30 YEARS OF SEISMICITY IN THE SOUTH-WESTERN ALPS AND NORTHERN APPENNINES AS RECORDED BY THE REGIONAL SEISMIC NETWORK OF NORTHWESTERN ITALY

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The aim of this work is to describe the seismicity of the South-western Alps and Northern Apennines from the very detailed picture provided by thirty years of operation of the Regional Seismic network of Northwestern Italy (RSNI hereinafter, www.dipteris.unige.it/geofisica). The RSNI network was established at the beginning of the '60 with the installation of the first instrument in Genoa, and underwent a relative slow development until the '80, which can be considered the starting date of operation in terms of the number of instruments, the azimuthal coverage and the transmission links. From the '80 on several technological improvements and a renewed interest in the seismic monitoring from funding agencies took the initially local network to one of regional to semi-national character. In particular, in the last decade, the network greatly improved its capability and functionality with the complete renewal of both the seismic stations and the transmission system, that is now fully digital and in real-time. Currently the RSNI network consists of 29 broadband seismic stations equipped with broadband (Nanometrics Trillium 40") and very broadband (Nanometrics Trillium 240") velocimetric sensors, high dynamic digitizers (> 120dB) and satellite or cabled UDP controlled links for the real-time transmission of the data to the processing centre located at the Laboratory of Seismology of the Genoa University. In the framework of recent national and international projects (e.g. RISE project, Réseaux Intégrés de Surveillance Sismologiques et d'Echange, Projet n° 045, Cooperation Territoriale Italie-France 2007-13 or the INGV-UNIGE contract for data management and exchange), the RSNI data centre manages real time data from other Italian (INGV, Istituto Nazionale di Geofisica e Vulcanologia) and European (ReNaSS, Réseau National de Surveillance Sismique – France, and ETH, Swiss Federal Institute of Technology, Switzerland) networks. At present, in the area of the RSNI network, the magnitude threshold for both earthquakes and quarry blasts is as low as 1.0 Ml.

Local and regional seismic events are located in both an automated procedure via an automatic picker engine based on the Akaike Information Criterion (AIC-picker), and manual P- and S-wave phase picking. In both cases, the hypocentral coordinates are computed through the Hypoellipse code using different 1-D velocity models, calibrated for each station to take into account lateral heterogeneities and derived from deep seismic profiles and tectonic constraints (Cattaneo et al., 1999; Spallarossa et al., 2001). The magnitude is computed adopting a Ml scale calibrated by Spallarossa et al. (2002) for the South-western Alps and Northern Apennines.

Although the basic goal of the network is the monitoring in real time of the seismicity and the prompt determination of hypocenter locations, magnitude and shake maps, however the rich database acquired in the many years of operation is used for research projects including high precision locations in one or three dimensions (HypoDD, NonLinLoc, Simulps), studies on the source, seismotectonic applications, computation of focal mechanisms and stress, computation of seismic hazard.

In the attempt of giving, for the first time ever, a comprehensive view of the seismicity in the area, this study describes the main characteristics of the dataset collected by the RSNI.

The progressive number and location reliability of the earthquakes recorded by the network are proportional to its evolution and to the availability of information technology facilities. During the 30 years of operation the RSNI network has detected and stored more than 30,000 earthquakes in North-Western Italy and surrounding areas. Of course, most of the events date back to the more recent years, but the data relative to the earlier years have a special interest because very few instru-

