Poster 188

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Abstract book, poster P55, p. 76
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Alkali Metals in Cometary Particles – what is the Chemical Context?

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The Rosetta mission is one of the few endeavors to visit a comet and to sample its coma. The COSIMA instrument on board Rosetta catches the dust and analyses it with its time of flight secondary ion mass spectrometer (SIMS).

Grains from 67P contain elements like sodium and others (Schulz et al., 2015). In this work we try to get an idea on the context in which the alkali metals Li, Na and K, as far as we can detect them, are present in the cometary particles. Correlation based methods are used to find associated elements and compounds.

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COSIMA is a time-of-flight secondary ion mass spectrometer on board the Rosetta spacecraft and is analysing cometary grains ejected off the nucleus of comet 67P/Churyumov-Gerasimenko since August 2014 [1,2,3]. In our effort to understand the composition and the history of these cometary particles, we integrated several hundred mass spectra and looked at the alkali composition. We also studied the characteristics of different meteorite samples with the COSIMA reference instruments at the Max Planck Institute for Solar System Research in Göttingen (Germany), with the goal to separate individual compounds and their fragmentation patterns.

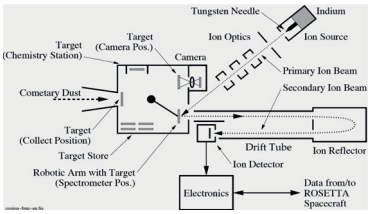

Figure 1: Diagram of the COSIMA flight model. COSIMA is a time of flight secondary ion mass spectrometer with a mass resolution of about 1:1400 at 100u.

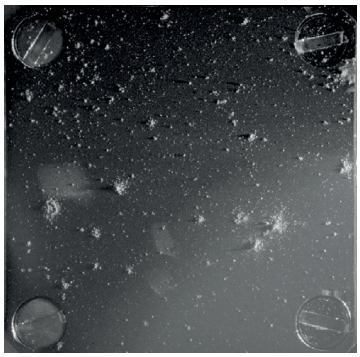

Figure 2: A COSIMA target plate (1cm x 1cm) with particles of various appearance, collected inside the coma of 67P [4]. Several of these grains were measured with COSIMA ToF-SIMS on board Rosetta.

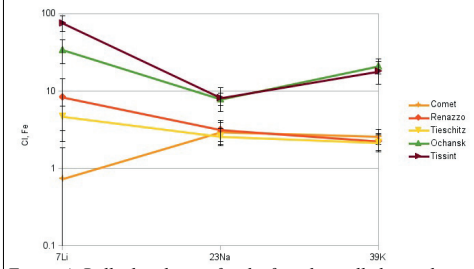

Figure 4: Bulk abundances for the first three alkali metals from the particles found on a single target (Fig. 2) and for four meteorite samples we measured with the COSIMA reference model [5,6]. All abundances are normalized to iron content and to CI reference values [7]. The error bars give the 2 sigma deviation from the variation within our samples. The actual errors might be a bit higher, since here, we do not account for the RSF uncertainties. For Na and K, we used RSFs from [8], for Li we adopped an RSF from [9].

