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Asthenospheric/Lithospheric interaction beneath Lianshan (Subei Basin, Eastern China)

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This contribution presents the geochemical characterization of peridotite xenoliths entrained in Cenozoic alkali basalts from Lianshan (Subei Basin, Eastern China). The majority of the samples are lherzolites (lh) subdivided in three groups depending on the modal contents of clinopyroxene (cpx): cpx-poor lh (6<cpx$\leq$8 %), lh (8<cpx<14 %) and cpx-rich lh (cpx$\geq$14 %). Solely two samples are harzburgites (hz, cpx<4%). The most common texture is coarse-grained protogranular, without any preferential mineral orientation.On the basis of cpx major and trace element contents ($Al2O_3$ c.a 7.00 wt% ; (Sm/Yb)n=0.79-1.02 Ybn and Lan=5.7-7.1), cpx-rich lh represent extremely fertile (close to PM) mantle fragments. An estimated partial melting degree (F) of less than 3%, would leave a residuum containing a cpx modal percentage comparable to that actually observed in this group. On the other hand cpx in lh, cpx-poor lh and hz show an $Al2O_3$ and REE (plus Th–U and Sr) enrichment in disagreement with respect to the observed cpx contents.

Considering the different Fe-Mg diffusion rates among peridotite minerals, T are calculated (P arbitrarily assumed as 20 Kbar) using different models based on Fe and Mg exchange between opx-cpx and ol-sp pairs. An increase in T from cpx-poor lh (and hz) to cpx-rich lh is observed (T=835+35°C and T=967+47°C respectively). This thermal regime reflects a redox conditions always below the FMQ buffer (DFMQ=-0.2 to -2.2), with the highest values recorded in the hz and cpx-poor lh groups (DFMQ=-0.9$\pm$0.5), and the lowest values recorded in the cpx-rich lh group (DFMQ=-1.4$\pm$0.5).

The water content measured in opx and cpx range from 13 to 45 ppm, and 37 to 102 ppm, respectively; it is negligible in ol. The calculation of whole-rock water contents assigns, as expected, the wettest lithology to the cpx-rich lherzolites (on average 20 ppm, also considering the highest Kd H_2O ol/cpx). No correlations were however observed between water content and degree of partial melting or metasomatic enrichment.

Using the average H_2O MORB composition and applying a simple mass balance regression model a PM mantle having 300 ppm of H_2O can be estimated. This value is in agreement with available published estimates (200-500 ppm) but far from the Lianshan cpx-rich lherzolites values.

It is speculated that the high-T, low fO_2, cpx-rich lh represents portion of fertile mantle (asthenospheric?) impinging the pre-existing lithosphere slowly re-equilibrating with time. The large dependence of the H diffusivity with respect to T may account for the anomalously low water content recorded by Lianshan mantle domains (which does not affect the major and trace element budget), which may be related to subsequent thermal event.