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Understanding the transitions between fallout phases and PDCs from textural and rheological constraints on the Agnano-Monte Spina eruption (Campi Flegrei, Italy)

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The 4.1 ka B.P. Agnano-Monte Spina eruption is the highest magnitude event of the past 5 ka at Campi Flegrei caldera. We investigated the textural characteristics and physical properties of three members (A, B and D) of the main fallout and subsequent PDCs phases. We aim to relate the textural features of the deposit to variations of intrinsic parameters of the magma during ascent along the conduit and to investigate how the fluid dynamics of the magmatic mixtures may have influenced both the generation of the sustained activity and the collapse and generation of the PDCs phases. A combination of field, grain-size, density, Vesicle Size Distribution, Crystal Size Distribution, fine-ash morphologies, experimental viscosity investigations and numerical simulations was carried out.

Each transition fallout/PDC (A1-A2, B1-B2, D1-D2) is accompanied by distinctive changes in textural properties of the magma, with drops in Vesicles Number Densities (VNDs) of about one order of magnitude (from 10^8 to 10^7 cm^{-3}), indicating a remarkable decrease in ascent rates. These VNDs drops translate into a strong decrease in decompression rates in PDCs with respect to the decompression rates calculated for the respective fallouts. The distinctive decompression rates, initial

water contents and minor changes in compositions are able to explain the different column heights and volumes erupted through the A1, B1, and D1 sequence of the eruption (5, 23 and 27 km respectively). Numerical simulations, taking into account decompression rates derived from textural analyses and Toramaru (1995) formulations, are able to reproduce the strong decreases in exit velocities responsible for such transitions in eruptive styles. Both a change in intrinsic properties of the magma (water content decrease) and/or a change in conduit/vent geometry, could be responsible for the sudden drop in magma ascent rate and the generation of the pyroclastic density currents.

Keywords : Agnano Monte Spina eruption, viscosity, textures, numerical simulations