Discovery of tazheranite (cubic zirconia) in the Allende meteorite

CHI MA* AND GEORGE R. ROSSMAN

Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA (*correspondence: chi@gps.caltech.edu)

During an investigation of the mineralogy of the Allende meteorite, we found Y-rich tazheranite (cubic zirconia) [$(Zr,Ti,Ca,Y)O_{1.75}$] in a refractory inclusion within an amoeboid olivine aggregate. Synthetic cubic zirconia is well known in the field of materials science. Tazheranite [$(Zr,Ti,Ca)O_2$] is a rare, naturally occurring cubic zirconia, discovered in the Tazheran massif, Russia in 1969 [1]. We report here its first occurrence in a meteorite, as an ultra-refractory mineral likely formed at the beginning stage of our solar system.

FE-SEM revealed that tazheranite occurs as subhedral grains (350 nm – 1.2 µm in dia.) along with zirconolite and Fe-Ni and alloys dominant in Os-Ir-Mo-W, occupying the core area in a refractory inclusion with a rim consisting of fassaite (cpx), surrounded by olivine (Fig. 1). The mineral was only found in one polished section, prepared from a 1-cm-diameter Allende fragment. The mean chemical composition of the zirconia phase determined by electron microprobe analysis is (wt%) ZrO_2 49.76, TiO_2 28.45, CaO 9.94, Y_2O_3 6.15, HfO_2 2.23, FeO 2.00, Al_2O_3 0.96, MgO 0.47, Sc_2O_3 0.43, sum 100.39, giving an empirical formula: $(Zr_{0.38}Ti^{4+}_{0.33}Ca_{0.17}Y_{0.05}Fe_{0.03}Al_{0.02}Hf_{0.01}Sc_{0.01}Mg_{0.01})_{\Sigma 1.01}O_{1.75}$. No other elements with atomic number greater than 4 were detected. *In situ* electron back-scatter diffraction analysis revealed that the zirconia phase has a fluorite-type *Fm3m* structure, identical to that of tazheranite [2] and synthetic cubic zirconia, showing a = 5.11 Å and Z = 4. This cubic zirconia likley formed by condensation in the solar nebula.

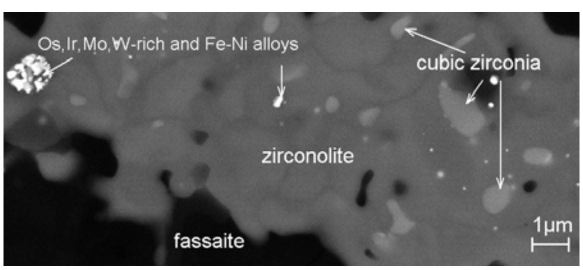

Figure 1: SEM image showing cubic zirconia in Allende.

1] Konev *et al*. (1969) *Doklady Acad. Nauk* 186, 917–920.
[2] Rastsvetaeva *et al*. (1998) *Doklady Akad. Nauk* 359, 529–531.