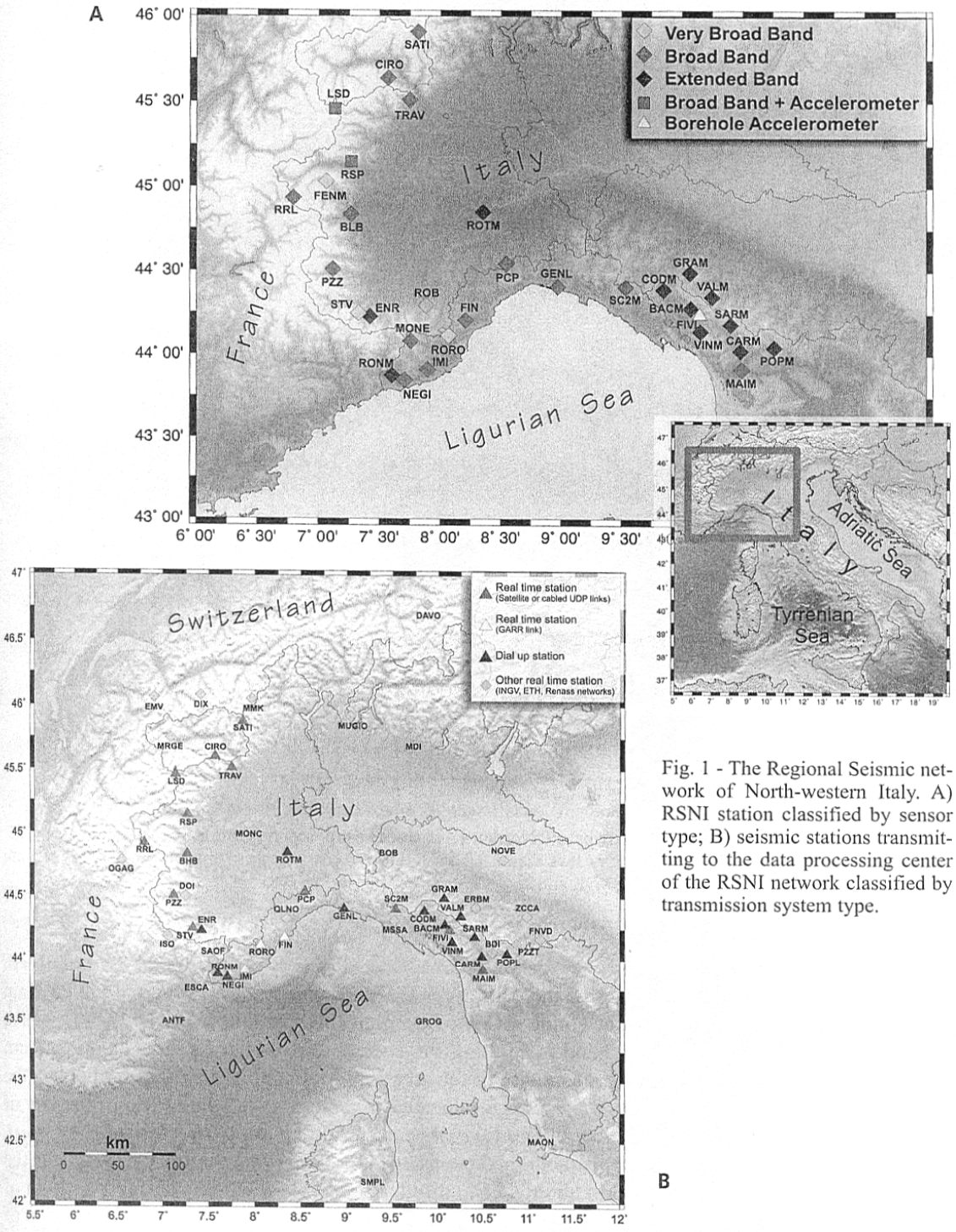

Fig. 1 - The Regional Seismic network of North-western Italy. A) RSNI station classified by sensor type; B) seismic stations transmitting to the data processing center of the RSNI network classified by transmission system type.

ments were in operation at that time. As a general comment, 30 years of recording allows us to make some statistics on the level of energy for the instrumental seismicity of the area. Although most of the earthquakes in this sector of the Italian peninsula are of low magnitude, nevertheless the events with magnitude greater than Ml=2.0 are 14,423 (Fig. 2) and the earthquakes with Ml greater than 4.0, shown in figure 3, account for 84 entries in the database.

