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High Resolution Magnetic surveys across the Emeelt and Hustaï faults near Ulaanbaatar, Mongolia

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During the 20th century, Mongolia was one of the most seismic active intra-continental areas in the world. Some recent observations raise strong concern on still unidentified structures around Ulaanbaatar (1.5 M inhabitants). Near the city, instrumental seismicity shows continuous activity with five M 4+ events since 1974 and a M 5.4. Since 2005, the number of earthquake in the shallow crust (above 10-20 km) has significantly increased on the Emeelt fault area, west of Ulaanbaatar. A multi-disciplinary study - including GPR profiling, magnetic mapping, DGPS microtopography, morphotectonic observations and paleoseismic trenching - was carried out in the fault areas to assess their seismogenic potential.

We present preliminary results of high resolution magnetic surveys using three axis fluxgate magnetic sensors. In Emeelt and Hustaï area, about 4 km^2 were prospected with survey line spacing of 5 m to investigate the subsurface characteristic of the active faults. The main faults are clearly detected as well as secondary branches that affect buried paleo-channels. The combined approach of morphotectonic observations and magnetic measurements was used to select the location of paleoseismic trenches. The fluxgate equipment, being an easy, non-invasive and high-resolution way of mapping was used inside trenches to map exposures. Micro magnetic surveys were conducted on the walls of the trenches along 30 m, with a vertical extent of 2 m and a spacing of 0.1 m between each line. These measurements are used to define different units of sediments with a very high level of detail particularly where the stratigraphic interfaces are poorly visible. Magnetic mapping reveals a fault zone in recent units that consists of intense deformational patterns. Simultaneous use of horizontal and vertical maps may yield a 3D interpretation of the distribution of sedimentary layers.

Faulted units related to recent depositional process attest for the ongoing activity of the Emeelt and Hustaï faults. This novel approach brings supplementary physical measurements to classic trench observations as well as access to physical properties not observable with the naked eye. It proves to be a useful complement to photologs and field observations. Finally, our multidisciplinary approach helps assess seismic hazard for the nearby capital of Mongolia, Ulaanbaatar.