



Push-up studies and determination of ancient earthquake magnitudes in the South Iceland Seismic Zone

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By determining earthquake displacements on active faults, one may evaluate the magnitude of historical earthquakes through empirical relationships between co-seismic displacement and earthquake magnitude. Push-ups structures along strike-slip faults provide a reliable way to determine the displacement, and hence the largest magnitude that should be expected in the area. In South Iceland, we first checked these empirical laws by using earthquakes of known magnitude, like the 1912 Selsund earthquake and the 2000 earthquakes.

The structural analysis of push-ups is made complex by the volume change induced by co-seismic deformation and the post seismic collapse of hillocks. The behaviour of push-up structures is influenced by both the fault segmentation and the décollement depth. Whereas length comparisons are subject to errors, volumetric analysis allows determination of shortening provided that volume changes are taken into account. The Selsund case study thus suggested that some earlier analyses, in which volume changes had been neglected, may have resulted in slightly underestimated offsets, and hence magnitudes.

An important target was the the Leirubakki Fault, where the largest earthquake in South Iceland may have occurred. We consequently undertook analyses along this major post-glacial rupture trace and two faults East and West of the Leirubakki Fault. The results confirm that volume changes at the time of push-up formation and syn-tectonic collapse of deformed rocks during the earthquake, in many cases followed by post-seismic gravitational sagging, cannot be neglected.

In agreement with studies of damage zones of historical earthquakes, our structural analysis of push-ups suggests that earthquakes with magnitudes around, or larger than, 7 have been common in the South Iceland Seismic Zone. The geometrical method presented for analysing push-up structures brings contribution to the evaluation of magnitudes of ancient earthquakes along strike-slip faults, and hence to earthquake risk assessment.