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The Notional Plan for Sample Collections by the Perseverance Rover for Mars Sample Return

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Abstract

The NASA Mars 2020 Perseverance rover mission will collect a suite of scientifically compelling samples for return to Earth. On the basis of orbital data, the Mars 2020 science team* identified two notional sample caches to study (1) the geology of Jezero crater, collected during the prime mission and (2) the ancient crust outside of Jezero crater, collected during a possible extended mission. Jezero crater geology consists of well-preserved, Early Hesperian to Late Noachian deltaic and lacustrine deposits sourced from a river system that drained Noachian terrain. The crater floor comprises at least two distinct units of sedimentary or volcanic origin whose relationship to the deltaic deposits is presently unclear. Remotely-sensed data reveal signatures of carbonate+olivine and clay minerals within crater floor and crater margin units. Samples from within Jezero that comprise the prime mission notional sample collection thus include: crater floor units; fine- and coarse-grained delta facies, the former with potential to preserve organic matter and/or biosignatures, the latter to possibly constrain the type and timing of sediment deposition; chemical sediments with the potential to preserve biosignatures; a sample of crater rim bedrock; and at least one sample of regolith. The region of southern Nili Planum, directly outside the western rim of Jezero crater, is geologically distinct from Jezero crater and contains diverse Early or even Pre-Noachian lithologies, that may contain records of early planetary differentiation, magnetism, paleoclimate and habitability. The notional sample collection from this region will include: layered and other basement rocks; megabreccias, which may represent blocks of (pre-)Noachian crust; basement-hosted

hydrothermal fracture fill; olivine+carbonate rocks that are regionally significant and may be related to units within Jezero crater; and mafic cap unit rocks. The samples described are notional and may change with ongoing surface investigations. However, the samples we anticipate collecting align well with community priorities for Mars exploration, addressing geologic diversity, potential ancient biologic activity on Mars, planetary evolution, volatiles, and human health hazards. *Many other Mars 2020 team members were involved in this planning

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The Plan for Sampling: Perseverance Rover Notional Caches for Mars Sample Return

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Abstract Text:

The NASA Mars 2020 Perseverance rover mission will collect a suite of scientifically compelling samples for return to Earth. On the basis of orbital data, the Mars 2020 science team* identified two notional sample caches to study (1) the geology of Jezero crater, collected during the prime mission and (2) the ancient crust outside of Jezero crater, collected during a possible extended mission.

Jezero crater geology consists of well-preserved, Early Hesperian to Late Noachian deltaic and lacustrine deposits sourced from a river system that drained Noachian terrain. The crater floor comprises at least two distinct units of sedimentary or volcanic origin whose relationship to the deltaic deposits is presently unclear. Remotely-sensed data reveal signatures of carbonate+olivine and clay minerals within crater floor and crater margin units. Samples that comprise the prime mission notional cache will thus include: crater floor units; fine- and coarse-grained delta facies, the former with potential to preserve organic matter and/or biosignatures, the latter to possibly constrain the type and timing of sediment deposition; chemical sediments with the potential to preserve biosignatures; a sample of crater rim bedrock; and at least one sample of regolith.

The region of southern Nili Planum, directly outside the western rim of Jezero crater, is geologically distinct from Jezero crater and contains diverse Early or even Pre-Noachian lithologies, that may contain records of early planetary differentiation, magnetism, paleoclimate and habitability. The notional cache from this region will include: layered and other basement rocks; megabreccias, which may represent blocks of (pre-)Noachian crust excavated by the Isidis and/or other large impact events; basement-hosted hydrothermal fractures; olivine+carbonate

rocks that are regionally significant and may be related to units within Jezero crater; and a mafic cap unit.

The caches described are notional and may change with ongoing surface investigations. However, the samples we anticipate collecting align well with community priorities for Mars exploration, addressing geologic diversity, potential ancient biologic activity on Mars, planetary evolution, volatiles, and human health hazards.

*Many other Mars 2020 team members were involved in this planning

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