Evidence for counter-clockwise block rotation linked to oblique rifting, at the Kereyu Lodge, in the Main Ethiopian rift (MER)

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We report new paleomagnetic results from the Main Ethiopian Rift (MER), the northern sector of the East African rift system. The floor of the MER is covered with thick pyroclastic materials (ignimbrites, tuffs) and basalts. We collected cylindrical core samples from 52 lava flows (ignimbrites and basalts) for paleomagnetic investigations. The samples from twenty-four of the sites were collected along the 100 m long Kereyu Lodge section, Awash National Park, of the Awash river while the remaining 28 sites were collected from lava flows at various locations spatially distributed around the Fentale caldera in Metehara and Awash. Available radio-isotopic ages indicate that the collected samples have ages in the ranges of 1.6Ma to 2.1 Ma. The axis of the MER, with N-S orientation, localized along the center of the rift, is characterized by an active volcano-tectonic segments composed of right stepping offset segments which form large zone of overlap. This study is targeted to unravel any rotation associated with the evolution of the MER; then to compare such quantitative paleomagnetic results with previous fault kinematics studies that suggested qualitative rotation.

Preliminary paleomagnetic analyses are done on seven samples per site where five were demagnetized by an alternating field (Af) while two complementary samples were demagnetized by thermal (TH) techniques and then measured using the Natsuhara SMM-85 Spinner magnetometer.

The natural remanent magnetization intensity for the ignimbrites and basalts are different but both showed a single modal distribution with a respective magnetization intensity of mean=5.0 A/m (s.d.=2.5, N=77) for basalts and mean=0.40 A/m (s.d.=2.8, N=87) for ignimbrites in good agreement with previous results (Kidane et al. 2003; Kidane et al. 2006).

Paleomagnetic direction measurements and analyses reveal one or two components of magnetization with the second component representing an overprinting of the current magnetic field direction at the site. Principal component analyses and site mean calculations of all the 24 lava flows indicated that 11 are either transitional or excursions while 13 lava flows gave stable normal polarity of which only 9 are time independent. An over all mean direction (D_s=347.6^0, I_s=12.0^0, N=9, alpha$_{95}$ =10.5^0) computed for the stable time independent flows results in a significant difference particularly in declination (delta D=-13.4^0+/-12.8^0), delta I=-4.4^0+/-12.8^0) when compared with the expected dipole field direction (D=1.0^0, I=16.4^0, alpha$_{95}$=2.3^0, N=44) obtained from the apparent polar wander path curve of African plate (Besse & Courtillot, 2003). The declination difference computed from this preliminary study could be related to a previously suggested (Boccaletti et al. 1989) vertical axis counter-clockwise rotation linked to oblique rifting in the MER. More precise results will be presented during the meeting.