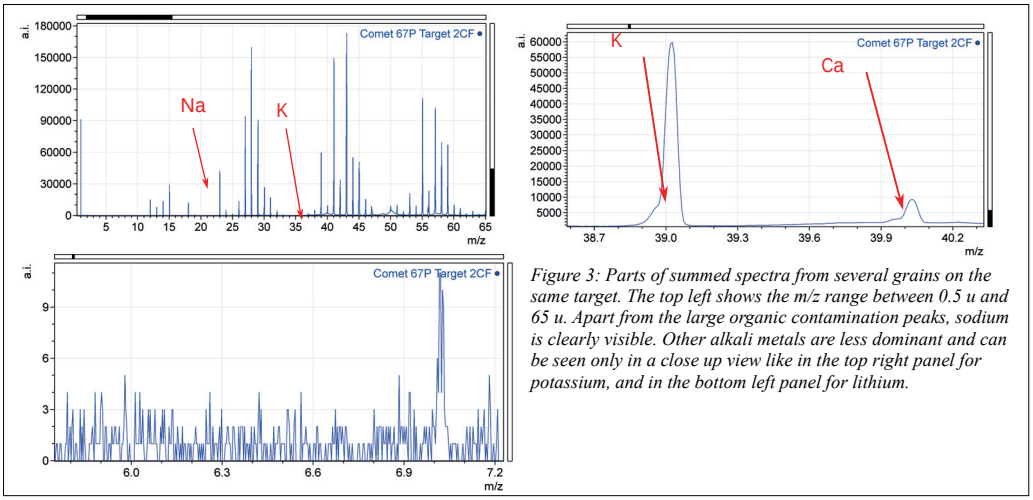

Figure 3: Parts of summed spectra from several grains on the same target. The top left shows the m/z range between 0.5 u and 65 u. Apart from the large organic contamination peaks, sodium is clearly visible. Other alkali metals are less dominant and can be seen only in a close up view like in the top right panel for potassium, and in the bottom left panel for lithium.

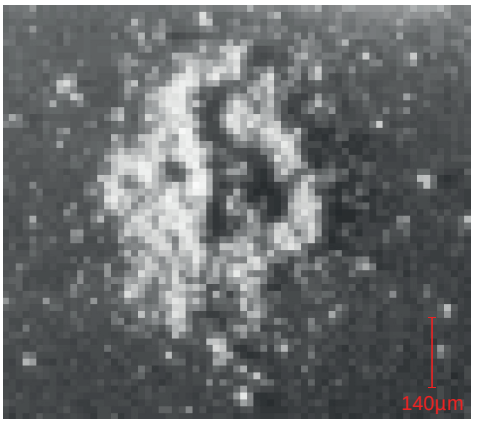

Figure 5: The particle Jessica, collected during 2015 on a gold black target inside the coma of 67P (Fig. 2). Jessica splashed onto the target, leaving a large area covered with cometary material. The SIMS process gives information only of the composition of the top most layers of a material. Therefore, grains like these give us the opportunity to look for compositional variations within cometary particles.

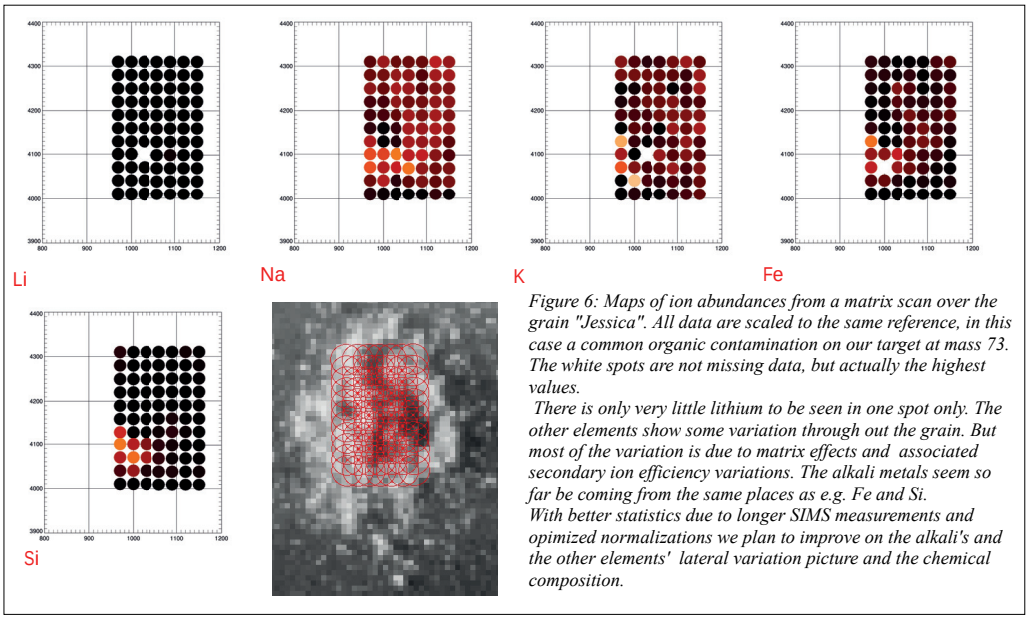

Figure 6: Maps of ion abundances from a matrix scan over the grain "Jessica". All data are scaled to the same reference, in this case a common organic contamination on our target at mass 73. The white spots are not missing data, but actually the highest values.
There is only very little lithium to be seen in one spot only. The other elements show some variation through out the grain. But most of the variation is due to matrix effects and associated secondary ion efficiency variations. The alkali metals seem so far be coming from the same places as e.g. Fe and Si.
With better statistics due to longer SIMS measurements and opimized normalizations we plan to improve on the alkali's and the other elements' lateral variation picture and the chemical composition.

