Quaternary Continental flood basalts of the Javakheti Volcanic Plateau, Lesser Caucasus: Reason for mass extinction?

Okrostsvaridze, A.

Ilia state University, 0162 Tbilisi, 3/5 K. Cholokashvili Avenue, Georgia
avtandil.okrostsvaridze@iliauni.edu.ge

Keywords: Javakheti Volcanic Plateau, continental flood basalts, mass extinction

Introduction

An eastern block of the Samtskhe-Javakheti volcanic province of the Lesser Caucasus is named the volcanic plateau of Javakheti; it is bordered on the western (Samtskhe) block by an active regional fault. Over 5.2 million years, in comparison with the western block, it has submerged by about 130 m (Okrostsvaridze et al., 2016). Both blocks of this volcanic province have almost similar geological structure, although in the Quaternary, the Javakheti submerged block has been covered with thick dolerite flow, the so-called Akhalkalaki suite (Skhirtladze, 1958). As a result of field, petrologic, petrochemical, and isotopic work conducted by us, it was established that these formations are typical continental flood basalts (traps), which are genetically related to mantle plume flows (White and McKenzie, 1989) and not to melting products of the residual subduction oceanic crust as has been considered.

Geology, petrochemistry, and isotopic geology of the Javakheti flood basalts

The Javakheti volcanic plateau was formed on Paleozoic continental crust of Artvin-Bolnisi bloc. There, the micro-plateaus of Akhalkalaki, Tsalka, Gomareti, and Dmanisi are distinguishable, in which basaltic flow are fully identical petrographically and geochemically. Thicknesses of these flow are almost equal and vary in the range of 100-270 m on average. The flow are grey, fully crystalline, coarse-grained, and weakly differentiated massive rocks, which mainly consist of olivine, basic labradorite, monoclinic pyroxene, and titanoaugite. By petrochemical data, they are more related to mid oceanic ridge basalts than to islands arcs. Content of SiO_2 in these strata varies in the range of 49-51%, and that of MgO varies within 6-8%. The $^{143}Nd/^{144}Nd$ parameter varies in the range of +0.51703 to +0.52304, and the $^{87}Sr/^{88}Sr$ parameter ranges from 0.7036 to 0.7042 (Okrostsvaridze, 2011). Magmatic zircons of the Javakheti plateau basalts have been dated by the U-Pb method. The results obtained vary in the range of 2.4-1.6 Ma (Chang et al., 2013).

The temporal link between the mass extinction and injection of continental flood basalt

The temporal link between the mass extinction and large igneous provinces is well known. It is notable that the best-constrained examples of death-by-volcanism record the main extinction pulse at the onset of (often explosive) volcanism, suggesting that the rapid injection of vast quantities of volcanic gas (CO_2 and SO_2) was the trigger for a truly major biotic catastrophe (Bond and Wignal, 2014). Based on the results of our work, we consider that the extinction of many vertebrates living in the area of the Javakheti volcanic plateau and habitats of the Dmanisi Paleolithic site among them, might have been caused by mass extinction from gases released as a result of powerful volcanic eruptions.

Figure 1. A general view of continental flood basalt of the Dashbashi canyon (upper reaches of the Khrami River) (left) and a detail photograph (right).

Conclusion

Based on the data from analyses of the results of geological work conducted at the Javakheti volcanic plateau, we believe that the upper segment of the plateau represents typical continental flood basalts. During the pulsating formation of these flood basalts, large amounts of poisonous gases were released. It should be noted that continental flood basalts of the Javakheti volcanic plateau are the youngest formation of the earth's continental crust (2.4-1.6 Ma). The formation of these flood basalts coincides in time with the beginning stage of hominin evolution in the region. That is why every big pulsation of its magmatic source could have disastrously affected the biological world in general, and hominines, in particular. Based on the above information, one can conclude that other important areas of mass extinction may be discovered in the Javakheti region in the future.

References

Bond, D.P.G., and Wignall P.B., 2014. Large igneous provinces and mass extinction: An update. In Keller, G., and Kerr, A.C., eds., *Volcanism, Impacts, and Mass Extinctions.* Geological Society of America, Special Paper 505. pp. 32-41.

Chang, Y.-H., Chung, S.-L., Okrostsvaridze, A., Javakhishvili, Z., 2013. Petrogenesis of Cenozoic Igneous Rocks in the Georgian Caucasus. *Goldschmidt2013 Conference Abstracts, Florence, Italy*, p. 853.

Okrostsvaridze A., Elashvili M., Popkhadze N., Kirkitadze G., 2016. New Data on Geological Structure of the Vardzia Cave City, Georgia. Bull. Georg. Natl. Acad. Scinces (in print).

Skhirtladze, N.I., 1958. *Post-Paleogene Effusive Volcanism of Georgia*. Metsniereba, Tbilisi. (In Russian)

White, R.S., and McKenzie, D.P., 1989. Magmatism at rift zones: The generation of volcanic continental margins and flood basalts. *Journal of Geophysical Research, Solid Earth*, 94(B6): 7685-7729.