TIMESCALES FOR THE DEVELOPMENT OF PLANETODIVERSITY IN THE EARLY SOLAR SYSTEM.

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In recent years, a variety of differentiated achondritic meteorites have been recovered that have been classified as "ungrouped" based on their chemical and isotopic characteristics (particularly their mass-independent O and Cr isotope compositions; e.g., Fig. 3 of [1]). These differentiated ungrouped achondrites likely represent crustal materials from several different planetesimals that accreted from precursor materials formed in isotopically distinct nebular reservoirs. Furthermore, these achondrites represent a significantly greater diversity of chemical and petrologic features than has been known to exist previously. For example, the bulk compositions of these achondrites range from eucrite-like ones (e.g. NWA 2976 and Bunburra Rockhole [1,2]) to ones that are significantly more silica-rich (e.g., GRA 06129/06128 and NWA 11119 [3,4]).

We have conducted high resolution chronological investigations of several of the recently recovered ungrouped differentiated achondrites in the Isotope Cosmochemistry and Geochronology Laboratory at Arizona State University, including GRA 06129/06128 [3], Bunburra Rockhole [5], NWA 2976 [2], NWA 7325 [6], and NWA 11119 [4,7]. The goal of these investigations is to gain a better understanding of the timescales over which the geochemical and petrologic diversity developed in crustal materials on planetesimals in the early Solar System. In this presentation, I will assess the age constraints that have been obtained thus far for these samples using the Pb-Pb and Al-Mg high-resolution chronometers (e.g., [2-8]). In particular, while the ungrouped achondrites with basaltic compositions yield crystallization ages of ~4563 Ma [2,6,8], the most silica-rich achondrite has an even more ancient age of ~4565 Ma [4,6]. In some cases, only upper limits on crystallization ages can be obtained (e.g., GRA 06129/06128 [3], Bunburra Rockhole [5]); however, in these cases, Al-Mg model ages assuming a bulk chondritic parent body composition suggest parent body silicate differentiation close to ~4565 Ma. These results have implications for the heat source, duration and style of igneous differentiation on planetesimals that accreted early in the history of the Solar System.

References: [1] Benedix G. et al. 2017. *Geochimica Cosmochimica Acta* 208: 145-159; [2] Bouvier A. et al. 2011. *Geochimica Cosmochimica Acta* 75: 5310-5323; [3] Shearer C. et al. 2009. *Geochimica Cosmochimica Acta* 74: 1172-1199; [4] Srinivasan P. et al. 2018. *Nature Communications*, in review; [5] Spivak-Birndorf L. et al. 2015. *Meteoritics and Planetary Science* 50: 958-975; [6] Dunlap D. et al. 2014. *80th Meteoritical Society Meeting:* #6268; [7] Dunlap D. et al. 2018. *49th Lunar and Planetary Science Conference:* #6268; [8] Koefoed P. et al. 2016. *Geochimica Cosmochimica Acta* 183: 31-45.