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Determination of paleoseismic activity over a large time-scale: Fault scarp dating with 36Cl

Nasim Mozafari Amiri (1), Dmitry Tikhomirov (1), Ökmen Sümer (2), Çağlar Özkaymak (3), Bora Uzel (2), Susan Ivy-Ochs (4), Christof Vockenhuber (4), Hasan Sözbilir (2), and Naki Akçar (1)

(1) Bern University, Geological Sciences, Bern, Switzerland (nasim.mozafari@geo.unibe.ch), (2) Department of Geological Engineering, Dokuz Eylül University, 35160 İzmir, Turkey, (3) Department of Geological Engineering, Afyon Kocatepe University, Ahmet Necdet Sezer Kampusü, 03200 Afyonkarahisar, Turkey, (4) Swiss Federal Institute of Technology, Institute for Particle Physics, Otto-Stern-Weg 5, 8093 Zürich, Switzerland

Bedrock fault scarps are the most direct evidence of past earthquakes to reconstruct seismic activity in a large time-scale using cosmogenic 36Cl dating if built in carbonates. For this method, a surface along the fault scarp with a minimum amount of erosion is required to be chosen as an ideal target point. The section of the fault selected for sampling should cover at least two meters of the fault surface from the lower part of the scarp, where intersects with colluvium wedge. Ideally, sampling should be performed on a continuous strip along the direction of the fault slip direction. First, samples of 10 cm high and 15 cm wide are marked on the fault surface. Then, they are collected using cutters, hammer and chisel in a thickness of 3 cm. The main geometrical factors of scarp dip, scarp height, top surface dip and colluvium dip are also measured. Topographic shielding in the sampling spot is important to be estimated as well. Moreover, density of the fault scarp and colluvium are calculated. The physical and chemical preparations are carried in laboratory for AMS and chemical analysis of the samples.

A Matlab® code is used for modelling of seismically active periods based on increasing production rate of 36Cl following each rupture, when a buried section of a fault is exposed. Therefore, by measuring the amount of cosmogenic 36Cl versus height, the timing of major ruptures and their offsets are determined.

In our study, Manastır, Mugırtepe and Rahmiye faults in Gediz graben, Priene-Sazlı, Kalafat and Yavansu faults in Büyük Menderes graben and Ören fault in Gökava half-graben have been examined in the seismically active region of Western Turkey. Our results reconstruct at least five periods of high seismic activity during the Holocene time, three of which reveal seismic ruptures beyond the historical pre-existing data.