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Geochronology and magma sources of Elbrus volcano (Greater Caucasus, Russia)

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Elbrus volcano (5642m), the largest Quaternary volcano in the European part of the Russia, is situated within the central part of Greater Caucasus mountain system at the watershed of Black and Caspian seas. Complex isotope-geochronological studies showed that the Elbrus volcano experienced long (approximately 200-250 thousands years) discrete evolution, with protracted periods of igneous quiescence (approximately 50 ka) between large-scale eruptions. The volcanic activity of Elbrus is subdivided into three phases: Middle–Neopleistocene (225–170 ka), Late Neopleistocene (110–70 ka), and Late Neopleistocene–Holocene (less than 35 ka). No eruptions presumably occurred during "quiescence" periods, while the volcano was dormant or revealed only insignificant explosive eruptions and postmagmatic activity.

Volcanic rocks of the Elbrus volcano are represented by biotite-hypersthene-plagioclase calc-alcaline dacites (65.2-70.4% SiO_2, and 6.4–7.9% K_2O+Na_2O at 2.7–3.9% K_2O).

Petrogeochemical and isotope-geochemical signatures of Elbrus dacitic lavas ($^{87}Sr/^{86}Sr$ – 0.70535-0.70636, Eps(Nd) from +0.8 to -2.3, $^{206}Pb/^{204}Pb$ - 18.631-18.671, $^{207}Pb/^{204}Pb$ – 15.649-15.660, and $^{208}Pb/^{204}Pb$ = 38.811-38.847) point to their mantle–crustal origin. It was found that hybrid parental magmas of the volcano were formed due to mixing and/or contamination of deep-seated mantle melts by Paleozoic upper crustal material of the Greater Caucasus. The temporal evolution of isotope characteristics for lavas of Elbrus volcano is well described by a Sr–Nd mixing hyperbole between mantle source of "Common"-type and estimated average composition of the Paleozoic upper crust of the Greater Caucasus. It was shown that, with time, the proportions of mantle material in the parental magmas of Elbrus gently increased: from $\sim$60% at the Middle–Neopleistocene phase of activity to $\sim$80% at the Late Neopleistocene–Holocene phase, which indicates an increase of the activity of deep-seated source at decreasing input of crustal melts or contamination with time.

Unraveled evolution of the volcano with discrete eruption events, lacking signs of cessation of the Late Neopleistocene–Holocene phase, increasing contribution of deep-seated mantle source in the genesis of Elbrus lavas with time as deduced from isotope–geochemical data, as well as numerous geophysical and geological evidence including presence of fumaroles in the summit part and thermal springs along the periphery of volcano indicate that Elbrus is a potentially active volcano and its eruptions may be resumed. One of possible scenarios for evolution of the volcano, if its eruptive activity were to continue, suggests the formation of large collapse caldera and catastrophic decomposition of volcanic edifice with large-scale pyroclastic ejection and melting of glaciers at the summit part of volcano.