A finding of fossil trees buried in dammed-lake deposits formed by the Dondokosawa rock avalanche of the late 9th century in the Akaishi Mountains, and its significance

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The Dondokosawa rock avalanche (DRA) initiated at an east-side slope of Mount Jizo, the Akaishi Mountains, the Southern Japan Alps, and traveled over 3.6 km along the mainstream of the Dondokosawa River. The displaced mass of the DRA completely blocked two parts, the outlet of a right tributary of the Dondokosawa River and the channel of the Ohdanasawa River, forming two dammed-lakes together with floodplain deposits beside the rock avalanche deposit (Kariya, 2012; Kimura *et al.*, 2018a). At these two sites, many fossil trees buried in lacustrine sediments were found by the authors. Yamada *et al.* (2018) applied the dendrochronological analysis using oxygen isotope ratios to tree-ring samples collected from two individuals (Hinoki cypress of >350 years old and Hemlock tree of >300 years old) and estimated death year of one individual to be around AD885 and that of the other to be AD888. These chronological constraints on the DRA strongly indicated that the DRA has occurred at the year of AD887 Ninna earthquake, which was one of the large ocean-trench earthquakes in Japan, or a couple of years later than the earthquake. The finding of fossil trees has a significance for not only estimating the age of the DRA but also reconstructing the paleoenvironment around the Akaishi Mountains. In this study, we present the vegetation characteristics of the Dondokosawa and the Ohdanasawa river catchments in the late 9th century, based on the tree species compositions of 41 samples analyzed in our previous studies (Kimura *et al.*, 2018b, 2019).

The sampling sites were named LLD and ULD, respectively. LLD is located at the confluence of the Dondokosawa and Ohdanasawa rivers, and has a drainage area of 8.81 km^2 with altitudes ranging from 1220 to 2780 m a.s.l. ULD is located at the outlet of the right tributary of the Dondokosawa River, and has a drainage area of 1.17 km^2 with altitudes ranging from 1470 to 2630 m a.s.l. We collected 41 samples (24 samples in LLD and 17 samples in ULD) between April 2012 and October 2017 and identified species or genus of each sample. The 24 samples in LLD include eight of Hinoki cypress (*Chamaecyparis obtusa*), seven of Hemlock tree (*Tsuga*), three of Sawara cypress (*Chamaecyparis pisifera*), two of Birch tree (*Betula*), and one each of Japanese larch (*Larix kaempferi*), Fir tree (*Abies*), Spruce tree (*Picea*) and Japanese Wingnut (*Pterocarya rhoifolia*). The other 17 samples in ULD include eight of *Tsuga*, four of *Abies*, two each of *L. kaempferi* and Willow tree (*Salix*), and one of Azalea tree (*Rhododendron*). The rates of *Tsuga* in LLD and ULD account for approx. 29% and 47%, respectively. Besides, the rate of cypress species (*C. obtusa* and *C. pisifera*) in LLD accounts for approx. 46%, while both of the two species are absent in ULD.

Although the above results are based on a limited number of samples, it is estimated as vegetation characteristics in the late 9th century, when the DRA occurred, as follows. In the Ohdanasawa River catchment, an old-growth forest dominated by Hinoki cypresses of >350 years old and Hemlock trees was established, while another old-growth forest dominated by Hemlock trees of >300 years old was established in the right tributary catchment of the Dondokosawa River. The remarkable difference in the abundance of cypress species in the two adjacent catchments suggests a possibility that the distribution of the two species has been limited within the Ohdanasawa River catchment and has not extended to the upper part of the Dondokozawa River from that time.

References:Kariya (2012) Trans. Jpn. Geomorphol. Union 33, 297-313 [in Japanese with English abstract]; Kimura *et al.* (2018a) J. Jpn. Landslide Soc. 55, 42-52 [in Japanese with English abstract]; Kimura *et al.* (2018b) JpGU2018 MGI25-P09 [in Japanese with English abstract]; Kimura *et al.* (2019) Quat. Res. 58, 65-72 [in Japanese]; Yamada *et al.* (2018) Quat. Geochr. 44, 47-54.

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