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Magmatic convection in a volcano conduit.

Nadezhda Ivanova and Melnik Oleg
Institute of Mechanics, Moscow State University, Russian Federation (nadezhda.al.ivanova@yandex.ru)

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Institute of Mechanics, Moscow State University.
A model of two fluids bi-directional flow is designed to describe the process of gas transport through viscous magma during passive volcanic degassing. Two viscous fluids move axis-symmetrically in the opposite directions in a cylindrical conduit. The steady bi-directional flow of the immiscible fluids is driven by the pressure gradient and fluids buoyancy. Generally the lighter magma saturated with gas moves upwards while the heavier magma moves in opposite direction. Nevertheless some of lighter magma may be pulled down as well as heavier fluid may be driven towards the surface. The heavier magma is treated as incompressible. Thermal effects are not considered.
There are four possible axi-symmetric patterns of the motion depending on the location of lighter fluid and the retraction of either light or heavy magmas. It is possible that light magma ascends in the middle or in the peripheral part of the conduit and the opposite – heavy magma sinks in the peripheral or central part of the conduit. Light magma can carry upwards some part of heavy magma or heavy magma can bring downward some light magma. In the first case all gas will be transported to the surface, in the second case some gas will be recycled.
The model based on mass conservation and Navier-Stokes equations was simplified to a system of two transcendent equations, relating the radius of the fluids contact and pressure gradient via the density ratio of the fluids.
We aimed to figure out the dependence of chamber pressure and magma discharge for a fixed length of the conduit. The obtained solutions are non-unique and refer to different possible states of the flow.
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