Crypt tephra detection and correlation in loess covering fluvial terrace surface formed in the earlier half of Late Pleistocene in the drainage of the Nanakita River, Sendai City, Northeast Japan

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1. Introduction

Well-developed fluvial terraces are distributed in Sendai Plain including drainage of the Nanakita River, Northeast Japan. Nakagawa et al. (1960), Nakada et al. (1976), Imaizumi (1983), Koiwa (1994) and Koike and Machida (2001) classified terrace surfaces based on aero-photo interpretaition and tephrochronology. Sakiie (2017) attempted to correlate terrace surfaces in drainage of the Nanakita River with ones in drainage of the Hirose River which adjoins the Nanakita River based on thickness of weathering crust of gravel yield in the terrace deposit. Morever, some of those terraces are displaced by several active faults (e. g. Ouchi, 1973; Nakada et al., 1976). However, previous studies have not yet reached unified opinion about geomorphic evolution around Sendai, so the evaluation of activity of those faults have not determined.

On the other hand, data of tephrochronology around Sendai have accumulated since 1960s (e. g. Nakagawa et al., 1960; Itagaki et al., 1981; Otsuki, 1987; Yagi and Soda, 1989; Koiwa and Soda, 1994; Hataya et al., 2005; Kawai, 2016). However, few previous studies did not explain geomorphic chronology in drainage of the Nanakita River, particularly before MIS 4.

Then, this study detected several crypt tephras in loess covering terrace surfaces formed in the earlier half of Late Pleistocene in drainage of the Nanakita River. Method of tephra analysis is measurement of refractive index with RIMS and major-element composition with SEM-EDS system of orthopyroxene and hornblende as volcanic glass shards lost because of weathering.

2. Crypt tephra detection and correlation

In Nejiroishi located on Uwamachi Surface (Nakagawa et al., 1960; Koiwa, 1994) estimated formed in MIS3 (Koike and Machida, 2001), I recognized loess above 7-m-thick terrace deposit eroding the Pliocene sedimentary rock horizontally. Near the top of the outcrop, weathering red scoria scatters, estimated correlated with Za-Kw (Itagaki et al., 1981; before 30 ka: Machida and Arai, 2003). I obtained samples of the loess including crypt tephras below the scoria. The obtained loess includes orthopyroxene, hornblende, clinopyroxene, cummingtonite, quartz, plagioclase and magnetite. By contrast, most of volcanic glass shards lost because of weathering. Range of refractive index of orthopyroxene and hornblende is each γ = 1.700-1.723 and n_2 = 1.667-1.691. Besides, Range of Mg# of orthopyroxene and hornblende is each 56-77 and 53-72. The frequency of refractive index and Mg# composition of orthopyroxene and hornblende has several peaks. Hence, the loess is originating from several tephras. In addition, the loess in 5cm below the scoria contains cummingtonite whose range of refractive index is n_2 = 1.665-1.671.

I attempted to correlate the crypt tephras detected in preceding paragraph with Late Pleistocene tephras previous studies described at southern Northeast Japan. The refractive index and major-element composition of some of orthopyroxene and hornblende in the crypto tephra resemble to ones of DKP (Machida and Arai, 1979; MIS4.22 - 4.0: 60.08±5.68 ka: Suzuki et al, 2016) or Ag-Ok (77-66 ka: Suzuki et al, 1995). Besides, the cummingtonite is probably originating from Nm-KN (Suzuki and Soda, 1994;

before 55 ka: Suzuki et al, 2016) based on stratigraphic position of the loess and range of refractive index. I plan to report the other detected tephra correlation on the presentation day.

3. Chronology of loess covering Uwamachi Surface

According to Lisiecki and Raymo (2005), the age of boundary of MIS 5/4 is 71 ka. This study detected Ag-Ok whose stratigraphic position is from MIS 5 to MIS 4 in loess covering the terrace surface called Uwamachi Surface. The tephra detection suggests Uwamachi Surface evolved before the Last Glacial Period. I cast whether there is no room for reconsideration about classification and chronology of fluvial terraces surfaces including Uwamachi Surface in drainage of the Nanakita River settled by previous studies, or not.

Keywords: crypt tephra, Late Pleistocene, tephrochronology, heavy mineral, Nanakita River, fluvial terrace

