

evidence from microearthquake activity and focal mechanisms. M.A. Romano (1-3, aromano@inogs.it), R. de Nardis (2-3), G. Lavecchia (3), M. Garbin (1), L. Peruzza (1), E. Priolo (1), M. Romanelli (1) and F. Ferrarini (3)

Seismotectonic setting of the Sulmona basin area (Abruzzo, central Italy):

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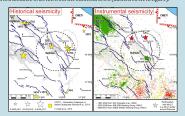


1. Motivations

ullet In the Sulmona basin area (yellow square) there are **ACTIVE FAULTS** (as the Morrone-Porrara alignment) which belong to the intra-mountain extensional province, site of several historical and instrumental earthquakes (e.g. Fucino, 1915; Colfiorito, 1997; L'Aquila, 2009).



 Historically, the Sulmona basin area was struck by at least three earthquakes with M≥5.5 (in 101 A.D., in 1706 and in 1933), while since last decades only four events with 3.5≤ M≤ 3.8 occurred in a distance of 20 km from the Sulmona town (dashed circle in figure).



• The SEISMIC RISK of the Sulmona area is extremely high, depending on

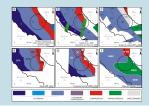
#seismic HAZARD related to its seismological features, i.e, to the presence of seismogenic faults capable of releasing earthquake with M~6.7 and with recurrence times comparable with the time elapsed since the last events (MPS, 2004; Pace et al., 2006; Ceccaroni et al., 2009; Galli

#LOCAL morphological and lithostratigraphical CONDITIONS, from which amplification of

#seismic VULNERABILITY of existing historical buildings;



 The SEISMOTECTONIC ZONATIONS proposed over the last 30 years looks quite different in the study area, due both to its tectonic complexity and to the lack of data (geological and seismological) necessary to constrain such models, on which seismic hazard evaluations are



carry out a microseismicity study?

#to define size, geometry and kinematic of seismogenic faults, especially when not

#to estimate the seismogenic layer depth and thickness #to evaluate the active strain field;

#to lower the completeness magnitude, constraining the Gutenberg-Richter model, the

THROUGH the installation of a local seismometric network (the Sulmona Temporary Network - STN: de Nardis et al., 2011) which integrates the permanent ones, both national (Centralized National Seismic Network - RSNC) and regional (Abruzzi Regional Seismic

Permanent networks are sometimes not adequate, because the detection and the accurate location of microearthquakes require a minimum number of stations, capable of acquiring good quality signals, arranged at very close distance and with a good azimuthal coverage

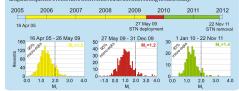


3. Data collection

The seismological data collected for this study are not only from STN, but also from RSNC and RSA; they cover a period longer than six years (from 16 April 2005 to 22 November 2011), subdivided into three time intervals (yellow, red and green bars).

They consist both of original waveforms acquired by STN stations, and of P and S arrival times of RSNC and RSA stations made available from their operators

The greatest part of such data are related to microseismicity (i.e. to events with M,≤2) L'Aquila sequence events have been removed as not interesting in such study.

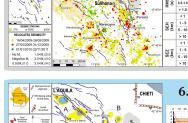


2. WHY (and HOW TO)

BECAUSE the microseismicity analysis is useful:

outcropping or unknown:

parameters of which are used in the seismic hazard assessment.



5. Earthquake locations

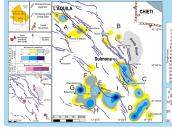
Final earthquake locations have been made by using the code Hypoellipse (Lahr, 1999) and the described local velocity model and V_v/V_s ratio. Corrections due to the elevation of seismic stations or to local velocity anomalies under them have been also taken into account

Totally 2097 earthquakes, with M. ranging between -1.5 and 4.0, have been relocated from 16 April 2005 to 22 November 2011.

From the epicentral map on the left, it can be observed that the seismicity, although consisting of only micro and small events, is not uniformly distributed in the study area, but rather clustered in specific

zones, mainly close to known active faults. Prevailing activity is observed (1) in the northwestern corner of the study area, which coincides with

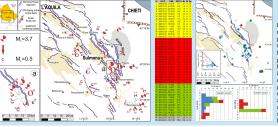
the southern end of the Paganica fault (seismogenic source of 2009 L'Aquila earthquake), (2) at southwest, in the area around Pescasseroli nearby the Marsicano fault, (3) at southeast, between Palena and Pescocostanzo villages, close to the Porrara fault, but also around Roccasicura, where active faults seem not to outcrop. Instead the Sulmona basin remained almost completely aseismic during the whole observation time, with only few and very small events occurred in the plain.



6. Seismicity areal density and seismogenic layer



Depth and thickness of the seismogenic layer, defined as the layer that releases the 95% o seismicity, have been estimated by using only events located with vertical error < 1.34 km (se



7. Focal mechanism solutions

mechanism solutions (FMS) have been computed using the FPFIT standard procedure (Reasenberg and Oppenheimer, 1985), which exploits P-wave first motion polarities. Totally 47 new FMS have been provided, the 60% of which having a number of polarities ≥ 8, no discrepancies, a very low degree of polarity misfit and uncertainties of strike, dip and rake < 20°

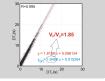
Following the Frolich (1992) classification scheme, the FMS are subdivided into five kinematic categories (see the inset in the map on the right), and when considering their spatial distribution it is possible to identify two disting groups with rather homogeneous kinematics. The first one, at east, show reverse, oblique-reverse and strike solutions at depth > 10km; the second one at west, shows mainly normal and oblique-normal solutions in the 0-10km depth range (see histograms on the left). It is also interesting to note a subordinate group of normal and oblique-normal solutions at depth >10kn

4. The local velocity model and V_p/V_s

In order to relocate the recorded microseismicity, have been used: # a local 1D velocity model (figure on the left), obtained by using the VELEST code (Kissling et al., 1994), which performs a simultaneous inversion of hypocentre locations, station corrections and parameters of the velocity structure;

a local V./V. (figure on the right), estimated through the modified Wadati diagram, as the slope of the linear relationship between the differences in P and S arrival times at two stations which have recorded the same event. See Romano et al. (2013) for details.

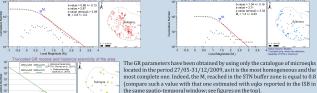




8. The Gutenberg-Richter model

> 220 260

< 0.5 1326 532 209



By comparing the historical seismicity with truncated GR models, built taking into account the parameters constrained by microseismicity, a good correspondence can be noted. The recurrence time of events with 6<M<7 estimated in this work is shorter than that one provided by Galli et al. (2013), who carried

out a paleoseismology study on the Morrone fault (see figure on the left). This implies the possible existence of other tectonic structures capable to generate events of similar magnitudes, confirming the high seismic hazard of the area.

References