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Mantle xenoliths from Central Vietnam: evidence for at least Meso-Proterozoic formation of the lithospheric mantle

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Intraplate Cenozoic basalts that are widely dispersed along the continental margin of East Asia belong to the Western Pacific “diffuse” igneous province. They consist mainly of alkali basalts, basanites,rarely nephelinites, which are mantle xenolith-bearing, potassic rocks and quartz tholeiites. The volcanism in this area has been attributed to the continental extension caused by the collision of India with Asia and by the subduction of the Pacific Ocean below Asia.
We studied a suite of 24 mantle xenoliths from La Bang Lake, Dak Doa district and Bien Ho, Pleiku city in the Gia Province, Central Vietnam. They are predominantly spinel lherzolites (19) but spinel harburgites (3) and two garnet pyroxenites are present as well. The sizes of the xenoliths range from 5 to 40 cm in diameter with medium to coarse-grained protogranular textures.
Whole rock major and trace element analyses display a wide range of compositions. The MgO concentration varies from 36.0 to 45.8 wt% whereas $Al2O_3$ and CaO range from 0.63 to 4.36 wt% and from 0.52 to 4.21 wt% (with one sample having CaO of 6.63 wt%) respectively. Both CaO and $Al2O_3$ positively correlate with MgO most likely indicating that the sampled rocks were derived from a common mantle source experienced variable degrees of partial melting.
Mineral analyses show that the rock forming minerals are chemically homogeneous. The Fo contents of olivine vary between 89.2 and 91.2 and the Mg# of orthopyroxene and clinopyroxene range from 89 to 92 and 89 to 94 respectively. The range of Cr# for spinel is 0.06-0.26.
Model calculations in both whole rock and clinopyroxenes show that lithospheric mantle underneath Central Vietnam experienced melt extractions that vary between 2-7, 12-15 and 20-30%.
The majority of the primitive mantle-normalized whole rock and clinopyroxene REE patterns are parallel to each other indicating that clinopyroxene is the main repository of the trace elements. Clinopyroxenes are divided into two groups: group A with concave upwards REE and (La/Yb)N < 1 suggesting various degrees of melt extraction and group B with (La/Yb)N ranging between 1 and 10. The group B in a mantle normalized trace element diagram shows negative Pb and Sr anomalies compared to their neighbour elements, which together with the general absence of hydrous phases, suggest variable interaction with percolating silicate melt(s).
The primitive-mantle normalized highly siderophile element (HSE) concentration pattern show almost no fractionation among Ir, Ru and Pt with only slight depletion in Os suggesting very limited effect of metasomatism on the HSE contents. On the other hand, most of the samples display clear Re addition from the percolating melts preventing calculation of reliable rhenium depletion ages (TRD). However, one sample with depleted Pd and Re signature yield TRD of 1.0 Ga which can be interpreted as a minimum SCLM stabilization age in this area.
Mantle xenoliths from Central Vietnam range from fertile to depleted compositions partly affected by metasomatic silicate melts. Re-Os isotopic composition reveals a Meso-Proterozoic minimum stabilization age of the lithospheric mantle.