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Volcanology

The Structural Position and Conditions of Formation of the Samsari Caldera Volcano (Javakheti Upland, Georgia)

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ABSTRACT. The geological-structural position of the Samsari caldera volcano-tectonic depression confirms its development at the site of the Samsari gigantic stratovolcano at the final stage of the strong acid volcanic cycle activity connected with the Attic orophase occurring at the turn of the Late Miocene Early--Pliocene boundary.

A view is put forth in the paper in connection with the mechanism of the origin of the Samsari caldera volcano-tectonic depression and the karstic forms (volcanokarst) developed on its surface. *© 2010 Bull. Georg. Natl. Acad. Sci.*

***Key words**: caldera, volcano-tectonic depression, volcanokarst, stratovolcano.*

The Samsari caldera is a major morphostructural unit of the massif of the same name. The Samsari massif creates a strongly rugged ridge of distinct semiarc form.

Of the several volcanic structures of central action ranged along the deep fault of submeridional direction passing through the crest part of the ridge, the Samsari stratovolcano is the lorgest and highest (3287,6m).

The Samsari massif is built of the products of Late Miocene–Early Pliocene magmatic activity,represented by andesites, dacites and rhyolites. To the east of the massif younger products of Late Pliocene–Early Pleistocene and Late Pleistocene magmatic activity are developed (Fig). Within the Samsari massif, the succession of lava breccias and lavas of dacite composition, are clearly observed. The section starts with strong massive brick-red dacite-porphyrite lavas that are replaced in the ascending section with volcanites of the same small grain massif grey composition. The latter is followed by breccias of grey dacitic composition. The section ends with clastic grey and brick-red dacites, of which the crest part of the semiarc range is built. The erosive and tectonically rugged relief of the Samsari massif creates vertical rocks in the east and steeply descends to the volcanic-tectonic depression in the north-east,on the Tsalka side. Most scientists consider the depression to be a caldera, and Samsari –a crater (calderic) volcanic structure [1,2]. Proceeding from the arrangement of the volcano-tectonic depression, its connection with fault structures is clear. From the east and west it is intersected by faults of submeridional direction, which are intersected by faults of sublatitudinal direction (Fig.), and they dismember the caldera volcanic-tectonic depression into blocks of various sizes. The faults are well observed in the relief and are deciphered even in aerocosmic photos.

The unity of the Samsari semiarc range and caldera volcano-tectonic depression causes no doubt in terms of the data analysis of geological observation and the petrographic composition of their building rocks. The same is confirmed by the glaciation traces on the surface of their relief, though in the case of the caldera volcano-tectonic depression their observation is sometimes made difficult because of the presence of very thick andesite and dacite lava and large-sized stones. The thick Attic

