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深部流体与岩浆活动:兼论腾冲火山群的深部过程

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摘要：

深部流体强烈影响许多地质过程的发生和发展,然而对其行为的理解却甚少。在所有可能影响岩浆活动的因素中,流体是最重要的。流体的高度活动性及其在熔体中的溶解度随压力减小而降低,暗示岩浆系统必然是开放的动力系统,流体的丢失和获得可戏剧性地影响岩浆系统的整体行为。流体对岩浆系统的影响主要通过改变熔体的黏度来实现,也改变岩浆的平均密度,以及固相线和液相线温度。少量流体的注入即可以导致熔体黏度出现几个数量级的降低,这种戏剧性改变进而导致岩浆柱与通道壁摩擦力的快速减小,因而岩浆上升速度也可以呈现几个数量级的变化。当岩浆上升到流体相分离的深度以后,岩浆系统的行为更加不可预测。反之,流体的丢失将导致岩浆系统的行为向相反方向变化,岩浆将滞留在深部。值得注意的是,丢失到通道中的流体可以弱化上覆岩层的力学性质,改善岩浆上升的通道条件。因此,如果上升岩浆能够得到持续的深部流体补给,其补给量至少等于丢失量,岩浆必将以越来越快的速度上升。据此,岩浆系统是一种复杂性动力系统,岩浆作用是一种非线性过程。这种分析结果与流行的岩石学认识不一致,却与火山学观察和成矿学研究结果相同。腾冲火山岩中的聚斑结构暗示某些岩浆在喷发之前曾经在深部作过停留,它们曾经位于不同的深度水平上。同岩浆交代结构暗示岩浆房的活化有赖于深部流体的注入,因而火山监测过程中关注岩浆房之下的深部流体活动是必须的。将岩浆房上、下两部分的流体活动紧密结合在一起,可能是火山监测的一个新方向。

英文摘要：

The deep fluids intensely affect many geological processes in their initiation and development. However, their behaviors are poorly understood till now. The fluid is the most important among the factors affecting magmatism. The fluid has higher activity, and its solubility in melt increases with pressure. These suggest that the magma system must be an open dynamic system, because both input and output of fluid dramatically affect the whole behavior of a magma system. The fluid affects the magma system mainly by changing the melt viscosity, also changing the average density and liquidus and solidus temperatures of the magma. Injecting a few of fluid induces the melt viscosity to change in several orders of magnitude. This dramatic change further leads to quickly decrease the friction between the magma and its conduit rocks. Therefore, the ascent rate of magma should be also increased in several orders of magnitude. When the magma reaches the depth where the fluid separates to different phases, the behavior of the magma system will be more difficult to be expected. Conversely, the fluid escape will cause the magma system to be changed toward the opposite direction. The degassed magma will be detained at the deeper depth due to increasing viscosity and density. It is important to indicate that the lost fluid to the conduit may weaken the mechanical properties of the upper lying substrata, and hence improves the ascent condition in the conduit. Therefore, if the ascent magma may obtained continued recharge of deep fluids, the amount of which is at least equal to the lost, the magma will ascent in a more and more rapid rate. Accordingly, the magma system is a complex dynamic system, and magmatism is a non-equilibrium and non-linear process. These analytical results disaccord to the traditional petrology, but are consistent with the volcanological observations and metallogenic researches. The phenocryst-assemble texture and the syn-magmatic metasomatic texture can be seen commonly in the volcanic rocks of the Tengchong volcano group. The phenocryst-assemble texture suggests that the magma has a brief stopover at some depth before it erupted to the surface. The mineral assemblages indicate different depths where the magmas stay. The syn-magmatic metasomatic texture suggests that the chamber activation depends on injection of the deep fluids. Therefore, it is necessary to pay more attention to the deep fluid process beneath the chamber in volcano monitoring. The close incorporation of monitoring the fluid processes beneath and above the chamber may be a new approach of the volcano monitoring.

关键词：深部过程 火山活动 岩石学 熔体-流体相互作用 云南腾冲

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