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Formation of Thermochemical Piles by Convection-Assisted Diffusion

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The complex nature of the core-mantle boundary (CMB) is well reflected in numerical mantle convection models. Observed thermal and chemical features are cold subducting slabs, hot rising plumes and dense piles. Particularly plumes are of importance as they are responsible for a number of structures. We find plume clusters when smaller plumes merge and line-plumes that leave a more elongated structure at the CMB. Additionally, plumes are known to push dense material up to form the piles which are related to the large low shear velocity provinces (LLSVPs). Typically dense material is inserted to the models by prescribing the thickness and density of an enriched layer at the lower boundary. Here we present another mechanism in which plumes play an essential role in order to form piles but without prescribing a dense layer. In our thermochemical model of mantle convection piles form by convection-assisted diffusion. The chemical transport across the CMB is strongly connected to plumes rising from the CMB. We discuss and compare the results of these self-organised structures to those obtained from our models in which an initial dense CMB layer is prescribed.