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A new sampling strategy for cosmogenic surface exposure dating of moraines: Amalgamated Boulder Chips (ABCs)

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Cosmogenic surface exposure dating has been applied to date numerous moraines worldwide. The geochronological data obtained from these studies have improved our knowledge on the timing of glaciation and allow us to reconstruct the paleoclimate. Due to the geomorphic complications after deposition, such as degradation, exhumation, bedrock erosion, snow cover and toppling of boulders, several (n>5) large boulder (>1-2 m) samples should be dated to obtain a reliable age distribution. Generally, the ages on a well-preserved moraine surface show unimodal normal distribution. Frequently, erosion, exhumation and boulder toppling are blamed for the younger outliers. On the other hand, although infrequent, older outliers will indicate inherited nuclide concentration from pre-exposure to cosmic radiation. To obtain the true age of a moraine deposit, one needs to collect several samples that not only greatly increases the budget of the project but also is time consuming.

To overcome this problem, we developed a new sampling strategy for dating moraine surfaces by cosmogenic nuclides. We collected rock chips (each ∼20-50 grams) from large boulder (>1 m) tops located on the crest of moraines. Fourteen to 32 boulders were chosen for sampling every ∼20 m. All rock chips were amalgamated to make one sample. To test the suitability of the method, we also sampled 3 large boulders (>1 m), as it is done classically, from the same surface. The age results from the two Late Pleistocene moraines and one rock glacier surface show no difference in terms of boulder exposure ages.

Three 36Cl ages from one single lateral moraine in Çimi Valley of Geyikdağ, central Taurus, Turkey, are 11.9±0.9 ka, 14.0±1.1 ka and 11.9±0.9 ka (all ages have no erosion corrections) and yield a mean age of 12.6±0.9 ka, while the amalgamated boulder chips' (ABCs) age is 12.0±0.9 ka. Another well developed terminal moraine (so called Zor Moraine) in the Güneycik Valley of Geyikdağ, yielded ages as 4.9±0.4 ka, 7.7±0.6 ka and 3.7±0.3 ka, while the ABCs' age is 6.4±0.6 ka. The rock glacier boulder samples yielded ages of 12.2±0.9 ka, 14.0±1.0 ka and 9.2±0.8 ka, while the rock glacier ABCs' age is 10.7±0.9 ka. These results clearly indicate that the age obtained from ABCs is reliable and can safely replace classical methodology that requires collection of several samples from a moraine surface. The use of ABCs sampling strategy will considerably decrease the time and budget allocated to date a landform. This work was supported by TUBITAK 112Y139 project.