Linking volcanism and long-wavelength domal swells in Cenozoic Africa

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The topography of present day Africa is influenced by two different wavelengths of dynamic support. The South African Superplume sits beneath Sub-equatorial Africa and is thought to be supported by a lower mantle thermo-chemical anomaly. On a smaller scale a series of domal swells, 1000km in diameter, occur across the continent. They are characterised by elevated dynamic topography, a positive long-wavelength gravity anomaly and a negative velocity perturbation in a higher mode surface wave tomography model. In addition, where the lithosphere is thinner than 100km, the swells are capped with volcanic products, erupted periodically since ~30 Ma. These include the Cameroon Volcanic line, Hoggar, Tibesti, Darfur, the Ethiopian Plateau and the Kenyan dome. The given relationships suggest the domal swells result from and are supported by upper mantle convection.

The extent of the velocity perturbation is variable. The greatest velocity perturbation being associated with Afar/Ethiopia and smallest perturbations found at the North African swells of Hoggar, Tibesti and Darfur. A database of geochemical data has been assembled for Cenozoic African volcanism of over 3000 samples both by literature search and by new analyses of samples from UK collections. Incompatible trace element ratios from primitive basalts (>7wt% MgO) are used to compare mantle velocity structures with the geochemistry of the products of mantle melting beneath the domal swells. Preliminary work has found the low seismic velocity Afar/Ethiopia region to have shallow melting at high melt fractions (La/Yb ~9) whereas North African swells with higher seismic velocities at 100 km depth, show deeper melting with smaller melt fractions (La/Yb ~30). With further modelling of major, trace and REE data we hope to provide insights into the variation in mantle potential temperature causing the differences in velocity structure and melting processes beneath the topographic swells across the African continent.

Chemistry and mineralogy of aeolian and fluvial supply in shallow-water sediments off Senegal (NW Africa)

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High resolution land related climatic records of the Late Holocene in NW African continental margin are very scarce. The dust material carried by the Trade winds from Sahelian and Saharan regions, and the Senegal River discharges load the continental margin with terrigenous material controled by climate conditions in the hinterland. Core 9504-3 was retrieved from 43 m water depth in front of the Senegal River mouth. We develop a new approach combining grain-size, elemental distribution and mineralogy employed in parallel with end-member modelling to trace dust and riverine sources through the past and understand how terrigenous components record climate variability.

On the basis of the grain-size distribution of the terrigenous fraction, a splitting was performed providing three subfractions: <2 μm, 2-18 μm and 18-63 μm. Major and trace element contents were measured by XRF powder and ICP-AES, and mineral identification and semi-quantification was performed by X-ray diffraction on each subfraction.

More than 80 % of the total Al and Fe terrigenous bulk sediment content is concentrated in the riverine fraction. Furthermore, despite strong variations, Ti is more abundant in the riverine fraction. Over NW of Africa, due to the scarcity of river draining the continent, Fe and Ti are usually used as dust proxies. Our study displays an alternative interpretation for the terrigenous material deposited off Senegal. K and Si can not be considered as specific proxies.

These results allow us to interpret the XRF core scanner Fe and Al curves as records of the river continental runoff. The correlation between low continental river runoff and period of enhanced dune reactivation in Mali associated with integrated palynological data from the neighbouring Core GeoB 9503-5 confirm these interpretations. The record displays one dry period from 1.9 to 1 cal kyr BP and two main humid periods from 2.7 to 1.9 cal kyr BP and from 1 to 0.7 cal kyr BP. The next step will be to compare this high resolution climatic record to other records in order to establish larger scale teleconnections and understand their mechanisms.