EVIDENCE FOR A HIGH TEMPERATURE EPISODE DURING MULTISTAGE ALTERATION OF ALLENDE DARK INCLUSIONS. F. E. Brenker[1] and A. N. Krot[2]. [1]Institut für Mineralogie and Geochemie, Universität zu Köln, Zülpicher Str. 49b, 50674 Köln, Germany, brenker@min.uni-koeln.de [2]Hawai'i Institute of Geophysics and Planetology, SOEST, University of Hawai'i at Manoa, Honolulu HI 96822, USA.

Introduction: The Allende dark inclusions (DIs) are CV-like chondritic fragments which experienced complex nebular or asteroidal alteration prior to and after incorporation into the Allende asteroid. A subset of the heavily-altered Allende dark inclusions are crossuct by Ca-rich veins and surrounded by Ca-rich rims composed of Ca,Fe-pyroxenes, wollastonite, and andradite. The same minerals are common in the Allende matrix. Based on the observed intergrowths of hedenbergite with P2/n structure and salite with C2/c structure and presence of andradite, Brenker er al. [1] concluded the matrix pyroxenes formed above 1320 K under extremely oxidizing conditions [logfO_2 (bar) = -15-10] and subsequently cooled >10°C/hr. Here we present SEM and TEM study of andradite, wollastonite and salite-hedenbergite pyroxenes in the Allende dark inclusions.

Results. The Allende dark inclusions 3529 and IV-1 consist of chondrules and Allende-like matrix composed of lath-shaped fayalitic olivine, nepheline, sodalite, and Ca,Fe-pyroxene ±andradite ±FeNi-sulfide nodules. Chondrule phenocrysts are extensively or completely replaced by fayalitic olivine, nepheline, and sodalite; metal nodules are replaced by FeNi-sulfides, andradite and Ca,Fe-pyroxenes. The chondrules and matrices are crosscut by Ca,Fe-pyroxene ±FeNi-sulfide ±fayalitic olivine veins. The inclusions are surrounded by continuous Ca-rich rims composed of andradite, wollastonite, kirschsteinite, and Ca,Fe-pyroxenes, whereas the outer portions of the inclusions are depleted in Ca. The outermost rim layers are commonly intergrown with the matrix olivines and chondrule fragments of the Allende host. TEM studies of the secondary Ca-rich phases within and around the inclusions indicate that growth of at least some Ca-rich phases in the Allende dark inclusions occurred at high-temperature followed by rapid cooling. The presence of several wollastonite polytypes (a polysynthetically-twinned polytype of pseudowollastonite, wollastonite-2M, and wollastonite-1T) and the presence of a hedenbergite-PM - augite intergrowth found in the central portion of the Ca-rich rim around the Allende dark inclusion IV-1 requires a temperature above 1000°C and a cooling rate of >10°C/hr during the rim formation. Pyroxenes in the inclusion matrices and chondrule pseudomorphs show no structural variations and belong to the C2/c space group.

Conclusions: We infer that the dark inclusions experienced complex alteration history prior and after incorporation into the host Allende. During the early stage of the alteration, which took place in an asteroidal setting, but not in the current location of the dark inclusions, chondrule silicates were replaced by secondary fayalitic olivine, nepheline, and sodalite. Calcium lost from the chondrules was redeposited as Ca,Fe-pyroxene veins and Ca,Fe-pyroxene±andradite nodules in the matrix. The late stage of alteration resulted in mobilization of Ca from the dark inclusions and its re-deposition as Ca-rich rims around the dark inclusions. The outermost Ca,Fe-pyroxene layer of the rims grew *in situ*. The inferred high-temperature episode(s) during overprint or formation of the central portions of the Ca-rich rims around dark inclusions might have occurred either in the CV asteroidal body during release of the supercritical fluid or in the hot vapor cloud prior to or during the accretion of the CV asteroidal body.

Reference: Brenker F. E. et al. (2000) *EPSL, 178*, 185-194.