Spinel Lherzolite Xenoliths from Mongolia; PGE, Re and Au Geochemistry

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Upper mantle rocks occur as peridotite massifs tectonically emplaced in the crust, and they are also found as xenoliths entrained in erupted basaltic and kimberlitic magmas. Mantle-derived spinel peridotite xenoliths, brought up from depths of <60-70 km to the Earth´s surface by intraplate extrusive rocks, provide direct information on the nature of the lithospheric mantle. The mantle xenoliths for this study were collected from the Tariat Depression in central Mongolia and the Dariganga Plateau in southeastern Mongolia. The Dariganga lava plateau is located outside regions of intensive Cenozoic tectonic activity and could be viewed as an intracontinental hotspot. The samples from the Tariat Depression were collected from a single basanitic tuff and breccia deposit (0.5 m.y. old) called the Shavaryn-Tsaram and known for its large and fresh mantle xenoliths. The six samples analysed include spinel lherzolites and one spinel harzburgite (Table 1). The lherzolite xenoliths are representative of the range of rock composition from Dariganga (CaO from 1.02 to 2.54%; MgO from 41.6 to 45.1%; S from 8 to 9 µg/g) and from Tariat (CaO from 2.02 to 2.92%; MgO from 38.5 to 41.8%; S from 16 to 23 µg/g). All samples show fractionated chondrite normalized PGE patterns (e.g., Pd/Ir=2.29±1.08; Pd/Ir_{CI}=1.21; Rh/Ir=0.39± 0.10; Rh/Ir_{CI}=0.31; Ru/Ir=2.06±0.28; Ru/Ir_{CI} =1.56; Os/Ir=0.90±0.16; Os/Ir_{CI}=1.06).

The late veneer is generally assumed to be representative of unfractionated meteorites, implying that ratios among the HSE (highly siderophile elements) in the present upper mantle are chondritic. The new data provide an important contribution to understanding the HSE behaviour of the terrestrial continental mantle at Mongolia and are relevant to the origin of variable HSE ratios.

The debate concerning the HSE systematics and the presence of light-PGE enriched domains in the earth mantle requires that processes affecting the primary HSE mantle signatures must be discussed. For example, subchondritic Os/Ir ratios from five of six Mongolian samples show that geological processes in the continental lithosphere may alter the primary HSE mantle signatures. Mobilization of Os by hydrothermal fluids is currently in discussion. Experimental evidence of selective transport of Os relative to Ir by Cl-rich magmatic fluids has been provided by Fleet and Wu [1].

Table 1: HSE abundances (ng/g) of xenoliths from Mongolia

Sample	Type	Os	Re	Ir	Ru	Rh	Pd	Au
Dar8520-15	lz	1,87	0,16	2,22	4,70	0,69	3,66	1,06
Dar8520-28	hz	2,66	<0,17	2,96	<4	0,90	6,01	1,76
Dar8520-7	lz	1,34	0,19	1,64	3,23	0,90	4,52	0,58
Mo8530-7	lz	1,54	<0,11	1,82	4,40	0,75	2,60	0,71
MHP79-1	lz	2,62	0,09	3,46	6,06	1,31	5,60	1,51
MHP79-4	lz	1,96	<0,25	1,61	<4	<1	6,90	0,34
Average		2,00	0,15	2,29	4,60	0,91	4,88	0,99
		0,55	0,05	0,77	1,16	0,24	1,59	0,55

The new data provide additional indications for a terrestrial mantle which is characterized by non-trivial variations of HSE ratios. The non chondritic siderophile element ratios of lherzolites xenoliths from Mongolia and other localities, would not support an association of the PGEs in these rocks with the late veneer model if these fractionations are geochemical features of the primitive upper mantle of the Earth.

[1] M.E. Fleet, T.S. Wu, Geochim. Cosmochim. Acta 59, 487-495.