Introduction

Long-term observation of seismicity of volcanic areas showed that earthquakes are generally characterized by significantly lower magnitude than tectonic areas, producing high intensities correlated to the shallow hypocentral depth and poor mechanical properties of rocks.

At Ischia volcanic island (Southern Italy) the historical seismicity shows characteristics: high intensity values rapidly decreasing with distance, shallow hypocentral depth, local amplification of damages and strong directional attenuation of effects.

Studies of historical documentation of earthquakes occurred in the island are fundamental to localize the seismogenic sources and to evaluate the seismic energy propagation for hazard assessment, also considering the lack of significant seismicity after the 1883 catastrophic event.

The central sector of Ischia is made up by the Mt. Epomeo structure (787 a.s.l.), marked by a NW-SE, NE-SW and N-S system of structurally significant faults and fractures. The uplift of Mt. Epomeo is correlated to resurgence of the caldera after a large explosive eruption (55 ka B.P.) that deposited the Mt. Epomeo Green Tuff (MGT1) (1.5,50-1.65). A laccolithic intrusion was hypothesized as source of Mt.Epomeo neaplastic block producing the tectonic of its boundary and volcanic activity (3,6,14).

The seismicity recorded in historical time is confined along the faults bordering the northern sector of Epomeo block.

Tectonic and seismicity of the island

The study of historical seismicity of Ischia has shown high intensity values rapidly decreasing with distance, shallow hypocentral depth, local amplification of damages, and strong directional attenuation of effects. In order to evaluate the temporal attenuation of intensity observed for the 1883 “Casamicciola earthquake” we use a widely intensity versus epicentral distance relation, Blake’s formula (1964).

The 1883 earthquake: macroseismic attenuation

The 1883 earthquake is ranked as a VII MCS degree which was very local covering an area of about 3 km². The comparison of this event with other similar magnitude events showed that high intensities are expected, even if earthquake magnitude is moderate, because of very shallow source and soft soils outcropping. For this reason, it is difficult to evaluate the return period of the earthquakes.

Seismic hazard

Attenution law and source parameters are fundamental for hazard assessment evaluation. The magnitude of 1883 earthquake (7.8) obtained taking into account the reliability of formula, was estimated to be 7.5-7.8, these values are equal to 4.3 and 5.2. Considering these values we can infer the possible fault surface of the earthquake.

Interpretation of source parameters has been inferred comparing the Akai and Richards point-source model (1990) with the macroseismic data obtained by filtering of attenuation.

The catastrophic 1883 event, the last occurred in the island, represent the unique example of earthquake in volcanic Mediterranean area which produced more than 2300 fatalities as a result of whole destruction of the town of Casamicciola and damaging of many buildings of the island (7,8). The catastrophic effects of this earthquake (650-700 degree MCS) was very local covering an area of about 3 km², with strong attenuation effects were observed especially along the east direction.

The observed intensity distribution and the inferred attenuation coefficients seems to be strongly influenced by the different mechanical properties of geological substrates. The data have been filtered in order to separate the different contribution of the different types of soils (soft = reworked tuff, medium = not reworked tuffs and hard = local).

The high housing density and high economic value exposed make the island of considerable interest for mitigation of the seismic risk. The study of historical seismicity allow us to define:

- the seismogenic sources are located along the faults bordering Mt.Epomeo, in the southern sector of the island, where probably brittle processes dominates in respect to the southern one where high geothermal gradient have been recorded (max 180°C km⁻¹).
- high intensity areas are expected, even if earthquake magnitude is moderate, because of very shallow source and soft soils outcropping. The complexity of the structure and the fuzzy sequence of the macroseismic data make it difficult to evaluate the return period of the earthquakes.
- strong attenuation processes are observed in the island, particularly along the eastern and southern sector where high friction of rocks, high temperature and low rigidity of the medium prevail over source effects;
- magmatic pressure and regional stress, joined to load of Mt.Epomeo block and thermal stress act in the island producing seismicity.