Geophysical Research Abstracts
Vol. 12, EGU2010-4795, 2010
EGU General Assembly 2010

Past earthquake history and seismic hazard in Fucino region, Central Italy

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Using 36Cl exposure dating (Schlagenhauf et al. 2009), we have recovered the Holocene earthquake history (in last ≈14 ka) of three large active normal faults (Magnola, Velino, Trasacco) in the Fucino region, Central Italy (last large earthquake in 1915, 30 000 casualties), nearby L'Aquila (last large earthquake in April 2009, 300 casualties). Magnola (L ∼13 km) and Velino (L ∼12 km) are parts of a ∼45 km-long NNW-striking fault system ('western Fucino north' or WFN), while Trasacco (L ∼30 km) is part of another yet adjacent fault system. We have analyzed the 36Cl content of 400 exhumed scarp samples collected at 6 sites along the faults, 4 on Magnola, one on Velino, and one on Trasacco. The Magnola and Velino faults broke concurrently in the past. Their rupturing occurred in phases apparently cycling at three different time scales: 1) The Magnola-Velino system primarily broke in discrete phases of paroxysmal activity (11-7.5 ka, then 5-3.5 ka), each lasting 2-4 ka, separated by ∼3 kyrs-long quiescence phases. The paroxysmal phases actually led to the breakage of the entire WFN system. 2) During each paroxysmal phase, 3-4 large 'rupture episodes' occurred at 0.5-1 ka intervals, each producing at most 1.5-3 m of vertical slip on the faults. In more detail, the last major rupture episodes to have broken the Magnola and Velino faults occurred ∼13.7, 10.7, 9.2, 8.5, 7.4, 4.8, 3.8, 3.3, and 1.1 ka ago (uncertainties of 0.5-1 ka on average). 3) Each of those rupture episodes seems to have been an earthquake sequence, made of several large earthquakes repeating at short time intervals (a few 10-100 yrs) and breaking in cascade the entire WFN fault system. If each earthquake broke a single major fault within the WFN system, the magnitudes estimated for those earthquakes are ∼6.5-6.9. The adjacent Trasacco fault shows a similar behavior, as it primarily broke during two 2-3 kyrs-long periods of paroxysmal activity, at 14.5-12 ka and 8.5-6.5 ka, which thus do not coincide in time with those recognized on the Magnola-Velino system. Assuming that the faults reload at a constant rate (mean slip rate estimated from our measurements), our data suggest that the faults have entered a paroxysmal phase when they had reached a certain threshold of cumulative strain. Though the Magnola-Velino fault system has not broken since long (≈1.1 ka), the cumulative strain it has accommodated since then is still far below the threshold discussed above. By contrast, though part of the Trasacco fault has broken less than a century ago (1915), the fault is approaching the cumulative strain threshold from which it may enter in a paroxysmal phase. Though those results need further refinements, they suggest that seismic hazard in the Fucino region is high.

References : Schlagenhauf A., Gaudemer Y., Benedetti L., Manighetti I., Palumbo L, Schimmelpfennig I., Finkel R., and Pou K. Using in-situ Chlorine-36 cosmonuclide to recover past earthquake histories on limestone normal fault scarps: A reappraisal of methodology and interpretations; in revision Geophys. J. Int., 2009