

GENESIS SOLAR WIND – CAPTURE, RETURN, CURATE AND ANALYZE: LOOKING BACKWARD REVIEWING SAMPLE COLLECTION HARDWARE. J. H. Allton¹ and C. P. Gonzalez², ¹NASA/JSC, Mail Code XI2, 2101 NASA Parkway, Houston TX 77058, judith.h.allton@nasa.gov, ²Amentum, JETSII, at NASA/JSC, Houston, TX.

Introduction: Genesis, as the first U. S. spacecraft to return astromaterial samples since Apollo, not only integrated the mission planning and flight teams, but also the science and sample curation teams during the mission development period. Since Genesis is a sample return mission, the Science Team was essential in certifying the collectors (sample containers for solar atoms) [1]. Burnett and the science team defined the purity of collector materials and ability to analyze solar wind composition to the precision required for planetary science. The science team’s choices included a variety of very pure materials which are described, including rationale for selection, in [2]. The JPL Project Scientist networked with specialty vendors refining specifications and fabricating several of the materials. JPL engineering team designed and fabricated the collector arrays. LANL designed and built an electrostatic concentrator [3]. JSC procured these materials with exacting specifications.



Fig. 1 One of 3 solar wind regime collector arrays unshaded in solar wind capture configuration (red arrow).



Fig. 2 Bulk collector array after mounting collectors.

Genesis Array Collectors as Flown:

Nine materials were flown on 5 arrays. Two arrays were exposed to the bulk solar wind, one exposed for each of three solar wind regimes. Exposure collection times: bulk 853 d, slow 334 d, fast 313 d, CME 193 d [4].

Table 1. Area in cm² for materials flown on arrays. Each hexagon is 65 cm².

	Bulk	Slow	Fast	CME
FZ silicon	2340	1430	1105	1105
CZ silicon	1755	585	455	585
Al on sapphire	845	260	325	455
Au on sapphire	780	650	845	520
Si on sapphire	585	260	260	260
Sapphire	520	260	260	390
Germanium	325	195	390	325
Diamond-like carbon	390	260	260	260
CCoAu on sapphire	130	0	0	0

Genesis Concentrator Collectors as Flown: Four “targets” of 25 mm radius were installed in the concentrator at LANL. Materials installed were two SiC, one 13-C, and one Diamond-like carbon on Silicon (DOS) [5] [6].

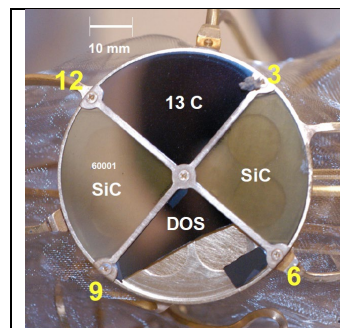


Fig. 3 Launch configuration mounting, but image was taken post recovery, showing broken DOS, the most fragile (78% of which was recovered) [.

What Survived? Size of Fragments Post-Crash:

Collector materials on silicon substrate broke into smaller pieces than sapphire substrate. Regime hexagons were more protected in the stack and average fragment area is larger.

Table 2. Size of collector fragments post-crash.

	BULK	SLOW	FAST	CME
Silicon-based				
Total Fragments	928	179	252	244
Area range, mm ²	3 to 268	5 to 212	4 to 262	5 to 184
Average area, mm ²	28	44	55	41
Sapphire-based				
Total Fragments	497	130	185	215
Area range, mm ²	4 to 5908	5 to 1296	12 to 3115	18 to 2537
Average area, mm ²	279	240	344	395

What collector materials have been most requested? Characterization of the fragments is still incomplete. The sapphire-based fragments > 2 cm are characterized, the silicon-based fragments >1cm are characterized and both groups are shown in the online catalog. When considered by number of fragments, there are more silicon fragments to choose from, and this likely contributes to the greater number of silicon-based allocations (Figs. 4 and 5).

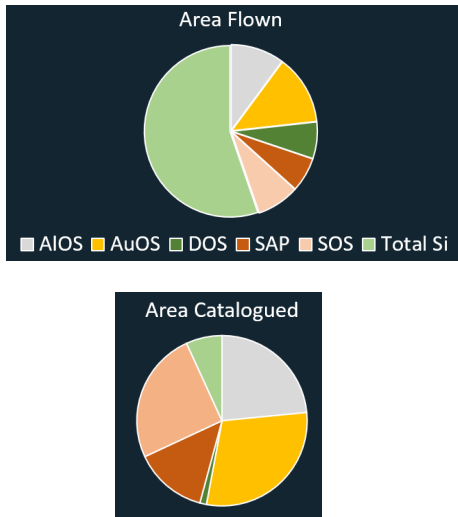


Fig. 4. Area flown compared to area catalogued for array fragments.

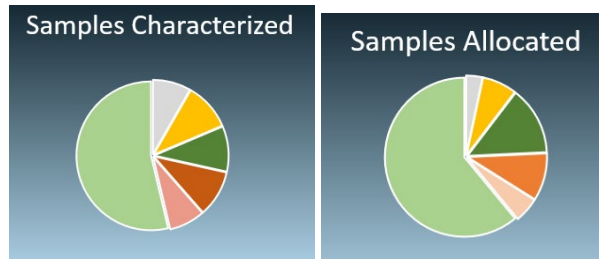


Fig. 5. Characterization and allocation of array fragments by number of fragments:

Other SW collector materials: Polished aluminum, gold foil, bulk metallic glass originally proposed for specific SW analyses have limitations, but may have a new future use. Another look at the concentrator targets may inspire. Reaching out – surfaces of the science canister may contain information for other disciplines.

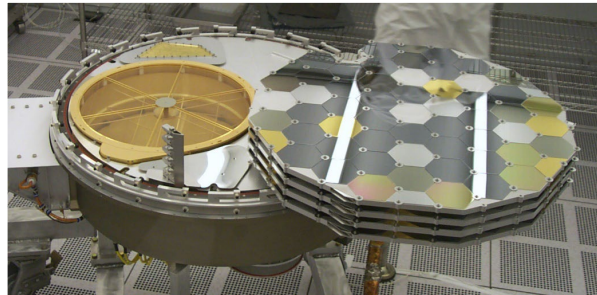


Fig. 6. View of array stack, concentrator, polished aluminum, gold foil.

References:

[1] Genesis Mission Reference Document, (2011) JPL D-62382. [2] Jurewicz A. J. G. *et al* (2003) *Space Sci. Rev.*, **105**: 535-560. [3] Nordholt J. *et al* (2003) *Space Sci. Rev.*, **105**: 561-599. [4] Reisenfeld D. *et al* (2013) *Space Sci. Rev.* DOI 10.1007/s11214-013-9960-2. [5] Allton J. *et al* (2017) 48th LPSC, # 1200. [6] Rodriguez M. (2009) 40th LPSC #1337.