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Structure and composition of the Late Miocene Goderdzi Volcanic Complex, Lesser Caucasus, Georgia: implication for resurgent caldera formation

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Abstract

As is known, resurgent calderas are formed after especially large volcanic eruptions by ground collapse, the diameters of which can reach many of kms. Post-caldera andesitic domes are typical for these types of calderas. Here we describe a special type of probably resurgent caldera complex, whose domes are currently up to 3000 m. a. s. l., which is not typical for these types of calderas. This is a late Miocene volcanic formation in the Georgian Lesser Caucasus, known as the Goderdzi Volcanic Complex. The complex, forms a volcanic highland, the thickness of which exceeds 1200 meters and occupies more than 4500 km² in Georgia. It is divided into three parts, near the rock-cut city of Vardzia, in the Mtkvari canyon: The lower part is composed by a thick of 200–250 m of pyroclastic material, predominantly andesitic-dacitic composition. This part is overlain by a 60–90 m thick andesitic-dacitic ignimbrite. On top of the ignimbrites, another thick layer of coarse-grained lithic breccia andesitic-dacitic composition is observed (700-900 m thick). Presumed, total volume of the Goderdzi Volcanic Complex within the territory of Georgia exceeds 500 km³. The SiO₂ content of this complex changes from 58% to 65%, εNd values vary between +2 and +4, and 87Sr/88Sr ratios vary between 0.7034 – and 0.7045, which indicate a mantle origin [1].

The volcanic center of this complex is located on the state border between Türkiye and Georgia. Part of this center is located on the territory of Georgia within the Niala caldera (~7x8 km) and the Gumbati andesitic dome (2996 m e.s.l.). The caldera also extends to the territory of Türkiye (NE part of the Kars Plateau), where the Keltepe Andesitic Complex (3032 m e.s.l) is located. The zircon U-Pb geochronology indicates, that the age of the Mtkvari Ignimbrites (flows from the Niala caldera and extends more 35 km) is ~7.5 Ma and the Gumbati andesitic dome is ~ 6.5 Ma [2].

The analysis of the structural and compositional data of the Goderdzi Volcanic Complex indicates that it may be linked to the eruption from a large resurgent caldera. The only objection to this assumption is the high altitude of andesitic volcanic domes (~ 3000 m. a.s.l.), which does not seem to be consistent with typical resurgent caldera structures. We suggest that this can be attributed to the regional uplift caused by the active continental collision between the Arabian and Eurasian over the last ~7 Ma.

During this period, the caldera structure appears to have experienced intense deformation and erosion, but the andesitic domes have been more resistant to these processes as a solid, hard igneous bodies.

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Keyword

Resurgent Caldera, Mtkvari Ignimbrites, Keltepe, Gumbati dome