# Illuminating with InSAR time series the strain distribution and evolution over a seismically active fault-bend-fold structure


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**Abstract**

The mechanisms by which earthquake cycles produce folding and accommodate shortening is fundamental to quantify the seismic potential and integrate aseismic sliding within the long-term deformation processes. However, measuring such small, broad aseismic and transient deformations in mountainous areas is challenging with current space-geodesy techniques.
Here, we conduct a multi-temporal InSAR analysis from four descending and one ascending Envisat tracks across the south-vergent Zongwulongshan thrusts. The study area is located in the northeastern Qinghai province, in Tibet, extending from the 2700 m high, flat and wide Qaidam basin in the south, to the 5500 m high Qilian Shan in the north. There, about 5-7 mm/yr of present-day convergence is accommodated across shortened folded sediments decoupled from the underthrust basement, identical to those of foreland basins. From 2003 to 2011 the system has experienced a high seismicity rate with three Mw_˜6 and five Mw_˜5 reverse earthquakes, representing thus a good opportunity to integrate the slow and shallow folding deformation processes within the earthquake stress changes along active thrust faults.

In order to jointly capture the slow inter- and post-seismic surface displacements with the high fringe rates associated to co-seismic rupture, we specifically address interferometric phase unwrapping challenges. We apply a series of corrections on the wrapped phase and we use a displacement template of the coseismic signal to assist the unwrapping of co-seismic interferograms. Combining the five overlapping tracks made of sporadic acquisitions together, we successfully produce a time series displacement maps with high temporal sampling and capture the complete seismic cycle of this fault-bend-fold structure. Coseismic and post-seismic maps are then inverted with teleseismic data to explore the fault-system geometry.
Our analysis first shows the benefits of a time series analysis approach for earthquake sources inference in order to improve the S/N ratio in comparison to single interferograms and separate the co and post-seismic deformations processes. Our observations and models then highlight that the shallow rising of the anticline ridges occurs both slowly during the inter-earthquake period than at higher rates during the post-seismic periods, which late up to 8 years after one of the Mw 6 event. This study represent thus a step forward towards a better integration of the seismic and aseismic slip partitioning within a fault-bend-fold structure, which ultimately will be fundamental to better assess their seismic hazard.


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