

Abstract - Morphostructural analysis of Ethiopian Highland based on remote sensing

The morphometric analysis of lineaments, valleys and signs of erosion taken from a digital elevation model (DEM) made it possible to not only confirm most of the conclusions of the morphotectonic development of the area from the previously published results of structural, petrological, tectonic and geochronological analyses from the Ethiopian Highlands, but to also to expand our knowledge by applying several new hypotheses. Faults, lineaments and valleys are predominantly oriented in a direction compatible to the published concepts of the tectonic development of the area. Overall, the most abundant NE-SW and NNE-SSW lines reflect a change of extension from a NW-SE to WNW-ESE direction during the Pliocene (~40° rotation), in relation to the creation and development of the Main Ethiopian Rift. The most pronounced morphological manifestations of the extension of the MER and western Afar during the Quaternary are confined to the borders of the MER, and the maximum SOLR values indicate a very short-lived effect of the stress field on the development of the landscape. The directions of the Pre-Neogene rift structures to the NW-SE and WNW-ESE are compatible with the oldest elements of the current landscape, i.e. the most developed high order valleys (and the corresponding lowest SORL values), and with the relict fragments of the radial valley network in the upper Blue Nile Basin, which could have been drained across current shoulders of the MER to the S and E before the Late Miocene. Trellis (in the eastern part of the study area near the Main Ethiopian Rift) and dendritic drainage patterns (in the western part of the study area) dominate the upper part of the Blue Nile Basin. The transition from the trellis to the dendritic drainage patterns reflects the decreasing importance of tectonics on the arrangement of landscape patterns associated with increasing distance from the Main Ethiopian Rift. In addition, the NW-SE belt of the trellis and rectangular drainage patterns in the western part of the study area corresponds to the direction of the Pre-Neogene rift structures. Parallel and drainage patterns occur on watershed ridges and radial drainage patterns occur on the slopes of Cenozoic shield volcanoes. The multifractal analysis of the valley networks in the Ethiopian Highlands by applying the Renyi dimension demonstrated to separate: 1) the trellis drainage patterns in the neotectonic landscape (higher values of monofractal dimensions); and 2) the dendritic drainage patterns in the landscape without the influence of neotectonics (lower values of monofractal dimensions).

Key words: neotectonics, valley networks, lineaments, river piracy, DEM, Main Ethiopian Rift, Ethiopian Highlands

