



## **The September 2005 Dabbahu (Afar, Ethiopia) rifting episode: an overview of the activity and latest results**

**G. Yirgu** (1), E. Lewi (1), A. Ayele (1), D. Ayalew (1), A. Asrat (1), T. Kidane (1), C. Ebinger (2), T. Wright (3), E. Calais (4), G. Orsi (5), D. Pyle (6)

(1) Addis Ababa University, Ethiopia, (2) University of Rochester, USA, (3) University of Leeds, UK, (4) Purdue University, USA, (5) Osservatorio Vesuviano, Italy, (6) University of Oxford, UK

The Afar depression is located at the junction between the Red Sea, Gulf of Aden and Main Ethiopian rifts. Since  $\sim 1$  Ma, tectonic and magmatic activities in northern Afar have localized to  $\sim 60$  km-long, seismically and volcanically active magmatic segments (or axial ranges). These segments include Erta Ale, Alayta, Tat Ali and Dabbahu (or Boina). The Afar magmatic segments are, in many geological aspects, similar to slowly-spreading Mid-Ocean ridges.

In September 2005, a seismo-volcanic event of unprecedented scale and intensity took place along the Dabbahu (or Boina) magmatic segment of the Afar rift, Ethiopia. Between September 4 and October 4, 2005, 163 earthquakes with mb between 3.9 and 5.6 occurred, clustered on the Dabbahu segment. Earlier field investigations on the northernmost sector of this segment revealed a narrow ( $\sim 0.5$  km) zone of recent ground breaks in the form of newly-formed and reactivated open fissures (up to 3 m wide) and normal faults (vertical displacements up to 2 m) and accompanied by intense degassing (with pungent smell) along the breaks. These initial observations convinced AAU geoscientists that a volcanic eruption here was imminent. On September 26, a small explosive eruption occurred along a 400-m fissure vent located on the southern flank of the small Da'Ure felsic volcano ( $12.652^{\circ}\text{N}$ ,  $40.519^{\circ}\text{E}$ ), some 5 km northeast of the summit of Dabbahu (Boina) stratovolcano. Local residents described a series of violent explosions from the vent that formed an umbrella-shaped dark cloud that darkened the sky for three days. The eruptive products consist of a thin (10 mm) sequence of fallout layers, predominantly composed of fine to coarse ash along with coarse pumice clasts, dense glass and lithics of rhyolitic lava. A white, fine ash blanket

dispersed to a distance of  $\sim 35$  km from the vent. A small, terminal lava dome has been emplaced in the center of the fissure vent.

Subsequent research by an international group of scientists included field investigations and sampling, studies of satellite radar images, geodesy and microseismicity. Preliminary results from these studies show that the 60-km-long Dabbahu magmatic segment ruptured in September 2005, when  $2.5 \sim \text{km}^3$  of magma was injected in the upper 10 km of the crust along a dike  $\sim 8$  m wide (Wright et al., 2006). Much recent seismic and InSAR data further evidenced that a second, smaller diking event took place in the middle section of the Dabbahu segment. Furthermore, significant vertical deformation has been documented at Dabbahu stratovolcano (deflation) and Gabho felsic center (inflation). The volume of pyroclastic material emitted from the Da'Ure eruption has been estimated at  $4 \cdot 10^4 \text{ m}^3$ . These products are all crystal-poor rhyolites and record a history of high eruption temperatures and protracted crystallization in a shallow silicic magma body. Comparison with Iceland rifting events (e.g. Krafla) suggest that the current activity in Afar would probably continue for several years.