THE GENESIS MISSION SOLAR WIND SAMPLES: COLLECTION TIMES, ESTIMATED FLUENCES, AND SOLAR-WIND CONDITIONS D.B. Reisenfeld[1], R.C. Wiens[2], B.L. Barraclough[2], J.E. Steinberg[2], C. De-Koning[2], T. Zurbuchen[3], D.S. Burnett[4], [1]Department of Physics & Astronomy, University of Montana (MS 1080 32 Campus Dr., Missoula, MT 59812; dan.reisenfeld@umontana.edu), [2]Space & Atmospheric Sciences, Los Alamos National Laboratory (MS D466, Los Alamos, NM 87545), [3]Atmospheric, Oceanic, and Space Sciences, University of Michigan (2455 Hayward St. Ann Arbor, MI 48109), [4]Geology & Planetary Sciences, Caltech (MS 100-23, Pasadena, CA 91125)

Introduction: The NASA Genesis mission collected solar wind on ultrapure materials between November 30, 2001 and April 1, 2004. The samples were returned to Earth September 8, 2004. Despite the hard landing that resulted from a failure of the avionics unit to deploy the parachute, many samples were returned in a condition that should permit achievment of the primary science goals of the mission. Analyses of these samples should give a far better understanding of the solar isotopic composition [1]. Further, the photospheric composition is thought to be representative of the solar nebula with a few exceptions, so that the Genesis mission will provide a baseline for the average solar nebula composition with which to compare present-day compositions of planets, meteorites, and asteroids.

However, the Genesis samples must be placed in the context of the solar and solar-wind conditions under which they were collected. Solar wind is elementally fractionated from the photosphere by the forces that accelerate the ions from the Sun. The elemental fractionations differ for the different solar-wind regimes [e.g., 2,3], of which Genesis collected separate samples. Isotopic fractionation of solar wind is still ambiguous, and constraining it is a major initial goal of Genesis.

For this reason, plasma ion and electron spectrometers continuously monitored the solar wind proton density, velocity, temperature, the alpha/proton ratio, and angular distribution of suprathermal electrons, and used these parameters to distinguish between the solar-wind regimes during collection. In addition, other spacecraft were monitoring the solar-wind conditions from the L1 orbit at the same time. Here we report on the solar-wind conditions and regime-selection parameters from *in-situ* instruments over the course of the collection period.

Solar-Wind Regimes: The interstream (IS), or slow (< 500 km/s), solar wind is the dominant regime encountered in the ecliptic. It is consistently fractionated based on first ionization potential (FIP), with elements having FIPs below 10 eV enhanced by a factor of about four relative to high-FIP elements. Coronal hole (CH) material is characterized by high velocity (500-800 km/s) and a relatively low FIP fractionation of around 2, with a consistent alpha/proton ratio of ~0.043. The Ulysses mission showed that CH is the dominant regime over the solar poles, particularly during the low-activity portion of the solar cycle [4]. Coronal mass ejections (CMEs) are characterized by strong and often uneven enrichments of heavy elements, including alpha/proton ratios often > 10%.

Collection Times and Fluences: Capsule lid foils, which were the only samples located outside the sample canister ("SRC Lid Foil Collectors"), were exposed a total of 886.84 days. Continuously exposed samples inside the canister collected solar wind for a total of 852.83 days. These include the "B" and "C" arrays, and the aluminum and gold "kidney" collectors. The Solar-Wind Concentrator was in operation for 803.28 days. The regime-specific arrays were exposed for the times listed in Table 1, which also gives proton and alpha particle fluences estimated from monitor data, and projected heavy ion fluences. The projected heavy ion fluences are based on the ratios of solar abundances [6] to helium fluences measured by the Genesis Ion Monitor (GIM) [5]. Note that the most recent compilation of solar elemental abundances [6] has significantly revised many of the volatile heavy elements (C,N,O, noble gases) relative to Anders and Grevesse [7].

Composition Analyses From In-Situ Detectors: Abundance ratios of He/H were measured with GIM. In addition, the Advanced Composition Explorer (ACE) Solar Wind Ion Composition (SWICS) instrument measures abundances of a number of heavy elements in the solar wind. Fig. 1, updated from [8] shows the abundance ratios of Mg/O from SWICS and He/H from GIM. The Mg/O, and to a lesser extent, the He/H ratios show well-known trends in elemental fractionation between fast and slow wind. Based on earlier solar abundance estimates, the low first-ionization potential (FIP) elements were considered to be fractionated more in the slow wind, with relatively little elemental fractionation for coronal hole (fast) wind. Based on the new solar abundance estimates, the average fractionation is now zero, with the fast and slow regimes fractionated by equal and opposite amounts from the astronomically-derived solar abundances.

H and He are both high-FIP elements. Relative to Mg/O, the overall difference in He/H between fast and slow wind is smaller but still significant. This difference may reflect the effects of Coulomb drag [cf. 3], or could reflect differences due to the FIPs of these elements.

