purity pollen pellets were determined using High Temperature Conversion Elemental Analyzer (TC/EA, Thermo Scientific) in the University of Tokyo.

The oscillation of the δ^{18}O value of the extracted pollen pellets roughly mirrored that of the NGRIP, showing typical climatic transitions that characterise the Late glacial period. Our results strongly imply that the stable isotope signal of fossil pollen grains is keeping record of past climate changes.

Keywords: Palaeoclimate, Stable isotope, Pollen, Cell sorter, Suigetsu

