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Magma plumbing system of Late Cretaceous volcanism in the Giresun area, NE Turkey: Evidences from mineral chemistry and thermobarometry

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Late Cretaceous volcanic activity of the eastern Sakarya Zone, northeastern Turkey, is one of the most important geological events of the region. This volcanic activity formed in two different periods (Turonian-Santonian and Late Santonian-Middle Campanian) is represented by large volume of mafic (basaltic to basaltic andesitic) and felsic rock series (dacitic to rhyolitic) within each period. Previous studies indicate that metasomatized lithospheric mantle is suggested to be the source of the mafic volcanics whereas lithospheric mantle-derived differentiated basaltic melts which experienced AFC and mixing processes are suggested to be the parent melt of the felsic rocks. However, there is no any evidence for crystallization conditions and depths of these mafic and felsic magmas formed in two different periods. To answer this question, we have used phenocryst compositions and some thermobarometric calculations to determine the P-T conditions of the magma reservoirs where crystallization occurred, then have used these data to reconstruct the magma plumbing system.

The mafic volcanics in both periods particularly contain phenocrysts of calcic plagioclase (An_{52-78}), K-sanidine and Mg-rich pyroxene ($Wo_{3-49}En_{35-69}Fs_{9-39}$ with Mg#=56-83) whereas the felsic rocks have phenocrysts of quartz, sodic plagioclase (An_{38-50}), K-sanidine, Mg-rich amphibole (Mg#= 64-54) and biotite (Mg#= 65-50). Normal and reverse zoning observed in the core-rim profiles of some plagioclase phenocrystals in both mafic volcanics indicate the changing in crystallization conditions (P, T, fO_2) and/or magma mixing process. According to the two feldspar thermometers, the crystallization temperatures of the first-stage mafic rocks (824-718^{o}C) are lower than those of the second series (983-958^{o}C). Based on the clinopyroxene-barometer, crystallization pressure and depths of the clinopyroxenes in the first mafic volcanics are much higher (4.6$\pm$2.7kbar and 13.8$\pm$8.1km) than those of the second ones (9.4$\pm$2.3kbar and 28.2$\pm$6.9km). On the other hand, it can be said that the crystallization pressures and temperatures of both felsic rocks in the late Cretaceous volcanic sequence are relatively low (1.4$\pm$0.6kbar and 788-717^{o}C) and their depths are shallow (5.3$\pm$2.5 km).

Geothermobarometry investigation based on mineral chemistry of the main phenocrystal phases suggests that the late Cretaceous mafic and felsic magmas underwent a polybaric evolution history, with crystallization and/or mixing processes occurring at different depths of the crust shortly before eruption.

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