A more plausible mechanism for the Meso-Cenozoic continental extension in East Asia

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The Meso-Cenozoic continental extension in East Asia concerns a huge area, extending east-westwardly from Japan to Gobi desert and north-southwardly from Mongolia to South China. This period is marked by an exceptional lithospheric thinning of about 100 km, exhumation of MCCs, a very important magmatic activity with emplacement of numerous plutons and extrusion of volcanic rocks, and the development of syn-extension sedimentary basins. Though numerous studies have been carried out, especially in petrology, geochemistry and seismology, mechanisms and motor of this geological event is currently still enigmatic. In particular the occurrence of MCCs is itself not yet explained as they surprisingly developed within a previously non-thickened continental crust here. To advance our understanding on mechanisms driving this lithospheric deformation and on the geodynamical context of the extension, a multidisciplinary study has been performed in North China, with a multi-scaled approach (massif, crust and lithosphere). This work provides new constraints from the analysis of finite strain (ductile and brittle), geochronology (U/Pb on zircon and of $^{40}Ar/^{39}Ar$ on synkinematic minerals) and geophysics (i.e. anisotropy of magnetic susceptibility, palaeomagnetism and gravity methods). Various key areas including MCCs and plutons, widespread in both space and time, have been chosen on both sides of the Meso-Cenozoic Songliao basin (e.g. Linglong and Gudaoling MCCs, and Yinmawanshan pluton on the southeastern side of the basin; Yiwulüshan and Yunmengshan MCCs, and Badaling pluton on the northwestern side). Integrating our new constraints with previous results, this work shows that: (1) crustal extension appears to be heterogeneously distributed in time and space with large MCCs, which highlight particularly high strain within the crust, however, emplaced between crustal-scale "boudin like" domains, displaying rather weak strain since J_3-K_1. (2) Lithospheric thinning recognized for the Mesozoic is mainly related to a particularly high mantle heat flux, the extension having a limited role in this thinning (<20%). (3) MCCs developed without any strong previous thickening of the crust (<40km) but should be resulted from an exceptionally high geotherm during that period. (4) Comparative analysis of stretching directions within the crust (i.e. MCCs and synkinematic plutons) and upper mantle (seismic anisotropies) highlights the role of successive subducted slabs along East Asia margin during Meso-Cenozoic times. Even if geodynamic causes (e.g. post-orogenic collapse, mantle plume, thermo-mechanical erosion, etc.) for this extension is still highly debated, this work, integrating available data at lithospheric-scale, involves that the more plausible motor of this continental extension may be related to slab retreat processes during the successive westward subductions of the palaeo-Pacific and Pacific plates along the East Asia margin during Mesozoic and Cenozoic times, coupled with a thermal erosion process. This should be tested in future through a better kinematical reconstruction of the palaeogeography of the East Asia margin for Meso-Cenozoic times as well as through thermo-mechanical numerical modelling of the subduction processes along this active margin.