Late metasomatic addition of garnet to the SCLM: Os-isotope evidence

V.G. MALKOVETS[1]*, W.L. GRIFFIN[2], N.J. PEARSON[2], D.I. REZVUKHIN[1], S.Y. O'REILLY[2], N.P. POKHILENKO[1], V.K. GARANIN[3], Z.V. SPETSIUS[4] AND K.D. LITASOV[1]

[1]V.S. Sobolev Institute of Geology and Mineralogy, Novosibirsk, 630090, Russia (*correspondence: vladimir.malkovets@gmail.com)
[2]GEMOC National Key Centre, Macquarie University, Sydney, 2109, Australia (wgriffin@els.mq.edu.au)
[3]Moscow State University, Moscow, Russia
[4]ALROSA Ltd., Mirny, Russia

Archean cratons are underlain by highly depleted subcontinental lithospheric mantle (SCLM). However, xenolith and xenocryst data [1; references therein] suggest that Archean SCLM has been extensively refertilized by metasomatic processes, with the addition of Fe, Ca, and Al to depleted protoliths. The distribution of sub-calcic garnets in the SCLM beneath the Siberian craton suggests (1) sub-calcic garnets and diamonds are metasomatic phases in the cratonic SCLM; (2) the distribution of both phases is laterally heterogeneous on relatively small scales and related to ancient structural controls [2].

Re-Os isotopic compositions of sulfide inclusions in lherzolitic Cr-pyropes from four Siberian middle Paleozoic diamond mines have been determined by laser ablation MC-ICP-MS: Mir (n=17) and Internationalnaya (n=109), Malobotuobiya field, Udachnaya (n=17), Daldyn field, and Nyurbinskaya (n=12), Nakyn field.

Most analysed sulfides (~84%) have very low Re/Os ratios (<0.07), and their Re-depletion ages (T_{RD}) fall between 2.2 and 3.0 Ga (±0.03 Ga, mean 2s analytical uncertainty). 10 to 15% of the sulfides give younger T_{RD} down to 600 Ma.

Our previous study [3] of sulfide inclusions in megacrystic olivines from the Udachnaya pipe suggests that most of the SCLM beneath the Daldyn kimberlite field formed at 3-3.5 Ga, and that lithosphere formation culminated at ca 2.9 Ga. Our new data suggest that refertilization of the highly depleted SCLM and the introduction of Cr-pyrope garnet occurred between 2.2 and 3.0 Ga; little garnet was present before 3 Ga. Pyropes with young sulfides (between ~1.9 and ~2.2 Ga) may have crystallised during the amalgamation of the Siberian craton in Paleoproterozoic time.

[1] Griffin *et al*. (2009) *Jour. of Petrol*. **50**, 1185–1204. [2] Malkovets *et al*. (2007) *Geology* **35**, 339–342. [3] Griffin *et al*. (2002) *Geochem. Geophys. Geosyst*. **3**, 1069.

On dating of groundwater with a high $^{234}U/^{238}U$ and Eh> 100mV

A.I. MALOV

Institute of the Ecologic Problems of the Northern Region, Naberezhnaya Severnoi Dviny, Arkhangelsk, 163061, Russia (malovai@yandex.ru)

In this report, on the basis of geological dating and developed PI Chalov method for determining the age of surface water for non-equilibrium uranium, attempted to assess the possibility of using isotopes U to determine the age of groundwater. In alpha-decay of ^{238}U atoms in an unbroken part of the mineral species appears disorders (disordered) region (*d. r.*) formed by atom recoil ^{234}Th. Among disordered may be the atom itself and the impact that formed this region. The probability of this event, p: $0 < p < 1$. If the groundwater is constantly supplied nonequilibrium uranium $^{234}U/^{238}U > 1$ ($\gamma_{d.\,r.}$) within a certain time t, then the following expression:

$$\gamma_{d.r.} = \left(\gamma_{t.water} - 1\right)\frac{\lambda_2 t}{1 - ?^{-\lambda_2 t}} + 1.$$

Therefore, asking a few randomly chosen values of t, we can define the corresponding values $\gamma_{d.\,r.}$. Then get some corresponding values N_{1rocks} / p:

$$\frac{N_{1rocks}}{?} = \frac{\lambda_2}{\lambda_1\left(\gamma_{dr} - \gamma_{rocks}\right)}.,$$

where N_{1rocks} - the number of atoms of ^{238}U, $\lambda_1 = 1.55 \cdot 10^{-10}$ years^{-1} and $\lambda_2 = 2.75 \cdot 10^{-6}$ years^{-1} - decay constant of ^{238}U and ^{234}U. Knowing the number of atoms of ^{238}U, located in the water contained in a unit volume of rock V_{unit} is currently $N_{1unit..\,water}$, and the activity of ^{238}U of the mineral species in the same volume $A_{1unit.\,rocks}$, you can roughly estimate the average number of atoms N_{1rocks} goes into the water from a disordered region:

$$N_{1rocks} \approx \frac{N_{1unit.water}}{?_{1unit.rocks} \cdot t}.$$

Having obtained the values N_{1rocks}/p and N_{1rocks}, we define p. As a result, for each of several arbitrarily chosen values of t we obtain the corresponding value of probability p. The values of t and p are related by a power dependence. Therefore, defining p, for several values of t, we can derive an equation of type $t = ap^{-0.971}$, where a - the age of groundwater at p=1%, and construct the corresponding diagram. The key point of the proposed method is the choice for charting the calculated value of p, on which is t, age-appropriate groundwater. On the example of North Dvina basin (northwest Russia) have shown that for aquifers with a high $^{234}U/^{238}U$ and Eh> 100 mV in increments homogeneous sandy rocks, p value is 0.35%. It is important to note that the chemical dissolution of equilibrium uranium contained in areas of undisturbed radioactive decay of rocks, as well as sorption to the results of calculations by the proposed method is not influenced.