EPSC Abstracts,
Vol. 4, EPSC2009-348-1, 2009
European Planetary Science Congress,

Exospheric signatures of alkali abundances in Europa's regolith

F. Cipriani (1), F. Leblanc (2), O. Witasse (1) and R.E. Johnson (3)

(1) ESA/ESTEC, Noordwijk, Netherlands (fciprian@rssd.esa.int / Fax: +31-71-5654697), (2) LATMOS/IPSL, CNRS, Verrières Le Buisson, France, (3) University of Virginia, Charlottesville, USA

Abstract

We carried out 3D Monte Carlo simulations of the sodium and potassium content of Europa's exospheres and surface induced by the surface bombardment by Jupiter magnetospheric ions and electrons.

We used observations of the exospheric Na/K ratio by Brown (2001) to adjust Na and K surface source rates. We find a ratio of the source rates close to 17, in good agreement with Johnson et al (2002). This in turn led to an average Na/K ratio in the surface that is close to 7. This implies there is a significant enrichment in the surface of potassium compared to sodium, due to preferential escape of sodium. Interestingly, we observe a steep increase in the Na to K ratio in the exosphere densities within 2 Europa's radii. This ratio varies with distance from Europa from the surface value of 7 up to the observed value of 26. Such increase vs altitude is directly related to the energy distributions of the ejected species and gives an observable parameter allowing characterization of the ejection processes by a Europa orbiter.

The variations of the calculated Na/K ratio at the surface will be related with the surface albedo derived from McEwen (1986) in 3 different areas of Europa's surface : a longitude band between 60°W and 90°W (low albedo surface features associated with an area of large mottled terrains next to bright plains), between 270°W and 300°W (high percentage of lineas features and mottled terrains, no bright plain), and an area centered 6°N, 322°W about 500km by 300 km (hummocky (mottled) terrains observed by Galileo).

Based on the analysis of the variations with altitude of the Na/K exospheric ratio over such areas, significant low altitude exospheric signatures of surface composition inhomogeneities could be easily detectable above 100 km in altitude when the surface ratio in a 20° width region is two times larger than its surrounding value. Such regions could correspond to areas having a high non-ice fraction and/or altered by warm ice/water resurfacing events. Therefore, in situ measurements of the exospheric composition should allow one to retrieve crucial information on the variations of the surface composition.

References

[1] Brown, M.E. (2001) *Icarus* 151, 190–195.
[2] Johnson, R.E. et al. (2002) *Icarus* 156, 136-142.
[3] McEwen, A. (1986) JGR, 91, 8077-8097.