Geophysical Research Abstracts, Vol. 7, 04028, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04028

The Voia Neogene deep volcanic structure, Metaliferi Mountains, Romania

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Introduction

Voia Neogene volcanic structure (VNVS) is situated in the central part of Brad-Sacaramb Tertiary Tectonic Basin (BSTTB)-a back-arc rifting area- with Badenian –Pannonian volcanics and related mineralizations (porphyry, skarns, HS, LS). This paper is focused to present the deep VNVS using mapping, exploration drillings and electromagnetic (MTS) data.

Geological setting

In VNVS ($\sim$4 km^2) are known 5 simple volcanoes, two polygenic stratovolcanoes (Macris and Cetras). The basement of this area consists of Early Tertiary continental deposits (argillites, sandstones, gravels, conglomerates), Lower Cretaceous sediments, Upper Jurassic ophiolites and limestones, and probably, Precambrian-Paleozoic (?) crystalline schists. It is penetrated by Eo-Cretaceous, Laramian and Neogene intrusions from which Voia polystage andesite-porphhyry diorite subvolcanic body (VADSB) is the most important , and covered by Badenia-Sarmatian marine and shallow water sediments, volcano-sedimentary formations and Badenian-Pannonian volcanics (pyroclastics, lavas) (Berbeleac, 2004). The volcanics belong to calc-alkaline K quartz andesite with amphibole, biotite and pyroxene (12.4-10.27Ma, Rosu et al., 2004) of Sacaramb and Cetras (Ghitulescu & Socolescu, 1941). Other older and younger andesites (lavas, pyroclastics, subvolcanic bodies) and large area of HS alteration are present in VNVS.

Suctural geology and deep structure

Kinematic evolution of VNVS consists, at least, of three brittle–ductile deformation

stages, D_1 to D_3, during which faults/structures were formed. In D_1(Middle Cretaceous), the E-W strike-slip and overthrust faults, inclusive Ardeu nappe system were formed. In the next deformation stage D_2 (End Cretaceous-Paleogene?), the NE-SW conjugate fault systems is dominantly. It is well expressed on eastern limit of BSTTB, within in Balsa-Techereu ophiolite block (Capalnas-Techereu ophiolite nappe). From here, toward SW, in the VNVS, under Early Tertiary sediments and Miocene volcanics, at least 3 subparallel fault systems (normal sinister, reverse faults) and shear zones, are present. This stage of deformation, together with D_1 and D_3, are responsible for Voia graben and volcanic structures, well emphasized by exploration drillings and MTS data. During the deformation D_3 (post-Upper Cretaceous), the NW-SE fault systems (normal, reverse and sub-parallel faults) were formed. In the same time, the deformations D_1 and D_2 have been reactivated. At the intersection and along of these fault systems lie the Macris, Coasta Mare, Geamana, Paua, Momeasa, Cetras and Buha necks (inscribed in a like-circle area $\sim$2km diameter), the VADSB, the andesitic dikes and related mineralizations (Cu-Au porphyry type; Py (Au) skarn bodies; HS (As-Cu-Au veins), LS (Au-Pb-Zn-Cu veins) and IS (Py (Au)-anhidrite veins and disseminations).

The Voia Neogene deep structure is the result of mapping, laboratory studies and interpretation data of 18 diamond drilling cores and 31 MTS (60-175m the distance between soundings; 2,800m in total length; 5.50 h the total measurement time/sounding; 5km the investigation depth). The drillings and MTS have been focused on VADSB ($0.\ 70\text{km}^2$). According to drilling data (100x100m; 450-1200m depth; about 15,000m) the VADSB and structure can be characterized such as: 1) the body no outcrops and it intrudes the Miocene volcanics and volcao-sedimentary formations, the Early Tertiary and Mesozoic sedimentary formations and ophiolites and probably Precambrian-Paleozoic crystalline schists; 2) it is older than high-K quartz andesite with amphibole, biotite $\pm$ pyroxene of Cetras type (11.7 Ma); 3) at shallow levels (under + 650-600m and – 400m) and along N-S ($\sim$1km length) and E-W axis (0.5km length), the body's form is like a reverse shoe. It seams to incline $45^0$to S, but under -400m it inclines nearly vertically; 4) the body shows an andesite-porphyry microdiorite composition and poly-stage evolution. It comprises at least three type of andesites, all in diverse degrees of hydrothermal alteration and mineralization: quartz andesite with hornblende, quartz andesite with hornblende$\pm$ biotite, pyroxenes and quartz andesite with hornblende and protoclastic texture; 5) the body is placed in a graben area, at the intersection of E-W, NE-SE and NW-SE vertical and regional faults, in a local ductile environment of the Sacaramb- Hondol- Gura Barza strike-slip duplex fault (Drew & Berger, 2001); 6) the body related mineralizations, as Cu-Au (Mo) porphyry and Au-Pb-Zn-Cu meso-LS mineralizations don't outcrops and are known in depth between + 450m and-400m.

Three MTS exploration profiles have been made in Voia area: one with NE-SW strike, 14 MTS on 1.250km length; the other one, with NNW-SSE-SW strike, 11MTS and 1.1km length, and the last one, with NW-SE strike, 7 MTS and 0.45km length. According to resistivity cross-sections, combined with drilling data, the authors obtained on about 5km depth new data about the regional and local geological tectonics, and come to following conclusions: 1) the first 500-1000m show low resistivities and probably represents Early Tertiary, Miocene and Mesozoic formation, middle to intense hydrothermal alterations; Jurassic limestone, Ca-Mg skarns and hornfels are the exceptions. Toward the depth, the ophiolites (0.5-1.7km) and probable crystalline schists (1.7-5.0km) show high resistivity values; 2) in general, until 2.5km the contacts of VADSB and the other similar bodies are nearly vertically and with low resistivities; down of this depth the contacts become clearly and at 5km depth the body's diameter is 0.3km; 3) from the many faults detected, only three exceed 5km in depth. They seam to control the Neogene magmatic and metallogenetic activity; 4) from the surface to depth, the following nappes can be possible to recognize: Ardeu, Capalnas-Techereu, Curechi-Stanija, Fenes, and Baia de Aries.

Conclusions

Within 4km^2 from Voia area there are 7 Neogene volcanoes, two of them with polystage evolution. The volcanic structures are inscribed in a circle with 2km in diameter. In this area many andesite-diorite intrusions are present, from which the most known being VADSB. The main products of volcanic activity are calc-alkaline andesites (lava, intrusions, pyroclastics, intrusive bodies), especially of Sacaramb and Cetras types (12.4-10.27, Rosu et al., 2004).

The spatial distribution and the forms of volcanic-subvolcanic structures have been strong influenced by at least three stages of brittle-ductile deformations: D_1-middle Cretaceous, D_2-Upper Cretaceous and D_3-Tertyary. According to the mapping, exploration drillings and MTS data, the deep structure of Voia area (graben, faults, nappes) and the intensity of alteration and mineralization processes have been controlled by these deformations.

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