Variability of elemental carbon input to the Lake Suigetsu sediments during the last 15,000 years

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Biomass burning in geologic ages has been controlled by natural variabilities in environment such as atmospheric oxygen concentration, vegetation, and climate, while human activity may have become another major controlling factor on biomass burning since Holocene. Measurement of elemental carbon (EC) in sediment archive is widely used to reconstruct biomass burning in the past. In order to evaluate drainage-scale influence of human activity and vegetation on biomass burning, we examined the EC in SG12 sediment core collected from the Lake Suigetsu, for which high resolution stratigraphy and age model has been already established and long-term human activities since 12,000 years ago is known from the remains of Jomon. EC is also classified into soot of submicron size and coarse grained charcoal, and the former can be transported for a long distance in the atmosphere. We also tried to evaluate the soot size EC independently from the charcoal size EC by grain size separation of the sediment samples in order to distinguish charcoal input from drainage from atmospheric soot input. Thermal optical transmittance (TOT) method was used to quantify and examine the EC fraction in fine (<2 um) and coarse (>2 um) fraction of the sediment.

High temperature resistant EC is dominant in coarse fraction which resembles to the EC fraction in surface water of the Lake Suigetsu and river waters flowing into the Lake. On the other hand, fine fraction of sediment contains less high temperature resistant EC which is similar to airborne materials collected at the Rishiri Island during Siberian fire in 2014. These facts suggest that coarse and fine EC are originated from drainage and airborne materials, respectively.

Temporal variability of coarse EC flux reconstructed from SG12 core shows increase at ~6500 years ago and ~2500 years ago, but does not show rapid increase from 6500 to 4000 years ago observed in charcoal contents measured from soils in Jomon remains. Vegetation change at 6500 years ago could be more responsible for the increase in the coarse EC. The increase at 2500 years ago could correspond to the onset of Yayoi culture around the Wakasa area. Fine EC flux variation is characterized by the gradual decrease after 9500 years ago and rapid increase at 2500 years ago. This pattern is similar to the Holocene charcoal variability compiled from the data in the Asia monsoon region, which suggests that fine EC could reflect regional-scale biomass burning history.

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