Chemical variations of the Early Pleistocene Shirakawa ignimbrites, NE Japan; Evidence for deep crustal stoping into hot zone

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The Shirakawa ignimbrites were generated by large-caldera-forming eruptions in Fukushima Prefecture, NE Japan, during Early Pleistocene. The ignimbrites consist of the Kumado (1.4 Ma) from Ono caldera, Ashino (1.3 Ma) and Nagurasawa (1.2 Ma) from Tonohetsuri caldera, Nishigo (1.1 Ma) from Narioka caldera and Ten-ei (1.0 Ma) from unknown-concealed caldera. These calderas overlap each other within 20-by-20 km area on the backbone range of the arc. Tonohetsuri (14 km in diameter) is the largest caldera of them and accompanied with a typical post-caldera resurgent dome. The Shirakawa ignimbrites are crystal rich and lack chemical zoning. Pumices of Kumado, Ashino, Nagurasawa, Nishigo and Ten-ei are 68-70 wt%, 67-70 wt%, 68-69 wt%, 72-74 wt% and 69-70 wt% in SiO_2 contents, respectively. They are plotted within medium-K field, but make different trends for other major-elements in same range of SiO2. So, these pumices are not generated by simple crystal fractionation from a parental magma. On the contrary, these are similar in trace-elements pattern having Nb, Ta and Ti negative anomalies, high LREE and flat HREE. Their variations can be explained by different degrees of partial melting from similar K-rich mafic sources. However, these pumices independently differ in isotopic ratios, which vary from 0.7044 to 0.7047 in 87Sr/86Sr and from 0.51271 to 0.51278 in 143Nd/144Nd, although they repeatedly erupted from overlapped calderas. These results suggest that the ignimbrite sources were made up of similar mafic rocks, but renewed at every caldera-forming eruption. In general, it is increasingly evident that some felsic magma is generated in the lower crust and erupts without spending a significant time in the upper crust. To explain renewal of the Shirakawa ignimbrite magmas, melted materials vanished from deep crustal hot zone due to upward migration and similar crustal materials subsequently stoped into the hot zone as source materials for the next eruption.