Volcanic architecture, eruption mechanism and landform evolution of a Plio/Pleistocene intracontinental basaltic polycyclic monogenetic volcano from the Bakony–Balaton Highland Volcanic Field, Hungary

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The Bakony–Balaton Highland Volcanic Field (BBHVF) is a Miocene-Pleistocene, small-sized (~50 eruption centres) typical continental basaltic monogenetic volcanic field. Recently however, several papers have revealed that there are examples of small-volume basaltic volcanic remnants closely resemble complex polycyclic nature of their eruption history among the volcanoes of the BBHVF. Bondoró Volcanic Complex (BVC), the subject of this study is one of the most complex eruption centres of BBHVF, which made up from basaltic pyroclastics sequences, a capping confined lava field (~4 km^2) and an additional scoria cone with a preserved diameter of ~1200 m and height of ~60 m. The scoria cone is well-preserved, in spite of its age of about 2.9–2.3 Ma. Its crater and cone flank are still recognisable. Here we document and describe the main evolutional phase of the BVC on the basis of its large erosional remnant and provide a general model for complex monogenetic volcano eruption style on the basis of volcanic facies analysis, drill core descriptions and geomorphic studies. We distinguished 13 individual volcanic facies on the basis of sedimentary descriptors such as bedding, grain size, gradation, component and general 3D architecture. Based on textural appearance (including bedding type, existence of accidental lithic from the underlying strata etc.) of volcaniclastic rocks, we infer that the eruption history of BVC contained several phases: (I) basal pyroclastics, which generated by the initial magma/water interactions driven phreatomagmatic eruptions; (II) reworked basalt debris, which infilled the previously formed crater and built up almost 30 m thick sequence with intercalated scoriaceous and lava units; (III) coherent lava flow units; and (IV) the final capping Strombolian-type scoria cones and associated lava flow unit.

The existing and newly obtained K-Ar radiometric data have confirmed that the entire formation of the Bondoró volcano finished at about 2.3 Ma ago, and the time of its onset can not be older than 3.8 Ma. Furthermore, the thick reworked unit (phase II) between the initial and the capping units are inferred to be deposited during relatively long period of time (from several decades up to hundreds of thousands years). Still K-Ar ages on neighbouring formations (e.g. Kab-hegy, Fekete-hegy, Agár-tető) do not exclude a long-lasting eruptive period with multiple eruptions and potential rejuvenation of volcanic activity in the same place indicating stable melt production beneath this location. The prolonged volcanic activity and the complex volcanic facies architecture of BVC suggest that this volcano is a polycyclic volcano, composed of at least two monogenetic volcanoes formed more or less in the same place, each erupted through distinct, but short lived eruption episodes. The total estimated eruption volume, the volcanic facies characteristics and geomorphology also suggests that Bondoró is rather a small-volume polycyclic basaltic volcano than a polygenetic one and can be interpreted as a nested monogenetic volcanic complex with multiple eruption episodes. It seems that BVC is rather a "rule" than an "exception" in regard of its polycyclic nature not only among the volcanoes of the BBHVF but also in the Neogene basaltic volcanoes of the Pannonian Basin.