Water diffusion by asthenospheric domain entrained in the lithospheric mantle of Lianshan (Subei Basin, Eastern China)

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The effects of mantle melting and the subsequent re-equilibration processes in the region of the Subei Basin (Eastern China) are here explored through the study of major and trace (including H) element distributions among minerals entrained in xenoliths from Lianshan Cainozoic basalts. They are anhydrous, medium/coarse-grained sp-bearing lherzolite (cpx-rich lh; lh and cpx-poor lh) and harzburgites. The cpx-rich lh do not record textural and chemical metasomatic efffects and are close in composition to Primitive Mantle (PM). In turn, cpx-poor lh (and lh) and harzburgites, record the circulation of a silicate melt (with crustal components) in a variably depleted mantle sector well before the entrapment of the xenoliths by the host basalt. The temperatures, determined with both ol-sp and cpx-opx geothermometer, are fairly constant from harzburgites to cpx-rich lh and never exceed 1021°C . Measured mineral water contents indicate that the whole rock contains, on average, 19+7 ppm of H_2O without any systematic variation among rock types nor correlation with Al_2O_3, light-REE and Yb (or Y) contents of cpx. On the basis of water contents of primary melts we calculate the water contents of the fertile mantle between 328 and 1440 ppm. Considering these estimates Lianshan cpx-rich lh (<3% of PM partial melting) have significantly lower water contents with respect to the theoretical values. Based on these petrographic and geochemical features, we suggest that cpx-rich lh constitute fragment of upwelling fertile asthenosphere, which caused the removal/erosion of the lowermost part of lithospheric mantle. This asthenosphere portion may have been incorporated in the lithospheric region (represented by cpx-poor lh and harzburgites) since Jurassic and it may have progressively cooled down after one (or more) partial melting episodes. The water depletion can be accounted for a continuous loss by diffusion during the subsolidus chemico-physical readjustment, well after (>5My, based on modelled H_2O solid-solid diffusion rate) the occurrence of the last melting episode.