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Geometry, kinematics and segmentation of a large active normal fault bordering the Linfen basin (Shanxi-Weihe graben system, China)

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The Linfen extensional basin, in the Shanxi-Weihe Graben System of northern China is a highly seismogenic area. Two large earthquakes occurred in historical times: the September 25, 1303 Hongdong earthquake (I=XI, M=8.0) and the May 18, 1695 Linfen earthquake (I=X, M=7.75). The latter earthquake seems to be likely related to the activity of the faults controlling the formation and evolution of the Linfen basin during Plio-Quaternary. The largest fault of the area, bordering the Linfen basin to the NW, is the Luoyunshan fault: a normal fault extending for about 100 km along-strike and delimiting at the footwall the Luliangshan Mountains of the Loess Plateau. We present the results of a field survey carried out along the Luoyunshan fault. By integrating surface and subsurface geology data, it is possible to subdivide the fault in 3 main fault segments. The northern and central segments (about 40 km long) strike on average NE-SW and dip toward SE; the southern segment (about 24 km long) strikes on average WNW-ESE and dips toward SSW. This segmentation pattern has a strong control on the geometry of the sedimentary basin, as well as on the morphology of the hanging wall and footwall blocks. At a closer view, the NE-trending segments result from the linkage of second-order segments ranging in length from 6 to 10 km. Second-order segments are arranged in a left-stepping en échelon fashion. The WNW-trending southern segment is separated from the central segment by a sharp bend. Its evolution is probably related to the reactivation of a pre-existing discontinuity inherited from the pre-Wutai tectonic period. The kinematics along the northern and central segments is mainly normal dip slip, with subordinate right-lateral oblique component.

Along the southern segment, the kinematics is more complex and both SE-trending and SW-trending slip vectors have been observed. In several places, the fault cut late Quaternary deposits and morphologies, suggesting that it can be considered an active fault. Preliminary reconstructions along geologic cross sections, allowed us to determine average long-term throw rates for the last 2.4 Ma (age of the Quaternary loess succession) and for the last 125 ka (late Quaternary).