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Discrimination of danburite from different deposits by chemical components: a femtosecond LA-ICP-MS study

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Femtosecond laser ablation-inductively coupled plasma-mass spectrometry was used to determine the concentration of 51 elements, i.e. Li, Be, B, Na, Mg, Al, Si, K, Sc, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Nb, Ag, Cd, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Pt, Au and Tl in 6 danburite samples from 3 deposits in Mexico (2 colourless samples), in Vietnam (2 light yellow samples) and in Tanzania (2 saturated yellow samples). Calcium was determined in a previous study by Huong et al. [1] with electron microprobe analysis and used as internal standard for the current LA-ICP-MS measurements. Femtosecond laser ablation allows non-matrix-matched calibration that is necessary since there is no suitable reference material for danburite [2]. The objective of this study is to characterize the elemental composition of danburite among the three deposits and to preliminarily understand the causes of yellow colour in this mineral.

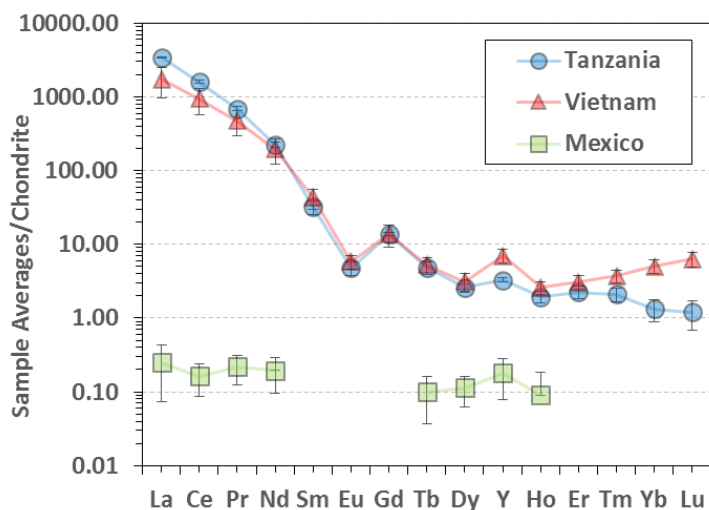


Figure 1: Chondrite-normalized plot of REY (REEs and Y) concentration in danburite from different deposits

whereby the concentrations of LREE exceed those of HREE by a 200-fold enrichment. The colourless Mexican danburites appear to be fairly clean from lanthanide with total contents of approx. 1.1 ppm. This finding suggests that REEs content might correlate with the yellow colour in danburite.

The three danburite origins can also be separated from each other by the mass fractions of minor and trace elements i.e. Be, Ti, Mn, Ni, As, Sr and Y. However, the contents of these elements are not related to the colour. In addition, low concentrations of 0.1 – 0.6 ppm of the radioactive element Th are identified in all samples independently from their origins.

The results show that the concentrations of REEs in samples from the three deposits differ significantly (Fig. 1). The Tanzanian danburite samples contain extreme high concentration of lanthanide impurities. Total lanthanide content of Tanzanian samples is about 1900 ppm, whereby the concentration of light rare earth elements (LREE: La, Ce, Pr, Nd, Sm, Eu) exceed those of the heavy rare earth elements (HREE: Gd, Tb, Dy, Ho, Er, Er, Tm, Yb, Lu) by a 450-fold enrichment. This result is in good agreement with the investigations of Chadwick and Laurs [3]. The Vietnamese samples are different with a total lanthanide content of ca. 1100 ppm,

References:

- [1] Huong et al. (in review) *Gems Gemol*
- [2] Jochum KP et al. (2014) *Geostand Geoanal Res* 38(3): 265–292.
- [3] Chadwick KM and Laurs BM (2008) *Gems Gemol* 44(2): 169-171