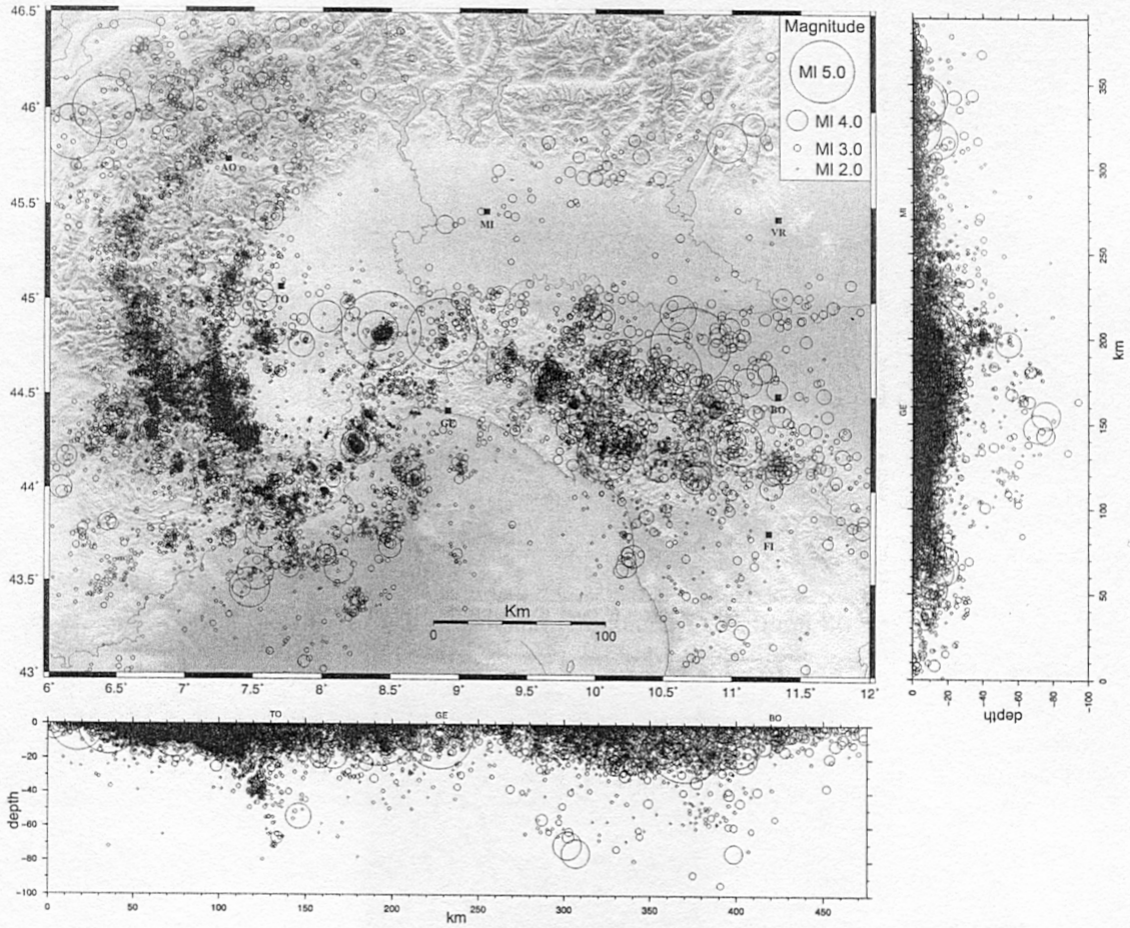

Fig. 2 – Seismicity of the South-western Alps and Northern Apennines as recorded by the RSNI network since 1980. Well locate (horizontal and vertical errors less than 10.0 km) earthquakes with magnitudes greater than 2.0 are reported. In the bottom and right panels W-E and N-S seismic sections are plotted.

The seismicity is spread almost over the entire area but it is mainly concentrated in the northern Apennines and in the western sector of the Alps. Few aseismic zones are observed in the Po Plain and in some smaller regions, like the south-western Piedmont (near the city of Cuneo) and the area north-east of Genoa. An aseismic band is splitting the eastern and western sides of the Northern Apennines. Generally speaking, the seismicity of the area is superficial; it is almost confined in the first 20 km of depth. Only few deeper events are located in a small area south-west of the city of Turin down to 80 km depth and below the northern Apennines down to 60-70 km depth.

One of the main feature of the seismicity is the existence of two branches which depart from the southern sector of the western Alps at about 44.5° latitude. The two alignments design a corridor of less frequent seismicity and seem to reunite at the border with Switzerland. The recent addition of seismic stations in the Valle d'Aosta region is giving more hints on the shape of the northern end of these branches and on the seismicity of the region itself. Finally, the areas where the highest magnitude earthquakes took place during the last three decades are the Garfagnana-Lunigiana (northern Tuscany) on land (October 1995, 4.9) and the Ligurian Sea (July 1963, 5.9; February 2001, 4.6).

