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THE DEBRIS AVALANCHE DEPOSITS (DADs) IN THE CĂLIMANI-GURGHIU-HARGHITA RANGE, THEIR ORIGIN AND EMPLACEMENT HISTORY AND HOW TO RECOGNIZE THEM IN THE FIELD

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Field volcanological data supported by K/Ar dating document the migration of volcanism from NNW to SSE along the Călimani-Gurghiu-Harghita (CGH) volcanic range, suggesting an almost continuous eruptive activity between 10.2 and 0.03 Ma. During this period a row of closely spaced, juxtaposed or partially overlapping medium-sized composite volcanoes were built. Two of these – Călimani and Fâncel-Lăpuşna evolved to the caldera stage almost simultaneously (7.0-6.8 Ma).

The assignment of the volcaniclastic deposits at the western periphery of CGH to different eruption centers has taken into account various genetic types of volcaniclastic deposits (pyroclastic, debris-avalanche, debris flow). In some cases, identifying the volcanic source has been difficult because of the rather monotonous petrography and geochemistry characterizing the entire range.

Figure 1. Quarry in proximal debris avalanche deposit in Ostoroş volcano, showing tilted, hydrothermally altered amphibole-pyroxene lava blocks of several cubic meters (toreva), in the right, in sharp contact with a monogenetic clast-supported pyroxene andesite lithic breccia, showing jig-saw cracks (see photo detail) in the left.

During the nineties, two major debris-avalanche deposits (DADs) have been identified at the western periphery of CGH. The largest one belonging to the Rusca-Tihu volcano (Călimani Mts.) has displaced ca. 26 km^3 of volcanic debris. The second one, originated in the Vârghiş volcano (North Harghita Mts.), has dispersed ca. 13 km^3 of collapsed material.

Recently, detailed geological mapping, petrographic observations, and K-Ar geochronology enabled a new comprehensive view about the origin and emplacement history of the volcanoclastic deposits including various DADs in the CGH. Major volcanic edifice failure events, besides caldera-forming eruptions, shaped the volcanic evolution of CGH. It has been identified and outlined three new, previously unknown, southward directed DADs in the Gurghiu and North and South Harghita Mts and one eastward directed in North Harghita. The DADs are typically represented by tens of meters thick chaotic mega-breccia with an unsorted, massive, polymictic character. They are heterogeneous at the outcrop scale, displaying sharp lateral variations in texture and lithology. DAD-specific features such as jigsaw cracks, breccia-in-breccia, and plastic (soft sediment) deformation are common. Several volcanoes experienced edifice-failure events and generated large-volume DADs at some point in their evolution: Rusca-Tihu (Călimani Mts.) at ~7.8 Ma, Fâncel-Lăpuşna (Gurghiu Mts.) at 6.8 Ma, Ostoroş-Ivo Cocoizaş at ~ 5 Ma, Vârghiş (North Harghita) at ~4.8 Ma and Luci-Lazu (South Harghita) at ~4.0 Ma. A smaller volume DAD originating in the ~1.7 Ma Pilişca volcano (South Harghita Mts.) has been also identified recently.

We suggest that most of the edifice failure events are closely related to a series of tectonic processes including the opening and southward propagation of the Borsec/Bilbor, Gheorgheni, Upper and Lower Ciuc Intermountain Basins and the growth of new volcanoes. The contemporaneous formation of basins and activation of volcanism, the southward propagating fault system, as well as the geometry of the faults and alignment of volcanic centers indicate strike-slip and normal extensional tectonics. Most of the known DADs were displaced in the SSW from their source volcanoes, most likely following the preexisting topography sloping toward the Transylvanian Basin.

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