Extraction of high-quality ^{14}C data from terrestrial sediments containing pollen fossils

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Fossil pollen grains, which are commonly found in various types of sediments, have great potential for radiocarbon chronological research. If measurable amounts of fossil pollen grains can be extracted readily from sediment matrices, then ^{14}C age determination could be performed at any depositional depth, regardless of with or without plant macrofossils, and the quality of the deposition age model can be considerably increased. Thus far, several lake sediments have been tested for pollen ^{14}C. However, technical issues such as complex preparation procedures, collection rate, and purity of concentrated sample persisted and pollen ^{14}C analysis has not been applied routinely. A novel pollen concentration method is developed herein using a next-generation cell sorter to quickly prepare pure concentrates of fossil pollen grains suitable for ^{14}C dating, with a relatively simple preparation procedure.
Cell sorter was originally developed for biomedical researches to instantaneously identify and separate cells of specific fluorescence and shape. Some of the latest model machines can perform machine tuning and sample preparation semi-automatically, and it is designed to solve most issues via the exchange of replacement parts. In the proposed method of pollen purification, pollen-enriched suspension is introduced into cell sorter, which can separate more than a million grains of fossil pollen in half a day. The pollen ^{14}C analysis was conducted using a SG06 sediment core from Lake Suigetsu, which has one of the most reliable age models that we can use as reference. Pollen fossil samples equivalent to 50–100 μgC were extracted from ca. 25-30 g of wet sediment and were measured using a compact AMS system (NEC 0.5 MV 1.5SDH-1) of LRD.UMUT. The ^{14}C data of the pure pollen samples agreed well with the Suigetsu's ^{14}C dataset on terrestrial plant leaf fossils. This result shows that accurate ^{14}C data can be obtained from any depth of the core, even at depths at which plant remains are not present. Using the proposed method, the Suigetsu's ^{14}C data can be enhanced for data density and evenness of the data intervals, both of which would directly contribute to the accuracy of the age model. We also believe that the proposed method can be applied to various sediment types from both marine and terrestrial realms, and will assist high-precision chronological study as well as quantification of marine reservoir age.

Keywords: Radiocarbon dating, Pollen fossil, Cell sorter, Suigetsu

