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MOZART – A seismological investigation of Central Mozambique, SE Africa

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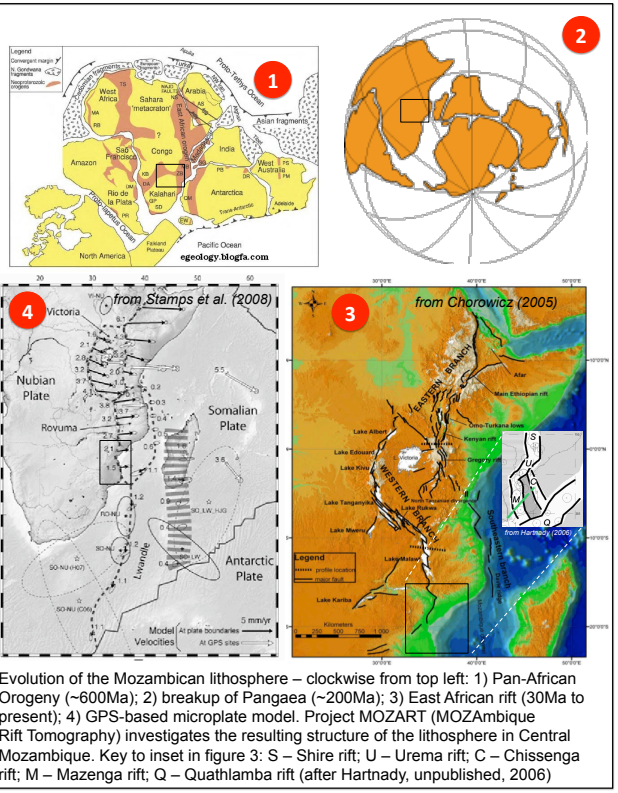
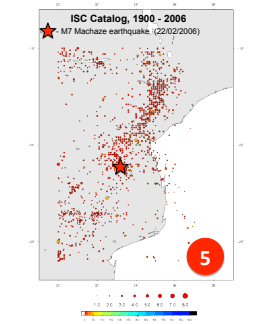
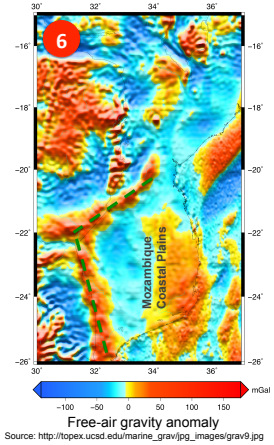
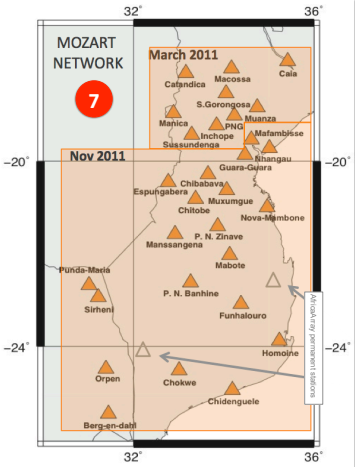


Evolution of the Mozambican lithosphere – clockwise from top left: 1) Pan-African Orogeny (~600Ma); 2) breakup of Pangaea (~200Ma); 3) East African rift (30Ma to present); 4) GPS-based microplate model. Project MOZART (MOZAmbique Rift Tomography) investigates the resulting structure of the lithosphere in Central Mozambique. Key to inset in figure 3: S – Shire rift; U – Urema rift; C – Chissenga rift; M – Mazenga rift; Q – Quathlamba rift (after Hartnady, unpublished, 2006)





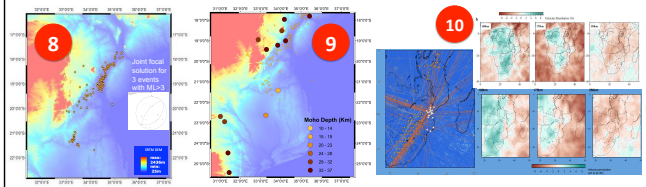


30 VBB (120s) seismographic stations on loan from SEIS-UK (Leicester, UK) where deployed in Central Mozambique and S.Africa to investigate the structure of the lithosphere and the seismicity. The deployment took place in March 2011 (1st phase) and November 2011 (2nd phase), and will last until July 2013.

The sensors are Guralp CMG-3T and the dataloggers are Nanometrics Taurus or Guralp DCM. The data are recorded locally and retrieved during service visits (~9 month intervals)

Preliminary results:

seismicity | receiver functions | surface wave dispersion

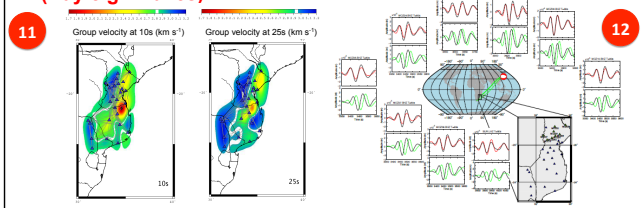


While data acquisition proceeds, processing and analysis of the partial data set is yielding promising results. The local seismicity (M_L 0.6 to 3.3) is delineating a long and linear active structure along the Urema rift with unprecedented clarity (figure 8). Receiver function results are documenting a strong contrast in Moho depth between the cratonic crust of western Mozambique and the coastal plains (figure 9). Surface wave dispersion is being used to densify previous regional models (Fishwick, 2010).

Ongoing work:

While furthering the analysis of seismicity, receiver functions and event-station surface wave dispersion, we are exploiting inter-station dispersion of ambient noise (figure 11), and implementing SPECFEM-3D to be used in tomographic inversion (figure 12).

Ambient noise dispersion (Rayleigh waves) | 3D SPECFEM forward modeling



Ambient noise crosscorrelation between stations is being inverted with the FMST code of Rawlinson and Sanbridge (2005) for Rayleigh wave group velocities.

Surface wave (T~100s) comparisons between real data (black) and synthetic waveforms calculated using S20RTS red) and PREM (green)

The lithosphere of Central Mozambique was involved in key tectonic events such as the Neoproterozoic Pan-African Orogeny (Holmes, 1951; figure 1) and the Jurassic breakup of Gondwana (figure 2). Presently, the region sits at the southernmost tip of the East African Rift (figure 3), and displays incipient rifting activity, including the M7 Machaze earthquake of 2006. GPS-derived models propose the existence of several microplates between the Nubia and Somalian plates in the region (Stamps et al., 2008; figure 6), but the scarcity of seismic stations leads to a diffuse seismicity pattern, hampering identification of active structures (figure 5). The epicenters located so far with the MOZART network (figure 8) depict the current activity of the Urema graben. An improved lithospheric model for the region, a central goal of project MOZART, is expected to further our understanding of its past geological evolution, and present rift inception.

Watts (2001) reported that the thermal beaviour of the eastern region of central Mozambique was characteristic of oceanic lithosphere, and proposed that the free-air gravity high of the Lebombo-Mateke-Save monocline (green dashed line in figure 6) might mark the ocean-continent boundary (OCB). Leinweber and Jokat (2011) pointed out that the onshore region east of the monocline displayed the magnetic signature of oceanic crust. Our preliminary receiver function results (figure 9) reveal the existence of a thin (~20km) crust under the Mozambique Coastal Plains (see figure 6 for location), contrasting strongly with the thick cratonic crust further west. This anomalous zone is depicted by ambient noise tomography as a ~200km-wide belt of low Rayleigh-wave group velocities (figure 11) which, mimicking the gravity anomaly, passes on to higher velocities towards the east suggesting a more complicated model for the continental margin.

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