Biot number influence on the crust-magma thermal regime under the volcano: evidences from integrating petrology and numerical models

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In volcanology the processes that operate in the magma conduit between the host-rock and the magmatic intrusion are essential to know the thermal regime during the process of crustal partial melting. The appropriate parameter to advance in the knowledge of this rock-magma interaction is the Biot number. However its use in volcanic models are normally taken in broad ranges (Biot tends to zero or Biot tends to infinity depending on the higher thermal resistance in the host or in the magma, respectively) instead of as precise values. To achieve the latter, an interactive approach that combines realistic samples from volcanic conduits (through crustal xenoliths) and numerical modelling of fluid dynamics, is indispensable.

We investigate the crust-magma thermal regime in the conduit by operating with different and precise Biot values in 2-D numerical approaches. They are further combined to the crustal samples erupted from depth in order to interactively both constrain the numerical parameters and boundary conditions before modelling, and interpret more accurately what the rocks have to tell us. The natural silicic samples from El Hoyazo volcano (SE Spain) where rapidly erupted after incorporated into dacitic lava by rooting up from the wall-rock and/or dropping into the magma conduit at 13-18 km depth. These crustal xenoliths represent unique natural scenarios to endeavour on the thermal history of magma flow in the conduit and, consequently, the crustal contribution -xenolith history- before (and during?) the eruption episode.

The results -depending on the different conduit depths, temperature gradients at the host and conduit, and conduit's radius- evidence significant differences in the heat transfer between magma and crust along the magma ascent process.