Acknowledgements

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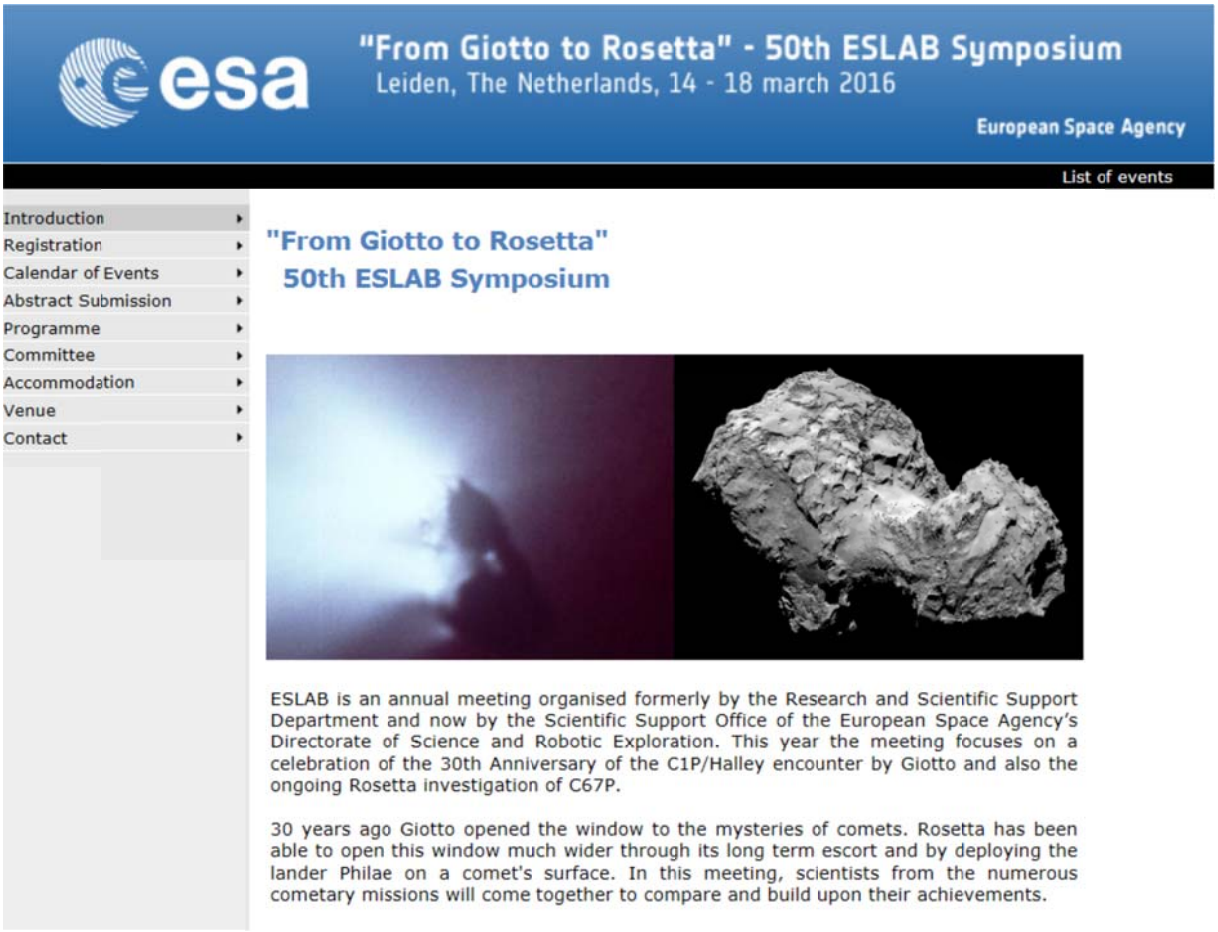

Poster P55, Abstract book, p. 76

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