
Introduction: Shortly after landing in Jezero crater, Mars, on 18 February 2021, the Perseverance rover began sending back high-resolution images from the Mastcam-Z instrument. Mastcam-Z [1] is a high-heritage imaging system that is based on the successful Mastcam investigation on the Mars Science Laboratory (MSL) Curiosity rover [2,3]. Mastcam-Z has all of the capabilities of MSL Mastcam, augmented with a 4:1 optical zoom capability that significantly enhances stereoscopic imaging performance for science and rover operations. Each camera has a selectable field of view ranging from ~7.7° to ~31.9° diagonally, with the ability to achieve pixel scales from 67 to 283 µrad/pix (resolving features ~0.7 mm in size in the near field and ~3.3 cm in size at 100 m) from its position ~2 m above the surface on the Perseverance Remote Sensing Mast.

Mastcam-Z Goals: The goals of the Mastcam-Z investigation are to: (1) Characterize the overall landscape geomorphology, processes, and the nature of the geologic record (mineralogy, texture, structure, and stratigraphy) at the rover field site; (2) Assess current atmospheric and astronomical conditions, events, and surface-atmosphere interactions and processes; and (3) Provide operational support and scientific context for rover navigation, proximity (contact) science, sample selection, extraction, and caching, as well as imaging support for other Perseverance instruments and rover tools.

Landscape/Terrain Observations: After initial checkout and characterization activities, Mastcam-Z acquired images of the Jezero crater floor that show cm-scale textures in the rocks in the immediate vicinity of the landing site (Figure 1). These textured rocks are interpreted as eroded bedrock units of the Crater Floor Fractured Rough [4]. Mastcam-Z images of the more distant terrain show detailed layering, particularly in the remnant buttes located towards the delta front, ~1 km south of the main.

Multispectral Observations: Mastcam-Z multispectral images show a diversity of spectral signatures related to ferric (Fe3+) and ferrous (Fe2+) mineralogy [6]. The layered units in the Séítah region are olivine-bearing,
consistent with orbital observations, while other layered units (e.g., Figure 3) show spectral signatures more consistent with pyroxenes. Some “paver” rocks (e.g., Figure 1), which have low relief and no obvious layering, have spectra consistent with fine-grained, red hematite.

**Helicopter Operations:** Mastcam-Z images and video of the Ingenuity helicopter [10] have provided critical documentation of the first powered flight of a vehicle on another planet (Figure 6). These images also show helicopter-induced dust lifting events caused by the helicopter blades. This information can be used to verify near-surface dust lifting models [11].

**Atmospheric Observations:** Mastcam-Z images of the sun acquired through solar filters at RGB and 880 nm wavelengths enable the direct measurement of dust optical depth. These images show optical depth trends consistent with typical Mars seasonal trends. Morning observations show higher optical depth relative to afternoon observations, consistent with atmospheric water ice particles in the morning.

**Summary:** As of Sol 300, over 61,000 Mastcam-Z images have been received from Mars. These images are processed and archived in the NASA Planetary Data System (PDS) within 6 months of receipt on Earth [12]. Mastcam-Z continues to function nominally.

**References:**