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DATING YOUNG LAVA FLOWS WITH COSMOGENIC 36Cl: AN EXAMPLE FROM THE LATE PLEISTOCENE – EARLY HOLOCENE ERCİYES MONOGENETIC LAVA DOMES IN CENTRAL TURKEY

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Precise dating of young lava flows is generally problematic because of the limiting factors of the applied technique. In-situ produced cosmogenic nuclides can be used to date very young lava flows if they show simple exposure histories and proper geochemistries. The Erciyes stratovolcano in the central Turkey has several dacite-rhyodacite monogenic parasitic lava domes that show clear exposure histories. Four young volcanic domes on the flanks of Erciyes Volcano have fresh-looking surfaces that are datable by cosmogenic surface exposure dating. We collected 36 cosmogenic samples from four lava flows namely Karagüllü, Perikartını, Dikkartın and Çarık, and obtained 36Cl exposure ages, all around Early Holocene, except for Çarık Lava flow which gave much older ages. Karagüllü, Perikartını and Dikkartın eruptions yielded average exposure ages at around 7.2±0.9 ka (n=11), 7.7±0.4 ka (n=6) and 8.8±0.6 ka (n=9), respectively. Two different eruption histories were determined from the Çarık Lava flow. They were centred at around 98.4±3.6 ka (n=7) and 36.1±1.1 ka (n=3).

We also tested our results by an independent dating method. The Perikartını eruption generated a pyroclastic flow that buried trees that were converted to charcoal. Two charcoal samples found in this flow were dated using the 14C method, and yielded an average age of 9735±155 years BP (calibrated using Calib 7.1). Our results show that the cosmogenic 36Cl ages from Perikartını flow (7.7±0.4 ka) are younger than the radiocarbon ages (9.7±0.2 ka). This discrepancy might be related either to the high Cl content (963 ppm) of the lava flow or high nucleogenic production of 36Cl due to the above average U (5.1 ppm) and Th (15.6 ppm) concentrations. The high Cl content of the samples may result erroneously (>20%) underestimated the low-energy neutron capture (epithermal and thermal) production rates. On the other hand, the calculated nucleogenic 36Cl makes up almost one-third of the measured 36Cl. If the nucleogenic components were set to zero, the average 36Cl ages of the three young lava flows would be 11.6±0.6 ka, 10.4±0.2 ka and 11.7±0.3 ka, respectively. In that case the 10.4±0.2 ka lava flow and radiocarbon dated (9.7± 0.2 ka) pyroclastic flow could be considered as contemporaneous.

In order to measure the nucleogenic 36Cl directly, we drilled the older part of Çarık Lava flow at depths where the cosmic ray nucleon intensity would be negligible and taken the two deepest samples from the 9.3 m long core. When we corrected the Çarık Lava ages according to the measured nucleonic components, the ages became older (101.4±3.7 ka and 38.5±0.9 ka). The youngest previously dated volcanic deposit on Erciyes was on Çarık Lava flow (80±10 ky old, from a single 40Ar/39Ar age). Our findings indicate that Çarık has at least two separate lava flows and that the recent activity of Erciyes stratovolcano continued at least till Early Holocene.