Mafic to Felsic Juvenile Fragments from the Felsic Pyroclastic (Tuffite) Dike: Their Occurrence and Implications

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We have found juvenile fragments composed of basalt, andesite and dacite from the pyroclastic (tuffite) dike, central Kii peninsula. Wada and Iwano (2001) has already reported that the dike includes a rhyolitic juvenile fragment. In this presentation, we report their occurrence and bulk chemistries, with an attention to both mafic to felsic dikes close to the pyroclastic dike, and boulders from unknown composite igneous bodies.

Basaltic, andesitic and dacitic fragments obtained from the felsic pyroclastic dike are up to a few tens of centimeters in diameter. More felsic fragments tend to be larger than more mafics. While more mafic fragments show irregular shape and their margins are wavy with quick step, more felsics are also irregular but show gentle wave. A rhyolitc fragment reported previously shows sigmoid lens shape. Microscopically the boundary between fragment and matrix is always wavy for all of fragments. The basaltic fragment includes many vesicles 5mm in maximum diameter, but they are occupied by secondary calcite. Both andesitic and dacitic fragments are finely vesiculated. Garnet phenocrysts are observed in dacite and rhyolite fragments. Furthermore, some dacitic fragments have darker margins than inside of the fragments.

These observations indicate that these fragments were hot when emplaced into the dike. The irregularity of fragments is because of its high temperature allowing to be deformed in ductile manner. This means these fragments are juvenile. This coincides with the paleomagnetic results where juvenile pyroclastic and accidental fragments and matrix composing the pyroclastic dike are thought to have been emplaced at the temperature more than 300 degree C (Wada and Itota, 2002). On the other hand, obvious chilled margins are not observed on any type of fragments. However, the dark margin of dacitic fragments shows microfelsitic texture under the microscope. This texture may be explained that the chilled glass of margin formed when hot dacitic magma contacts with cold host rock materials, and then the glass was reheated and devitrified during the mixing with hot pyroclastics.

Although juvenile fragments of basalt, andesite, dacite and rhyolite in the felsic pyroclastic dike have 51.20-84.59 wt.% SiO_2, most of the data are plotted in the range 60-70 wt.%. The juvenile pyroclastic fragment as the main component of the pyroclastic dike shows 74.91 wt.% SiO_2. On the other hand, mafic to felsic dikes close to the pyroclastic dike indicate the bimodal chemical character consisting of mafic (50-60 wt.%) and felsic (70-80 wt.%) rocks. There is also a composite dike where basalt and rhyolite coexist (Wada and Nakamura, 2000). Additionally, boulders of the unknown composite rock, including the data from those composed of mafic component only, have a similar bimodal characteristic with the dikes close to the pyroclastic dike.

Most of data with the medium composition between mafics and felsics are obtained from juvenile fragments of the pyroclastic dike. On the oxides-SiO_2 diagram, especially for Al_2O_3, CaO, Na_2O and K_2O, chemical data for the most of juvenile fragments is not on the trend formed by mafic to felsic dikes and boulders from the unknown composite rock. Therefore, the medium component cannot be occurred by the mixing both of those mafic and felsic components mentioned before. Furthermore, the juvenile fragments may be reheated a few times, as inferred by the observation. There is a possibility that the migration of chemical elements occurred during the reheating event.

In conclusion, observations of juvenile fragments ranging from mafic to felsic components in the felsic pyroclastic dike strongly suggests that the mafic magma operated on the formation process of the pyroclastic dike. Additionally it may be suggested that magma in the chamber was chemically diverse such as zoned magma chamber, or in the magma plumbing system a few kinds of magma or magma chamber could interact one another.