Is the Mid-Atlantic Ridge becoming hotter with time?

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More than 20 million years of oceanic lithosphere accretion history at a segment of the Mid-Atlantic Ridge are recorded in the Vema Lithospheric Section (VLS), a 300 km long flexured and uplifted sliver of lithosphere exposed near the Vema Fracture Zone in the Central Atlantic. Systematic sampling of the basal mantle ultramafic unit and of crustal basalts along the VLS together with geophysical surveys gave us the opportunity to study temporal changes in the processes of generation of the oceanic lithosphere at a ridge axis. The degree of melting of the mantle upwelling below the ridge axis, estimated from the chemistry of mantle-equilibrated mineral phases in the peridotites, as well as crustal thickness, inferred from shipboard and satellite gravity data, both show ~3-4 my long oscillations superimposed on long-range steady increases with time. Based on basaltic glasses elemental and isotopic chemistry, we assume the composition of the source stayed nearly constant. The steady increase with time of mantle degree of melting and of crustal thickness suggests that the mantle rising beneath the MAR became gradually hotter during the last 20 million years, even though the spreading half rate slowed significantly during this time. We offer two explanations for the increase in mantle temperature with time at the Mid-Atlantic Ridge. A first possibility, of local significance, calls for gradual lengthening of the eastern MAR segment where the VLS was created, leading to an increasing degree of melting below center of the segment as it lengthens, due to the a decreasing influence of the "cold edge effect" from the Vema transform. The second, of broader significance, calls for a gradual increase of mantle potential temperature along a significant portion of the northern MAR during the last 20 million years, resulting in an increase of melt production despite decreasing spreading rates. This second hypothesis is supported by an increase of crustal thickness towards ridge axis observed at several other locations in the northern MAR. The

chemistry of basaltic glasses, collected along the VLS above the peridotites, suggests that no deep plume source is involved in the steady heating of the Ridge.