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Simultaneous generation of multiple silicic magmas and their zoned magma chamber related to a caldera-forming eruption:

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It has been widely believed that a large scale, caldera-forming eruption was derived from a zoned magma chamber, which was composed of single, voluminous silicic magma associated with a small amount of mafic magma. In almost all the cases, the mafic magma injected into the silicic magma before the eruption to erupt as mixed or mingled magma with the silicic one. This is consistent with both of the temporal change of eruptive magma during the eruption and evidence of magma mingling and/or mixing. However, there also exist several eruptions in which distinct types of slicic to intermediate magmas erupted with mafic magmas. In this study, we show two examples from Hokkaido, Japan, in which ditinct silicic magmas coexisted in addition to mafic magma. During 40 ka caldera-forming eruption of Shikotsu volcano, eruptive materials can be divided into two types, aphyric (A-type) and porphyritic (P-type) ones. A type is voluminous rhyolitic magma and the mixing product of high-Si and low-Si rhyolitic magmas. These can be distinguished by Sr isotope ratios, indicating that these two magmas are no genetic relationship explained by fractional crystallization. On the other hands, the P type magma is also mixing products and several dactic and andesitic magmas. There is no mxing relationship between A and P types, indicating that the climactic caldera-forming eruption derived from simultaneous eruption of multiple magma chambers. In summary, the silicic magmas during the caldera-forming eruption of Shikotsu caldera consisted of two types of rhyolitic magmas and one or two types of dacitic magmas. In the case of 120 ka caldera forming eruption of Kuttcharo volcano (KpIV eruption), voluminous silicic magma erupted with small amount of mafic (andesite) magmas. The silicic magma is the mixing products of rhyolite and dacite magmas, which can be clearly distinguished by Sr isotopes. Thus, as in the case of Shikotsu volcano, the silicic magma of KpIV eruption consisted of multiple silicic magmas, which should be independently formed. However, these magma would be simultaneously formed. It has been widely believed that mafic magma plays as a heat source to produce silicic magma. If the silicic magmas were produced by crustal melting, partial melting of heterogeneous crustal materials might occur to produce several distinct silicic melts. It should be noted that the simultaneous generation of several types of felsic magma would be common especially in the case of large scale silicic magmatism such as caldera-forming eruptions. In such a case, mafic magma as a heat source would be enough large to melt crustal materials extensively.

Keywords: magma, silicic magma, caldera-forming eruption, crustal melting, magma genesis, zoned magma chamber