Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18309

Sapphires and syenite skarn: oxygen isotope trends among Mogok-area mines, Myanmar

RACHELLE B. TURNIER[1,2], AARON C. PALKE[1], KOUKI KITAJIMA[2] AND JOHN W. VALLEY[2]

[1]Gemological Institute of America
[2]University of Wisconsin–Madison
Presenting Author: rturnier@gia.edu

The Mogok Metamorphic Belt in Myanmar is a ~50 by 1500 km belt of mainly amphibolite to granulite-facies gneisses, schists, and marbles with extensive deposits of sapphires, rubies, and other gems. Sapphires are found in syenitic intrusions near the contact with country rock; these primary deposits are often weathered to secondary, detrital gravels. In this study, oxygen isotope ratios in corundum are used to constrain lithologic and metasomatic inputs among different Mogok-area sapphire mines.

In situ secondary ion mass spectrometer (SIMS) measurements of oxygen isotopes in corundum (n = 171 crystals), zircon inclusions in corundum and in matrix (n = 69 crystals), and matrix calcite (several domains; n = 2 rocks) reveal differences in the range of intra- and inter-crystalline $\delta^{18}O$, which reflects the extent of metasomatism at different localities (table 1 shows the minimum, maximum, average $\delta^{18}O$ value, the number of crystals analyzed for zircon (Zrc) and corundum (Crn), and the corundum type sampled, whether detrital crystals (detrital) or from rock matrix (matrix)). Large intra-crystalline zonation, up to 8‰, occurs in sapphires from Lisu-konzan (LK) and Thurein-taung (TT) but with opposite trends (i.e., LK corundum rims have higher $\delta^{18}O$ than cores; at TT, rims have lower values than cores). Corundum crystals from other deposits have less extreme intra-crystalline oxygen isotope ranges, either being homogeneous within analytical precision (avg. 2SD = 0.2‰) or ranging by up to 2‰.

Oxygen isotope signals imparted during the genesis of syenite-hosted corundum are controlled by the fluid pathways, composition and flux, and country rock lithology (gneiss or marble). Syenite-hosted corundum crystals with the largest intra-crystalline $\delta^{18}O$ gradients occur closer to gneiss-marble contacts, probably reflecting larger fluid/rock ratios and mixing of fluid sources. Deposits that are further away from lithologic contacts typically have intra-crystalline zonation around 2‰ or less. At Bernardmyo, one corundum crystal has $\delta^{18}O$ values averaging 7.2‰, consistent with primary I-type syenite signatures for $\delta^{18}O$(WR), but this occurs north of the Mogok area. Among Mogok-area deposits, elevated $\delta^{18}O$ values in primary syenite-hosted corundum are typical. These higher values of $\delta^{18}O$ indicate significant crustal input during sapphire genesis or an S-type origin for syenites.

Table 1.

	Corundum			Zircon			
Locality	**Min $\delta^{18}O$**	**Max $\delta^{18}O$**	**Avg. $\delta^{18}O$**	**Min $\delta^{18}O$**	**Max $\delta^{18}O$**	**Avg. $\delta^{18}O$**	**Comments**
Thurein-taung	8.4‰	22.2‰	17.1‰	12.5‰	23.9‰	18.1‰	38 Crn, 12 Zrc, matrix & detrital
Ohn-gaing	10.1‰	24.8‰	15.6‰				12 Crn, matrix & detrital
Lisu-konzan	10.0‰	19.2‰	13.7‰	14.6‰	19.4‰	16.5‰	25 Crn, 17 Zrc, matrix & detrital
Ma Padar Sho	12.0‰	20.1‰	15.6‰	13.1‰	18.1‰	16.3‰	17 Crn, 17 Zrc, matrix
Bawmar	11.0‰	16.1‰	13.1‰				37 Crn, matrix
Lay-thar	12.4‰	16.4‰	14.5‰	14.3‰	15.8‰	15.2‰	40 Crn, 8 Zrc, matrix
Bernardmyo	6.5‰ 15.5‰	7.5‰ 16.5‰	7.2‰ 16.0‰	7.4‰ 13.5‰	9.6‰ 17.1‰	8.6‰ 16.1‰	1 Crn, 7 Zrc, detrital 1 Crn, 8 Zrc, detrital