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Gemmological properties and chemical composition of gem-quality taaffeites and musgravites from Sri Lanka and Africa

K. Schmetzer[1], M. Krzemnicki[2], H.A. Hänni[2] and H.-J. Bernhardt[3]

1 Petershausen, Germany (SchmetzerKarl@hotmail.com)
2 SSEF, Basel, Switzerland
3 Ruhr-University, Bochum, Germany

Abstract

The taaffeite group consists of three independent mineral species, namely taaffeite, musgravite and pehrmanite. Only taaffeite and musgravite are known in gem quality, especially from Sri Lanka. Taaffeite, $BeMg_3A1_8O_{16}$, is a rare collector's stone, and musgravite, $BeMg_2A1_6O_{12}$, is considered as one of the rarest gem species known to date. According to the theoretical formula, the difference in beryllium content between taaffeite and musgravite is only 1.56 wt.% BeO. Due to the similar chemical composition and crystal structure of taaffeite and musgravite, the gemmological properties of these independent species overlap. Consequently, for an unequivocal determination of faceted gems of this group a combination of special physical techniques such as X-ray diffraction (powder or single crystal techniques) and/or quantitative chemical analysis (e.g. by electron microprobe) and/or Raman spectroscopy is needed.

A summary of physical properties and chemical composition of gem-quality taaffeites and musgravites from Sri Lanka was given by Schmetzer et al. (2006). Taaffeites from Sri Lanka, in general, contain minor amounts of transition metals, especially iron and zinc; in red to purplish red samples traces of chromium up to 0.33 wt.% Cr_2O_3 are also present. In a few samples with extraordinarily high values of refractive indices and specific gravity, extremely high zinc and/or iron values up to 8.87 wt.% ZnO and up to 5.62 wt.% FeO were observed. Only five quantitative chemical analyses of gem-quality musgravites from Sri Lanka are published. Only one iron-rich musgravite from Sri Lanka with relatively high iron contents of 4.91 wt.% FeO is known. Zinc-rich musgravites of gem quality were not described up to now and chromium-bearing red or purplish red musgravites are unknown.

Recently, the authors examined a mixed lot of 25 faceted gemstones originating from Tunduru, Tanzania, and/or from Ilakaka, Madagascar, by electron microprobe and Raman spectroscopy and identified 15 samples as taaffeites and 10 faceted gemstones as musgravites. Quantitative chemical analysis showed that the variation of gemmological properties and chemical composition of these gem-quality taaffeites and musgravites from Africa are within the compositional range and the range of physical properties (specific gravity and refractive indices) known so far

for samples from Sri Lanka. Within the taaffeites, zinc and iron values up to 4.78 wt.% ZnO and up to 2.79 wt.% FeO were observed. The musgravites showed similar iron values up to 2.00 wt.% FeO, but no sample with high zinc concentrations was observed (maximum value 0.36 wt.% ZnO). Similar inclusions as those already known from gem materials of both mineral species from Sri Lanka were determined in samples of African origin.

Gemmological properties of taaffeites and musgravites such as specific gravity and refractive indices for both groups of gemstones, i.e. from Sri Lanka and Africa, were found to be correlated with trace element contents of individual samples.

Reference:

Schmetzer, K., Kiefert, L., Bernhardt, H.-J., Burford, M. (2006): The variation of gemmological properties and chemical composition of gem-quality taaffeites and musgravites from Sri Lanka. Australian Gemmologist, Vol. 22, No. 11, pp. 485-492.