Stratigraphical study on the Middle Pleistocene pyroclastic flow deposits, northern Tochigi and southern Fukushima Prefectures and the eruptive history of Takahara volcano

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Introduction Middle Pleistocene pyroclastic flow deposits are distributed in northern Tochigi and southern Fukushima Prefectures. Shiobara-Otawara pyroclastic flow deposit (So-OT; Suzuki et al., 2004) is widely distributed in the northern Tochigi Prefecture. Moreover, fall-out tephra of So-OT is distributed into southern Aizu region (Suzuki et al., 2004), off Shimokita Core (Suzuki et al., 2012). However, there are controversy on stratigraphy and ages of So-OT and its related tephras. This is caused from the difference in the identifications of APms (Suzuki & Hayakawa, 1990) and KMT (Suzuki, 2000). This paper discusses the stratigraphy and ages of So-OT and its related tephras, and refers to the source of two newly defined tephras. Finally, we discuss the eruptive history of Takahara volcano.

Characteristic properties of the pyroclastic flow deposits We recognized three pyroclastic flow deposits, that is, So-OT, First Shiobara-katamata Tephra (So-KT1; new defined), and Second Shiobara-katamata Tephra (So-KT2; new defined) in descending order. So-OT is roughly divided into lower and upper parts. Lower part is a pumice fall deposit. Upper part is pyroclastic flow deposits. This pyroclastic flow deposits are divided into pumice flow deposit (lower), pumice flow deposit (middle), and scoria flow deposit (upper). Middle pumice flow deposit is widely distributed in the area from Utsunomiya City to Nasu Town, and is cropped out in the Yaita Hills as the thickest deposit. So-KT1 is divided into Unit a-d. Unit b is a pyroclastic flow deposit, and widely distributed in the east part of Yaita Hills. Refractive index of orthopyroxene in So-KT1 is higher than those in So-OT and So-KT2. Major chemical composition of volcanic glass shards of So-KT1 is distinguishable from those of So-OT and So-KT2. So-KT2 is a pumice flow deposit. The differences between So-KT1 and So-OT are mineral assemblage (only So-KT2 contains quartz and small amount of hornblende), and major chemical composition of volcanic glass shards.

Stratigraphy and ages of the pyroclastic flow deposits Pyroclastic fall deposits of So-OT are observed at 6 points on land. The most northern point is located in the southern Fukushima City. We newly defined Sawada fall pumice deposit (SwdP) at Tsurugaike in Shimogo Town, Fukushima. SwdP is sandwiched between lower APms and upper So-OT, and distribution and layer thickness are similar to So-OT fall tephra. SwdP has maximum refractive index of orthopyroxene similar to So-OT. Stratigraphy of the pyroclastic flow deposits shown above and other<s>s</s> tephras in descending order is So-OT, So-KT1, A_2Pm (Suzuki & Hayakawa, 1990), So-KT2 and A_1Pm (380-410 ka; Suzuki and Hayakawa, 1990; Suzuki, 2000; Machida & Arai, 2003), and BT72 (349 ka; Yoshikawa & Inouchi, 1991; Nagahashi et al., 2004) is positioned under So-KT1. A_2Pm is positioned under Kkt (334 ka; Machida & Arai, 2003; Nagahashi et al., 2004)(Suzuki & Hayatsu, 1991). Correlation of A_1Pm and A_2Pm is confirmed by mineral composition and refractive index of orthopyroxene. These stratigraphical relationships indicate that ages of So-OT and So-KT1 is 300-349 ka and that of So-KT2 to be 334-410 ka.

Source of pyroclastic flow deposits and the eruptive history of Takahara volcano It is assumed the source of So-OT, So-KT1 and So-KT2 is the Shiobara caldera due to grain size of essential products in pyroclastic flow deposits, and distribution, grain size and thickness changes of fall deposits. From the results shown above and previous studies (Inoue et al., 1994; Okuno et al., 1997; Tsurumaki et al., 2013 etc.), we considered the eruptive history of Takahara volcano, and concluded

that it is roughly divided into 5 stages. Eruptions of the three pyroclastic flows equivalent to the second stage is Formation of caldera had occurred, within 100,000 years.

Keywords: Pyroclastic flow deposit, Takahara volcano, Shiobara Otawara tephra, Middle Pleistocene, Tephrochronology,

