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Importance of india and asia subductions for the growth of the Tibetan plateau

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How and when the largest plateau on Earth, the Tibetan plateau, growth during Cenozoic time is a long-standing question. Addressing this question does not only concern the relationship between India-Asia collision but more generally the behavior of the continental lithosphere in convergent zone Some models emphasize the role of the Indian plate in the Tibetan thickening processes. They focus on the relative importance of underthrusting of the Indian plate beneath Tibet. They implicitly or explicitly admit that the strength of the Tibetan lithosphere is mostly located in the upper crust. Others invoke that crust and the lithosphere are weak. In that case, thickening of the Asian lithosphere is distributed or localized into the lower crust. Last models suggest a relatively strong whole lithosphere allowing the stress to be transmitted north of the Plateau. They focus on asian subductions or lateral extrusion. In this paper we will show that early continental subduction of the indian lithosphere in the south and asian lithosphere in the north, largely contribute to the earlier building of the Tibetan plateau 40 Ma ago. We will use tomography imaging to infer the indian and asian slabs position, tectonic reconstruction to infer the crustal mass budget, age of magmatism, and petrologic/rheologic evolution of the lower crust during flat subduction. The combination of three main factors concurred to the early and rapid growth of a wide Tibetan plateau : 1) the occurrence of cold and strong continental cratonic lithospheres north and south of Paleozoic to Mesoic accreted terranes. These cratonic terranes partly subducted but also play the role of indenters. 2) a “normal” initial Tibetan crust constitutes by the amalgamation of continental terranes and arc related crustal products. This initial crust was enough rigid to transmitted instantaneously the horizontal forces from the Indian plate to the Asian plate and 3) an initial Tibetan lithosphere soft enough to facilitate the subduction of cratonic lithosphere. In this global system, the thickening of Tibetan crust was probably accommodated by almost three or four complementary mechanisms: nappe stacking in the upper crustal levels, underthrusting of indian and asian crustal materials at the moho level, mantellic magma underplating at the base of the Tibetan moho. Magma formation was discontinuous in space and time and mostly controlled by slab breakoff processes ($\sim$45 Ma and 25-15 Ma for India, 45-33 Ma for Asia). During these peculiar periods, the Tibetan crust was partly molten at the scale of the magmatic province enhancing local crustal flow but also local homogeneous thickening. A secondary effect of partial melting of the Tibetan crust is its progressive granulitisation and consequently its stiffening.