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An analysis of seismic hazard in the Upper Rhine Graben enlightened by the example of the New Madrid seismic zone.

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Seismic hazard in the "stable" continental regions and low-level deformation zones is one of the most difficult issues to address in Earth sciences. In these zones, instrumental and historical seismicity are not well known (sparse seismic networks, seismic cycle too long to be covered by the human history, episodic seismic activity) and many active structures remain poorly characterized or unknown. This is the case of the Upper Rhine Graben, the central segment of the European Cenozoic rift system (ECRIS) of Oligocene age, which extends from the North Sea through Germany and France to the Mediterranean coast over a distance of some 1100 km. Even if this region has already experienced some destructive earthquakes, its present-day seismicity is moderate and the deformation observed by geodesy is very small (below the current measurement accuracy). The strain rate does not exceed 10-10 and paleoseismic studies indicate an average return period of 2.5 to 3 103 ka for large earthquakes. The largest earthquake known for this zone is the 1356 Basel earthquake, with a magnitude generally estimated about 6.5 (Meghraoui et al., 2001) but recently re-evaluated between 6.7 and 7.1 (Fäh et al et al., 2009).
A comparison of the Upper Rhine Graben with equivalent regions around the world could help improve our evaluation of seismic hazard of this region. This is the case of the New Madrid seismic zone, one of the best studied intraplate system in central USA, which experienced an M 7.0 – 7.5 earthquake in 1811-1812 and shares several characteristics with the Upper Rhine Graben, i.e. the general framework of inherited geological structures (reactivation of a failed rift / graben), seismicity patterns (spatial variability of small and large earthquakes), the null or low rate of deformation, and the location in a "stable" continental interior. Looking at the Upper Rhine Graben as an analogue of the New Madrid seismic zone, we can re-evaluate its seismic hazard and consider the possibility of an earthquake of magnitude 7 or greater.