Cenozoic intra-plate volcanism in Northeast Africa: Evidence for African plate motion

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Northeast Africa witnessed considerable Cenozoic volcanic activity. Flood basalts, shield volcanoes and trachyte domes are exposed in Libya the tholeiitic to alkaline basaltic rocks of Egypt and Sudan the Afar depression transitional volcanics and the surrounding Ethiopian plateau basalt. These volcanic provinces have been formed over the last 50 Ma. Chronological data reveal an increase in age from SSE toward a NNW.AS an example in Libya the Gharian province in the far NNW has an age of 42±10 Ma. Gabal El Hasawina24±1Ma and the Gabal As Sawda range from 12.3 to 10.9 Ma, whereas at Gabal El Haruj 6.0 to 0.04 Ma and the Tibisti volcanic series in the far SSE extend from Pliocene to Quaternary.

Cenozoic intra-plate volcanism in the Northeast Africa is either mantle plume (e.g. Libyan basaltic rocks) or rift-related (e.g. volcanics of the Red Sea region). It is believed that the linear trend of the Tertiary volcanic provinces of Libya (SSE-NNW) follow one track over a hot spot. This trend reveals the direction in which African plate is moving. The calculated rate of the absolute movement is an approximately 2 to 10 cmy^{-1} in the NNW direction.

Phototrophic Fe(II) oxidizing bacteria – Strategies to avoid encrustation by Fe(III) minerals

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Bacteria can oxidize Fe(II) to Fe(III) under anoxic conditions either phototrophically or chemotrophically with nitrate as electron acceptor. The Fe(III) is poorly soluble at neutral pH and usually precipitates as Fe(III) (hydr)oxide. Bacteria catalyzing the oxidation of Fe(II) to Fe(III) at neutral pH therefore face the challenge dealing with an almost insoluble product. SEM and TEM show for phototrophic Fe(II) oxidizing cells at circumneutral pH show no precipitation of Fe(III) minerals on the cell surface. Thus, neutrophilic Fe(II)-oxidizing cells accept electrons from Fe(II) without acting as a nucleation site for the Fe(III). It is vital for a cell to avoid mineral precipitates at the cell surface as these would limit the uptake of substrates and therefore metabolic activity of the cell.

Several strategies are plausible for the cell to avoid precipitation of minerals: i) modification of the cell surface; ii) acidification of the cell vicinity; iii) production of Fe(III)-chelating ligands.

In order to test the hypothesis of acidification of the cell microenvironment we determined the pH around cells with confocal laser scanning microscopy in combination with a pH-sensitive fluorescent dye. We showed that an acitve cell metabolism was necessary. Biogeochemical modelling confirmed that a low pH-microenvironment is beneficial to the cell as it slows Fe(III) precipitation and reduces the extent of Fe(III) mineral precipitation on the cell surface.

We thus demonstrated the benefits of an actively modified pH-microenvironment around a cell dealing with poorly soluble Fe(III) minerals.