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The contribution of broader geological information in modern seismic hazard analyses: the European example

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Up until about 20 years ago, in most European countries the contribution of the geological community to the problem of assessing seismic hazard usually involved the identification of "Quaternary faults" (or even "Neotectonic faults") and the preparation of fault maps, generally at regional if not national scale. These maps were generally unfit for seismic hazard purposes, essentially because they described the complexity of outcrop-scale surface faults rather than the location and 3D extent of the main potential seismogenic sources. For this reason they were normally ignored by seismic hazard practitioners, that resorted to a combination of historical seismicity catalogues and loosely drawn "seismogenic areas" encircling the epicenters of the largest earthquakes.

Starting with the end of the 1980s, paleoseismology became a standard approach for investigating the behavior of large faults, and the first direct observations of repeated earthquakes shed light on unexpectedly long recurrence intervals for most European faults (with the only exception of Greek faults). The 1990s recorded a surge in the interest for direct investigations of fault scarps in young sediments and of the paleoearthquake record. However, recurrence intervals from trenching were too few and too scattered for any use in the seismic hazard assessment chain. Most practitioners kept ignoring this emerging contribution from the geological community, except for specific applications in the deterministic assessment of seismic hazard.

The second part of the 1990s also marked the onset of "fault catalogues" and "fault databases", extensive compilations that attempted to blend conventional tectonic and

fault information with paleoseismological results and instrumental data. Unfortunately, this time was also marked by a number of significant earthquakes generated by blind faults, both in Europe and worldwide. This raised the awareness that a compilation based on standard geological observations will necessarily be incomplete; it will fail to identify as much as 50% of the potential earthquake sources almost everywhere in the world, and nearly 100% in large portions of central and northern Europe.

In this presentation I advocate a new course in deriving geological information that effectively contributes to the assessment of seismic hazard and to the mitigation of the associated risks. XXI century Quaternary geologists must finally cross existing disciplinary boundaries and seek cooperation with marine geologists, experts in the interpretation of subsurface data, seismologists, geodesists. Their goal is to grant completeness of their observations and to develop earthquake source models that are not easily jeopardized by hard-to-find or barely visible faults. I will show examples of how this goal can be achieved by a) exploiting a broader range of geological observations, including those that apparently lie very far from conventional active faulting studies (e.g. gravimetric data, coastal uplift data, drainage anomalies, anomalous crustal fluids); and b) by developing new forms of contamination between strictly geological observations and all other manifestations of tectonic activity and secular strain build-up.