Contribution ID: **19** Type: **Oral**

CFD modeling of ascending strombolian gas slugs through a constricted volcanic conduit considering a non-linear rheology

Wednesday, 12 February 2020 12:06 (18 minutes)

The Strombolian eruption style, named after Stromboli volcano (Italy), can be attributed to large gas slugs that coalesce from exsolved gas bubbles during their ascent inside the volcanic conduit. Moreover, field observations at the vent reveal that eruptions consist of pulses on the order of a few seconds. One possible explanation for this behaviour is a constricted conduit through which the slug has to squeeze, at which point smaller bubbles separate from the main slug. In this study, a commercial CFD software is used, and a custom non-linear viscosity model is implemented, to shed more light onto this hypothesis. We carry out systematic, cylinder symmetric model calculations to explore the conditions of gas slug disintegration in the case of a non-newtonian rheology. In a conduit of 3 m diameter and 150 m length we found that a numerical resolution of 3 cm or less is necessary to achieve a meaningful solution. We find that a gas slug of 100 kg water vapor will be disintegrated into 18 separate smaller slugs. Further results will be discussed and because this problem is highly non-linear, numerical solutions are sometimes difficult to attain. The numerical problems encountered during this work will also be discussed.

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Session Classification: Subsurface & Surface Processes

Track Classification: Subsurface & Surface Processes