Quantifying crustal components in the mantle sources of Cenozoic continental basalts from eastern China

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Continental basalts of Cenozoic age generally show OIB-like geochemical compositions and thus their origin has great beraing on mantle geochemistry. In this regard, it is important to decipher the nature of their mantle sources. We have carried a geochemical study of Cenozoic continental basalts from eastern China. Qualitativ discussions have determined three types of crustal components in the mantle sources: (1) igneous oceanic crust (IOC) which contains fresh and alterated MORB and gabbro, (2) seafloor sediment (SS), and (3) lower continental crust (LCC). Further studies have desmonstrated that these crustal components were incorporated into the mantle sources in the forms of hydrous felsic melts rather than rocks themselves.

In order to verify the above arguments, we have carried a series model calculations for this series of petrogenetic processes from the recycling of crustal components through melt-peridotite at the slab-mantle interface to the partial melting of mantle metasomatite. We consider that the IOC and SS components were dehydrated at foreatc to subarc depth, then the dehydrated IOC and SS as well as LCC underwent low-degree partial melting at postarc depths. This yields hydrous felsic melts from these crustal components, which would react with the depleted MORB mantle (DMM) to generate the ultramafic metasomatite that serve as the mantle source of continental basalts. Finally partial melting of this metasomatite will produce basaltic melts.

We set up four groups of P-T condititions in the model calculations. The calculation results indicate that addition of less than 1% dehydrated IOC-derived melt ± dehydrated SS-derived melt and/or LCC-derived melt, even if very small amounts for the latter two melts,, can produce trace element distribution patterns similar to those for the Cenozoic continental basalts in eastern China. The model calculation also suggests that only very small amount (<1%) melts can significantly change the trace element and radiogenic isotope compositions of mantle sources. In other words, the trace element and radiogenic isotope compositions of basalts are primarily controlled by the crustal components rather than the depleted MORB mantle.