Oxygen isotopic dendrochronology of a gigantic rock avalanche and its comparison with historical documents -an interim report of the research group on high resolution chronology of large deep-seated landslides

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A lot of huge granitic rock clasts are located on the bank of Dondokosawa River in the east of Mount Ho-ou, the Akaishi Range, central Japan. Radiocarbon ages of tree trunk samples buried in the sediment around the river imply that the giant clasts were originated from a gigantic rock avalanche, and formed natural dams in the ninth century (Kariya, 2012, TJGU, 33: 297-313). In this study, we performed oxygen isotopic dendrochronology analysis in order to reveal the inducement of this ancient rock avalanche and the depositional process of the clasts. The sample for dating (DDK03) was a disk-cut fossil wood log of Japanese cypress (Chamaecyparis obtusa; ca. 50 cm diameter, and ca. 400 years old estimated by counting annual rings) that was found one meter below the surface of the lacustrine sediment in the Dondokosawa natural dam. Cellulose was extracted directly from a thin wood plate (1 mm thick and 1 cm wide) that was sliced parallel to the butt end of the disk. 53 cellulose rings at the outer most part of the disk were dissected out and their oxygen isotope ratios were measured with the combined instrument of a pyrolysis-type elemental analyzer and an isotope ratio mass spectrometer, installed at the Research Institute for Humanity and Nature, Kyoto, Japan. We compared the inter-annual variations in oxygen isotope ratios of cellulose for DDK03 with those of predated master chronologies made for the Kiso-hinoki cypress, and determined that DDK03 died at AD 883+x (1 < x < several years).
On the basis of radiocarbon age of 809-987 CalAD (2-sigma) measured for another tree trunk sample at the same outcrop (DDK-D: Kariya, 2012), four candidates of paleoseismic events can be listed in existing documents (e.g., Usami, et al., 2013, Materials for Comprehensive List of Destructive Earthquakes in Japan, 599-2012, Tokyo University Press), such as earthquakes at AD 841 in Shinano area, AD 841 Izu, AD 878 Kanto resion, and AD 887 Goki-Shichido, if it is assumed that the rock avalanche was induced by strong ground motion from a large earthquake. Oxygen isotopic dendrochronology age of DDK03 (AD 883+x), however, narrows the four candidates down to a single one of the AD 887 Goki-Shichido earthquake. This is consistent with Kariya et al. (2014; JPGU 2014, HDS29-P01); they performed conventional dendrochronology of the same DDK03 sample with the use of the fluctuation pattern of tree ring width and microscopic observation of cell structures of the outer most tree ring, and concluded that DDK03 died in the late summer of AD887 and that slope movement related to the rock avalanche might have been caused by the AD 887 Goki-Shichido earthquake.
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Keywords: dendrochronology, oxygen isotope ratios, large landslide, Akaishi Range, Gokishichido earthquake

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