INTRODUCTION

The Uzon caldera is confined to a major Pleistocene volcanic center and is part of the Uzon–Geiser-Valley volcano-tectonic depression. The depression is centered nearly at the axial zone of the Kamchatka East Volcanic Belt. The caldera occupies the west of the depression and is a basin (9 by 12 km) with a comparatively flat and swamped bottom (Fig. 1). It is flanked by steep scarps 200 to 800 m high on the south, west, and north. The caldera is filled with numerous lakes, rivulets, and brooks that are drained by the Shumnaya River. The structure was generated when the roof of a magma chamber collapsed after the eruption of large amounts of pumice and ignimbrites in the area [Erlikh, 1966].

The caldera shows violent hydrothermal activity. In its diversity of thermal occurrences, the Uzon thermal field is unique and has no rivals in Kamchatka. The study of the deep structure in the area is of great scientific interest. Magnetotelluric and magnetovariational soundings were performed in the area in 2012 in order to study the deep structure of the caldera. The present paper discusses the methods of the study and the results that were obtained.

A BRIEF GEOLOGICAL AND GEOPHYSICAL DESCRIPTION OF THE AREA OF STUDY

The information that follows concerning the geology, tectonics, hydrothermal activity, and geophysical data for the area of study was borrowed from [Aver'ev et al., 1971; Zubin et al., 1971; Bratiseva et al., 1974; Pilipenko, 1974; Belousov et al., 1983; Karpov, 1988; Leonov et al., 1991; Leonov and Grib, 1998, 2004].

There are three rock complexes of Pliocene to Quaternary age in the area: a local one, a complex that is synchronous with the caldera generation, and a postcaldera one, corresponding to three major phases of postvolcanic activity [Braitseva et al., 1974]. The rocks of the pre-caldera complex (N2–Q1) consist of basalts and tuff breccia beds. They compose the edifices of Uzon Volcano and of an older shield volcano whose sections can be observed in the caldera wall. The complex has a total thickness of 800 m or less.

The postcaldera complex consists of igneous rocks (dacite extrusions and pumice sheets), as well as of lacustrine and pyroclastic deposits (members of layered aleuro-pelite tuffs, agglomerate pumice tuffs, layered psammitic and pumice sand). The dacite extrusions formed simultaneously with the lacustrine deposits; this was the case, in particular, with the nearest extrusion...
A GEOELECTRIC MODEL FOR THE UZON CALDERA, KAMCHATKA

The youngest occurrence of volcanism in the caldera is the Lake Dal’ni maar. This maar (~1 km across) is surrounded by a circular ridge that formed 7500 years ago, according to Leonov et al. [1991]. The ridge is mostly composed of scoria, bombs, lapilli, and blocks of basaltic andesite lava. The southwestern part of the caldera is occupied by an extensive moraine field that was deposited during the second phase of the Upper Pleistocene glaciation. The terminal moraine ridge (20–40 m high) intersects the caldera through the center from northwest to southeast. The moraines cover the greater part of the lacustrine section. The Holocene deposits are peat bogs (swamp deposits), as well as talus and piedmont, gravel, and pebble deposits.

Gravity data revealed several basement blocks of different heights in the depression [Zubin et al., 1971]. Zones with higher gravity gradients suggest faults that strike nearly east–west and northwest; it is to this knot of intersections that the zones of thermal fields are confined.

The present-day hydrothermal activity is concentrated in the central part of the Uzon caldera, which shows the highest level of fragmentation. This zone was a center of explosive activity accompanied by ejection of bombs in the past (Upper Pleistocene). A large explosion crater 4–5 km across formed there and was filled with young deposits of Lake Uzon. The crater has surface expression in the form of a large-amplitude gravity low that is nearly isometric in map view. The low is thought to be due to deposits of low density, which are as thick as 1 km. The explosion crater was formed at the knot of intersections of tectonic faults and disrupted the continuity of the tuffaceous sediments; it began to function as a central heat-releasing channelway. The caldera also contains a series of small explosion craters.

The rocks of the postcaldera complex are fissured; this facilitated the arrival of deep-seated thermal water and steam, which is visible at the surface as hot and boiling springs, mudpots, and minor mud volcanoes emitting steam, and as patches heated to different temperatures with dispersed gas discharges. The springs have temperatures of 45–96°C, with the maximum temperature of the gas–steam jets being 102°C. The total mineral contents of the hot springs vary between 0.5 and 5 g/L. The springs show a pulsating mode of discharge, occasionally actually becoming geysers [Pilipenko, 1974].

Fig. 1. A map of thermal occurrences in Uzon Caldera [Pilipenko, 1974].
(1) patches of present-day hydrothermal activity, (2, 3) patches with hydrothermally altered rocks, (4) cold groundwater springs, (5) freshwater lakes, (6) horizontal contours at intervals of 100 m, (7) bedrock scarps on Mt. Uzon, (8) scarps on the inner slopes of the caldera and minor volcanic edifices. The numerals in this figure (names of thermal patches): (1, 2, 3) patches in Vostochnoe field, (4, 5, 6) Tsepochka; the Oranzhevaya, and Severnaya patches; (7) the Vos’mernaya and Krainaya patches, (9) part of Lake Fumarol’noe, (10 and 11) patches in Teplye Bolota and Yuzhnii Patch, (12) Beregovoi patch, (13) Zapadnoe field, (14) Mt. Belaya patch. Filled circles mark MTS sites along the I–I and II–II lines.