Evidence of subsolidus oxidation for olivine phenocrysts in apparently unaltered basalt lava

T. EJIMA[12]*, M. AKASAKA[2], T. NAGAO[3] AND H. OHFUJI[4]

[1]Mineral resources research group, National Institute of Advanced Industrial Science and Technology, Tsukuba Central #7, Tsukuba 305-8567, Japan (ejima-t@aist.go.jp)

[2]Department of Materials Creation and Circulation Technology, Graduate School of Science and Engineering, Shimane University, Matsue 690-8504, Japan (akasaka@riko.shimane-u.ac.jp)

[3]Department of Earth Sciences, Graduate School of Science and Engineering,Yamaguchi University, Yamaguchi 753-8512, Japan (tnagao@yamaguchi-u.ac.jp)

[4]Geodynamics Research Center, Ehime University, Matsuyama 790-8577, Japan (ohfuji@sci.ehime-u.ac.jp)

Oxidation state of Fe and crystallization of precipitates within olivine phenocrysts from an olivine-basalt from Kuroshima volcano, Goto Islands, Nagasaki Prefecture, Japan, were investigated using electron microprobe analysis, ^{57}Fe Mössbauer spectroscopy, Raman spectroscopy and transmission electron microscopy, to reveal the oxidation mechanism of olivine phenocrysts with decreasing temperature after the solidification of magma.

Olivine phenocrysts in the Kuroshima basalt are apparently unaltered. The average Fo content of the olivine phenocrysts is 76.2 mol% · The olivine phenocrysts— occasionally have precipitate minerals at their rims. The ^{57}Fe Mössbauer spectrum of olivine separates consists of two doublets assigned to Fe^{2+} at the octahedral M1 and M2 sites, and a Fe^{3+} doublet at the M1 and M2 sites. The Fe^{2+}:Fe^{3+}-ratio is 90(5):10(1). Precipitates consisting of magnetite and enstatite-like pyroxene occur at the rims of the olivine phenocrysts, and grow parallel to the olivine *c*-axis. Moreover, clusters consisting of nanoscale domains of a few tens of nm in size occur in the host olivine. Their rounded form and appearance in transmission electron microscope images are similar to those of the magnetite precipitates, but have olivine structure and can be regarded as embryos of magnetite within the olivine. The coaxial relations of precipitates to host olivine reflect the crystallization process of precipitates from host olivine under cooling conditions after solidification of magma.