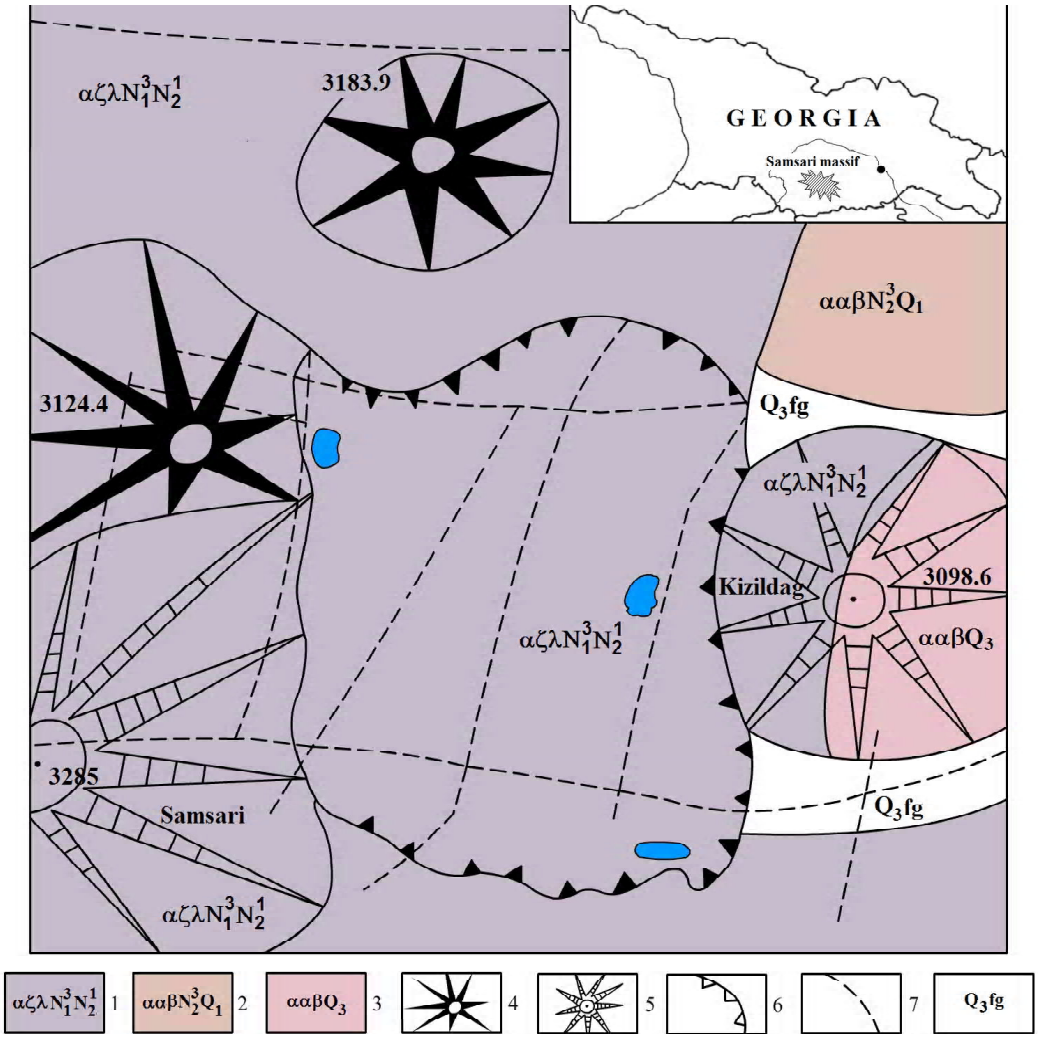

Fig. Schematic Geological map of Samsari massif
1 – Late Miocene-Early Pliocene. Andesite Dacite, Rhyolite; 2 – Late Pliocene-Early Pleistocene. Andesite, Andesitebasalt; 3 – Late Pleistocene. Andesite, andesitebasalt; 4 – Monogenic volcano; 5 – Stratovolcano; 6 – Border of caldera; 7 – Fault, 8 – Fluvioglacial deposits

orogenic phase, identified at the Late Miocene–Early Pliocene boundary, played the principal role in shaping the relief of the Samsari caldera volcanic-tectonic depression.

The formation of the caldera volcano-tectonic depression started immediately after the folding and the volcanic activity ended (Late Miocene-Early Pliocene), continuing to the present day. An important role in the formation of the relief is played by exogenic processes (weathering, erosion, denudation, gravitation forces, glaciation activity, etc) along with endogenic (tectonics, volcanism) processes.

The bottom of the Samsari caldera volcano-tectonic depression is characterized by hilly relief (3 km. diameter) and is situated at the absolute height of 2713-1759 m. In the west it is elevated (2804 m) and is clearly bordered by almost semicircular steep-rocky slopes (difference in heights 140-150m) of semiarc range-Samsari old volcanic remainder. On the slopes of the ridge bounding the caldera paleoglacier relief forms – cirques, carrs, troughs-have been identified. The glaciers located in the corrie troughs feed the caldera volcano-tectonic depression with a large number of fracture bits of weathered rocks. Several small lakes have developed on the caldera surface.

On the relief of the caldera volcano-tectonic depression for the first time we have found several hundreds of karst forms, which are represented by holes of different sizes. The holes often become united, creating narrow karst grooves. It should be noted that the karst relief (volcanokarst) is characteristic of regions with young volcanic rocks (particularly pyroclasts). In our case it is difficult to restore the full picture of the pyroclastic structures owing to the thick stones lying on them. But this does not rule out the presence of pyroclasts under them, for fragmental natural and artificial outcrops are established in contiguous regions of the

caldera volcano-tectonic depression. Their existence has been recorded in bore holes as well.

Geological-petrological data confirm the formation of the Samsari caldera volcano-tectonic depression at the site of the gigantic Samsari stratovolcano 9-10 mln years ago at the final stage of Early-Mio-Pliocene acid volcanic cycle manifestation.

In our opinion, the mechanism of the origin of caldera depression is as follows: As a result of powerful eruptions from the Samsari volcanic centre, freeing of undervolcanic space took place from feeding sources and large vacua were created in their place. As a result of subsidence of the erupted powerful mass in a vertical position in the liberated space caldera volcano-tectonic depression (downfault caldera) appeared. As for the process of the origin of the karst forms (volcanokarst), it seems to be connected with the appearance of vacua caused by the impact of water percolation influence onto pyroclastolites and local faults.

ვულკანოლოგია

ვულკან სამსარის კალდერის (ჯავახეთის ზეგანი, საქართველო) სტრუქტურული პოზიცია და ფორმირების პირობები

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სამსარის კალდერის ვულკანო-ტექტონიკური დეპრესიის გეოლოგიურ-სტრუქტურული პოზიცია ადასტურებს მის განვითარებას სამსარის გიგანტური სტრატოვულკანის ადგილას, გვიანმიოცენ-ადრეპლიოცენის მიჯნაზე გამოვლინებულ და ატიკურ ოროფაზისთან დაკავშირებულ მძლავრ მჟავე ვულკანური ციკლის მოქმედების დამამთავრებელ ეტაპზე. შრომაში გამოთქმულია მოსაზრება სამსარის კალდერის ვულკანოტექტონიკური დეპრესიისა და მის ზედაპირზე განვითარებული კარსტული ფორმების (ვულკანოკარსტი) წარმოშობის მექანიზმის საკითხთან დაკავშირებით.

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