Ridge jumps associated with plume-ridge interaction: 1. Off-axis heating due to lithospheric magma penetration

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Surface manifestations of hotspot-ridge interaction include geochemical anomalies, elevated ridge topography, negative gravity anomalies, off-axis volcanic lineaments, and ridge reorganization events. The last of these is expressed as either captured ridge segments due to associated asymmetric spreading, such as at the Galapagos, or as discrete jumps of the ridge axis toward the hotspot, such as at the Iceland, Tristan de Cuhna, Discovery, Shona, Louisville, Kerguelen, and Reunion hotspots. Mid-ocean ridge axis reorganizations cause variations in local volcanic patterns, lead to changes in overall plate shape and ridge axis morphology, and alter local mantle flow patterns. It has been proposed that discrete ridge jumps are a product of interaction between the lithosphere and a mantle plume. An expanding mantle plume causes buoyant uplift and asthenospheric shear on the base of the lithosphere as well as enhanced volcanism above the plume center. To begin exploring th! e above effects, we limit the current study to the effect of thermal heating of the lithosphere due to plume-induced magma penetration. Using a two-dimensional finite element code (FLAC), the lithosphere is treated in cross section with a visco-elastic-plastic rheology. We examine the amount of heat input required to produce a ridge jump, the effect of various distributions of this heat, and the effect of crustal thickness variations.