SURFACE COMPOSITION OF ASTEROIDS MEASURED USING A DUST ANALYZER INSTRUMENT.

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Introduction: The compositional diversity of asteroids is key to the understanding their origina and processing in the space environment, which in turns reveals details about the formation and the history of the Solar System. An alternative to remote sensing method to measure the composition of the surface material of these objects is using a dust analyzer instrument. Asteroids, similarly to all airless bodies, are engulfed in a cloud of ejecta particle originating from the surface and released due to the continual bombardment by micrometeoroids. Current models of ejecta production rates suggest that the number densities of such dust clouds are sufficiently large to allow for a compositional analysis of a statistically significant number of samples (>100) from a flyby at a reasonable altitudes from the surface (~100 km). In order to demonstrate the science potential of this method, we have performed a set of laboratory measurments using the dust accelerator operated at the University of Colorado and the laboratory prototype of the SUDA (Surface Dust Analyzer) instrument. The dust samples used in these experiments were saponite and olivine samples that were ground into micron and submicron size range and coated with platinum for usability in the accelerator. The 3 MV electrostatic accelerator was used to accelerate the particles to 1-50 km/s velocities. The SUDA instrument then was used to measure the mass spectra of individual dust grains after they impact-ionized on a clean iridiaum coated target surface. The SUDA prototype instrument is a reflectron-type time-of-flight mass analyzer that combines larger target area and high mass resolution, and is under development for the upcoming Europa mission.

The saponate and olive analog samples were selected for a particular reason to demonstrate the capability of detecting the water mass lines in the mass spectrum of water bearing minerals (saponite). Over 1,000 individual mass spectra from individual impact events were collected. The analsysis of the data demonstrates that the mass specta bear information on the mineralogy of the measured samples. The collected spectra and their variation with impact speed are also imporatan for future missions to identify the elemental and some extend the chemical makeup of particels detected in space.

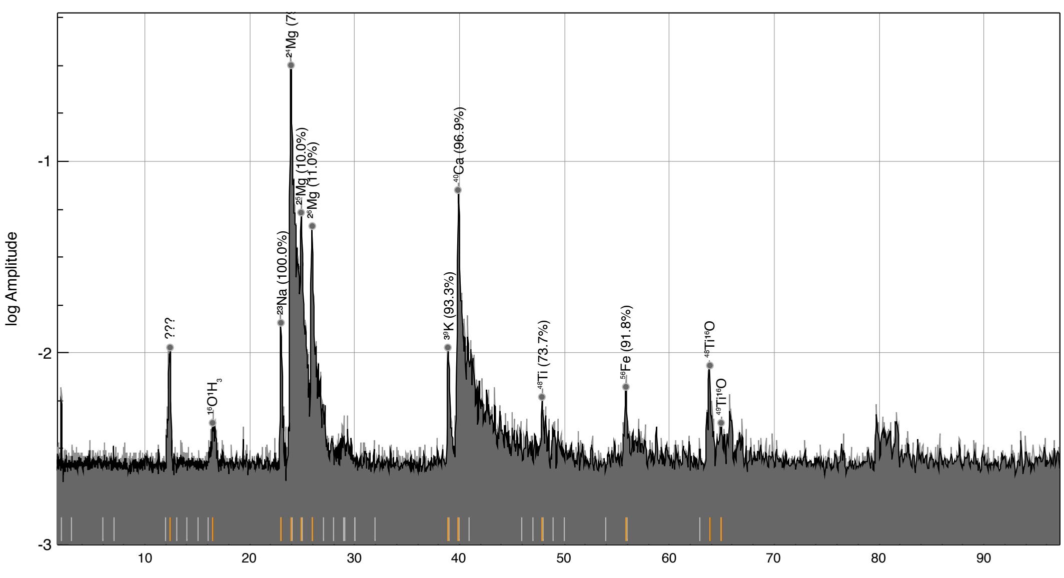

Figure: A sample of the measured saponite mass specta measured with the SUDA prototype instrument. The spectra clearly shows the elements present in the mineral ($Ca_{0.25}(Mg,Fe)_3((Si,Al)_4O_{10})(OH)_2 \cdot n(H_2O)$.), includingthe signatures of water.