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Kinematics of the Wonji Fault Belt (Main Ethiopian Rift): first results from GPS measurements

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The Wonji Fault Belt (WFB) is a NNE-SSW trending narrow zone of active deformation made up of high-angle en-echelon normal faults which occurs at the eastern border of the Main Ethiopian Rift (MER) in the Asela-Ziway area (central Ethiopia).
Important volcano-tectonic activity is recognised along the WFB from the Early Pleistocene. Normal faults realize a system of tilted blocks bordered by steep fault-escarpments at the boundary between the Ethiopian highlands (Somalia plate) and the Ethiopian Lakes region (MER floor). Moreover, Quaternary volcanic rocks are associated to and affected by normal faults, which slip-rate has been inferred to be about 2.0 mm/y.
In order to measure the actual deformation rate within the WFB, a dense GPS network arranged into two roughly NW-SE trending transects made up of about 30 survey points was realised in 2004. Assuming that ground deformation is mostly accommodated by extensional faulting couples of survey points were positioned, where possible, on both the hangingwall and footwall of normal faults, to the aim of monitoring relative displacements between the base and the top of steep fault escarpments. The network was measured in December 2004, January 2006 and October 2007, utilising GPS survey sessions of 2-3 hours based on the leap-frogging scheme.
Data were post-processed by means of both the single baseline Leica Geo Office (LGO) and multipoint solution GAMIT/GLOBK software.
The latter software allows to integrate and adjust the dataset of the three campaigns as a whole, providing positions, velocity and precision for the survey points. Within the LGO environment, data snooping for the three campaign was implemented in order to identify and remove outliers; after, network adjusting and comparison among relative survey points coordinates was performed.
Results obtained from the above described procedures are self-consistent both in terms of displacement directions and velocity: assuming the Asela survey point as a reference, horizontal displacement vectors point out that extensional processes are currently acting along the N110 direction, within the WFB between Asela and Ziway, with total average velocity of ca. 10 $\pm$ 3 mm/y obtained from GAMIT/GLOBK and ca. 6 $\pm$ 4 mm/y obtained from LGO. Moreover, our preliminary GPS results have also shown the occurrence of aseismic deformation related to the volcano-tectonic activity along the WFB. Since for some survey points the displacement vector magnitude is similar to the precision of measurement, next survey campaigns possibly will allow to strengthen the kinematical model here presented, related to a time interval of about three years. A longer time interval would also improve the signal-to-noise ratio for the estimation of the vertical component of displacement.