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Analysing fault growth at the continental break up zone in Afar, Ethiopia

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Continental break up, the formation of new oceans still holds many unanswered questions. The continental rift of Afar, Ethiopia is the only place on Earth today where the final stages of continental rupture and the beginning of seafloor spreading are occurring above sea level. In September 2005 a new rifting episode started at the Dabbahu segment with the intrusion of about 2-2.5 km^3 of magma into a 60-km-long dyke (Wright et. al., 2006; Grandin et. al., 2009), causing horizontal opening of up to 8m. Faults within the research area show fresh slip of up to 3m along fault segments of about 10km (Rowland et. al., 2007). Since then 13 further dyke intrusions showing surface deformation have been detected and analysed using InSAR data. However, how faults grow remains a key question. To establish fault growth models, distribution of displacement along surface tracks as well as scaling relationships of faults of different order of magnitudes within a similar lithological setting are essential (eg. Walsh and Watterson, 1988; Cowie and Scholz, 1992). Set in Pliocene flood basalts the highly faulted Dabbahu segment forms an ideal study case. We used 6 pairs of SPOT5 images with a pixel size of 2.5m to create a relative DEM of 6m resolution covering the whole of the 60km x 30km Dabbahu segment. By tying the relative DEM to the georeferenced 90m resolution DEM from SRTM data and applying linear and bi-quadratic polynomial transformations we were able to georeference the DEM. During October 2009 a LiDAR survey took place over the central rift segment with additional cross profiles. The additional data has enhanced the DEM spatial resolution to 1m in the centre. Using this large, precise dataset we have developed an automated method to systematically derive the distribution of displacement along the surface expression of the faults. This enables us to determine whether scaling relationships derived in other areas are valid for magmatically-driven faults. Here we present first results of these statistical analyses.