



## Eruptive frequency of the Bora-Baricha-Tullu Moye (BBTM) volcanic system in the Central Main Ethiopian Rift

**Amdemichael Zafu Tadesse**<sup>1</sup>, Karen Fontijn<sup>1</sup>, Abate Assen Melaku<sup>2</sup>, Ermias Filfilu Gebru<sup>3</sup>, Victoria Smith<sup>4</sup>, Emma Tomlinson<sup>5</sup>, Dan Barfod<sup>6</sup>, Phillip Gopon<sup>7,8</sup>, Dereje Ayalew<sup>2</sup>, Gezahegn Yirgu<sup>2</sup>, and Snorri Gudbrandson<sup>9</sup>

<sup>1</sup>Université Libre De Bruxelles (ULB), Department of Geosciences, Environment and Society, Belgium  
(Amdemichael.Tadesse@ulb.be)

<sup>2</sup>Addis Ababa University, School of Earth Sciences, Ethiopia

<sup>3</sup>Université de Fribourg, Geosciences, Switzerland

<sup>4</sup>University of Oxford, Research Laboratory for Archeology and the History of Art, UK

<sup>5</sup>Trinity College Dublin, Department of Geology, Ireland

<sup>6</sup>Scottish Universities Environmental Research Centre, NERC Argon Isotope Facility, UK

<sup>7</sup>Montanuniversität Leoben, Department of Applied Geosciences and Geophysics, Austria

<sup>8</sup>University of Oxford, Department of Earth Sciences, UK

<sup>9</sup>Reykjavik Geothermal Ltd, Iceland

The Main Ethiopian Rift (MER) is the northern portion of the East African Rift System and separates the Eastern and Western plateaus of Ethiopia. The recent volcanic and tectonic activity is largely focused within the rift basin along a 20 km wide zone on the rift floor. Large silicic volcanic complexes are aligned along this central rift axis but their eruptive histories are not well constrained.

The Bora-Baricha-Tullu Moye (BBTM) volcanic field is situated in the central Main Ethiopian Rift and has a different appearance than the other MER volcanic systems. The BBTM constitutes several late Quaternary edifices, the major ones are: Tullu Moye, Bora and Baricha. In addition, there are multiple smaller eruptive vents (e.g. Oda and Dima), cones, and domes across the ca. 20 X 20 km wide area. Currently, there is very little information on the frequency and magnitude of past volcanic eruptions. We present a new dataset of field observations, componentry, petrography, geochronology (<sup>40</sup>Ar/<sup>39</sup>Ar), and glass major and trace element chemistry. The data are assessed as potential fingerprints to assign diagnostic features and correlate units across the area, and establish a tephrostratigraphic framework for the BBTM volcanic field.

Two large-volume and presumably caldera-forming eruptions are identified, the younger of which took place at 100 ka. The volcanic products exposed in the BBTM area show that the volcanic field has undergone at least 20 explosive eruptions since then. The post-caldera eruptions have comenditic (Tullu Moye) and pantelleritic (Bora and Baricha) magma compositions. Other smaller edifices such as Oda and Dima also erupted pantelleritic magmas, and only differ slightly in composition than tephra of Bora and Baricha. Tullu Moye had two distinct explosive eruptions that

dispersed tephra up to 14 km away and on to the eastern plateau. Bora and Baricha together had at least 8 explosive eruptions. Their deposits can be distinguished by their light grey color and unique lithic components. Oda had 7 eruptions, the most recent of which generated a pyroclastic density current that travelled up to 10 km away from the vent. Dima experienced at least 3 eruptions, generating tephra with a bluish-grey colour.

This mapping and compositional analysis of the deposits from the BBTM in the MER indicates that the region has been more active in the last 100 ka than previously thought, which has implications for hazards assessments for the region.