V-rich davisite in a compact type A CAI from a CV carbonaceous chondrite

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Most compact type A calcium-alminum-rich inclusions (CTAs) are considered to have crystallized from partial melts of preexisting condensate materials [1]. However, there are some CTAs which show several distinct textural and chemical features that could not be readily explained by crystallization from a melt [1]. We focused on one CTA (R3C-01) from Roberts Massif (RBT) 04143 (CV_{red}), which seems to be dominated by relict grains, in order to constrain characteristics of precursors and formation and thermal histories of CTAs.

R3C-01 is an irregular-shaped CTA composed of five lithological units (unit 1-5), all of which are surrounded by a Wark-Lovering rim and further by an olivine rim. Unit 1 of R3C-01 (R3C-01-u1) is a texturally unzoned object composed of melilite, spinel, perovskite and Al-Ti-rich Ca-pyroxene. Melilite shows bimodal compositions ($Åk_{10-15}$ and $Åk_{20-25}$) with no dominant zoning pattern, suggesting that the CTA has never been completely molten. While most Al-Ti-rich Ca-pyroxene grains occur along with other phases, all tiny (<5 μm) davisite ($CaScAlSiO_6$; [2]) grains are just isolated in melilite. These isolated davisite grains are enriched in Sc and V (5-10 wt% Sc_2O_3 and 1-4 wt% V_2O_3) with higher V/Sc ratios (~0.3) and lower Zr/Sc ratios (≪0.1) than davisite in other compact type CAIs, most of which are adjacent to other phases [2–7]. Considering their occurrences and distribution coefficients (D) of Sc, V and Zr between Al-Ti-rich Ca-pyroxene and melt ($D_V > D_{Sc} > D_{Zr}$ [8, 9]), the relict origin of isolated V-rich davisite in R3C-01-u1 is most preferable; the high V/Sc and low Zr/Sc ratios of the V-rich davisite might have resulted from a reaction between condensate V-poor davisite [e.g., 10] and a partial melt of R3C-01-u1.

[1] Simon *et al*. (1999) *GCA*, **63**, 1233-1248. [2] Ma *et al*. (2009) *Am. Mineral*., **94**, 845-848. [3] Davis (1984) *Meteoritics*, **19**, 214. [4] Simon *et al*. (1996) *MAPS*, **31**, 106-115. [5] El Goresy *et al*. (2002) *GCA*, **66**, 1459-1491. [6] Lin *et al*. (2003) *MAPS*, **38**, 407-417. [7] Ivanova *et al*. (2012) *MAPS*, **47**, 2107-2127. [8] Hart *et al*. (1993) *Contrib. Mineral. Petr*., **113**, 1-8. [9] Simon *et al*. (1991) *GCA*, **55**, 2635-2655. [10] Zhang *et al*. (2015) *GCA*, **163**, 27-39