They are indeed the areas where the most damaging historical earthquakes occurred, giving emphasis, if necessary, to the importance of a continuous seismic monitoring.

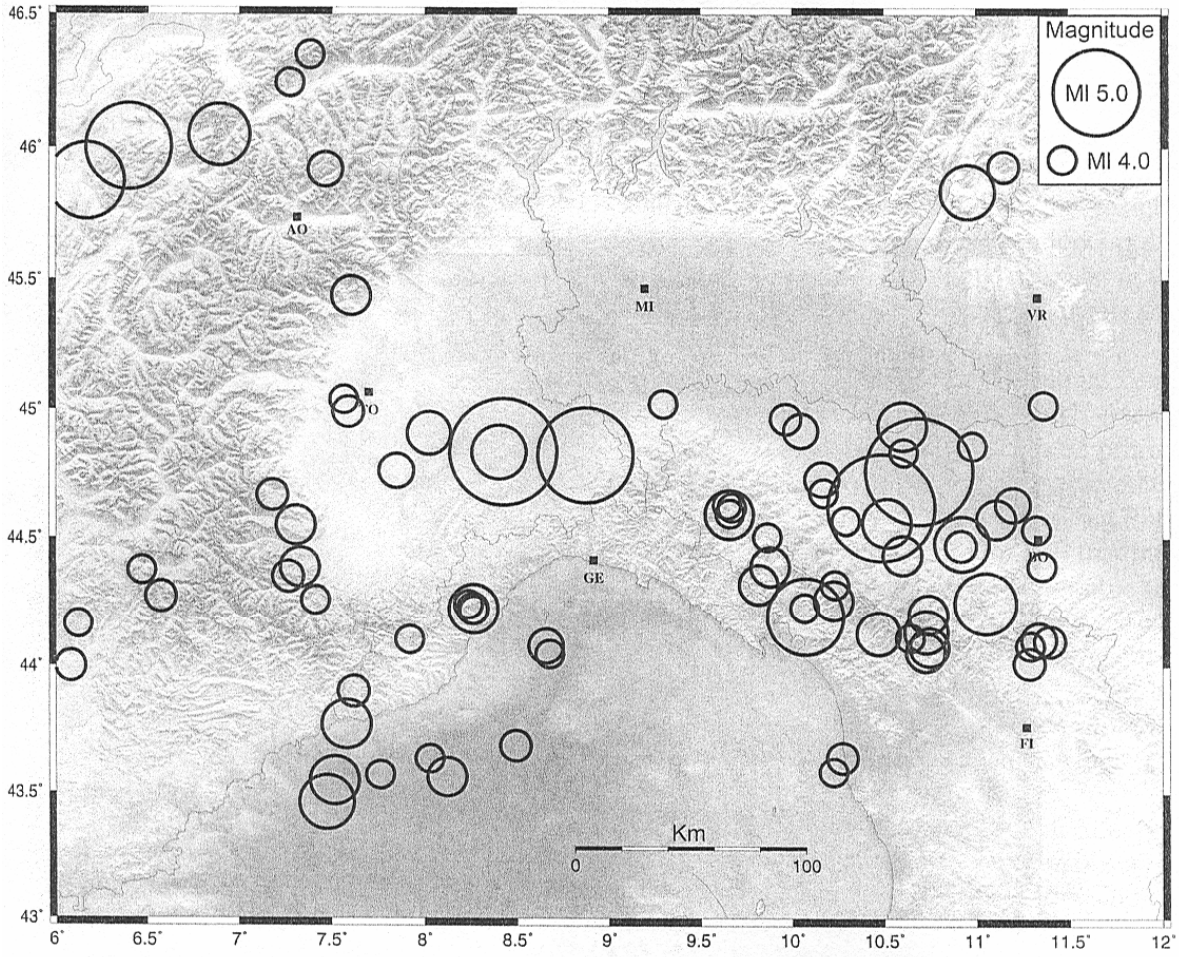

Fig. 3 – Same as Fig. 2 but plotting earthquakes with magnitudes greater than 4.0 only.

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