PRESOLAR OXIDE AND CARBONCEOUS GRAINS IN ASTEROID RYUGU AND IVUNA.

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Introduction: Presolar grains are tiny (nm- to low µm-sized) and rare dust grains that formed around dying stars and were part of the original building blocks of the Solar System. They were trapped and preserved in primitive chondrite matrices and can be identified by their highly anomalous O or C isotopic compositions. Their study allows unique insights into galactic, stellar, interstellar, and asteroidal evolutionary processes. In 2020, JAXA's Hayabusa2 spacecraft returned over 5 g of material from C-type asteroid (162173) Ryugu. Preliminary chemical and isotopic data suggests that Ryugu samples experienced extensive aqueous alteration and closely resemble the CI chondrite group [1]. We aim to characterize and ascertain the inventory of preserved presolar grains in Ryugu samples, and compare their abundances and characteristics to carbonaceous chondrites.

Methods: We used the Carnegie NanoSIMS 50L to search for presolar grains in thin sections of Ryugu (A0058-2) and Ivuna (CI1). $^{12,13}C^-$, $^{16,17,18}O^-$, $^{28}Si^-$ and $^{27}Al^{16}O^-$ ion images for contiguous 10×10 µm^2-sized frames were collected in multi-collection mode with a Cs+ primary beam (~0.7 pA), and analyzed via standard methods [2]. We further analyzed C isotopic compositions of microtomed Ryugu samples (A0108-8, -9, -11, -14; C0109-8, -11, -19) and Ryugu grains (A0108-13, C0109-2) that were pressed into Au foils, including grains from both touchdown sites (Chambers A and C). Presolar SiC grains were identified by their highly C-anomalous isotopic compositions, associated with ^{28}Si [2]. Sixteen C-anomalous grains from all Ryugu samples were remeasured for N and Si isotopes.

Results: In the Ryugu thin section, we mapped a total area of 18,400 µm^2 and identified 1 presolar oxide (Fig. 1a), 8 SiC grains and 8 grains that may be SiC or graphite. Another 10 C-anomalous presolar grains were detected in the other Ryugu samples (~10,000 µm^2 area). In the Ivuna thin section, a total area of 23,100 µm^2 was analyzed, containing 12 SiCs and 5 grains that may be SiC or graphite. The abundances of all C-anomalous presolar grains with 1σ uncertainties is 32^{+7}_{-6} ppm in Ryugu (combined from all samples) and 35^{+11}_{-8} ppm in Ivuna (Fig. 1b). The Al-rich oxide (Fig. 1a) is a highly ^{17}O-enriched Group 1 grain with a diameter of 0.26 µm. Most SiC grains have $^{12}C/^{13}C$ ratios between 13 and 69 and thus likely belong to the mainstream group, though contribution from nearby organics could dilute the extremely ^{13}C-rich signatures of type AB grains.

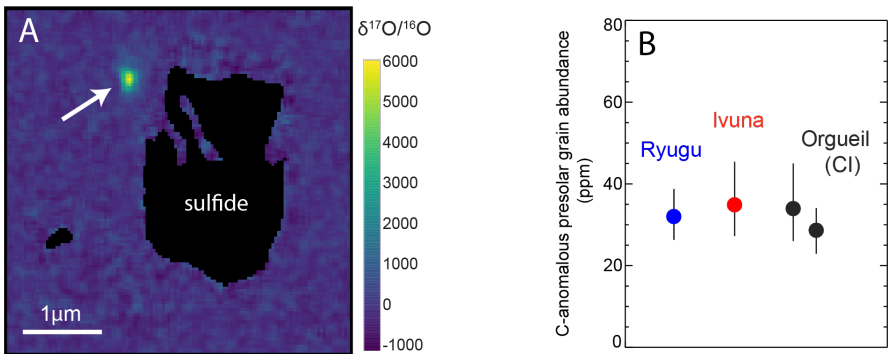

Figure 1a) Group 1 presolar oxide grain found in Ryugu with $\delta^{17}O$ = 3488 ± 179 ‰. b) C-anomalous presolar grain abundances determined in Ryugu and Ivuna. Orgueil data are SiC abundances taken from [3, 4].

Discussion: Ryugu samples contain abundant C-anomalous presolar grains. Refractory O- and C-rich phases survived the pervasive aqueous alteration that Ryugu has experienced, whereas presolar silicates were probably destroyed. The identical SiC abundance found here for Ryugu and Ivuna, which also agrees with literature data acquired by different methods for Orgueil [3, 4], further supports a Ryugu-CI connection. No differences were observed between Chamber A and C grains, although statistical errors for Chamber C are large and no thin section has been analyzed thus far.

References: [1] Yurimoto H. et al. (2022) *53rd LPSC,* abstract #1377. [2] Nittler L. R. et al. (2018) *GCA* 226:107–131. [3] Davidson J. et al. (2014) *GCA* 139:248–266. [4] Huss G. R. and Lewis R. S. (1995) *GCA* 59:115–116.