Soluble Salts at the Phoenix Lander Site

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Soluble salts are widespread on Mars with many implications for past/present aqueous processes [1, 2]. The Wet Chemistry Laboratory (WCL) on NASA's Phoenix Lander measured soluble salts in soils by adding liquid water and detecting dissolved ions [3]. Results indicate soils rich in Mg^{2+}, Na^+, SO_4^{2-} and ClO_4^-, with minor Cl^-, K^+, and Ca^{2+}. Other ions that are likely present, but not measured, include NO_3^-, HCO_3^-, and ClO_3^- [4] We investigated the range of soluble salt assemblages that would dissolve to give rise to the measured ions [5]. After reanalyzing the WCL data using improvements to original analyses (Table 1), we modeled salts that precipitate during freezing. Thermodynamic models, such as FREZCHEM, yield anamolous predictions when perchlorates are included. As an alternative, we used a chemical divide model (Fig. 1). Meridianiite, carbonate, and perchlorate salts dominate probable salt assemblages. We deduce >1.3wt% bound water in soils. Also, hygroscopic perchlorates should form brines in the summer.

Ion	Conc. (mM)
pH	7.67±0.08
Ca^{2+}	0.16±0.07
Mg^{2+}	2.91±0.85
Na^+	1.46±0.33
K^+	0.33±0.05
Cl^-	0.39±0.04
ClO_4^-	2.89±0.54
SO_4	4.17±3.47
$CaSO_4^0$	0.05
$MgSO_4^0$	0.56

Table 1: Reanalyzed ions in Rosy Red soil at the Phoenix site.

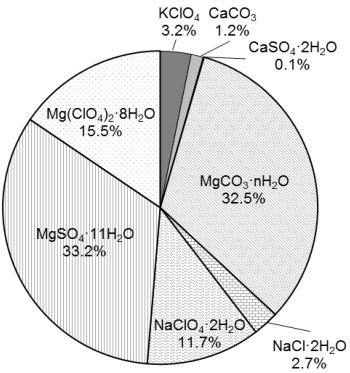

Figure 1: Soluble salt precipitates (wt. %) predicted from Table 1 using our chemical divide model.

[1] Haskin *et al* (2005), *Nature*, **436**, 66-69 [2] Squyres *et al* (2004), *Science*, **306**, 1709-1714 [3] Kounaves *et al* (2010) *JGR*, **115**, E00E10 [4] Kounaves *et al* (2014), *Icarus*, **229**, 206–213 [5] Toner *et al* (2014), *GCA*, in review.