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Importance of inherited CO_2-rich soft lithospheric mantle for the growth of the Tibet Plateau: petrological and numerical approaches

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The timing and mechanism of formation of the Tibet Plateau remain elusive. Resolving whether most growth really occurred during the Cenozoic, either by continuous and homogenous thickening of the whole lithosphere followed by mantle delamination, or by localized continental subductions reactivating ancient suture zones, requires a better assessment of the composition and rheological properties of the deepest parts of the Tibetan lithosphere. Here we report mantle phlogopite xenocrysts and carbonate-bearing cumulate microxenoliths preserved in Eocene potassic rocks from Eastern Qiangtang that provide evidence that the lithospheric mantle in Central Tibet was enriched in H_2O and CO_2 prior to the India-Asia collision. Rheological calculations and numerical modeling suggest that: (1) such metasomatized mantle would have been significantly softer than a normal mantle, but buoyant enough to prevent its sinking into the deep mantle; (2) the slow seismic anomaly beneath Central Tibet may image this metasomatized lithosphere of normal thickness, rather than an asthenospheric upwelling after lithospheric delamination; and (3) intra-continental subduction can have triggered Eocene ultra-potassic magmatism in Central Tibet. these results confirm that a soft and buoyant inherited Tibetan lithosphere may have permitted the growth of the Tibet Plateau by underthrusting of stronger Asian continental slab.