

Analysis of the Inter-Diking Deformation Pattern at the Ongoing Dabbahu-Manda Hararo (Afar), Ethiopia Rift Segment Using GPS and InSAR Technique

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The Afar Depression, in the northeastern part of Ethiopia, offers unique opportunities to study the transition from continental rifting to ocean floor spreading. This process, which is the outcome of tectono-magmatic events, has been under investigation using different geophysical and geological techniques. The current study mainly focused on GPS and InSAR methods to analyze the inter-dyking deformation pattern along the Dabbahu-MnadaHararo (Afar) rift segment. The InSAR data was used to identify the time of dyke events and the GPS data to study the inter-diking deformation pattern. A sequence of 12 dyke events occurred from June 2006 to June 2009 and based on the GPS data two major pattern of deformation have been identified. These are being categorized into before and after June 2009 dyke events. Most of the GPS stations before June 2009 showed larger displacement rate whereas after June 2009 intrusion, the displacement in most of the stations was relatively smaller. Even though the deformation process is still active, sites such as DAFT, DA45, DAYR and DATR indicated that the displacement rate is relatively stabilizing in the post seismic relaxation period. Moreover, sites such as DA25 and DA35, had large offsets in their time series right at the time of dyking events, which is an indication of major deformation due to the rifting process. Except the distant sites DA60 and DASM all the other stations were mostly affected by the dyke intrusion, such that there was an offset in the data during the dike intrusion. Stations DA25, DA35, DA45, DA60, DAFT and DAYR that are located in the west side of the rift, where the 2005 diking event took place, showed displacement as large as -84mm/yr, -53mm/yr, -46mm/yr, -17mm/yr, -23mm/yr, -17mm/yr and -6.36mm/yr towards the west direction respectively. Sites DASM, GABH and DABB have a displacement towards the North East direction. The site GABH, which is situated in Gabh'o volcano, shows rapid inflation from January to June (2006) and continued with a slow uplifting till February 2007. Inflation began in June 2006 in the composite volcano DABB site while subsidence that amount of about 16mm/yr is observed in Semera station called DASM.

Key words: Afar, Deformation, Inter-Dyking, InSAR, GPS, Rifting