THE CLOSELY LINKED TIMING OF CHONDRULE AND CHONDRITE FORMATION.

C.M.O'D. Alexander. DTM, Carnegie Institution for Science, Washington DC 20015, USA (calexander@carnegiescience.edu).

Introduction: Dating of chondrules suggest that: (1) most O, CO chondrites and Acfer 094 chondrules formed 1-3 Myr after CAIs, (2) CV chondrules 0 to >3.4 Myr after CAIs, and (3) CR chondrules began forming contemporaneously with O and CO chondrules, but the youngest formed >3-4 Myr after CAIs. Taken at face value, these chondrule ages imply that their chondrite parent bodies all formed >3-4 Myr after CAIs, but the apparent spreads in chondrule ages are problematic [1]. It is difficult to preserve the distinct chondrule physical and chemical properties of groups against turbulent mixing over 1-3 Myr timescales. However, given the uncertainties in the Al-Mg ages most chondrules in a group could have the same age or a narrow range of ages [1, 2], and that the youngest chondrule ages, at least, reflect disturbance by parent body processes [1].

Discussion: It is essential to study only the most primitive members of a group and to select only those chondrules that can be shown to have undergone no secondary modification. The most careful Al-Mg study of chondrule ages to date has been for Acfer 094 where 9 of 10 chondrule are within error of a mean of $2.3^{+0.5}_{-0.3}$ Myr after CAIs [3]. Selecting only similar (type I) chondrules from a previous study of a primitive CO [4] gives a mean chondrule age of $2.0^{+0.3}_{-0.2}$ Myr after CAIs. The Al-Mg system is more suspect in Semarkona, the most primitive OC, but the chondrules have a mean age of $2.0^{+0.5}_{-0.3}$ Myr after CAIs [5, 6], which is consistent with a 1.7±0.7 Myr Hf-W mean age for H chondrite chondrules [7].

Modeling of the thermal histories of chondrites provide additional constraints since chondrules ages cannot post date accretion. Estimated accretion ages for the OCs are ~2-2.3 Myr after CAIs [8, 9, 10], which is very similar to the mean ages of OC chondrules. This is further evidence that OC chondrule formation occurred over a much narrower time interval than commonly stated, and that OC accretion occurred soon after chondrule formation. It also hints at a link between chondrule and chondrite formation. A lack of samples from the deep interior of the CO parent body, for example, could explain why the estimated accretion age of the COs (~2.7 Myr after CAIs) is younger than for the OCs despite their similar average chondrule ages. Thermal modeling suggests that the parent bodies of the CI, CM and Tagish Lake meteorites formed 3-4 Myr after CAIs [9]. Since no chondrites appear to be younger than this, this may mark the end of planetesimal formation and dissipation of the gas disk.

References: [1] Alexander C.M.O'D. and Ebel D.S. 2012. *M&PS* 47:1157-1175. [2] Kita N.T. and Ushikubo T. 2012. *M&PS* 47:1108-1119. [3] Ushikubo T. et al. 2013. *GCA* 109: 280-295. [4] Kurahashi E. et al. 2008. *GCA* 72:3865-3882. [5] Kita N.T. et al. 2000. *GCA* 64:3913-3922. [6] Villeneuve J. et al. 2009. *Science* 325:985-988. [7] Kleine T. et al. 2008. *EPSL* 270:106-118. [8] Henke S. et al. 2013. *Icarus* 226:212-228. [9] Sugiura N. and Fujiya W. 2014. *M&PS* 49:772-787. [10] Blackburn et al. 2015. *This issue.*