ASSESSING THE DEGREE OF SECONDARY ALTERATION IN CHONDRULES FROM ONE OF THE LEAST ALTERED CR CHONDRITES, EET92042.

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Introduction: EET92042 (along with paired EET92062 and EET92105) is one of the least altered CR chondrites, classed by [1] as subtype 2.8. Bulk chondrule oxygen isotope compositions for chondrules we extracted from this chondrite lie on a slope-one line on an oxygen three-isotope diagram [2]. The chondrules we analyzed showed little to no secondary alteration. However, the degree of alteration in this chondrite is somewhat ambiguous. [1] did not describe smooth phyllosilicate rims on chondrules in EET92062, as observed in MET00426 and QUE99177 (both subtype 2.8), suggesting that EET is less altered. But [1] suggested that chondrule glass shows evidence of minor hydration, based on low totals in EPMA analyses, [3] showed alteration at the edges of type II chondrules in EET92105, and [4,5] described phyllosilicates and other hydrated phases in EET92042 matrix. EET92042 is a breccia [4] which may account for these different observations. We have examined the degree of alteration of chondrules in EET92042, in order to clarify the nature and extent of alteration for interpretation of oxygen isotope data.

Methods: We examined the following EET92042 material: thin section EET92042,27; a TEM section; 25 chondrules and chondrule / matrix fragments extracted by freeze-thaw disaggregation; and a polished mount ~30 mm^2. These were studied using SEM and analyzed with EPMA. We also examined the edges of a type I and a type II chondrule with ToF-SIMS mapping [6].

Results: Several type I chondrules contain glassy mesostasis: these show minimal to no zoning attributable to leaching. EPMA analyses of glass give totals >99%, with up to 3 wt% Na_2O, 0.2 wt% K_2O, and 14 wt% CaO. Primary silica in type I chondrule interiors is unaltered. Mesostasis in type II chondrules is glassy or microcrystalline, and minor alteration at the edges includes a thin phosphate rim, as observed by [3]. Smooth rims, up to 30 μm thick, and consisting of hydrated Fe,Si-rich phyllosilicate or possibly an amorphous gel-like phase, are common around chondrules. Compositions are similar to those in MET and QUE [1]. These rims are particularly well developed at the periphery of silica-rich igneous rims around type I chondrules. Contacts with matrix are sharp, and commonly decorated with sub-μm sulfides.

Discussion: Development of smooth phyllosilicate rims on chondrules in EET92042 appears similar to MET and QUE. In EET92042, observed alteration effects are heterogeneous because they are dependent on local mineralogy, rather than because of brecciation. The association of smooth phyllosilicate with silica suggests that local dissolution of free silica in an Fe-bearing fluid was a driving force for formation of phyllosilicate. Interiors of most type I chondrules appear to be close to pristine, supporting the interpretation that the slope-one oxygen isotope line determined for type I chondrules is a primary chondrule reservoir [2].

References: [1] Harju E.R. et al. (2014) *GCA* 139, 267–292. [2] Jones R.H. et al. (2014) *77th Meteoritical Society Meeting*, #5165. [3] Burger P.V. and Brearley A.J. (2004) *25th LPSC*, #1966. [4] Abreu N.M. and Brearley A.J. (2005) *36th LPSC*, #1826. [5] Le Guillou C. et al. (2015) *EPSL* 420, 162–173. [6] Henkel, T. et al. 2007. *Rev. of Sci. Instr.* 78: 055107.