NEOTECTONIC HISTORY AND LANDSLIDES IN THE MAIN ETHIOPIAN RIFT AND AFAR TRIPLE JUNCTION

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This study presents several case studies across large area of the Main Ethiopian Rift (MER) and Afar triple junction - the central part of the Afar Depression in northeastern Ethiopia that represents a junction of three regional rift systems. These regional structures accommodate the active extension between the Nubia, Arabia and Somalia plates since the Late Miocene. Morphotectonic analysis of remotely sensed data was used to understand fault geometries in regional scale. Field structural mapping of brittle structures was carried out in mesoscopic scale. High correlation of newly identified linear indices derived from morphotectonic analysis with field structural data was found. New petrological and geochronological data of various volcanic products (32–0.9 My) are also presented.

The superposition of different sets of brittle structures were identified across the area in all mapped volcanic formations (e.g., regional normal faults to oblique slip faults, shear joints and extensional joints). The origin of these brittle structures have been related with the relatively younger evolution of two dissimilar rift zones. The southern part of the Afar area predominantly exhibit N–S to NE–SW trending faults and shear joints associated with NNE–SSW trending Main Ethiopian Rift System. Identified kinematic indicators reveal a normal movement. In the central part of the Afar area these steep faults sharply change strike to the ~NW–SE direction. Towards the northeast these faults dip steeply to the NE or SW and contain steeply to moderately plunging slickenslides. Indicators of normal or oblique left-lateral movement become dominant. On several localities across the Afar area these faults appear to be relatively younger than previous one forming the main escarpments of the Tendaho and Dobi grabens.

Early Oligocene stages (ca. ~32 My) of rifting are characteristic by dominant normal faulting with paleostress orientation WNW–ESE perpendicular to the main rift normal faults oriented NNE–SSW to NE–SW. During late stages of rifting paleostress rotated anticlockwise to present-day WSW–ENE orientation which caused in addition to N–S to NNE–SSW normal faulting also important sinistral faulting along conjugate faults. Dextral conjugate faulting occur locally in the southern part of MER (e.g., Arba Minch area), which reflects different geometry of the main rift. Faults formed during these late stages show smaller vertical displacement and form less prominent geomorphic features. Slope instabilities are commonly located along the active fault zones; steep slopes, rock/mineral alteration and rheological weakening together with seasonal heavy rainfall and occasional seismic events are the main trigger for landslides, rockfalls and other slope instabilities.