Crust recycling-induced melt-peridotite interactions in the northern margin of the North China Craton

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Recycling and subsequent melting of crustal rocks (via delamination or subduction) in the upper mantle is thought to be partially responsible for generating mantle heterogeneity and drive evolution of the continental crust to a bulk andesitic composition. It could have induced widely silicate melt-peridotite interaction, and a network of pyroxenite veins in the lithospheric mantle of different ages is then expected. Such pyroxenites have been sampled as garnet/spinel pyroxenite veins hosted in the spinel lherzolite xenoliths carried by the basalts in the northern margin of the North China Craton (NCC). Zircon U-Pb age, single melt inclusions and profile analyses of minerals of peridotite and pyroxenite xenoliths carried by the Neogene basalts are combined to investigate the mantle peridotite-melt interactions in the northern margin of the North China Craton.

Continental crust-derived Precambrian zircon xenocrysts and igneous zircons of 315 ± 3 Ma (2σ), 80 - 170 Ma and 48 - 64 Ma were separated from the pyroxenite veins, which provide evidence for the lower continental crust and oceanic crust recycling-induced multi-episodic melt-peridotite interactions in the central zone of the NCC. The combination of the positive εHf (t) values (2.91-24.6) of the 315 Ma zircons with the rare occurrence of subduction-related diorite-granite plutons of 302 - 324 Ma in the northern margin of the NCC implies that the igneous zircons of 315 Ma could record the melt-peridotite interactions in the lithospheric mantle induced by the Palaeo-Asian oceanic crust subduction. Igneous zircons of 80 - 170 Ma generally co-exist with the Precambrian metamorphic zircons. The 170-110 Ma zircons are generally characterized by negative εHf (t) values, while the 110-100 Ma zircons are featured by positive εHf (t) values. These observations suggest that the melt-peridotite interactions at 80-170 Ma were induced by partial melting of a recycled continental crust. The igneous zircons of 48 - 64 Ma are characterized by negligible Ce anomaly, unusually high REE, U and Th contents and positive εHf (t) values. These features imply that the melt-peridotite interactions at 48 - 64 Ma could be associated with a depleted mantle-derived carbonate melt/fluid.

The 4.2ka BP climate event and its influence on Neolithic Cultures around the middle reaches of Yangtze River, China

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A sudden collapse of Neolithic Cultures in China around 4ka BP presents a problem for archaeologists. Recently reported records of the 4.2ka BP event in China [1], raises the possibility of Chinese cultural collapse corresponding to this climate anomaly [2]. However, climate change in China around 4ka BP is not well studied as sites, materials and proxies differ in their sensitivity, response time, duration and temporal resolution. To address this question, information on the 4.2ka BP event at high temporal resolution is required.

A precisely dated stalagmite, HS4, covering the last 9000 years, with clear annual growth banding [3], collected from Heshang Cave in the middle reaches of Yangtze River (30.44°N, 110.42°E), provides an apparent record of 4.2ka BP event. Oxygen isotope data from HS4 with an average resolution of ~16a suggests there is a weak monsoon event between 4.4 ka and 4.1 ka. Following this event, the subsequent 2000 year oxygen isotope average value shows an increase of ~1‰, compared with the previous 3000 year, suggesting the 4.2ka BP event is a marker of the end of the Holocene Climate Optimum. Growth rates of HS4 around 4.2ka BP also show a decrease from 300 μm/yr to 200 μm/yr, extending for 240 years, suggesting less water supply to the cave. Furthermore, Mg/Ca ratios from HS4 at seasonal resolution during this event show a prominent increase by ~40% with large variations, indicating an unstable and severe drought condition.

Consistent climate information from all three proxies from HS4 appears to support the thesis of a severe drought during 4.2ka BP around the middle reaches of Yangtze River. An extensive drought covering a period of over 200 years would devastate rain based agricultural and be a prime cause of the collapse of the flourishing Shijiahe Culture, marking the disappearance of local Neolithic Cultures in the middle reaches of Yangtze River.

[1] Xu *et al*. (2006) *PALAEO* **230**, 155–164. [2] Wu & Liu (2004) *INQUA* **117**, 153–166. [3] Hu *et al*. (2008) *EPSL* **266**, 221–232.