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The 2004 dyke-fault interaction at Dallol, northern Afar (Ethiopia)

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The 2005 Dabbahu intrusive event in Afar highlighted the importance of magma in controlling rifting along divergent plate boundaries. Here we show that a further intrusive event occurred in late 2004 at Dallol, along the axis of the Red Sea Rift in northern Afar. Dallol consists of an hydrothermal area lacking significant volcanic activity at the northern end of the Erta Ale volcanic segment. We use InSAR and seismicity data to constrain the geometric and kinematic features of the intrusion, as well as its possible effects. The dyke intruded a 6 km portion of the rift, from Dallol volcano, which subsided, to the south. The intrusion was accompanied by a seismic sequence, including a Mw 5.5 earthquake on 22 October. The larger events were registered by several seismic stations worldwide and located by the International Seismological Center (ISC). InSAR data from Envisat allow us to measure the surface deformation associated with these events. An inversion for a simple elastic model suggests that a $\sim$3m wide and $\sim$46km3 volume dyke was accompanied by fault slip. Seismicity observations suggest that the Mw 5.5 earthquake was triggered by the dyke intrusion. These results at Dallol provide the northernmost evidence of dyke-induced extension in Afar, occurring shortly before the 2005 event at Dabbahu.