Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37288

Diverse ancient igneous lithologies of the Jezero crater rim examined by M2020 PIXL

MARIEK E SCHMIDT[1], YANG LIU[2], ALLAN TREIMAN[3], GEORGE E WHITE[1], SCOTT J VANBOMMEL[4], JOEL HUROWITZ[5], MICHAEL M. TICE[6], DAVID T FLANNERY[7] AND JUSTIN I. SIMON[8]

[1]Brock University
[2]Jet Propulsion Laboratory, California Institute of Technology
[3]Lunar and Planetary Institute
[4]Washington University in Saint Louis
[5]Stony Brook University
[6]Texas A&M University
[7]Queensland University of Technology
[8]NASA Johnson Space Center

The prevailing view that Mars' crust is predominantly basaltic is based on remote sensing, mainly Amazonian-age Martian meteorites, and rover analyses that until recently were limited to Hesperian terrains, collectively suggesting a cooling planet with a thickening lithosphere and declining interior H_2O over time. In contrast, Noachian-aged (~4.1–3.7 Ga) outcrops examined by the Mars 2020 *Perseverance* rover along the Jezero crater rim have exposed a far broader suite of ancient lithologies, including ultramafics, felsites, and impactites. Critical to their interpretation are elemental analyses by Planetary Instrument for X-ray Lithochemistry (PIXL), a micro-X-Ray Fluorescence (XRF) spectrometer, which maps chemical, mineralogical, and textural information (spot size ~120 µm) on rock surfaces. The inner crater rim is a faulted mixture of coarsely crystalline and finer grained rocks. The former (grain size >2 mm) include low-Ca pyroxene (LCP)-bearing intrusive rocks, including feldspar-rich norite (Cat Arm Reservoir, sol 1361) and anorthosite (Knapsack Pass, sol 1309); the latter (grain size <2 mm) include olivine+carbonate (Eremita Mesa, sol 1261) and olivine+LCP (Ranger Falls with Al-chromite, sol 1317, and Rio Chiquito with plagioclase feldspar, sol 1335) rocks. Outside the crater, Perseverance encountered mega-breccia that was likely emplaced by the Isidis Basin-forming impact. Outcrop-scale blocks in the mega-breccia include variably serpentinized dunite (e.g., Stigbreen, sol 1634, Mg#=~76) and the melt-bearing impact breccial Aitkenodden (sol 1658), which includes evolved igneous lithologies, even a 3 mm granitic clast with quartz, alkali feldspar-and accessory zircon and apatite. The regional olivine carbonate unit was examined at several locations, including the Coopers Head outcrop (sol 1506), which is dunite with lower Mg# (~65) and larger (up to 7 mm) relict olivine than in the mega-breccia. The likely youngest unit in the crater rim region is spherule-bearing basaltic deposit that is rich in S and Cl and interpreted as impact ejecta (Hare Bay, sol 1480). These observations show that Noachian crust was diverse and dynamic, and likely fueled by high heat flow with multiple inputs of high-degree mantle melts and crystallization and churned and redistributed by impacts.