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Growth and propagation of normal faults in the Asal-Ghoubbet rift from ^{36}Cl cosmogenic dating and offset measurements

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We quantify the evolution of normal faults in Asal-Ghoubbet rift, one of the most recent and active of Afar. To estimate initiation ages of five of these faults, we collected basalt samples at several locations along them, and set up a chemical protocol for extraction of Cl from the samples and then implemented a numerical code to calculate ^{36}Cl exposure ages. Our approach was validated by determining exposure ages obtained on plagioclases, whole-rock and on the matrix of several samples, and also by age estimates of a basalt lava flow located on limestones of known age. Offset measurements of various Holocene markers, determined from digital photographs calibrated by distance measurements using laser ranging binoculars, make it possible to record the vertical slip along these faults for the last 6 ka from lacustrine limestones and for the last thousand years from scarcely eroded scarps. The results show that the tectonic activity initiated 60-70 ka in the South-East of the Asal rift and becoming established by $\sim$35 ka, with the faults reaching their maximum length $\sim$20 ka. This suggests that these faults reached their maximum length before accumulating a vertical displacement, contrary to a simple self-similar development. The faults and the Northern bordering fault system of the rift propagated rapidly towards the North-West (40-70 cm/year) with a high vertical slip rate (10 mm/year) which seems to have decreased progressively with their development. Lastly, the growth mode of the faults does not seem to have changed on time scales of a few tens of ka.