ORIGIN OF CHLORINE IN THE MESOSTASIS OF QINGZHEN (EH3) CHONDRULES.

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Introduction: The chlorine abundance of EH3 chondrites, 570 ppm, is the highest of any chondrite group other than CI chondrites (700 ppm) [1]. Because chlorine is highly volatile and also hydrophile, understanding where Cl resides would help in understanding the formation histories of EH chondrites. In EH3 chondrites, a large fraction of Cl is present in sulfide phases such as djerfisherite [e.g. 2], but chondrules are also known to contain significant amounts of Cl in their mesostases [2,3]. Grossman et al. [3] reported compositions of chondrule mesostases from Qingzhen (EH3) that contained up to 2.2 wt. % Cl. We have examined the same suite of chondrules in more detail to investigate the nature and composition of Cl-bearing phases.

Results: Three of the Qingzhen chondrules contain significant amounts of chlorine in their mesostases. Our mesostasis analyses for chondrules 3, 7 and 10 have mean Cl concentrations of 4.1, 1.5, and 1.8 wt.%. Chondrules 7 and 10 both have porphyritic olivine-pyroxene textures [3]. Mesostasis in both chondrules is glassy with compositions that are rich in SiO_2 (58 and 56 wt.%, respectively), Al_2O_3 (22 wt.% in both), and Na_2O (11 and 13 wt.%). Microcrystallites, possibly sodalite, are present in both glasses. Chondrule 3 is 2.5 mm in diameter and consists of radial pyroxene laths, with interstitial glassy mesostasis areas ~10 μm across [3]. Two distinct glass compositions, one Cl-rich (4 wt.%) and one Cl-poor (0.02 wt.%), are separated by a sharp boundary. Cl-poor glass occurs in a region several hundred μm across, in the outer part of the chondrule. Mean concentrations of the two glasses differ in Na_2O (13.0 and 11.3 wt. %), SiO_2 (64.1 and 68.4 wt. %), and Al_2O_3 (17.4 and 19.1 wt.%) for Cl-rich and Cl-poor glass, respectively.

Discussion: We consider several different possible sources for chlorine in chondrule mesostasis. Chlorine could have been present in chondrule precursor material. Sodalite, which is expected to condense at 863 K [4], is a possible Cl-bearing chondrule precursor phase. It would also be a significant source of Na. A Na- and Cl-rich (and K-poor) precursor for EH3 chondrules was also proposed by [2]. Zoning of Cl and Na in chondrule 3 could represent volatile loss from the surface of the molten chondrule. Condensation of chlorine into chondrule melts during cooling would produce Cl enrichment around the chondrule edge, the opposite of what we observe. It is unlikely that Cl was introduced into chondrule mesostasis during a secondary alteration event, as this would also produce the reverse of the zoning we observe. Loss of Cl from the outer zone of chondrule 3 would probably require fluid-assisted mobilization,, but no evidence exists for aqueous alteration or fluid-driven metasomatism of E chondrites. Overall, it appears that the best explanation for the origin of Cl is in chondrule precursor material, possibly as sodalite, in the EH chondrule formation region.

References: [1] Lodders K. and Fegley B. Jr. 1998. *The Planetary Scientist's Companion,* 371 p. [2] El Goresy A. et al. 1988. *Proceedings NIPR Symposium Antarctic Meteorites* 1, 65-101. [3] Grossman J.N. et al. 1985. *Geochimica et Cosmochimica Acta* 49, 1781-1895. [4] Fegley B. Jr. and Lewis J.S. 1980. *Icarus* 41, 439-455.