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Tectonic Morphology of the Hustai Fault (Northern Mongolia) : A Source of Seismic Hazard for the city of Ulaanbaatar

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Beside the famous series of M 8 earthquakes that struck western Mongolia in the first half of the 20th c., the Hustai fault in northern Mongolia presents a more directly concerning picture in terms of hazard and risk. With its northeastern tip located ∼10 km from the city of Ulaanbaatar (1 M inhabitants), the 92-km-long fault may produce consequential M 7+ earthquakes. No known historical earthquake occurred on the Hustai Fault in the last 500 yrs while instrumental seismicity shows continuous activity with five M 4+ since 1974 and a M 5.4 event in that same year. Most events occur in the shallow crust above 10-20 km.

We present preliminary results of a multi-disciplinary study of the Hustai Fault in order to assess its seismogenic potential. By combining high-resolution satellite images, digital elevation models, magnetic mapping, geomorphology and trenching, we provide a detailed map of the fault's active trace as well as insight on its recent episodes of surface faulting.

The Hustai Fault is more than 92 km long and divided into three segments. The northern segment is 23 km long and oriented N 68; the central segment is 33 km long and oriented N 55; and the southern segment is at least 36 km long and oriented N23. Overall, the Hustai Fault forms a wide W-shape open to the southeast. The active trace runs along the foot of the main topography of the Hustai Range and is outlined by exhumed chert slabs, contrasts in water content and vegetation reflecting changing soil conditions, right-laterally offset streams and elongated sag basins. The latter are 600- to 800-m-wide and bounded at their SE edge by antithetic faults. Stream bed topographic profiles show a systematic uplift of the NW block by 20-30 m and high-resolution satellite images document right-lateral offsets in the range of 20-30 m, thus suggesting an oblique regime. Antithetic faults only exhibit dip-slip movement in the order of a few meters (< 10 m).

An exploratory 106-m-long trench dug across the main trace reveals faulted shallow units associated with the presently active streams and trapped inside the sag basins. These recent units overlay a 1- to 2-m-thick succession of paleosols interpreted as late Pleistocene to Holocene in age and which display general warping and faulting with metric-size grabens and reverse branches as well as purely strike-slip ones resulting from the oblique nature of the fault.

Faulted units observed close to the surface and related to recent to present depositional processes evidenced by actively depositing local streams and sag basins attest for the ongoing activity of the Hustai Fault and its seismogenic potential for the nearby city of Ulaanbaatar.