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## A SEISMIC ARRAY IN NORTH-WEST ITALY

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The adaptation processes of the crust to the orogenic movements of the Alps produce sudden release of elastic energy, i.e. earthquakes. These phenomena usually take place where the structural heterogeneities are large, in particular along fault lines.

After centuries active seismic areas have been ascertained along the great displacement band which crosses the Maritime and West Alps, ranging from the Imperia province and the neighboring part of the Savona province (through the Tenda pass, the areas of Entracque-Valdieri, Demonte-Vinadio and the upper Val Grana) to the Briançon zone in France. In this respect one should remember the destructive earthquake of Feb 23, 1887, with its epicenter in the Bussana-Porto Maurizio area.

For the purpose of investigating the seismicity of the above mentioned section of northwest Italy and to acquire data on the generation mechanism of earhquakes as well as on the structure of the crust and upper mantle, a network of seismic stations has been established. Further development of this network is planned. Now there are ten stations active, and their locations are shown in Fig 1. Some stations are equipped with only vertical component seismometers, predominantly Geotech-Teledyne instruments. In the stations at Genoa, Mt. Capellino, Roburent, Cuneo and S. Anna di Valdieri, Wood-Anderson horizontal seismometers are also operated and are useful for measuring magnitude of local earthquakes. The small network of S. Anna di Valdieri, Roaschia, Vernante and S. Lucia is in addition equipped with accelerometers. The stations having only vertical instruments will be supplemented in order to have all stations equipped with the same 3-component seismometers. At all stations, the time is automatically recorded on seismograms by the reception of signals from the Neuchâtel Radio



Fig 1. Map showing the geographic location of the seismic stations and the seismic active areas.

Station. Because the mountaineous region where the seismic stations are placed, it was not possible to establish radio or phone connections between them. At Genoa the displacements of a vertical Geotech seismometer (model S 10) are recorded at the Institute from more than two years by radio (Lennartz-system) on both paper and tape (Bossolasco et al, 1971). In the same manner continuous recordings of a quartz strainmeter (10.4 m long) are radiotransmitted to the Institute (Bossolasco and Cicconi, 1971). The seismic station of S. Anna di Valdieri is similarly equipped. Since the seismic signals are recorded on magnetic tape, different kinds of analysis can be performed rapidly and efficiently.

As may be seen from Fig 1, our present network can be considered a regional array with its center either at Genoa, or in Roburent or in S. Anna di Valdieri. This network of stations does not represent a

a true array because the sensor separations distances are very large compared to the wave length of short period seismic waves. Therefore the above network do not exhibit the main characteristics of a typical seismic array.

During the last years the seismic activity has been concentrated prevalently in three areas, as is indicated in Fig 1; near Valdieri-Entracque-Roaschia, part of the above mentioned great displacement band, where strong fault lines occur, near Monte Settepani and southward about 15 km NW of Finale Ligure, and an area near Monte Nero (Castell'Ermo), 12-15 km west of Albenga. In addition to these swarm areas, other sequences and isolated earthquakes in the West Alps (Apennine Region) and in the Ligurian Sea have been recorded and investigated (Evar1968; Bossolasco and Eva, 1969).

The most active areas are the first two, with swarm sequences lasting several months and totaling some hundred earthquakes.

By investigating the major shocks of the swarm sequences that occurred during 1968-69 in the Monte Settepani area, some results about the structure of the crust beneath the Maritime Alps have already been obtained (see Bossolasco and Eva, 1969). In addition, from the swarm that occurred Feb - Mar 1967 in the Valdieri-Entracque area new data on the structure of the southern West-Alps was derived (Bossolasco and Eva, 1970).

As seen in Fig 2 the epicenter location of the principal shocks during the swarms of 1967 and 1970 was in the Valdieri-Entracque area. It follows that the active area has been practically the same in both swarms, namely close to and along the main fault line indicated in Fig 2. The focus of the second swarm was at a very small depth (1.5-2 km), whereas that of the first one reached depths up to 8 km.

Among the deductions of general interest derived from studying the seismograms gathered in our network the following should be emphasized:

- On the average, beneath the Maritime Alps the hypocentral depths increases from north to south, i.e. moving toward the sea. As an example one should recall the undersea earthquake of Jul 19, 1963 (Max Magn. 6.2) whose hypocenter was located at Moho at nearly 30 km depth (Bossolasco and Eva, 1965).



Fig 2. Epicenter location of the main shocks belonging to the two swarms of Mar 1967 and of Nov 1970 in the Valdieri-Entracque area.

- For the earthquakes recorded at Genoa (Mt. Capellino and Roburent) the attenuation of seismic waves is generally greater for events located westerly, i.e. in the Maritime Alps, in comparison to those placed easterly with epicenters in the Emilian Apennines. This is a consequence of the large heterogeneity in the structure of the crust beneath the Maritime Alps and neighboring areas and of the existence of a low velocity layer in the crust at a depth of 7-9 km (Bossolasco and Eva, 1969).

- The installation of clinometers at some seismic stations, Genoa and Roburent, allowed us to draw some preliminary conclusions on the block structure of the western Ligurian belt. In this area we have found high crustal differential strains, which sometimes are highly correlated with the seismic activity (Bossolasco et al, 1968). These investigations belong to a wider framework concerning the earthquake mechanism.

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