Geophysical Research Abstracts
Vol. 12, EGU2010-9620-1, 2010
EGU General Assembly 2010

High-Resolution satellite imagery mapping of the Ms 7.9, 11 august 1931 Fuyun earthquake, Northern Xinjiang, China

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The 11 August 1931 Fuyun earthquake (Ms 7.9), which ruptured about 160 km of the strike-slip Fuyun fault, western front of the Altai Mountains, is part of a series of 5 major events of similar magnitude that occurred in Mongolia in a lapse of 30 yrs. It counts among one of the major continental strike-slip earthquakes of the last hundred years. However, The rupture geometry and the slip distribution, key data to document fault segmentation and faulting recurrence, are poorly known for this event.

A new set of high-resolution satellite images (QUICKBIRD, ASTER) provide insights into the surface rupturing process associated with this earthquake. Thanks to the arid climate conditions that prevail in the area, analysis of these images allowed us to constrain the length, the width, and the coseismic horizontal slip distribution of the Fuyun earthquake rupture zone.

We have mapped the trace of the fault at the surface with accuracy using this high-resolution (<1m) data set. Detailed mapping reveals a linear right-lateral shear zone striking NNW that can be mapped for about 160 km from the Kayirti River in the north to the Ulungur River in the south. NNE-trending extensive structures as pull apart (Xinshankou pull apart), and NNW-trending compressive structures as thrust faults (Karaxingar thrust fault and Saribastaw feature) are present too and consistent with this strike.

According to rupture azimuth changes, the 1931 surface rupture can be divided into four main geometric segments. These segments, with a length ranges from 27 to 55 km, present a mainly right-lateral motion with moderate normal component in the North and minor reverse component in the South. This mapping also suggests that these four first order segments can be further separated into more higher order segments, linked by geometric discontinuities like step-overs, bends, fault branches of different scales. Following Kame and al. [2003], the splay fault angle and spatial distribution of these branches along the 1931 would favour the possibility of a rupture propagating faster than classic S-wave speed.

By measuring offsets that have affected geomorphological markers at the surface (e.g. rivers beds, fans, topographic crests…), we are able to reconstruct the distribution of slip along the fault. 561 new geomorphic offsets either related to the last event or to cumulative offsets were measured. For the last event, defined by 291 offsets with an average slip amount of 5.6m, the slip distribution is unusually flat over long distances. For the older events, each slip distribution follows the same pattern and suggests a similar slip distribution during the last four earthquakes along this fault, supporting a characteristic earthquake model.