Trace Element and Sr Isotope Characteristics of Ruby

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Rubies are amongst the most valuable of gemstones. The realization of the importance of the geology of gemstone deposits for prospecting and mining has led to a significant improvement in our knowledge of the formation of corundum deposits. However, these gems form in very different geological contexts, and details of the mechanisms of formation, and the origin of the mineralizing fluids remain insufficient for development of precise genetic models [1]. In addition to better geological understanding there is a growing need to be able to geographically discriminate rubies and other gems. Trace element analysis is a powerful tool to investigative the source characteristics of ruby-forming fluids and crystallization environments, but because most elements in ruby are present at ultra-trace levels quantitative data remain sparse. Here we aim to (1) refine the LA-ICP-MS method to produce more accurate in-situ trace element data, and to (2) obtain the first measured radiogenic isotope compositions of ruby using a newly developed off-line laser sampling technique [2]. We analyzed rubies from two different localities but similar deposit type, the Montepuez ruby deposit (Mozambique) and the Aappaluttoq ruby deposit (SW Greenland). A total of 49 elements were initially selected for trace element analysis. We are able to obtain quantitative data (> LOQ @ $10\sigma_{bg}$) for 33 elements using a fluence of ~6.6 Jcm^2 and a 285 μm spot at 20 Hz. Results show very similar trace element charateristics for rubies from both localities, however, the Greenland rubies show greater variance and higher median concentrations for a number of elements, most notably for Mg, Ti, Mn, Fe, Nb, Ta, W, Th, and U. Initial results of Sr isotope analysis show a surprisingly narrow range of $^{87/86}Sr$ for the Mozambique rubies (0.71135 to 0.71295, n=3) compared to a much wider range and more radiogenic values for the Greenland rubies (0.7575 to 0.934, n=4). This reflects the involvement of more ancient host rocks in the formation of the Greenland rubies. The trace element and isotopic differences show great promise for discriminating rubies from different locations using geochemistry.

[1] Giuliani et al., 2014. *In: Geology of Gem Deposits. 2nd Ed. MAC Short Course* **44**, 29-112 [2] McNeill et al., 2009. *J. Phys. Condens. Matter* **21**, 364207