

Analysis of fluid induced earthquake swarms at a proto spreading ridge in the East African Rift

MARTINA RAGGIUNTI¹, DEREK KEIR^{2,3}, CAROLINA PAGLI⁴ AND AUDE LAVAYSSIÈRE⁵

¹University of Pisa

²Univeristy of Florence

³University of Southampton

⁴Department of Earth Sciences, University of Pisa

⁵Institut de Physique du Globe

Presenting Author: martina.raggiunti@phd.unipi.it

An increase of fluid pressure can induce fault slip and lead to the occurrence of earthquakes.

We analysed the EAGLE database, that includes the earthquakes occurred in the proto spreading ocean ridge in the Northern Main Ethiopian Rift from October 2001 to February 2003.

We focus on the Fentale-Dofan magmatic segment, an area involved in the active rifting process with a widespread seismicity and hydrothermal activity. The earthquakes were first relocated with NonLinLoc using a non-linear method and the velocity model from controlled source seismology. Then, the events relocated was divided in four distinct clusters and each cluster was then relocate separately with HypoDD double-difference location algorithm, including implementation of waveform cross-correlation. The earthquake magnitudes, b-values and seismic moment were also computed. Seismic data was interpreted with hydrothermal surface data obtained from automated remote mapping from Landsat 8 images.

The analysis of the temporal-spatial distribution of earthquakes shows that some of the clusters are strongly concentrated in time and in space, and therefore swarm-like. These swarms are characterized by events with similar waveforms. There is direct correlation between the increase of seismic rate in the cluster and the presence of families of similar earthquakes. The seismic moment suggests that the events are originated from activation of rift related structures. This is supported by the N to NE elongation strike of clusters highlighted by the HypoDD location, in accordance with the tectonic setting of the area. The events are mostly localized in the top 15 km of the crust. The b-values calculated for the clusters are smaller than 1, with the exception for the cluster localized near Dofan volcanic complex. The mapped hydrothermal deposits are mainly focused in two areas: on the western side of Dofan volcanic complex, in an area intense faulted by NNE-SSW faults, and around the Fentale volcano with a circular pattern on southern side of volcanic edifice, without a clear correlation with the seismicity.

It is possible to conclude that these earthquakes have a component fluid induced, but the origin of these fluids are deeper than the fluids that feed the hydrothermal systems.