

# Solid Phase Extraction on Reverse Phase Chromatographic Media Subjected to Stresses

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## ABOUT THE STUDY

The solid phase sample preparation techniques, such as solid phase extraction, will likely be required for particles analysis of liquid samples collected from bodies in our solar system that contain liquid, to concentration and desalt analytes of interest from the expected brines on these ocean Worlds. Media to be used for these extraction procedures will have to survive the stresses of the long spaceflight required to reach these bodies, and remain functional once at that location. This work utilized tryptophan as an initial representative analyte to evaluate capture and desalting efficiencies *in silica* and polymeric reverse phase media, to determine how these solid phases might withstand stresses they could experience during deployment, including vacuum exposure, freezing, and heating/sonication treatments.

Further experimentation on irradiation and long term freezing of media with an expanded array of analytes evaluated the utility of reverse phase media for this application. Kromasil C-18 silica particles performed well, showing no loss in capture or desalting efficiency for the initial stress treatments or irradiation, but long term freezing after irradiation caused issues with this media. Oasis HLB polymeric particles performed better, with 100% capture efficiency and 90% recovery of the tryptophan analyte for all treated and the untreated media.

The development of analytical methods particles analysis of the atmospheres and materials from other planetary and transitory bodies in our solar system has been an international effort for a number of years. These efforts have resulted in missions to Mars and Venus, the Galileo mission detailing the Jovian atmosphere, and the Cassini-Huygens effort that explored the rings of Saturn and the atmosphere and reactions taking place above the surface of Titan. The Mars Science Laboratory mission provided the basis for direct surface sampling for *in situ* analysis through the Sample Analysis at Mars (SAM) instrument suite.

The Cassini mission performed particle the analysis of organic all compounds escaping the surface of Enceladus on emitted ice

grains, while the Rosetta mission to Comet 67 P/Churyumov-Gerasimenko allowed for particles analysis of cometary material. A number of recent missions to comets, asteroids, and Mars, are collecting samples that are to be returned to earth, where the full suite of analytical methods available to scientists can be employed to analyze and evaluate the materials collected. For *in situ* analysis, however, the constraints on space instrumentation including mass, size, mechanical strength, automation and energy consumption, and the limitations on the amounts and types of reagents that can be transported severely limit the kinds of analyses that can be performed.

Spectroscopic instruments provide some direct information on the molecules and minerals present in either the atmosphere or the surface layer. Landing instruments on Mars has allowed subsurface molecules to be detected through drilling or surface ablation. Direct crashes into the surface of various bodies have also provided plumes or ejection of subsurface material that could be analyzed spectroscopically *in situ*. Unfortunately, many of the molecules of interest for detection of current or past life on these bodies are not spectroscopically active, and thus are not going to be detected in this way.

Mass spectrometry (MS), has also been a workhorse detector for extraterrestrial analytical missions, providing data on the masses of the molecular ions or ionized fragments generated from a sample. While these materials were often gas samples, laser ablation of solids or pyrolysis has provided information on volatile molecules in rock and soil samples as well. Since both analytes of interest and unknown/unknowable interferents are likely present in any given sample, a separation method is often also employed before the MS analysis. By breaking a single sample into multiple, time resolved fractions entering the MS detector, a separation step allows for easier interpretation of the mass data to determine what compounds may be present.

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