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Crustal thickness variations at plume – ridge interaction spreading centres: dynamic models of crust accretion with hydrothermal cooling

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New determinations of lateral crustal thickness variations at anomalous oceanic spreading centres such as Iceland have shown that the crust may be thinner at the ridge axis above the plume thickening towards the sides (Bjarnason and Schmeling, 2009, see Schmeling, 2010). Crustal accretion models have been carried out solving the conservation equations of mass, momentum and energy with melting, melt extraction, and feedback of extracted material as newly formed crust for spreading ridge system underlain by a hot mantle plume. Hydrothermal convection is included using appropriate scaling laws. Accretion is modelled 1) by vertical influx of extracted material from above, mimicking intrusional heating by a locally elevated surface temperature (Schmeling, 2010), and 2) by volumetric influx of hot extracted material into an intrusion zone. Both approaches lead to four accretional modes with characteristic lateral crustal thickness variations. Mode 2 or 3 (moderately sideways thickening or constant thickness) may be identified with the situation in Iceland. No accretional mode with maximum crustal thickness above the plume at the rift axis has been found. The absence of mode 1 accretion (very thin crust at axis) on earth may be an indication that in general crustal accretion is not cold (and shallow). The effect of hydrothermal cooling will be discussed.

Schmeling, H., 2010: Crustal accretion at high temperature spreading centres: Rheological control of crustal thickness. Phys. Earth Planet. Int., 183, 447 – 455.