The 2007 rifting event in Northern Tanzania studied by C and L-band interferometry.

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Abstract

Surface displacements resulting from continental rifting events are rarely observed by other techniques than GPS. During the summer of 2007 a seismic swarm in northern Tanzania, culminating with a peak value of 5.9 Mw on July 17, was recorded by a nearby GPS station and monitored by two radar instruments on the ALOS and Envisat satellites. The area is located at the eastern branch of the East African Rift (EAR) and is defined by a salt lake (Lake Natron) and two main volcanoes, Ol Doinyo Lengai and Gelai, located to the south and south-southeast of the lake, respectively. Remarkably, some effusive eruptions of the Lengai volcano were observed in September 2007. This suggests a large role of magma in the seismic swarm, which was observed two months earlier.

The joint analysis of InSAR and other geodetic measurements (GPS and seismic measurements), revealed that this swarm is the consequence of a dyking episode from July till August 2007 centered on the southern flank of the Gelai volcano. This study presents an in-depth analysis of the surface displacements observed by InSAR and applies the InSAR multi-acquisition cascading approach based on numerical modeling.

The approach aims to create artificial interferograms with decreased temporal baselines, in order to provide a more detailed analysis of complex sequences of geophysical events, such as observed in the present study. For this particular study, 8 interferograms from 4 different acquisition geometries are selected based on coherence and surface displacements. Furthermore, short temporal and perpendicular baselines are preferred in order to diminish the temporal and geometrical decorrelation, respectively.

The modeling technique is a 3D Mixed Boundary Element Method (3D-MBEM) combined with a near-neighborhood (NA) algorithm. 3D-MBEM allows to model any number and geometry of sources and has the advantage that it takes the topography into account.

This work will present another hypothesis and applies a different modeling method than in previous studies. Results show that the observed displacements are caused by a complex interaction between fault slip and magma intrusions on the southern flank of the Gelai volcano. Recent models indicate a migration of magma injections towards the northeast (below the southeastern flank of the Gelai volcano) as well as to the north and south. Each dyke has its own corresponding west-dipping fault. Most likely this west-dipping trend is due to the fact that the Natron basin is a half graben, which is defined by the east-dipping border faults that are located at the escarpments in the west. The last interferogram mainly shows deformation to the east of the Gelai volcano. Its corresponding model considers a combination of small faults that reach the surface and a deep, buried fault. This supports the hypothesis of the additional NE striking dyke.

The fact that the results of the different studies are not unambiguous, demonstrates that the knowledge of the (complex) geophysics behind rifting episodes, in particular during its early stage, is still poor. Therefore, extensive monitoring of the EAR by means of (radar) remote sensing instruments is highly recommended.