

Rates of migration of volcanic activity and magma output along the Calimani–Gurghiu–Harghita volcanic range, East Carpathians, Romania

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Based on a large amount of recently obtained K-Ar data, we definitely confirm along-arc migration of volcanic activity in the Calimani-Gurghiu-Harghita Volcanic chain (CGH). Realistic volume and magma output rate calculations are presented for the first time for Neogene volcanism in Romania. CGH is the southeastern and youngest sector of the Neogene subduction-related volcanic arc of the Carpathians with obvious along-arc migration of volcanic activity which took place during ca. 9 Ma (from 9.3 to 0.2 Ma), from northwest to southeast. The four segments of CGH are progressively younger as a whole: 9.3–6.8 Ma in Calimani, 8.8–5.7 Ma in Gurghiu, 6.3–3.9 Ma in North Harghita, 3.6–0.2 Ma in South Harghita. Duration

of volcanic activity was ca. 2.7 Ma in average for each segment. The average migration rate along the whole CGH is 17.6 km/Ma. Migration rates are comparable in Calimani, Gurghiu and North Harghita (15.7 km/Ma, 18.4 km/Ma, and 14.6 km/Ma respectively), while South Harghita yields a different rate, of 9.6 km/Ma. The total volume of volcanic products in CGH is ca. 1400 km³ to (420 km³ in Calimani, 315 km³ in Gurghiu, 285 km³ in North Harghita, and ca. 180 km³ in South Harghita). Volumes of eroded volcanics that have been completely removed beyond the present-day area of the volcanic chain are considered as negligible. The total volume corresponds to ca. 8.1 km³ of volcanics per each 1 km arc segment. Eruption rates along segments are comparable for Calimani (168.4 m³/Ma), Gurghiu (172.5 km³/Ma) and North Harghita (128.6 km³/Ma), but much less in the chain-ending South Harghita segment (29.4 km³/Ma). The average eruption rate for the whole CGH is ca. 152 km³/Ma,

which means ca. $0.9 \text{ km}^3/\text{Ma}$ for each 1 km of arc segment. These calculations point to roughly similar magma output rates for CGH as compared with other subduction-related volcanic arcs worldwide. The values are comparable for Calimani and Gurghiu, while along North Harghita and, especially, South Harghita decreasing volumes and output rates have been observed. Youngest age, lowest volumes and output

rates, as well as enhanced along-arc migration particularise South Harghita with respect to the other CGH segments. Our quantitative approach helps understand better the dynamics of magma generation and eruption along a subduction-related volcanic arc segment in the Carpathians. It also allows to put interpretations related to links between magmatism and regional tectonic events on more objective grounds.