**Rb-Sr Dating with Accuracy of < ±150 MA Using a Portable LDRIMS for the 2020 Mars Rover**

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**Goals**

We propose a Mars in situ geochronology mission that will triage and validate samples for Mars Sample Return (MSR). This mission will address:

1. The National Research Council Decadal Survey call for: “long-term development of instruments … focusing on the most important future in situ measurements... [including] ... in situ geochronology experiments” [1];

2. MEPAG Goals III.A.3-10, but especially 3, specifically calls for “Constraining the absolute ages of major Martian crustal geologic processes... with both in situ and returned sample analysis...”;

3. NASA’s integrated technology roadmap for Science Instruments, Observatories, and Sensor Systems [2] specifically calls for “Surface Chronology” and “Age Dating to ±200 Myr on surface”;

4. And from the Mars 2020 SDT charter: “Explore an astrobiologically ... ancient environment ... to decipher ... geological history, including ... past habitability...” and “Demonstrate progress towards... return of... well-documented samples.”

**The Science: Dating Processes**

**Why Rb-Sr?**
- Rb-Sr widely used
- More dependable than K-Ar for SNCs
- Used for igneous, metamorphic, & sedimentary rocks [3]
- Relatively immobile [3]

**However, New Estimates of Moon & Mars Flux Highlight Discrepancies**
- LROC data suggests that previous flux curves may be wrong
- Provides constraints for identifying regions for isotopic dating

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**Date alteration by H2O**
- Rb-Sr used to date primary formation and secondary alteration
- Leminit Tuff, NM, 28 Ma [5]
- Metasomatism & cementation 6 Ma

**Date Life on Mars?**
- Aqueous alteration abundant
- Hydrothermal sites ideal for IDKing life [6]

**Laboratory Prototype Demonstrates Repeatability, Accuracy, & Precision of 60-90 Ma**

**Benchtop LDRIMS: Proof of principle**
- Designs show these systems could fit in a 13-foot box, compatible with MSL

**Field Test Reported by Nature News [7]**
- LDRIMS makes ~300 spot measurements

**Summary & Flight Implementation**

1. State of the art in-situ dating has significantly advanced
   - Accuracy and precision ±60-90 Ma
   - Speed < 24 hours

2. Precursor/Triage for MSR; does NOT replace MSR

3. Is important for triage, both scientific and political:
   - Reduces risk of caching by pre-assessing rocks
   - Reduces risk of later mission loss
   - Addresses long fiscal commitment/initial low science return

**References**


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