



Discontinuous Generation of Granite Plutons

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The generation of granitic magmas begins when the lower crust starts melting, often with the active help of the underlying mantle. Since melting is driven by heat, it consists in a pervasive and continuous process that develops over wide regions. In contrast, the building of a granitic pluton is highly discontinuous in time. Several inputs of magma, with sometimes a different chemical composition, have to be focused toward a specific region where magmas accumulate. They form a large pluton, often separated from an adjacent pluton by some 50 km. The process of pluton building is therefore discontinuous in space and time. This sudden switch from continuous to discontinuous process has rarely been addressed before, though it constitutes a fundamental point of magma generation. Discontinuities result from non-linear processes that develop during segregation and ascent of the magma. They basically rely on the non-linear rheology of partially molten rocks. Hence, thresholds control the change from a solid-like to a liquid-like behavior of the magma. In between, the rheology consists in sudden changes from one state to the other. Because two phases continuously coexist, namely the matrix and the melt, strain is highly partitioned between them. Those factors induce highly discontinuous melt segregation, which needs both pure and simple shear to develop. Melt focusing is controlled by the viscosity contrast between the two phases. It gives place to different compaction lengths depending on the region, a partially melting source or a nearly brittle crust, develops. It results from a discontinuous segregation process that intermediate magma chambers could develop with different temperature and magma composition. They could be the place of enhanced magma mixing. Because ascent and emplacement are discontinuous in

time, they provide time for the crust to relax, avoiding the room problem for a pluton intruding the upper crust. Finally, the stress conditions, which differ for each tectonic setting, could have an influence on the type of the granite.