**REGIONAL PALEOENVIRONMENTS RECORDED IN SEDIMENTARY ROCKS OF THE WESTERN FAN-DELTA, JEZERO CRATER, MARS.**

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**Introduction:** The Mars 2020 *Perseverance* rover science team recently completed an investigation of the fan-delta sedimentary sequence [1] and has begun exploration of the crater margin. High resolution chemical, mineralogical, and morphological observations collected with the rover instrument payload provide powerful constraints on rock origins, contextualizing the suite of high-value samples collected as part of the Mars Sample Return campaign.

**The PIXL Instrument:** The PIXL instrument (Planetary Instrument for X-ray Lithochemistry) [2] provides co-aligned capabilities for x-ray fluorescence, multi-spectral VNIR imaging, and limited x-ray diffraction. We used PIXL maps collected from 11 abraded surfaces to estimate mineral abundances, Mg# = 100Mg/(Mg + Fe) of Mg,Fe-bearing minerals, Ti# = 100Ti/(Ti + Cr) of Cr,Ti-spinels, and textures in sedimentary rocks from the fan-delta sequence and margin units using methods described in [3–6].

**Results:** Sand-sized grains in fan-deltaic and margin successions are dominated by olivine and olivine-derived alteration products with locally significant contributions from eroded sediments or sedimentary rocks (Fig. 1). Common pore-filling cements include Mg,Fe-carbonate, silica, serpentine-group minerals (hisingerite-greenalite-lizardite), and an unidentified amorphous silicate or phyllosilicate (the "low-Mg,Fe-silicate" of [5]). These are also present as components of sand and pebble clasts. Common accessory clasts include Ca-rich pyroxene (augite), feldspar, and Ca-phosphates. Three major groups of Cr,Ti-spinels are also present: Ti# < 6 ("Cr-spinels"), 6 < Ti# < 28 ("high-Cr"), and Ti# > 90 ("Ti-spinels").

From the base of the Shenandoah fm. to the top of the Otis Peak fm., sandstones and conglomerates become overall more enriched in olivine, carbonate minerals, and silica (Fig. 1). Rocks of the Shenandoah fm. contain the most Mg,Fe-sulfate and serpentine group minerals. Margin unit (Turquoise Bay fm.) rocks have greater abundances of carbonate and silica than all but those observed in the "Thornton Gap" abrasion of the basal Tenby fm.

Cr-spinels are absent in the Shenandoah fm. but abundant in the rest of the succession (Fig. 2). Ti-spinels are the majority in the upper Shenandoah fm., rare in the Turquoise Bay fm., and variable elsewhere.

Olivine and serpentine in fan-delta rocks typically have 50<Mg#<60. Mg# in co-occurring minerals generally follow carbonate < olivine ≈ serpentine < sulfate. However, sulfate and serpentine are characteristically closer in composition near the base of the fan-delta, and carbonate compositions approach olivine in the basal Tenby fm. and the margin unit.

**Paleoenvironmental Influences on Rock Compositions:** Olivine, detrital serpentine, and spinel compositions reflect an ultramafic source, with upward increasing Cr-spinel content likely produced by progressive fluvial exposure of less-evolved rocks. Variable incorporation of Ti-spinels suggests episodic access to a less ultramafic source, possibly due to changing hydrologic conditions.

Detrital secondary minerals likely formed under low water/rock weathering conditions [5,7]. However, the paucity of olivine in the Shenandoah fm. suggests more intense weathering. Abundant soluble Mg,Fe-sulfates in the same rocks therefore could have resulted from repeated filling of Jezero during wetter intervals followed by evaporitic concentration of sulfate. Shifting sulfate and carbonate Mg# likely also reflect changing evaporative contributions to precipitation.

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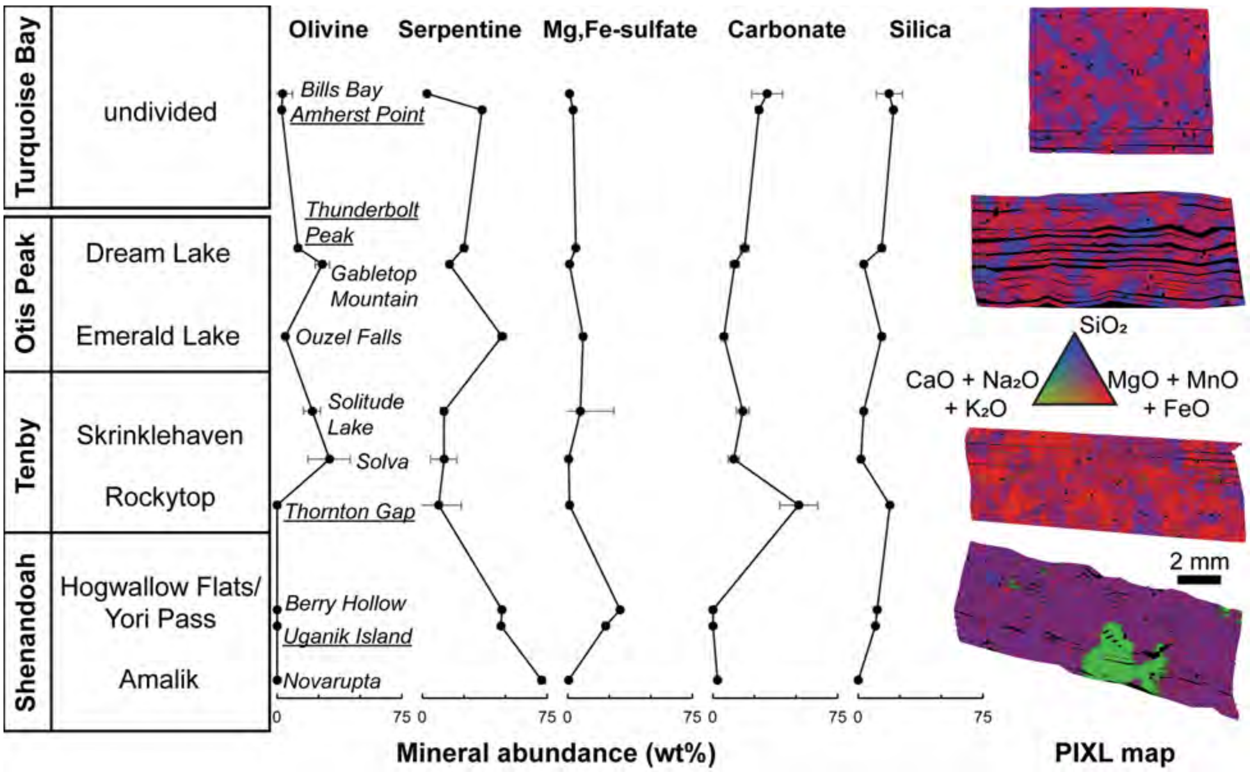


