

Nature of Sub-volcanic Magma Chambers in Emeishan Province, China: Evidence from Quantitative Textural Analysis of Plagioclase Megacrysts in the Giant Plagioclase Basalts

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Sub-volcanic magma chambers in the Crust might be a widespread component of large flood provinces, however these magma processes in Emeishan large igneous province (LIP) remain unclear. The Giant Plagioclase Basalts (GPB) which can reveal the sub-volcanic magma chambers' presence widely occur in Emeishan LIP. The plagioclase megacrysts are 2 -5 mm, have compositions ranging from An_{53} to An_{60} and are generally weakly zoned, The GPBs are texturally classified into isolated coarest crystals(IC) and glomeroporphyritic crystals(GC) type. A completed Permian basaltic section in the middle Emeishan LIP is studied in order to further constrain GPBs' petrogenesis and sub-chambers magma process. The IC basalts and the GC basalts in this section are interlayered, the GPB flows can be divided into five flows which are GC1 flow, IC1 flow, GC2 flow, IC2 flow and GC3 flow. The crystal size distributions(CSD) of these megacrysts mostly plot as almost straight lines on a classic CSD diagram, and the characteristic lengths of the five flows are 1.54 mm, 2.99 mm, 1.70 mm, 3.22 mm and 1.86 mm, respectively. Taking a simple assumption of plagioclase steady-state magma chamber models and simple continuous growth at the rate of 10^{-10} mm/s, the results suggest the possible every flow magma residence times of 489.2 years, 946.7 years, 538.7 years, 985.9 years and 588.3 years, respectively. Using the thickness and duration of IC1 flow, GC2 flow and IC2 flow, we may get the megacryst-bearing magma eruption rate of 0.422 m/year, 0.324 m/year and 0.350 m/year. However, the lack of crystals smaller than 2 mm suggests that coarsening may have been involved because of temperature cycling. A possible history is as follows:(1) magmas derived from mantle start to accumulate at crust, forming the sub-volcanic chambers;(2) the glomeroporphyritic crystals grow in higher-level static sub-volcanic chamber, the isolated coarest crystals grow in lower-level sub-volcanic chamber which is filled gradually with hot, new magma and coarsen in response to thermal cycling;(3) the five flows of GC type and IC type are the products of volcanic magma cycle. If we take the duration of IC1 crystallization as aphyric basalts eruption duration, we can give a 23.9-m-thick aphyric basalts flow rate of 0.049 m/year. Quantitative integration of textural and field information for igneous rocks can contribute to our understanding of physical processes and petrogenesis in the sub-volcanic chambers of Emeishan LIP.