OXYGEN ISOTOPIC COMPOSITION AS INDICATOR FOR THE GENESIS OF CORUNDUM

Baksheev I.A. (Geol. Dep. MSU)
baksheev@geol.msu.ru; Fax: (495) 932-88-89; Ph.: (495) 939-25-60
Ustinov V.I. (IGAC RAS), **Dolgova O.S.** (Geol. Dep. MSU),
Balitsky V.S. (IEM RAS), **Ekimenkova I.A.** (Geol. Dep. MSU)

Experience in the study of natural and synthetic gems demonstrates that standard gemological techniques often are not enough to distinguish natural and synthetic stones. Sometimes recognition of geographical location of the stone source can be important, because a price of stone can be influenced significantly by this fact.

Along with diamond and emerald gem quality corundum (foremost ruby) has the highest price in the world market. Therefore a finding of criteria to distinguish gem quality natural samples and synthetics is important. On the other hand the market price of natural stone can be influenced by a geographical location and genetic type of deposit. For instance in the early of last century best quality sapphires from lamprophyre of the Yogo Dike, Montana, USA were positioned as "Kashmir blue" sapphires, because the price of the latter is much higher. The source of the "Kashmir blue" sapphires is a number of deposits in the North India that are related to desilicified pegmatite hosted in gneiss and marble [1].

Since sometimes standard gemological techniques are not enough to distinguish natural and synthetic stones the isotopic study is considered to contribute to this procedure. In addition isotopic study can help to recognize genetic type of source deposit and occasionally geographical location of the deposit.

In 2005 French scientists published a paper about oxygen isotopic composition of rubies and sapphires from 106 deposits all over the world and some data on fluxing samples [2]. In that study, however, there is no data on corundum from Russian deposits and hydrothermal synthetic corundum. We have studied oxygen isotopic composition of corundum from igneous, skarn, hydrothermal and metamorphic deposits in Russia, as well as some fluxing and hydrothermal synthetic corundums (Table).

Table. Oxygen isotopic composition of studied samples

Sample brief description	$\delta^{18}O$‰ (SMOW)	Sample brief description	$\delta^{18}O$‰ (SMOW)
Red, skarn, Pamir	+8.4	Red, fluxing	+7.9
Red, metamorphic, Rai-Iz, Polar Urals	+3.1	Red, fluxing	+4.8
Red, "hydrothermal" breccia, Alabashka, Middle Urals	+9.1	Red, fluxing Ramaura	+14.8
Red, altered metamorphics, Khitostrovskoye, Karelia	-14.7…-11.3	Blue, hydrothermal synthesis	-5.8
Blue, syenitic pegmatite, Madagascar	+6.3	Gray, hydrothermal synthesis	-3.6
Blue, syenitic pegmatite, Ilmen Mts, South Urals	+8.8	Green, hydrothermal synthesis	-5.0
Blue, syenitic pegmatite, Umba Valley, Tanzania	+9.1	Greenish-gray, hydrothermal synthesis	-0.7
Blue, margarite veinlets, Emerald mines, Middle Urals	+2.0	Red, hydrothermal synthesis	-1.3
Blue, syenite [2]	+7.6…+7.8	Red, hydrothermal synthesis	-2.1

The $\delta^{18}O$ value for most studied samples ranges from +2.0 to +9.1‰, and taking into account published data [3] this range increases up to +23.0‰. However there is anomalous light oxygen isotopic composition of corundum from the Khitostrovskoye occurrence, Karelia, ranging from -14.7 to -11.3‰. This corundum is considered to be formed at 650-700^{o}C during alteration of metamorphic rocks at the second stage of regional metamorphism [4]. Currently we can not explain so low $\delta^{18}O$ value that is not characteristic for metamorphic conditions.

Oxygen isotopic composition of flux corundum (+4.1…+14.8‰) is identical to that for natural corundum. The $\delta^{18}O$ value of hydrothermal synthetic corundum, however, is strongly different from natural and fluxing corundums, ranging from -5.8 to -0.7‰. Taking into account the same temperature of synthesis (~600°C) a lack of isotopic equilibrium can be supposed.

Thus, oxygen isotopic composition can be used as one of criteria to distinguish hydrothermal synthetic corundum on the one hand and natural and flux corundum on the other. Very low $\delta^{18}O$ value (<-10‰) would indicate the Khitostrovskoye occurrence as a stone source.

This study has been financially supported by the Geological Center of Lomonosov Moscow State University

References

1. *Allen R.M.* The Yogo sapphire deposit: New discoveries create more interest in America's finest gemstone // Gem. Diary. 1991. V. 3. N. 2. PP. 9-16.
2. *Polyakov V.B., Ustinov V.I.* Equilibrium isotopic constants ($\beta^{18}O$-factors) of corundum // Geochemistry. 1997. N. 10. PP. 1019-1025. (In Russian).
3. *Giuliani G., Fallick A.E., Garnier V., France-Lanord C., Ohnensteter D., Schwarz D.* Oxygen isotope composition as a tracer for the origins of rubies and sapphires // Geology. 2005. V. 33. N. 4. PP. 249-252.
4. *Serebryakov N.S., Aristov Vs.V.* Conditions of localization of the collected quality corundum occurrences, hosted in the Chupa sequence of the Belomorian complex. North Karelia // Izv. Vuzov. Geol. Razv. 2004. N. 4. PP. 36-42. (In Russian).

Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(24)'2006
ISSN 1819 – 6586
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2006
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2006/informbul-1_2006/izotop-1e.pdf

Published on July, 1, 2006