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# Snapshots from deep magma chambers: decoding field observations

Cristina P. De Campos
University of Munich, GeoCenter, Earth and Environmental Sciences, Munich, Germany (decampos@lmu.de)

During the post-orogenic stage of a Neoproterozoic orogen (Araçuaí-West Congo), inversely zoned calc-alkaline to alkaline plutonic structures intruded previous geologic units. Structural measurements, mapping of flow patterns and additional geochemical and isotopic data point towards different compositional domains which have been generated during a time span between 20 to 30 Ma. The result from decades of mapping revealed the architecture of ca. 10 large plutons in more détail.
This work will focus on the dynamics of magmatic interaction for six different plutons ranging from c.20 to 200 km2 in outcropping area. Conclusions are based on already published and new unpublished data aiming the state of the art.
In the silica-richer structures concentric fragmented and folded layers of granite in a K-basaltic matrix contrast with predominant more homogeneous K-basaltic to gabbroic regions. These may be separated by stretched filament regions (magmatic shear zones) where mixing has been enhanced resulting in hybrid compositions. Locally sharp and pillow-like contacts between granitic and K-basaltic rocks depict a frozen-in situation of different intrusive episodes. In the silica-poorer plutonic bodies gradational contacts are more frequent and may be the result of convection enhanced diffusion. For all plutons, however, mostly sub-vertical internal contacts between most- and least-differentiated rocks suggest generation from predominat large magma bodies of variable composition which crystallized while crossing the middle to lower crust (< 25 km depth). They have been catch in the act on their way up. Accordingly mushroom- to funnel-like magma-chambers and/or conduits could register snapshots of the interaction dynamics between granitic and noritic/dioritic or syeno-monzonitic and gabbroic magmas.
Different compositional domains within different plutons suggest distinct kinematics. Nevertheless all studied plutons provide outstanding evidence for mixing, not only mingling, between contrasting magmas generated from different sources and depths.
When flow patterns from these plutonic structures are compared to those obtained from experiments and numerical modeling, vortex-like systems may be locally recognized with chaotic regions among concentric regular flow cells, separated by major flow shearing zones. These patterns may be in remarkable good agreement with less complex flow patterns obtained for simpler dynamic systems. Differences in the magma supply and flow regimes between distinct plutons, in time and space, depict frozen moments in their evolution and therefore may explain some of the discrepancies in the different hybridization degrees for different complexes.
The combination of detailed mapping of flow patterns in the field, numerical modeling and experimental results using natural magmatic products as end-members may provide new insights into the dynamics of magma chambers, specially for shallow chambers in a volcanic environment. Due to high viscosities and non-Newtonian behavior during a long time-interval, the application of fluid dynamics to understanding magmatic processes, especially those taking place in the deep crust, is still a major challenge to Geosciences. Extrapolation for plutonic environments remains therefore a great defiance. This discussion aims to show that it is nevertheless worthwhile.