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# Modelling fluid flow in clastic eruptions: application to the Lusi mud eruption.

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Clastic eruptions involve the rapid ascension of clasts together with fluids, gas and/or liquid phases that may deform and brecciate the host rocks. These fluids transport the resulting mixture, called mud breccia, to the surface. Such eruptions are often associated with geological structures such as mud volcanoes, hydrothermal vent complexes and more generally piercement structures. They involve various processes, acting over a wide range of scales which makes them a complex and challenging, multi-phase system to model.

Although piercement structures have been widely studied and discussed, only few attempts have been made to model the dynamics of such clastic eruptions. The ongoing Lusi mud eruption, in the East Java back-arc basin, which began in May 2006, is probably the most spectacular clastic eruption. Lusi's eruptive behaviour has been extensively studied over the past decade and thus represents a unique opportunity to better understand the dynamics driving clastic eruptions, including fossil clastic systems.

We use both analytical formulations and numerical models to simulate Lusi's eruptive dynamics and to investigate simple relationships between the mud breccia properties (density, viscosity, gas and clast content) and the volumetric flow rate. Our results show that the conduit radius of such piercement system cannot exceeds a few meters at depth, and that clasts, if not densely packed, will not affect the flow rate when they are smaller than a fifth of the conduit size. Using published data for the annual gas fluxes at Lusi, we infer a maximal depth at which exsolution starts. This occurs between 1800 m and 3200 m deep for the methane and between 750 m and 1000 m for the carbon dioxide.