Instrumentation development for planetary in-situ $^{40}Ar/^{39}Ar$ geochronology

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The key to understanding the history of planetary and asteroidal bodies is the accurate and precise determination of the timescale over which they developed. Absolute dating of planetary materials remains a primary goal of planetary research. Given the success of recent unmanned missions to Mars (e.g., Spirit, Opportunity, Curiosity) in understanding geological processes, development of an *in situ* numerical dating instrument packages for future robotic missions is a logical next step.

Several ongoing programs of research are seeking to develop instrument packages for *in situ* application of the K-Ar technique (e.g., [1,2]). For terrestrial rocks, the K-Ar method has largely been replaced by the $^{40}Ar/^{39}Ar$ technique, which can determine thermal histories and provide internal reliability assurance. The $^{40}Ar/^{39}Ar$ method is the most promising geochronometer for obtaining accurate ages and thermal histories for rocks on the Martian surface but relies on the $^{39}K(n,p)^{39}Ar$ reaction so that ^{39}Ar can be measured as a proxy for the parent element K. As the mass and power requirements of a nuclear reactor are not compatible with spaceflight, an alternative neutron source must be employed. Here, we examine the potential of ^{252}Cf, which generates neutrons through its decay by spontaneous fission.

We will present initial results from neutron modeling and technological considerations towards the development of an *in situ* dating package, including a ^{252}Cf neutron source, a subcritical ^{235}U neutron multiplier, quadrupole noble gas mass spectrometry, and sample drilling and handling strategies.

[1] Farley *et al* 2013, *GCA*. [2] Farley *et al* 2013, *Science*.