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Petrology of large lava flow off the East Pacific Rise : Crystallization process of the large ponded lava from ODP hole

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Petrology of large lava flow off the East Pacific Rise : Crystallization process of the large ponded lava from ODP hole 1256C

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91‘56.1‘W on the 3650-m deep Guatemala Basin on the Cocos plate formed at ˜15 Ma at the East Pacific Rise. A large off-ridge lava flow 75-100m in thickness and ca. 10 cubic kilometers in volume was drilled at site 1256, providing a unique opportunity to understand the inner structures and solidification and emplacement processes of an off-ridge large lava flow. Hole C penetrated a 35-m thick lava from 280 mbsf to 315 mbsf. We present mineral compositions and grain size analyses of the core sample from hole 1256C, and discuss the crystallization and emplacement processes of the large off-ridge lava flow.

Phenocrysts are olivine, clinopyroxene and plagioclase, and the groundmass minerals are clinopyroxene, plagioclase and magnetite. Varioles are present in the upper and in lower sections with a few biotite in granophyre veins in the middle. The lava flow consists mostly of NMORB with high-K2O EMORB intervened at a depth interval of 290-300 mbsf (Wilson, et al.,2003). High-K2O EMORB has high-Mg# (60˜70) clinopyroxenes and is interpreted to have intruded into the solidifying lava body at the final stage of the lava emplacement.

Just above the EMORB is the level of the most differentiated lava that has low-Mg# (50˜60) clinopyroxenes, granophyric veins and pods. Plagioclase and clinopyroxene crystals are largest in this level. These facts indicate that increase in water content in the residual liquid with the crystallization differentiation reduced magma viscosity and resulted in crystallization of biotite-bearing granophyre and the largest crystal sizes.

I compared olivine phenocryst size distribution and number density distribution with phenocrysts sedimentation model of Rowland and Walker (1988). In cases where phenocrysts sedimentation velocity faster than cooling rate of lava body, olivine phenocrysts have slightly in uppermost part and have very few in upper part. In upper two third of olivine phenocrysts increase rapidly to maximum volume and decrease by degrees for lower section. Two parts that lower section and direct top of layer of intruded EPMA suggests these similar pattern with lower section of phenocrysts sedimentation model. It shows two lower sections in this lava body. The fact cannot explain by one lava flow, more than once lava flow units grew together and then intruded EMORB at the center.

Pigeonite occurs through the whole section as a discrete crystal in some cases and more commonly enclosed by augite. Augite has Mg#60˜75, Al2O3 1.5˜2.0 wt%, TiO2 0.6˜0.8 wt% except 292 mbsf. Pigieonite has Mg#65˜70, Al2O3 0.8˜1.1 wt%, TiO2 0.3˜0.4 wt%. Pigeonite and augite in contact with each other is considered to be in equilibrium in terms of Fe-Mg distribution. However, augite crystals away from the contact with pigeonite inclusions are disequilibrium with the pigeonite. This suggests that augite including pigeonite was incorporated into the host magma which was unsaturated with pigeonite.

Keywords: off-ridge lava flow, olivine phenocrysts, pigeonite