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Ancient Continents among the Accretionary Complexes of the Central Asia Orogenic Belt: in Situ Os Isotope Evidence

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Recent studies have noted that volumes of ancient depleted material can survive in the convecting asthenospheric mantle for long periods so that the use of Os model ages of mantle xenoliths to constrain the age of lithospheric mantle events should be approached with caution. In this study, we demonstrate the in situ Os dating work on sulfides in the peridotitic xenoliths from cratonic (Tok, Russia) and off-cratonic (Tariat and Dariganga, Mongolia; Vitim and Hamar Daban range (HDR), Russia; Fig. 1) setting of the Neoproterozoic-Phanerozoic Central Asia Orogenic Belt (CAOB) to examine lithospheric formation. One least-disturbed sulfide from Tok region, with $^{187}Re/^{188}Os$=0.063, yield T_{MA} model age of 1.2 Ga. A few Tok sulfides yield an apparent isochron indicating an age of 3.2 Ga. The initial $^{187}Os/^{188}Os$ ratio (0.117) of depleted component in the Re-Os mixing line shows similar value with the lowest whole-rock $^{187}Os/^{188}Os$ ratio reported by Ionov et al. (2006; 0.116). All of the above indicate the presence of an Archean domain beneath the Tok region, which was affected by Neoproterozoic CAOB event.

Both T_{MA} from the least-disturbed sulfides ($^{187}Re/^{188}Os<0.07$) and T_{RD} from higher Re/Os sulfides without later introduction/loss of Os, yield model ages ranging from 0.5 to 3.0 Ga, with peaks around 1.7-1.5, 1.2 and 0.7-0.5 Ga. These ages suggest that the sub-continental lithospheric mantle (SCLM) beneath the Tariat region formed at least by the Proterozoic time, and that some domains are Archean (Wang et al., 2013). The oldest age reported on the Precambrian Tarvagatay Terrane, where is underlain by Tariat volcanic field, is ca 3.05 Ga by Pb-Pb zircon dating in anorthosite (Mitrofanov et al., 1985). Other zircon U-Pb ages from nearby anorthosites are 1.78 and 1.7 Ga (I. Kozakov unpubl. data). The sulfide Os ages are consistent with these formation events recorded in the overlying crust. Younger sulfide Os ages (1.2 and 0.7~0.5 Ga) may mark the commencement of the Central Asia Orogeny since the Neoproterozoic and involvement of the mantle as suggested by Jahn (2004).

For HDR peridotites, both T_{MA} from the least-disturbed sulfides and T_{RD} from higher Re/Os sulfides yield model ages ranging from 0.7 to 3.0 Ga, with peaks around 2.0 and 1.2-1.0 Ga. These ages suggest that the SCLM beneath the HDR region formed at least by the Proterozoic time, and that some domains are Archean. For Vitim peridotites, although their sulfides have younger model ages, which range from 0.6 to 1.8 Ga with peak ages at 1.2-1.0 and 0.5 Ga, these ages still indicate parts of the SCLM beneath Vitim region have resided at least since Mesoproterozoic. The sulfide Os ages are consistent with these formation events recorded in the overlying crust. Younger sulfide Os ages (1.2-1.0 and 0.5 Ga) may mark the commencement of the Central Asia Orogeny since the Neoproterozoic and involvement of the mantle as suggested by Jahn (2004). This could be the first result showing ancient root beneath the HDR region, consistent with dating results of detrital zircons from near-by regions up to 2.9 Ga (Kovach et al., 2013). However, compiling with Mesoproterozoic Os model ages (up to 2.0 Ga) from the Vitim region, ancient lithospheric mantle domains are prevailing in the Central Asia Orogenic Belt, which might diminish extents of juvenile crustal growth in the Orogeny as expected before.

