LATE STAGE HIGH TEMPERATURE PROCESSING OF CA, FE-RICH RIMS AROUND ALLENDE DARK INCLUSIONS DI. F. E. Brenker[1] and A. N. Krot[2], [1]Institut für Mineralogie und Geochemie, Universität zu Köln, Zülpicher STr. 49b, 50674 Köln, Germany, brenker@min.uni-koeln.de, [2]Hawai'i Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, Honolulu HI 96822, U.S.A.,

Introduction: Secondary Ca, Fe-rich minerals and aggregates (CFA) are widespread in the Allende meteorite. About 90vol% of the total CaO-content of the matrix is concentrated in Ca, Fe-rich aggregates (CFA). The conditions and environment (solar nebula or asteroidal) of this alteration is still matter of controvers scientific discussion [see summaries in 1,2]. Here we present novel compelling evidence of late stage high temperature processes recorded in Ca, Fe-rich rims around Allende dark inclusions. A detailed scanning (SEM) and transmission electron microscopical (TEM) work on dark inclusions 3529 and IV-1 were performed.

Results: The rim shows a shell like structure divided in three different layers. The outermost rim layers are commonly intergrown with the matrix olivines and chondrule fragments of the Allende host indicating formation in situ, after consolidation as a rock. In the central portion of the rim around dark inclusion IV-1, we found several wollastonite polytypes (a polysynthetically-twinned polytype of pseudowollastonite, wollastonite-2M, and wollastonite-1T) and a intergrowth of hedenbergite-PM - augite. These findings require an unexpected high temperature above 1000°C and a cooling rate of >10°C/hr during or after formation of the central part of the rim. The close relation within a few micrometer of three different polymorphs of wollastonite tends to a very localized process or incomplete retrograde transformation between the wollastonite polytypes. The innermost rim again shows the same intergrowth features like the outermost rim but with the dark inclusion matrix and to a lower extend. High temperature features are absent in the outer, the innermost rims and the CFA of the inclusion.

Conclusion: We infer that the dark inclusions experienced complex alteration history prior and after incorporation into the host Allende. The early stage of the alteration took place in an asteroidal setting, but not in the current location of the dark inclusions. During this stage the first generation of Ca,Fe-rich minerals in veins, aggregates and around nodules are formed. The next stage of alteration, which occurred during or after fragmentation of DI parent material, resulted in mobilization of Ca and its re-deposition as Ca-rich rims around the dark inclusions forming the central part of the rim. The rim and probably also the CFA of the Allende matrix described by [2] was partially heated most likely due to shear heating during several impact events, similar to a recent model on Mokoia DI [3]. We assume that shock heating was most effective at locations with high porosity contrast. During this short stage of heating and the subsequent cooling history the outermost and the smaller inner Ca,Fe-pyroxene layer of the rims grew in situ in its present position. Ca-mobilisation will also explain the low Ca-contents of pyroxenes found in CFA of the Allende matrix. This model is in good agreement with recent data on REE pattern [4] and oxygen isotopic compositions [5].

References: [1] Krot, A.N. et al. (1998) MAPS 33, 1065-1085. [2] Brenker, F.E. et al. (2000) EPSL 178, 185-194. [3] Ohnishi I. & Tomeoka K. (2002) MAPS 37, 1843-1856. [4] Brearley, A.J. & Shearer, C.K. (2000) Meteorit. Planet. Sci, #5012. [5] Cosarinsky, M. et al. (2003) LPSC XXXIV, #1043.