

Towards accurate analyzes of Genesis Solar Wind samples: evaluation of surface cleaning methods using
Total Reflection X-ray Fluorescence Spectrometry

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Total reflection X-ray fluorescence spectrometry (TXRF) was used to analyze surface contaminations on Genesis solar wind samples to determine the suitability of different cleaning methods. The Genesis mission was the first mission returning solar material to Earth since the Apollo program. Solar wind was collected during a period of 854 days on collectors made of various ultra clean materials such as silicon, sapphire and silicon-on-sapphire. Unfortunately the collector material acquired surface contamination and fractured into small pieces upon return of the capsule to Earth. This presents new challenges for analysis of the solar wind material embedded into the collectors. Different cleaning procedures were developed and are still in the process of development for removal of larger and smaller particles as well as film like contamination. An ultrapure water and ozone UV radiation treatment is routinely applied to the samples by the curatorial team at NASA's Johnson Space Center. Additional cleaning steps involve various forms of acid treatment and/or carbon dioxide snow treatment. After each cleaning the samples were analyzed by lab-based total reflection X-ray fluorescence for remaining contaminants. The analysis comprised of manually mapping the samples by orienting them with respect to the incident X-ray beam in such way that different regions were covered. The results showed that cleaning with concentrated hydrochloric acids and aqua regia decreased inorganic contaminants in most samples, but some persistent contaminants remained. Subsequent cleaning with a combination of hydrochloric and hydrofluoric acid removed the majority of these contaminants, but increased surface roughness in some samples. Since solar wind material might be embedded relatively shallow under the surface, how much solar wind was removed by this treatment must be evaluated. Application of carbon dioxide snow for surface cleaning is currently being tested as well. Carbon dioxide snow should not result in any surface roughening, but remove most of the more persistent contaminants by dissolving them. In an effort to identify very persistent contaminants, selected samples were subjected to environmental scanning electron microscopy. The results showed a good agreement with TXRF analysis.