It would be a remarkable coincidence if sulfides derived

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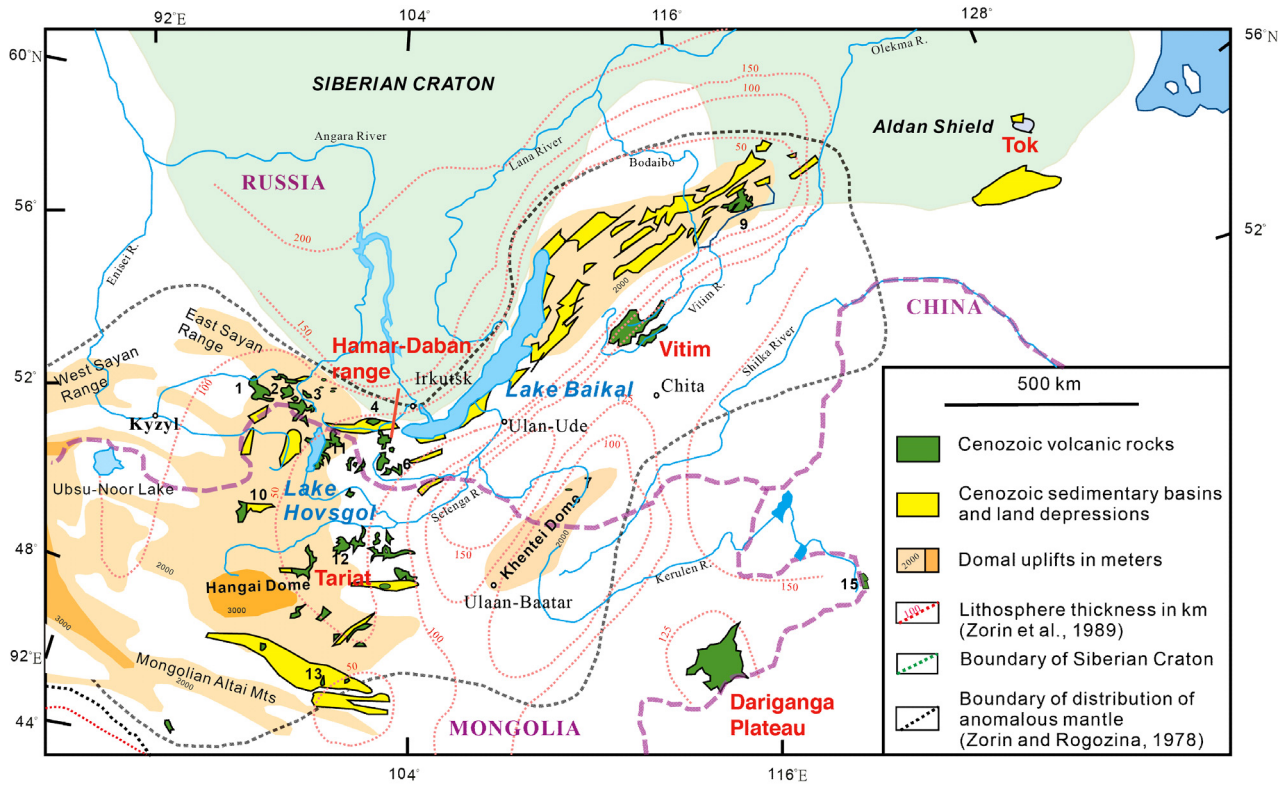

Fig. 1 Distribution of Cenozoic basalts and lithosphere thickness in the Baikal-Mongolia region (modified from Litasov and Taniguchi, 2002).

from randomly selected fragments of refractory materials in the convecting asthenospheric mantle would combine to give such a systematic correlation. Moreover, some of the ancient Os model ages are from apparently residual sulfide phases with subchondritic $^{187}Re/^{188}Os$ and $^{187}Os/^{188}Os$. To interpret these sulfides as derived from depleted material residing within the asthenospheric mantle, it would be necessary to quantitatively melt the older sulfides, transport them into the SCLM and deposit them again without modifying their isotopic systematics. This seems to be an unlikely scenario. We therefore prefer the simplest interpretation of these data: the sulfide Os ages in the Tariat, HDR and Vitim peridotites record major events (i.e., melt extraction) that affected the underlain SCLM.

Sulfides in Dariganga peridotites also have Mesoproterozoic Os model ages (two T_{MA} of 2.0, 1.4 Ga and two T_{RD} of 1.8, 1.2 Ga). Although Proterozoic crustal events have not been reported in this region so far, Proterozoic Nd model ages for basement rocks around the Xilinhot region in the vicinity of the Dariganga Plateau (B. Chen, pers. comm.) suggest that a Precambrian crustal terrain, a counterpart of the underlying Mesoproterozoic lithospheric mantle, should be expected and might be found by studies of deep-crustal xenoliths in the Dariganga region.

Key words: Central Asia, peridotitic xenoliths, mantle suflides, subcontinental Orogenic Belt (CAOB), in situ Os isotopelithospheric mantle (SCLM)

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