Revisiting stratigraphy and age of so-called Otsukigawa debris avalanche deposits in the upper Otsukigawa and Yukawa Rivers on the eastern side of Yatsugatake Volcano in central Japan

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On the east side of Yatsugatake Volcano, large-scale landslide features with a long and clear head scarp and undulated emplacement bodies with hummocks exists. This spectacle landforms and their forming materials have been called "Otsukigawa debris avalanche (ODA)" and "Otsukigawa debris avalanche deposit (ODAD)", respectively (Kawachi 1983). The cause of ODA has been attributed to the AD887 Ninna mega-earthquake generated from the Suruga-Nankai submarine troughs based on conventional ¹⁴C dates and interpretation of historical documents. However, the recent novel study by Yamada et al. (2021) using oxygen isotope dendrochronology of ODAD suggests that there is doubt about the age of ODA. Therefore, based on field investigations, we reexamined ODA and ODAD in the upper reaches of Otsukigawa and Yukawa Rivers on the east side of the volcano. We reconfirmed a previous study by Machida and Tamura (2010) that ODAD is distributed along the Otsukigawa River and its tributaries, from Midori-ike Pond immediately below the head scarp to the confluence point between Otsukigawa and Chikuma Rivers. ODAD consists of non-sorted breccias, dominantly bearing hornblende andesite, and yellowish white to dark brown fine-grained matrix with a hydrogen sulfide odor. We carried out new age determination of the upper part of ODA by ¹⁴C, all wood samples gave the range from AD772 to 976. Additionally, an unreported mudflow deposit was newly found in the east of Inagoyu Spa, showing 42 to 48¹⁴C ka. We name this "Inagoyu mudflow deposit (IMD)". The age of IMD coincides with the Last Glacial period around MIS4 and one of activated periods of Yatsugatake Volcano, suggesting that IMD would be derived from snowmelt or icemelt lahar. We also found another landslide deposit different from ODAD and IMD on the banks of Yukawa River near Honzawa Spa. We call this "Honzawa debris avalanche deposit (HDAD)". The fossil wood collected from HDAD shows 3.6 to 2.8 cal ka. From these results, it is considered that large to middle scale landslide phenomena have occurred repeatedly in the period from 48 ka to 1 ka on the eastern side of Yatsugatake Volcano. Our data suggest that the thick debris, which was conventionally called as ODAD, was not produced by single large-scale landslide event, and the ages of ODAD span widely from the late Pleistocene to the recent millennia. However, it should be emphasized that debris avalanche occurred in the period from AD772 to 976 in the upper Otsukigawa River. The latest event in AD772 to 976 may be caused by AD887 Ninna earthquake or AD762 Mino/Hida/Shinano earthquake, as well as AD841 Shinano earthquake. Aftershocks by these earthquakes were also possible triggers. More information on the stratigraphy and ages of "so-called" ODAD is required.

Keywords: Yatsugatake Volcano, Otsukigawa debris avalanche, AD887 Ninna earthquake, Paleoearthquake



Figure and picture A to C ; A)Topography of the study area. Contour interval is 20 m. B)Picture of Outcrop(HDAD). C)Picture of Outcrop(ODAD).