**Figure 1. Estimated mineral abundances and textures.** Points distributed vertically to represent stratigraphic relations, not thicknesses of respective units. Abrasion patch names indicated next to olivine. Underlined patches correspond to PIXL maps on the right. Colors map to molar SiO2-CaO + Na2O + K2O-MgO + MnO + FeO diagram. Color scale is identical between maps.

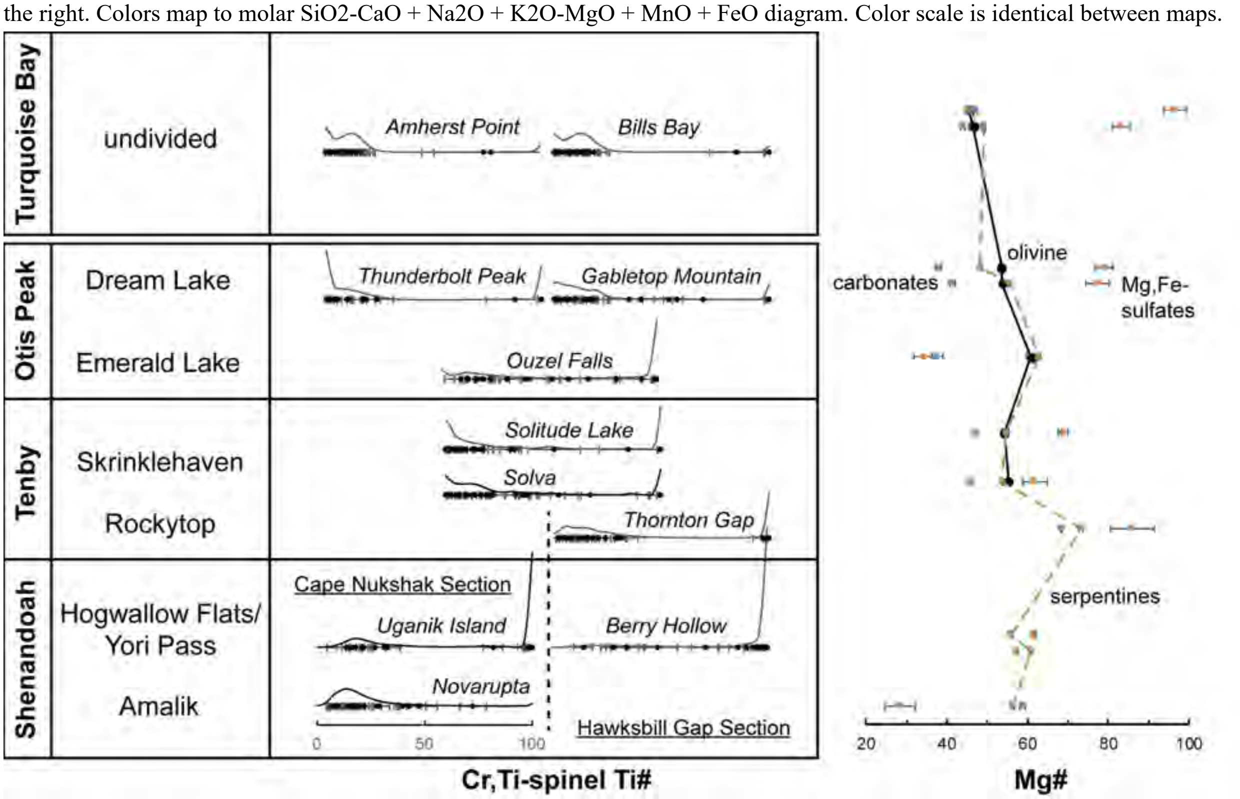


**Figure 2. Spinel population Ti# = 100Ti/(Ti + Cr) and average mineral Mg# = 100Mg/(Mg + Fe).**