5.7.12

Os isotopic compositions of mantle xenoliths in east China: Implications for evolution of continental lithospheric mantle beneath China

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Geochemical and isotopic data on mantle peridotite xenoliths provide key constraints on the evolution of lithospheric mantle beneath the thick continental crust. Here we report both Re and Os abundance and Os isotopic compositions of 13 peridotite xenoliths collected from Cenozoic continental basalts which are widely distributed in eastern China.

Re and Os abundance obtained for the xenoliths range from 30 to 350 ppt and from 600 to 4750 ppt, respectively. The $^{187}Os/^{188}Os$ ratios of these samples range from 0.1140 to 0.1391. The xenoliths except for garnet lherzolites form positive correlation in $^{187}Os/^{188}Os$ vs. Al_2O_3 space. The Al_2O_3 content is one of the depletion factors for peridotite. On the basis of the Re depletion model age of the y-axis intercept in the Al_2O_3-$^{187}Os/^{188}Os$ diagram, an initial $^{187}Os/^{188}Os$ of the xenoliths of 0.1144 was obtained, which corresponds to the Re (melt) depletion age of 2.0 Ga. Nagler and Kramers (1998) [1] proposed that most of the continental crust were formed before 2.0 Ga, which is inconsistent with melt depletion age of the underlying lithospheric mantle. This result implies that lithospheric mantle was replaeced by ascenospheric mantle ca. 2.0 Ga, as pointed out by Gao et al. (2002) [2]. However, the possibility cannot be ruled out that the continental crust served as an anchor for the later forming lithospheric mantle, suggested by Meisel et al. (2001) [3]. In this case, the continental crust and the underlying lithospheric mantle are complementary neither in chemical composition nor in age.

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5.7.13

The age of the lithospheric mantle in the Central Asian Lithospheric Belt from Os isotope data on xenoliths

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The Central Asian Orogenic Belt (CAOB) between the Siberian, Tarim and North China cratons is a major tectonic unit encompassing southern Siberia, Mongolia and northern China. The CAOB is made up of Paleo- and Meso-Proterozoic 'micro-continents', island arc complexes and other accreted terrains and includes a large amount of Paleozoic to Mesozoic granitic rocks. Peridotite xenoliths brought up by Cenozoic basaltic magmas from depths of 35-80 km in the CAOB are typically fertile to moderately depleted, by contrast with highly refractory mantle beneath the Siberian craton. The age and nature of the lithospheric mantle beneath the CAOB are poorly defined. The fertile xenolith suites have been interpreted to represent young asthenospheric mantle accreted after a most recent 'tectonothermal' crustal event [1]. Alternatively, Os isotope data on xenoliths from Vitim east of Lake Baikal [2] and some Sr-Nd isotope data yield Meso-Proterozoic depletion ages, similar to oldest crust-forming events in the CAOB.

$^{187}Os/^{188}Os$ in peridotite xenoliths from Tariat in central Mongolia range from 0.113 to 0.131. $^{187}Os/^{188}Os$ in most refractory (Al_2O_3 <1.4%) Tariat peridotites are highly variable (0.113-0.128). The least radiogenic values yield model Re depletion ages of ~2 Ga identical to those from the Vitim suite and to formation ages of several Meso-Proterozoic terranes in the CAOB. The elevated $^{187}Os/^{188}Os$ could reflect metasomatic overprinting of older residues in Phanerozoic times, possibly facilitated by greater Os mobility due to the exhaustion of sulfides during high degrees of prior melt extraction and by high melt permeability of olivine-rich rocks. $^{187}Os/^{188}Os$ in >80% of Tariat xenoliths define good linear correlations with Al contents and other melting indices, similar to those obtained for Vitim xenoliths. Preliminary Os-isotope data on xenoliths from several other sites in southern Siberia are generally consistent with the Proterozoic model ages and 'alumichrons' obtained on the Tariat and Vitim suites. We interpret these results as evidence for the formation of the lithospheric mantle beneath the CAOB in a major Meso-Proterozoic melting event roughly coeval with the formation of the early crust.

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