Voluminous silicic magma formation for the 30 ka Aira catastrophic caldera-forming eruption: contributions of crust-derived mafic and felsic magmas

*西原 歩[1]、巽 好幸[2,1]、鈴木 桂子[2,1]、金子 克哉[1,2]、木村 純一[3]、常 青[3]、日向 宏伸[4]、宮崎 隆[3]、Bogdan Stefanov Vaglarov[3]
*Ayumu Nishihara[1], Yoshiyuki Tatsumi[2,1], Keiko Suzuki-Kamata[2,1], Katsuya Kaneko[1,2], Jun-Ichi Kimura[3], Qing Chang[3], Hironobu Hinata[4], Takashi Miyazaki[3], Bogdan Stefanov Vaglarov[3]

1. 神戸大学大学院 理学研究科惑星学専攻、2. 神戸大学 海洋底探査センター、3. 海洋研究開発機構 地球内部物質循環研究分野、4. 神戸市立垂水中学校
1. Department of Planetology, Graduate School of Science , Kobe University, 2. Kobe Ocean-Bottom Exploration Center, 3. Department of Solid Earth Geochemistry, Japan Agency for Marine-Earth Science and Technology, 4. Kobe Municipal Tarumi Junior High School

Aira catastrophic caldera-forming (CCF) eruption occurred at 30 ka and discharged voluminous silicic magma with a small amount of less silicic magma. In order to understand the genesis of magmas in the Aira CCF eruption, petrological and geochemical characteristics of the juvenile clasts and plagioclase phenocrysts in them were investigated. Important petrological and geochemical features of the Aira ejecta and related rocks are described as follows:
1. Juvenile ejecta discharged by the Aira CCF eruption consist of three types of clasts; white pumice, dark pumice, and scoria clasts. Whole-rock chemical compositions of the dark pumices are less SiO_2 contents (67.5-75.7 wt.%) than those of the white pumices (74.3-77.2 wt.%). The scoria shows andesitic composition (SiO_2=59.0 wt.%).
2. In whole-rock characteristics, the SiO_2-poor juvenile clasts have higher $^{87}Sr/^{86}Sr$ (0.70856±0.00001 of the dark pumice and 0.70738±0.00001 of the scoria) than the white pumice (0.70597±0.00001).
3. An-contents of plagioclase cores in the white and dark pumices show bimodal distributions with peaks of An_{45} and An_{80}, while the scoria contains solely high-An (>An_{65}) plagioclase.
4. In plagioclase phenocrysts of the Aira juvenile clasts, Sr isotopic ratios of the high- and low-An plagioclase cores are different (0.70680±0.00117 and 0.70575±0.00040, respectively).
5. Basement rocks beneath the Aira caldera consist of Shimanto sediments and Miocene granites. These materials have much higher $^{87}Sr/^{86}Sr$ (Shimanto sediments: >0.70965; Miocene granites: >0.70885) than the Aira juvenile clasts.
6. Pre-caldera basaltic lavas, which are the most SiO_2-poor ejecta around the Aira caldera, have lower $^{87}Sr/^{86}Sr$ (0.70425-0.70469) than the Aira juvenile clasts.
The above features suggest that voluminous silicic magma bearing the white pumices in the Aira CCF eruption was produced by mixing between low-$^{87}Sr/^{86}Sr$ felsic and high-$^{87}Sr/^{86}Sr$ mafic magmas, crystallizing the low- and high-An plagioclase, respectively. The low-$^{87}Sr/^{86}Sr$ felsic magma was distinguished from both the upper crust and pre-caldera basaltic materials in $^{87}Sr/^{86}Sr$ characteristics. If the basaltic materials show the mantle signature, the low-$^{87}Sr/^{86}Sr$ felsic magma was derived from a lower crust material. The geochemical signature of the high-$^{87}Sr/^{86}Sr$ mafic magma can be explained by assimilation of high $^{87}Sr/^{86}Sr$ upper crust materials. The lowest $^{87}Sr/^{86}Sr$ recorded in the high-An plagioclase is higher than the whole-rock $^{87}Sr/^{86}Sr$ of the pre-caldera basalts, suggesting the mafic end-member magma for the Aira CCF eruption was the lower crust origin. A frequency ratio of the low- to high-An plagioclase in the white pumice proposed that the mixing ratio of the felsic and mafic magmas was estimated at a ratio of ~8:2, which is consistent with whole-rock $^{87}Sr/^{86}Sr$ variations of the white

pumice. In conclusion, the crust-derived low-$^{87}Sr/^{86}Sr$ felsic and high-$^{87}Sr/^{86}Sr$ mafic magmas had contributed to the formation of voluminous magma discharged by the Aira CCF eruption.

キーワード：Aira caldera、caldera-forming eruption、Sr isotope ratio、magma mixing、crustal assimilation
Keywords: Aira caldera, caldera-forming eruption, Sr isotope ratio, magma mixing, crustal assimilation

