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Plume head -lithosphere interactions near intra-continental plate boundaries.

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In continents, Plume-Lithosphere Interactions (PLI) are often identified near boundaries between younger plates (e.g., orogenic) and old stable plates (e.g., cratons), which represent important geometrical, thermal and rheological barriers that interact with the emplacement of the plume head (e.g., Archean West Africa, East Africa, Pannonian - Carpathian system). The observable PLI signatures are conditioned by plume dynamics but also by lithosphere rheology and structure. We address the latter problem by considering a free-surface numerical model of PLI with two stratified elasto-viscous-plastic (EVP) continental plates, one of which is older and thicker than another. The results show that: (1) plume head flattening is asymmetric, it is blocked from one side by the cold vertical boundary of the older plate, which leads to the mechanical decoupling of the crust from the mantle lithosphere, and to localized faulting at the cratonic margin; (2) the return flow from the plume head results in sub-vertical down-thrusting (delamination) of the lithosphere at the margin, producing sharp vertical cold boundary down to the 400 km depth; (3) plume head flattening and migration towards the younger plate results in concurrent surface extension above the centre of the plume and in compression (pushing), down-thrusting and magmatic events at the cratonic margin (down-thrusting is also produced at the opposite border of the younger plate); these processes may result in continental growth at the “craton side”; (4) topographic signatures of PLI show basin-scale uplifts and subsidences preferentially located at cratonic margins. Negative Rayleigh-Taylor instabilities in the lithosphere above the plume head provide a mechanism for crustal delamination. Inferred consequences of PLI near intra-continental plate boundaries, such as faulting at cratonic edges and enhanced magmatic activity, could explain plume-related met-

allogenic crises, as suggested for West Africa and Australia. This study suggests that the plume impact may have complex consequences for surface evolution. In particular, absence of magmatic events should not be interpreted as evidence for the absence of plume events. If some melts/magmatic events are observed at the surface, they will not necessary have unambiguous deep geochemical signatures, as the hot source plume material stalls below Moho and forms a long-lasting (10 to 100 Myr) sub-Moho reservoir. This should induce strong crustal melting that may overprint deeper signatures since crustal melts are generated at much lower temperatures than mantle, and produce light low-viscous rapidly ascending magmas. In addition, drip-like down-sagging of the lithospheric mantle and metamorphic lower crustal material inside the plume head may contaminate the latter and thus alter the geochemical signature of plume-related magmas.