

# Re-examination of tephrostratigraphy of youngest stage of Zao Volcano

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Zao Volcano is one of representative active stratovolcanoes in NE Japan. Many historical eruptions were recorded, and future eruptions are concerned. Therefore, this volcano is included as part of target volcanoes of the Integrated Program for Next Volcano Research and Human Resource Development by MEXT, Japan. Constructing event trees based on the eruption history for the active volcanoes is one of the important objects of this program.

The volcanic activity is divided into six stages and the newest stage is from about 35 ka to present by the Geological Map of Zao Volcano published in 2015. Summarizing previous studies, four, nine, one, and nine tephra layers have been recognized during ca. 33 to 13 ka, 9 to 4.1 ka, around ca. 3 ka, after ca. 2 ka, respectively.

In the integrated program, the tephrostratigraphy of Zao Volcano has been re-examined by the observation of outcrop as well as the trenching survey. Extensive carbon-14 datings as well as detailed facies analysis were performed. Current achievements are as follows.

**ca. 33 to 13 ka:** Four tephras corresponding to previously recognized ones were re-confirmed. These are composed of laminated scoriaceous ash layers with or without scoria layers. The names of Za-To1 to 4 by previous studied are followed. However, the distribution of the tephras, especially Za-To3 and 4 were substantially revised. The estimated ages of the four tephras are ca. 32.5, 30.7, 27.1, 12.9 ka, respectively, according to Miura et al. (2008).

**9 to 4.1 ka:** It was revealed that three tephras, correspond to Za-To6,7,8 of previous studies, widely distribute in eastern foot area and it was re-confirmed that one tephra, Za-To5 of previous studies, locally distributes on southern hillside. Za-To6,7,8 are mainly composed of laminated scoriaceous ash layers, whereas Za-To5 consists of scoria layers. Based on newly and previously obtained carbon-14 data, the estimated ages of Za-To5,6,7,8 are ca. 5.8, 5.6, 5.0, 5 to 4.5 ka, respectively.

Among the previously recognized five tephras bellow Za-To5, the top one was turned out to correspond to lower part of Za-To6. Although previous studies showed the rest four taphras distribute mainly in northern area, it was shown these distribute around southern part as well. These four tephras consist of lower thicker hydrothermally altered ash layer having lapilli in places and upper thinner scoriaceous ash layer. The names of Za-To5a,b,c,d in ascending order by previous studied are followed. Ca. 8.5 to 9 ka and ca. 6.5 ka carbon-14 ages were obtained for samples from paleosol layers below Za-To5a and c, respectively.

**around 3 ka:** Seven tephras were newly recognized by the research during this program. These were named Za-pre Goshikidake a to g in ascending order. These tephras but Za-pre Goshikidake b consist of hydrothermally altered ash layer. Za-pre Goshikidake e,f in places near the eruption center have coarser matrix and include lapilli. Za-pre Goshikidake b is composed of pale gray to gray hydrothermally altered ash layers. Ca. 4.5 ka and ca. 2.8 ka carbon-14 ages were obtained for samples from paleosol layers below Za-pre Goshikidake a and g, respectively.

**after ca. 2 ka:** The facies features and distribution of previously recognized nine tephras were re-examined and re-confirmed. The top one is composed of hydrothermally altered ash layer which includes lapilli near the eruption center. The other tephras mainly consist of laminated scoriaceous ash layers. The hydrothermally altered ash layer and /or scoriaceous lapilli layer are included in some tephras. The nine tephras were named Za-To9 to 16, 1895 ash in ascending order by previous studies. Za-To9, 10 were

revealed to be from eruption centers older than the Okama, the youngest crater in Zao Volcano, whereas the others were from the Okama crater. Therefore Za-To9 to 16, 1895 ash were renamed Za-Gs1,2 and Za-Ok1 to 7. Based on newly and previously obtained carbon-14 data as well as eruption records, the estimated ages of Za-Gs1,2 were revised to be 2 to 1.4, 1.2 to 1 ka and those of Za-Ok1 to 7 were partly revised to be 13 to 14 century, 14 century, 14 to 15 century, 15 to 16 century, 17, 19 century, 1894 to 1897 CE.

Keywords: Zao Volcano, tephrostratigraphy, eruption sequence