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Disequilibrium Petrographic Textures and their Genesis: Evidences from Shield-forming Lavas of Tianchi volcano between China and North Korea

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Volcanic system is an open dissipative system far from equilibrium [1]. The strongly nonlinear and time-dependent processes of volcanic system lead to the uncertainty and complexity of volcanic forecasting [2]. Previous researches have shown that magmatic evolution in the volcanic system has the characteristics of nonlinear interaction of multi-component and multi-parameter coupling, and the coupled reaction-diffusion of cooling, solidification, convection, mixing, assimilation, fractional crystallization and degassing produce a large number of disequilibrium textures [3]. Therefore, how to identify the non-equilibrium evolution of volcanic activities from the texture and composition of the mineral and rock is an essential way to accurately forecast eruption.

Tianchi volcano, located in the border area between China and North Korea, is a giant stratovolcano, and mainly composed of basaltic shield, trachytic cone and alkaline rhyolitic pyroclastic sheet. From the old to the new, basaltic shield has been divided into basalt - trachybasalt-basaltic trachyandesite rock association of Quanyang Period, Toudao Period, Baishan Period and Laofangzi Xiaoshan Period. Geochemical studies show that the shield-forming lavas belong to alkaline series and tholeiitic series, and were not formed by simple crystallization differentiation of magma from a single source.

The different period of shield-forming lavas in the Tianchi volcano have different type, content, generation and disequilibrium texture of mineral phenocrysts. Coarse-grained phenocrysts are mainly basic to intermediate plagioclase, clinopyroxene, orthopyroxene and olivine, which often exhibit complex oscillatory zoning, resorption, reaction rim and overgrowth in the shield-forming lavas. Mineral chemistry shows that resorption core of plagioclase or coarsely-sieved plagioclase has relatively low content of An (An=40-50), and plagioclase in the matrix has high content of An (An= 50-60), but plagioclase of reaction rim and overgrowth lies in between. With these complex plagioclase textures, zoning and reaction rim of clinopyroxene, orthopyroxene and olivine phenocrysts are also very common and the contents of Mg in these phenocrysts generally decrease from core to edge. Fine-grained intermediate plagioclase, clinopyroxene and olivine phenocrysts have homogeneous compositions and

structures. Due to the difference of cooling rate, the matrix texture presents the glass-filled texture or pilotaxitic texture of microcrystalline.

The diversity of mineral shape and struture in the shield-forming lavas of Tianchi volcano is a reflection of the various dissipative structures, fractal and chaotic phenomena which are formed under the far-from-equilibrium condition. Their main mechanism probably includes: (1) magma mixing, (2) magma convection in magma chamber, (3) coupled reaction-diffusion effect between mineral and magma, (4) magma degassing, and (5) changes of temperature and pressure as magma ascends to the shallow level or erupts to surface.

References:

[1] Yu CW (2006) Fractal growth of mineral deposits at the edge of chaos. Anhui Education Publishing House

[2] Sparks RSJ (2003) Earth Planet Sci Lett 210: 1-15

[3] Perugini D et al. (2003) J Petrol 44(4): 733-756