EXPERIMENTAL STUDY OF THE FELSIC ASTEROIDAL CRUST FORMATION RECORDED IN GRA 06128 AND GRA 06129.

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Introduction: Recently discovered paired achondrites GRA 06128 and GRA 06129 (hereafter referred to as GRAs) represent unique asteroidal magmatic processes. They could originate from a low-degree partial melt from a volatile-rich oxidized asteroid that did not segregate metallic core [1, 2]. This study performs low-degree partial melting experiments of chondrites to constrain a newly recognized style of asteroidal crust formation recorded in GRAs.

Results: Melting experiments were conducted using a gas-mixing furnace at ambient pressure with two distinct fO_2 conditions (IW and IW+2) that cover the reported fO_2 range for the magmatic condition of GRAs [2]. We used synthesized H- and CR-chondrite compositions as starting materials. Detailed experimental and analytical methods are described in [3].

The experiments were conducted at temperatures of 1050-1200 °C, resulting in variable fractions of low-degree melts (F = 6-21 %). All experimental charges contain olivine (Fo_{55-58}) and glass (Mg# = 29-33) with minor spinel and FeNi metal. Olivines in the oxidized (IW+2) experiments are distinctly enriched in Fe and Ni contents compared to those in the reducing (IW) experiments. Plagioclase (Ab_{30-47}) is present below 1090 °C. Clinopyroxene ($Wo_{46}En_{36}Fs_{17}$) and merrillite are present at 1070 °C only for the CR-chondrite composition. Clinopyroxene is characterized by high Al_2O_3 (>3 wt%) and TiO_2 (>1 wt%) contents.

Glass at both IW and IW+2 is characterized by low silica and high alkali contents (37-46 wt% SiO_2 and 2-6 wt% Na_2O), resulting in critically silica-undersaturated (nepheline normative) compositions. The degree of silica-undersaturation is more prominent in the IW+2 experiments than the IW+0 experiments.

Discussions & Conclusions: GRAs are characterized by high abundances of sodic plagioclase ($Ab_{\sim 80}$), resulting in alkali-rich felsic whole-rock compositions [1, 2]. Our study demonstrates that any low-degree partial melts of H- and CR-chondrites under the reported fO_2 conditions are critically silica-undersaturated and cannot be parental to GRAs that mainly consist of sodic plagioclase, olivine, and orthopyroxene. Mineral chemistries in the experimental charges (e.g., low-Ab contents in plagioclase) are also inconsistent with those in GRAs. Thus, our study suggests that GRAs might have formed at more reducing magmatic condition than IW, followed by post magmatic events under more oxidizing conditions (IW~IW+2). We require redox conditions low enough to produce silica-saturated liquids, but not so low that siderophile elements largely sequestered to an asteroidal core.

References: [1] Day J. M. D. et al. 2009. *Nature* 457: 179-182. [2] Shearer C. K. et al. 2010. *GCA* 74: 1172-1199. [3] Usui T. et al. 2010. Abstract #1186. 41st Lunar & Planetary Science Conference.