Pyroxenites sow discord between parent mantle and daughter MORB

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Mantle rocks and MORBs sampled along the 26 Ma record of the Vema Lithospheric Section or VLS (Mid Atlantic 11°N) reveal a profound divergence between parent and daughter rocks in their compositional evolution. Finding the cause of this discordance requires comparing the evolution through time of the extent of melting with the produced crustal thickness and changes in the chemistry and isotopic composition of the sampled rocks. Mantle rocks show a progressive increase of their degree of melting during time, as if the potential temperature had increased in the last 26 Ma. However, plate kinematics reveal a significant decrease of the spreading rate that should sensibly lower the average degree of melting. MORB inferred degree of melting decreases through time while their isotopic fingerprint becomes more depleted. The observed variations can be reconciled by considering that a variable amount of low-melting lithologies entered the melting region. The observed decoupling of the degree of melting of mantle and MORB is attributed to the effect of undercooling exerted by low-melting heterogeneities due to heat diffusion before the host mantle starts melting itself. The observed temporal evolution is matched by a decreasing amount of low-melting, isotopically enriched, lithologies (pyroxenites) dispersed in a DMM-type host mantle. Approaching the present day setting, the amount of pyroxenites has become negligible restoring harmony between parent mantle and MORB daughters in terms of degree of melting and integrated melt production.

This observation can be extended to the entire MOR system revealing the sensitivity of the spreading system to the amount of low-melting lithologies dispersed in the depleted mantle host. At limit conditions of the mantle potential temperature, heat diffusion into the low-solidus melting lithology prevents the host mantle from reaching its solidus.