Highlights of Astronomy, Volume 14
IAU XXVI General Assembly, 14-25 August 2006
Karel A. van der Hucht, ed.

doi:10.1017/S1743921307010848

Genesis discovery mission science results

Donald S. Burnett

Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA
email: burnett@gps.caltech.edu

Abstract. Results of the Genesis mission to sample the solar wind are summarized.

Keywords. Solar wind, space vehicles

1. Results

Genesis returned samples of high purity materials exposed to the solar wind for 27 months, including separate samples of 3 solar wind regimes. The science objectives of the mission are to measure solar isotopic and elemental abundances to a precision sufficient to address planetary science problems.

A crash upon Earth return resulted in massive breakage of collector materials, serious losses of large amounts of materials, and particulate surface contamination. However, atoms are not destroyed by impact. We have over 15,000 pieces of collector materials greater than 3 mm in size. We can show that the implanted solar wind resides safely beneath the surface of the collector materials, while the contamination is on the surface. We have a margin of only 100 Å, but, because we are a sample return mission, we can use all of the twenty-first century's technology to exploit this margin. We were fortunate in that three-fifths of the materials for dedicated experiments survived in relatively good shape.

A major issue is the extent to which the acceleration of the solar wind has modified elemental and isotopic abundances from the photospheric values. Spacecraft studies show that elements with first ionization potential (FIP) greater than 9 eV are depleted in the solar wind relative to lower FIP elements, but the lower FIP elements, which make up most of terrestrial planet material, appear unfractionated. Our preliminary *Genesis* Fe/Mg is 0.78, which is in good agreement with both spacecraft data and the photospheric absorption line ratio.

Little is known about isotopic fractionation in the solar wind, but our regime samples represent materials formed by different solar processes. The isotopic compositions of Ne and Ar in the different regime samples agree with permil level precision. There is no evidence for isotope fractionation in the solar wind relative to the photosphere.

A sample of bulk metallic glass (BMG) which etches uniformly with nitric acid vapor was recovered intact. This sample provides a check on the presence of higher energy (SEP) solar ions with different isotopic compositons. Extensive lunar sample analyses indicated an SEP $^{20}Ne/^{22}Ne$ ratio of 11.4 compared to 13.7 for the solar wind. BMG etching produced a continuously dropping 20/22 ratio down to at least 10.8. The trend matches exactly what is seen in lunar samples; however, the trend can be quantitatively reproduced by allowing for the differential implantation of ^{22}Ne and ^{20}Ne, and differential implantation appears to explain the lunar results as well.

2. Mission details

Launch date: 8 August 2001

Collector opened: 30 November 2001

Collector closed: 1 April 2004

Return to Earth: 8 September 2004

Payload mass: 494 kg

Primary science instrument:

Three distinct collector arrays, each a grid of ultra-pure wafers of silicon, gold, sapphire, diamond and other materials, designed to collect solar wind particles during different periods of solar wind activity.

An electrostatic mirror (concentrator): focuses incoming O and N ions from a diameter of about 20 cm onto a 6 cm diameter set of target materials, to increase the signal for these particular elements.

3. For further information

A detailed description of the *Genesis* mission can be found in Burnett *et al.* (2003). Results from the mission have yet to be published in one place, but can be found in abstract form in the 2006 meetings of the American Geophysical Union and the Meteoritical Society. One result recently published in Grimberg *et al.* (2003) compares the solar wind neon measured by Genesis with that found in the lunar noble gas record, concluding that the solar neon isotope composition seen in lunar samples may be due to the solar wind being fractionated during implantation.

References

Burnett, D. S., Barraclough, B. L., Bennett, R., Neugebauer, M., Oldham, L. P., Sasaki, C. N., Sevilla, D., Smith, N., Stansbery, E., Sweetnam D., & Wiens R. C. 2003, *Space Sci. Revs*, 105, 509

Grimberg, A., Baur, H., Bochsler, P., Bühler, F., Burnett, D. S., Hays, C. C., Heber, V. S., Jurewicz, A. J. G., & Wieler, R. 2006, *Science*, 314, 1133