Toward a better characterization of small to moderate earthquakes seismological pattern in Northeastern France

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Seismic risk assessment in intraplate regions with low surface deformation, such as Northeastern France, and its border countries of Germany and Switzerland, faces important challenges related to vulnerability due to the : high density of population, numerous industries with sensitive activities (nuclear power plants, mines, quarry blasting, chemical and bacteriological industries), and fragile historical heritage to protect. However, despite being located at the middle of the western Europe, seismic hazard estimation in our study area remains poorly constrained, especially because of lack of knowledge on active structures' identification and the nature of the processes responsible for earthquakes. Furthermore, the regional seismicity encompasses significant historical and recent earthquakes (intensity up to IX and X), together with a regular activity heterogeneously distributed over the whole region, and affecting all the main geologic domains : the Upper Rhine Graben, the ancient massifs of the Vosges and the Black Forest, the Jura mountains with the molassic basin and the Alps. We focus here on the small events, whose the space time evolution and the statistic analysis are important criteria to characterise the seismic behaviour of the region and its potential seismogenetic structures. By taking advantage of an exceptional, recently densified seismic network (development of temporary stations (2015-2020) in the framework of the European AlpArray project, reinforcing the growing permanent national networks of France, Germany, Switzerland and Belgium), we are building a new seismic catalog following a methodology specifically adapted to this network and its low level of detection, the current regional seismicity and the large amount of waveforms analysed. Doing so, we reduce the magnitude of completeness and access to more accurate hypocentral localizations and magnitude estimations, which are crucial for the seismic event classification and a better characterisation of the seismic behaviour of the region.

Session 3 / **41**

Archeoseismology in Machu Picchu, Paleoseismology and Lacustrine records in Cuzco region as key interdisciplinary approaches for intraplate deformation characterization on the Andean Altiplano

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In South America, human beings are prone to settle along fault scarps. Emblematic among them in Peru, the touristic and tectonic Cuzco region is affected by damaging earthquakes since the Spaniards arrived, as demonstrated by the 1650, 1950 and 1985 events. This area in the high Altiplano, sitting 400km away from the subduction zone, exhibits a combination of strong seismic hazard and high vulnerability through the presence of active fault segments in densely populated areas. The accurate estimation of past effects of previous earthquakes on build heritage is a

key to provide additional data (reccurence, and past impacts) to properly assess the seismic risk in intraplate deformation zones such as the Andean altiplano. Indeed, archeoseismological pioneering studies demonstrated that faulted and disturbed architectural remains can be used as valuable markers to extend the catalog of more classical paleoseismological studies. Prehistoric monumental architecture in Peru goes back to 3000yrs BCE and the construction techniques have been used throughout the country on Machu Picchu and Choquequirao sites among others, proving to be a sustainable resource for the evolution of the south american culture. We plan to map and study the past seismic effects on archeological remains, the construction modes and designs on monumental heritage to complement the evidences of deformation issued from archeological soils, fault trenching and proximal lake coring. Thus we aim to build a catalog prehistoric earthquakes and their induced effects. The overall purpose is to extend the knowledge and time window for the crustal fault activity on the Cuzco-Vilnacota fault system. This work present the first paleo events records from trenching efforts we pursued on the different fault segments and the targeted post glacial lake to core, and monumental building to be studied.

Poster Session 1 / 42

Amateur seismological stations in Belgium and Zeeland

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We report on the installation and maintenance of professional-grade seismic stations by amateurs in Berloz (Belgium) and Oostburg (Zeeland, The Netherlands) and the usefulness of the data provided by their stations.

Poster Session 1 / 43

Seismotectonic markers along the Hockai Fault Zone (East Belgium) – new insights

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The historic 1692 Verviers Earthquake (Ms 6-6.3) represents one of the most significant events in NW Europe, with its supposed epicentral area being located along the Hockai Fault Zone (HFZ) in East Belgium. This, and other seismic events in the past, characterises the 42 km long HFZ as a seismically active zone of multiple fault segments, which also crosses the entire Stavelot Massif. In this work, we present various geomorphological markers that can be used as proxy indicators to characterise the seismotectonic activity of the area. A special focus is laid on recently discovered geomorphological features in the region of Malmedy, i.e. a steep scarp in the orientation of the HFZ adjacent to two ancient landslides. These features have been investigated by various geophysical techniques, notably passive and active seismic measurements (H/V method and seismic refraction) as well as electrical resistivity tomography (ERT). Seismic and electric profiles across the scarp reveal a significant contrast in geophysical properties of soil, confirming its assumed tectonic origin. Results of our field campaign are compared to earlier research of the better known slope failures in the northern segment of the HFZ - the landslides of the Pays de Herve (region of Battice). These slope failures can be essential markers in order to understand not only the geomorphological history of the region, but also to confirm the seismotectonic context of the region.