Structure and Evolution of the African Plate from Geophysical Observations

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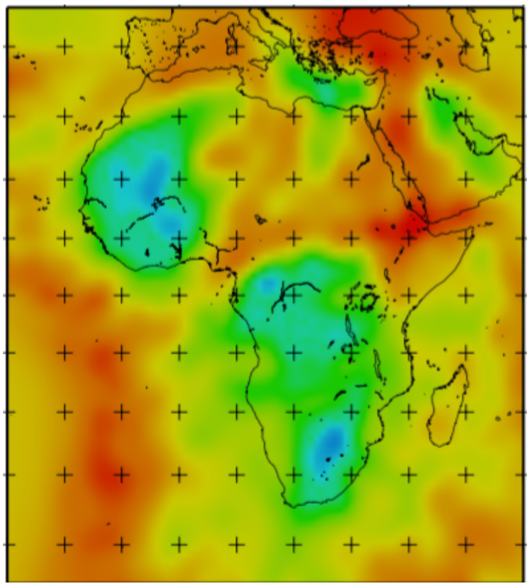
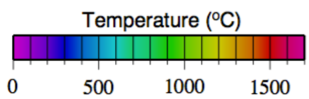
Background:
The African plate is unique in that it is underlain by several deep-rooted mantle upwellings. These are a likely cause of the ongoing rifting and associated seismic and volcanic hazard in the East African Rift. Even away from the rift zone, the tectonic evolution of the plate appears influenced by hot upwellings which can destabilise lithospheric roots and cause volcanism (e.g., along the Cameroon line) and subsidence (e.g., at the West African margin). The upwellings are also likely to be responsible for the current high elevations across East-Africa, controlling surface processes and affecting drainage patterns.

Rationale:
Seismic imaging is the most powerful method to study structure of the lithosphere and underlying mantle. In Africa, the resolution of such images has been limited by the distribution of stations (which can be challenging to install and monitor in many parts of the continent) and earthquake sources (of which there are relatively few within the continent away from the rift zone). However, over the past 10-20 years, many initiatives have deployed regional and local seismic networks, dramatically expanding data. Our team of supervisors has been strongly involved in this push for additional data collection and analysis and has built models for parts of the continent using either body wave travel times (Hammond et al, 2013), receiver functions (Thompson et al, 2015) or surface wave data (Fishwick, 2010).



An estimate of temperatures at 100 km depth below Africa determined from the surface wave velocities from Fischwick (2010).



This project:
This previous work puts us in a unique position to merge these data sets and for the first time jointly invert them to get much higher resolution images of seismic velocity structure of the African lithosphere and underlying mantle. This project will combine the body wave and surface wave data and jointly invert them using methods developed by Rawlinson. Interpretation of the images in terms of temperature, composition and presence of melt will be done using methods developed by Goes and co-workers and the implications of these thermochemical structures on uplift and subsidence will be evaluated using expertise from

Roberts and his group. A second step of the project will be to add the constraints from receiver functions, and refine the interpretations accordingly.

Our Team:
The lead supervisor of the project will be Saskia Goes. The team of co-supervisors have previously worked together in various configurations, and thus the student will be joining an already existing multi-institutional research team. At Imperial, the student would join a group of about 10 academic staff, about 15 PhD students and 3 postdocs that actively work on shallow and deep geophysical imaging, surface processes and plate dynamics

Student Profile: We are seeking a highly motivated individual with a background in geophysics, physics, or geology with a strong quantitative foundation. The successful candidate will be able to work independently, and have a keen interest to do interdisciplinary work on the dynamics of the deep Earth. Previous experience with seismic data analysis and inversion is highly desirable. For more information on this project please contact Saskia Goes (s.goes@imperial.ac.uk)

Application: This project is advertised through the NERC Science and Solutions of for a Changing Planet DTP, and also available for students who apply for other Imperial or international scholarship schemes. For more information on the project please contact Saskia Goes at s.goes@imperial.ac.uk or Gareth Roberts at gareth.roberts@imperial.ac.uk.

References and further reading

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