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Compositional profile of the Enceladus dust plume

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Saturn's icy moon Enceladus emits jets of water vapour and ice particles from fractures near its south pole [1, 2, 3, 4]. Data obtained by the Cassini Cosmic Dust Analyser (CDA) during recent close flybys of Enceladus will be presented. Prior compositional measurements of E ring grains suggested salt-rich water as the dominant source of Enceladus' famous plume [5]. Although the E ring dust population is dominated by ice particles stemming from Enceladus it was unclear if their composition might have been altered in comparison to freshly ejected particles. Moreover, it was not clear if the populations ejected into the E ring are not prone to selection effects (e.g. that certain species preferably escape the moon whereas others preferably fall back). During 2008 and 2009 Cassini passed deep into the plumes on several occasions, allowing the CDA team to analyse the compositions of freshly ejected plume particles for the first time. From this information a compositional profile of the plume has been inferred. The compositional grain types found within the E ring also dominate the plume. However, the profile along Cassini's trajectory shows strong variations, in particular a steep increase of salt rich grains close to Enceladus' surface. The measurement shows that salt rich particles indeed dominate the mass production of the Enceladian dust plumes. Moreover, there is indication for increased abundence of ice grains containing organic compounds in the densest part of the plume. Our refined numerical modelling, including gas and dust dynamics and production, successfully reproduces the measured compositional profile of the plume. The best fit requires as a dominant slow diffuse plume component along the tiger stripes as well as supersonic, collimated jets [6, 7]. Our results are not in agreement with plumes fuelled by ice sublimation and clearly favour a liquid salt water plume source close to Enceladus icy surface.

References:
[1] Spahn, F. et al., Science 311, (2006)
[2] Hansen, C. J. et al., Science 311, (2006)
[3] Porco, C. C. et al. Science (2006)
[4] Spencer, J. R. et al. Science (2006)
[5] Postberg, F. et al., Nature, (2009)
[6] Spitale, J. N., Porco, C. C., Nature (2007)
[7] Hansen, C.J. et al., Nature (2008)