EPSC Abstracts
Vol. 8, EPSC2013-423, 2013
European Planetary Science Congress 2013

Mineral clouds and ionisation processes in extrasolar, planetary atmospheres

Ch. Helling (1), M. Jardine (1), C. R. Stark (1), P. Rimmer (1), D. A. Diver (2)
(1) SUPA, University of St Andrews, St Andrews, UK (email: ch@leap2010.eu)
(2) SUPA, University of Glasgow, Glasgow, UK

Abstract

The steady increase of the know extrasolar planets broadens our knowledge and at the same time, reveals our lack of understanding. The habitability of a planet depends, amongst other things, on the exposure of the planetary surface to radiation, how clouds form and which effect clouds have on the composition and on the electric state of the gas from which they form.

We have studied the formation of mineral clouds (Fig. 1) on planetary atmospheres using a kinetic approach which allows us to predict the size distribution and material composition of the cloud particles. Using theses results we have investigated whether such clouds can be charged and under which conditions an electric field breakdown of the ambient gas, such as lightning or other transient luminous events, may occur. Our results suggest that different intra-cloud discharge processes dominate at different heights inside a cloud. We discuss the efficiency of electric field breakdowns and the electron enrichment (Fig. 2) to be expected in extrasolar atmospheres.

Acknowledgements

We highlight financial support of the European Community under the FP7 by an ERC starting grant.

References

[1] Helling, Ch., Jardine, M., Diver, D., Witte, S. 2013a, P&SS 77, 152

[2] Helling, Ch., Jardine, M., Stark, C., Diver, D. 2013b, ApJ 767 136

[3] Helling, Ch., Jardine, M., Mokler, F. 2011, ApJ 737, 38

[4] Helling, Ch., Woitke, P., Thi, W.-F. 2008, A&A 485, 547

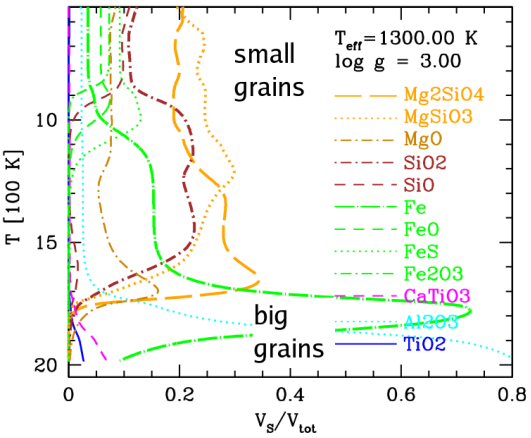

Figure 1: The material composition of the cloud particles: The top of the cloud is made of small ($< 1\mu$m) silicates grains with inclusions of various iron compounds. The cloud base at higher temperature is made of big iron grains with inclusions from Al_2O_3[s], TiO_2[s], $CaTiO_3$[s]. The calculations were carried out for a giant gas planet atmosphere models (Helling et al. 2013a).

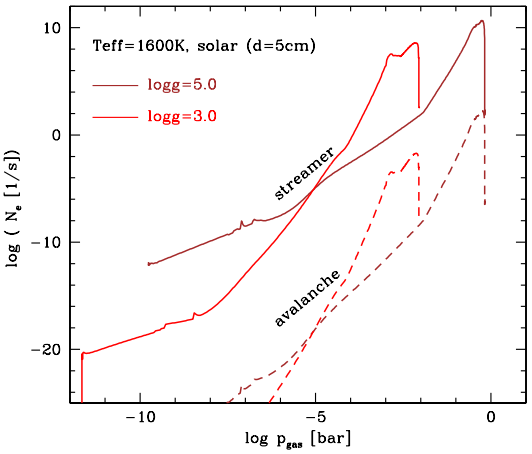

Figure 2: Gas-phase enrichment by dust-dust collision triggered discharges. Electron avalanche (dashed) yields considerably less free charges than streamer events (solid) (Helling et al. 2013b).