COMPOSITION OF THE SOLAR WIND. S. T. Suess, National Space Science & Technology Center, NASA Marshall Space Flight Center, Mail Code VP62, Huntsville, Alabama 35812, USA, email: steven.t.suess@nasa.gov.

Introduction: The solar wind reflects the composition of the Sun and physical processes in the corona. Analysis produces information on how the solar system was formed and on physical processes in the corona. The analysis can also produce information on the local interstellar medium, galactic evolution, comets in the solar wind, dust in the heliosphere, and matter escaping from planets.

History: The first measurement of solar wind composition was done by exposing aluminum foil on the surface of the Moon and by studying implanted ions in lunar rocks and soils. The asbsence of a significant lunar magnetic field means the solar wind impinges directly on the lunar surface and on the foils. Ions were embedded in the foils and later analyzed by acid etching after return to Earth. This revealed the particle tracks, and permitted recovering a portion the trapped material. Not only elements, but also individual isotopes were measured.

In intervening years, plasma detectors have been developed that analyze solar wind charge state and composition. The first of these was the Solar Wind Ionization and Charge state Spectrometer (SWICS) on Ulysses. The Gensis mission is the latest attempt to more deeply probe the composition of the solar wind. This mission used the Apollo approach in a modern context – samples of various types of material (ceramics, metals, ...) were exposed to the solar wind for varying lengths of time up to months (cumulative). A small solar wind plasma instrument determined the instantaneous type of solar wind (fast, slow, transient). Three sets of surfaces were exposed, each only to one type of wind. This is because solar wind composition depends on the type of solar wind. For rarer elements, an electrostatic concentrator was employed to enhance the effectiive collecting area.

Why the Moon?: Deployment on the Moon circumvents several limitations imposed on Gensis. The first advantage is that the Moon provides a benign, stable platform in the solar wind. The second is that there is not the physical limitation on collecting area inherent on a freely flying spacecraft. The range of particle fluxes varies by perhaps up to 10^{10}. Genesis and the lunar foils were therefore excluded from analyzing the rarest species. The third advantage is that exposure times can be relatively long. Although a new lunar experiment would not be as simple as the ‘roller shade’ lunar foils that were deployed in 1969-1974, they would be very simple in comparison to any modern spacecraft flight experiment.

Requirements for the Moon: For lunar deployment, the simplest set of instruments would be a stationary array of materials like flown on Genesis. With sufficiently long exposures, this would produce improved results for minor species. A better experiment would have solar arrays and a solar wind monitor with deployable collectors that extend for differing solar wind regims. An electrostatic concentrator, achieving enhancements of more than 20, would probe minor species even more deeply. Technically, the instrument would be an evolutionary advance over Genesis.

Anticipated Results: The best way to illustrate the types of results that can be anticipated is to list some of the results from the lunar foils, lunar soils, SOHO/CELIAS, and Ulysses/SWICS. These are: Measurement of the Abundance of Helium-3 in the Sun and in the Local Interstellar Cloud with ULYSSES/SWICS [1]. Isotopic composition of solar wind neon [2]. SWICS/Ulysses observations: The three-dimensional structure of the heliosphere in the declining/minimum phase of the solar cycle [3]. An Empirical Study of the Electron Temperature and Heavy Ion Velocities in the South Polar Coronal Hole [4]. Origin of the Solar Wind From Composition Data [5]. Chemical evolution in our galaxy during the last 5 Gyr [6]. Unusual composition of the solar wind in the 203 May 1998 CME observed with SWICS on ACE [7]. Elemental composition of the inner source pickup ions [8]. Implication of the observed anticorrelation between solar wind speed and coronal electron temperature [9]. These papers reflect the broad range of subjects mentioned in the Introduction.

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