Silicate Atmosphere & Clouds of Hot Earth-like Exoplanets.

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Introduction: The discovery of the rocky exoplanet CoRoT-Exo-7b, with day side surface temperatures between 1800 – 2600 K [1], shows that some exoplanets are hot enough to vaporize silicates. We predict that the atmospheres of these planets will contain O_2, O, rock-forming metals, and silicate clouds.

Methods: We used thermochemical equilibrium calculations to model the gas-melt interactions on an Earth-like exoplanet at T = 1500 – 3000 K. We used several starting compositions, including: continental crust, oceanic crust (N-MORB), lunar crust, and the bulk silicate Earth (BSE) (shown below). We include the elements Na, K, Fe, Mg, Si, Ti, Ca, Al, and O. Results are given as a function of surface T. Our companion abstract [2] discusses the effect of fractional vaporization on the atmospheric composition.

Results: At low temperatures, Na is the major gas, followed by O_2 and monatomic O (Figure 1). As temperature increases, the Na gas abundance decreases, and the abundances of other gases increase. At T > 3000 K, SiO becomes the most abundant gas. Total pressure decreases in the order N-MORB, BSE, continental crust, lunar crust. For the BSE, $\log_{10} P_T\,(\text{bar}) = 5.77 - 21524 / T + 492766 / T^2$ from 1500 to 3000 K. The table shows condensation temperatures of different silicate clouds in an adiabatic atmosphere of a BSE planet with a surface temperature of 2000 K.

Acknowledgments: This work is supported by Grant NNG04G157A from the NASA Astrobiology Institute.

References: [1] Léger, A. and 148 colleagues. 2009. *Astronomy & Astrophysics*, submitted. [2] Schaefer, L. and Fegley, Jr. B. 2009. *Meteoritics & Planetary Science*, this conference.

Condensate clouds (2000 K surface T)[1]

Cloud	T_{cond}(K)	Z(km)	Cloud	T_{cond}(K)	Z(km)
Mg_2SiO_4	1955	~4.5	Fe_3O_4	1817	~18
$CaAl_2Si_2O_8$	1931	~7	TiO_2	1602	~40
$CaSiO_3$	1896	~9.5	Na_2O	1169	~82
SiO_2	1870	~13			

[1]calculated using the dry adiabatic lapse rate and terrestrial *g*

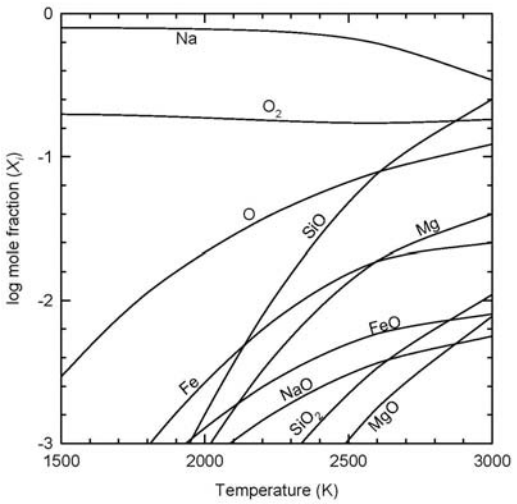

Fig. 1. Sub-cloud atmosphere for BSE composition as a function of surface temperature.