V056-P006 Time: May 28 17:15-18:45

Surface morphology of LA lava flow of Izu Oshima 1986 eruption

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The 1986 eruption in Izu Oshima produced three different types of lava flows (LA, LB, LC) from different craters; central crater of Mt. Mihara, fissure craters on the caldera floor, and fissure craters on the flank. There exists many observations on the emplacement of the lava flows, and they still preserve their surface morphology. For these reasons, the Oshima 1986 lavas seem to be an appropriate field to understand what factors control lava surface morphology. However, as for LA lava flow which overflowed from the summit lava lake to caldera floor, precise survey on surface morphology and modeling on its formation process are still lacking. Although we recognize the great influence of crystallinity on lava flow morphology through rheology change, there are few quantitative data on crystallinity change against flow distance. In the present study we discuss the factor controlled the surface morphology and crystallinity distribution of LA lava flow.

LA lava flow consists of four flows, LA-I to LA-IV named in order of overflow, and they are all classified in aa flow. Contrary to general aa flows whose surface clinkers are scoriacious, LA surface mainly consisted of dense platy or blocky clinkers with red oxidized surface. Scoriacious clinkers distributed only flow edges, i.e., near flow front and on outer flank of levee. These mean that the formation process of LA surface morphology was different from that of general aa flows.To reveal the origin of such clinkers, we examined their shape and size against flow distance. They became rounder and their average long axis sizes tended to decrease with distance (e.g., LA-II: about 140 cm at 10m and 80 cm at 700 m). They may be the results that solidified clinkers broke and rubbed on each other while advancing. With the facts that the distribution boundary between dense and scoriacious clinkers was unclear and no clinker had their transitional texture, we conclude that LA surface clinkers did not originate from usual scoriacious clinkers but from autobreccia formed on the summit lava lake.

Next, we examined crystallinity in LA lava groundmass.Both plagioclace and clinopyroxene tended to increase with flow distance (LA-II: plag 32.5% and cpx 24.5% at 10m, plag 35.5% and cpx 30.0% at 700m)If the temperature before overflow and the following cooling rate was the same, the crystallinity should be independent of flow distance, because the time available for nucleation and crystal growth was the same anywhere. We further classified the plagioclase in groundmass into microphenocysts and microlite by their shapes and sizes; microphenocysts is thought to nucleate through rise from magma chamber, and miclolite after effusion from vent (Lipman et al., 1985). As for miclophenocrysts the crystallinity seemed to be almost constant or rather decrease with distance, and the number density and the mean length did not change systematically. On the other hand, microlites tended to increase their number density and decrease their mean lengthlength length (e.g., LA-II: 1.8*10^-3 N/micron^2 and 40micron at 10m, 2.3*10^-3 N/ micron^2 and 30micron at 700m, respectively).These may reflect the difference of thermal history the lava had suffered before overflow, because when the degree of undercooling is high, nucleation rate becomes high and, resultantly, crystal number density becomes high and mean crystal size becomes small (Crisp et al., 1994). The present results imply that the front (i.e., the earlier overflowed) lava suffered higher degree of undercooling when microlites nucleated. If the microlites nucleated in the lava lake, the difference of their number density and size may correspond to the difference in the time spent near the surface; the later effused lava was not exposed at the shallower part of the lava lake longer, where the degree of undercooling was high.