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Quaternary volcano-tectonic activity of the western rift margin in the Soddo region, southern Main Ethiopian Rift

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The Main Ethiopian Rift (MER) in East Africa is considered the ideal place to analyze the process of continental rifting since along its length it records all the different stages of rifting. Indeed, whereas the southern parts of the rift are believed to record the early stages of extension, with deformation localized at large boundary faults, the northern rift sectors are in incipient break-up stage, with focused tectono-magmatic activity at the rift axis. However, although the distribution and style of Quaternary volcano-tectonic deformation have been described in detail in both the northern and central rift sectors, knowledge of these characteristics is comparatively less constrained southwards. Analysis of fault distribution and comparison with analogue models, together with the characteristics of the seismic activity, suggest localized deformation at the rift margins during the Quaternary, with almost absent axial tectono-magmatic activity. However, geological data are currently still scattered in the area.
In this contribution we present new geological and geochemical data from the western rift margin in the Soddo region, north of Lake Abaya, between latitudes 7°10' and 6°30'. Despite the lack of major fault escarpments, the area is characterized by numerous normal faults, which are typically sigmoidal in shape and en-echelon arranged; associated to these faults is a widespread volcanic activity, with recent volcanic centers (domes, scoria cones, fissures, etc.) aligned along and strongly interacting with normal faults. The volcanic activity is distinctly bimodal, with intermediate terms completely lacking. Erupted products are represented by alkali basalt, trachybasalts and rare tholeiitic basalts in the 45% to 49% SiO_2 variation interval and alkali rhyolites with subordinate trachytes in 65%-74% range. The new field data coupled with new radiometric dating of faulted rocks suggest a Late Quaternary-Holocene age of the volcano-tectonic activity at this rift margin. This, together with a subordinate axial faulting, supports previous models that predict an along-axis, north to south decrease in rift maturity in the MER.
Consistent with previous analogue models, the general fault architecture is coherent with the regional plate kinematics that gives rise to conditions of low-obliquity rifting. However, inversion of fault-slip data reveals local variations in the paleo-stress field that could result from local stress reorientations and/or influence of volcanic activity.