References: [1] Burnett D.S. et al. (2003) *Spa. Sci. Rev. 105*, 509-534. [2] Neugebauer M. (1991) *Science 252*, 404-409. [3] Bochsler P. (2000) *Rev. Geophys. 38*, 247-266. [4] McComas D.J. et al. (2002) *Geophys. Res. Lett. 29*, 1314-1317. [5] Barraclough B.L. et al (2003) *Spa. Sci. Rev. 105,* 627-660. [6] Asplund M., Grevesse N., and Sauval A.J. (2005) The Solar Chemical Composition, in *Cosmic Abundances as Records of Stellar Evolution and Nucleosynthesis, ASP Conference Series, Vol. XXX*, F.N. Bash, T.G. Barnes, eds., in press. [7] Anders E. and Grevesse N. (1989) *Geochim. Cosmochim. Acta* 53, 197-214. [8] Reisenfeld D.B. et al. (2003) *Solar Wind X* (M. Velli, R. Bruno, F. Malara, eds.) *AIP Conf. Proc. 679,* 632-635.

Table 1. In-situ measured and estimated solar-wind fluences for Genesis collectors.

	SRC Lid	B & C Arrays	Interstream	Coronal Hole	CME
Exposure (days)	886.84	852.83	333.67	313.01	193.25
H fluence (cm^{-2})	1.9e16	1.9e16	8.3e15	5.9e15	4.0e15
He fluence (cm^{-2})	7.3e14	7.2e14	2.8e14	2.1e14	1.8e14
O fluence (cm^{-2})	4e12	4e12	2e12	1e12	1e12
Ne fluence (cm^{-2})	6e11	6e11	2e11	2e11	2e11
Fe fluence (cm^{-2})	2e11	2e11	9e10	7e10	6e10
Xe fluence (cm^{-2})	2e6	2e6	6e5	5e5	4e5
U fluence (cm^{-2})	3e3	3e3	1e3	8e2	6e2

H and He fluences estimated from GIM data. O, Ne, Fe, Xe, U fluences projected from solar abundances.

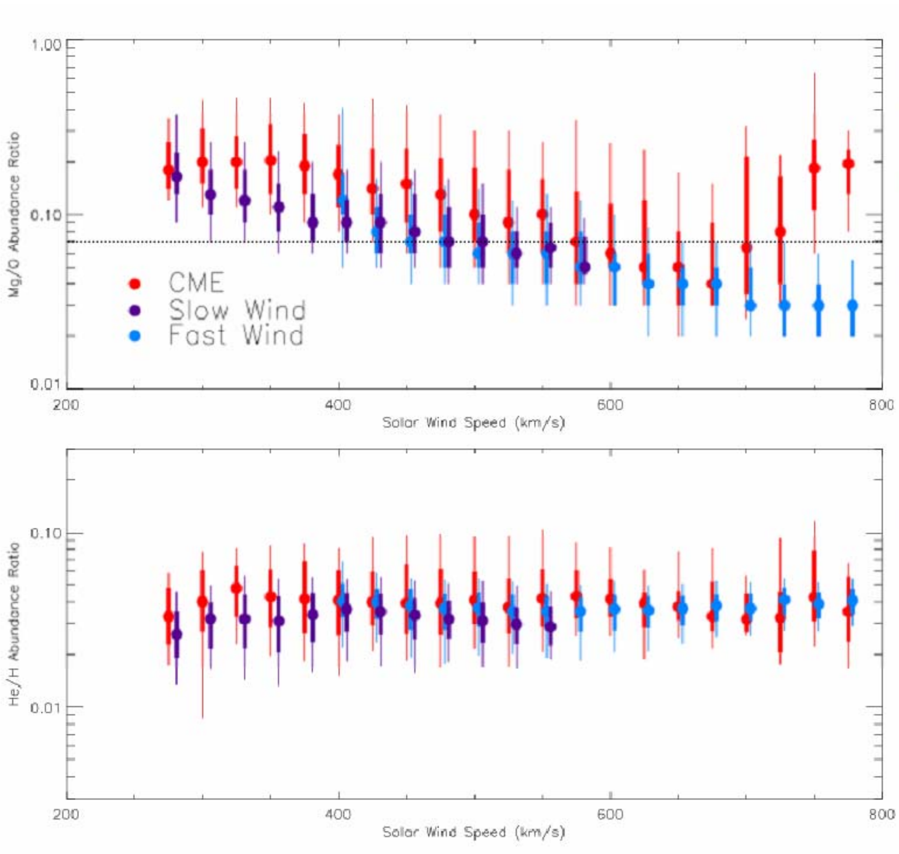

Fig. 1. Solar-wind compositional data as a function of solar wind speed and regime during the Genesis collection period. Mg/O data are from ACE/SWICS, based on the Genesis regime selection. The dashed line indicates the solar abundance ratio. He/H data are from Genesis/GIM. Each bar represents the distribution of measurements within a 25 km/s-wide velocity bin. The dot indicates the median value; the thick bar spans the 25% to 75%-ile range of the distribution; and the thin bar spans the 10% to 90%-ile range.