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SuperCam Chlorine Detections on the Jezero Crater Floor

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Volatiles, such as chlorine (Cl), are important species that are easily mobilized by fluids and thus play a key role in alteration processes on Mars [1]. The first detections of Cl were made in the 1970's by the Viking 1 & 2 X-ray fluorescence (XRF) spectrometers. The □-proton x-ray spectrometer (APXS) instruments onboard the Mars Pathfinder (Sojourner), Mars Exploration rovers (Spirit & Opportunity), and the Curiosity rover continued to document Cl at their respective landing sites [2,3,4,5,6]. The Phoenix mission also detected Cl mainly in the form of soluble perchlorates and chlorides in the soil at its landing site [7]. The coexistence of soluble perchlorate and chloride salts in the soils of the Phoenix landing site is highly relevant for the redox potential point of view. The PIXL instrument onboard Perseverance produced Cl maps that show the Cl-rich regions overlapping sodium.

The SuperCam instrument onboard the Perseverance rover has been collecting Laser Induced Breakdown Spectroscopy (LIBS) data along our traverse for almost 1500 sols, with an elevation increase of 700 meters from the crater floor up to the crater rim. During this time, we have obtained more than 700 Cl-bearing points in approximately 310 targets which have all been quantified. LIBS has the ability to detect Cl above 0.8 wt.% using the model developed by Wolf et al., (2025) [8]. All LIBS data collected by SuperCam were quantified and categorized by geologic unit and rock type. Results show that Jezero crater has higher average Cl concentrations in soil, rock exterior, and rock interiors compared to previous landing sites. Results also show that Cl is highest in the rock interiors on the crater floor at the lowest elevation of -2500 meters in the Máaz formation. Raman data collected in abraded patches of Máaz formation confirmed that one of the phases of Cl present on the crater floor is Na-perchlorate [9]. The presence of perchlorate salts in the pores of the rocks suggest the past presence of perchlorate-rich fluids in contact with the basaltic rocks of Máaz formation when the crater floor was covered by water. Quantified values show rock interiors on the crater floor have up to nearly 6 wt.% Cl, with an average concentration that is higher than all other geologic units including analyses on soils, rock exteriors, and rock interiors. This demonstrates a unique aqueous alteration history in Jezero crater, Mars compared to the landing sites of other rovers.

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