Evaluation of the detectability of hydrated salts on recurring slope lineae on Mars.

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On present-day Mars, pure liquid water is thermodynamically unstable; whereas, high-salinity brine can exist on the surface, at least temporally, due to freezing point depression [1]. Deliquescence and melting of subsurface ice are proposed as being the major processes of formation of liquid brine on Mars [2, 3]. Although liquid brine is suggested to form upon Mars' daily and seasonal changes [2, 3], generation of brine flow has not been confirmed on current Mars. Our previous study suggests that cycles of formation and evaporation of liquid brine can generate characteristic morphological features of downward-elongated flows on steep slopes [4]. This happens because precipitated salts within soil dramatically decrease the porosity and permeability, leading generation of surface flows [4]. Our study also suggests that precipitation of salts reaches up to ~30% in volume within the soil, implying that any detection of such salt may be evidence for the occurrence of brine flow on current Mars [4]. Proposed morphological features formed by current brine activity include recurring slope lineae (RSL) [5, 6]. Although hydrated salts are suggested to exist on RSL at a few locations [6], identification of salt compositions is still challenging. Additionally, there are no reports on detection of hydrated salts at most of the RSL sites across Mars.

In the present study, we investigate the conditions of identification of hydrated salt compositions on RSL using Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) onboarded on Mars Reconnaissance Orbiter (MRO). We calculate synthesized spectra of mixtures of basaltic soil and various hydrated salts (such as $MgCl_2 \cdot 2H_2O$) with the different mixing ratios using a linear combination method and an addition of random noise with a Gaussian distribution. We evaluate the threshold mixing ratios of salt for the identification of the salt compositions based on the analyses of the synthesized spectra. Our results show that if the mixing ratio of hydrated salt exceeds 20% in volume, O-H bands attributed from hydrated salts can be detected with CRISM. We discuss the observational conditions, such as the observational altitude from the surface, for the identification of salt compositions on RSL in future missions.

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Keywords: Mars, CRISM, salt

