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Mixing haplogranite and haplobasalt : first experimental results under controlled chaotic conditions

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Mixing is known to be an interplay between convection/advection and diffusion. Its efficiency can be controlled by chaotic dynamics. These processes are thought to be the source of fractal structures propagating within natural magmatic systems, from meter to the micrometer length scale (Perugini et al., 2006; and references therein).

We developed a special high temperature device (up to 1700P^{oP}C) for experimental studies of chaotic mixing dynamics in silicate melts. This device has been built after the eccentric cylinder geometry (journal bearing system) for viscous fluids from Swanson and Ottino (1990). The choice for this geometry is based on its feasibility and simpler analytical solution for the stream function.

In the journal bearing system the flow region, is confined in the torus between the centers of the two eccentric cylinders. In order to generate chaos in a flow, the streamlines must be time dependent, resulting in alternating movements between the two cylinders. This means that at least one of the cylinders has alternating rotation directions. The dimensions of this new experimental device are constrained to induce the development of chaotic flow fields.

Following synthetic compositions are being used in the mixing experiments: 1) endmember A is a haplogranite (HPG8 from Dingwell et al., 1993), which has been doped with Rare Earth Elements, Rb, Sr, Ba and Zr; while 2) endmember B is a haplobasalt with the eutectic composition for the Diopside-Anorthite system. We present the first results for a prototypical system, under different mixing protocols.

References:

Dingwell et al., 1993, Eur. J. Mineral., 5: 133-140.

Perugini et al., 2006. EPSL, 234: 669-680.

Swanson and Ottino, 1990. J. Fluid Mech., 213:227-249.