THE CONTRIBUTION OF LUNAR METEORITES TO OUR UNDERSTANDING OF THE MOON. K. Righter[1]. [1]Mailcode KT, NASA Johnson Space Center, 2101 NASA Parkway, Houston, TX 77058; kevin.righter-1@nasa.gov

Introduction: The discovery of a meteorite from the Moon in 1982 sparked interest in samples from regions on the Moon that were not sampled by the Apollo or Luna missions. Currently, there are 37 recognized lunar meteorites in world collections, comprising 26.4 kg, and representing many unique sites on the Moon [1] (some of the 37 are launch paired).

Apollo-era paradigms: Intensive study of the Apollo and Luna sample collections has created a detailed history of the Moon with several specific highlights [2]: development of an early feldspathic crust that floated on a lunar magma ocean (LMO), basaltic magmatism that lasted from 4.4 to 2.7 Ga, bimodal high and low Ti volcanism, an incompatible element enriched residual liquid from crystallization of the LMO (KREEP), and a spike in the impact flux at 3.9 Ga.

Lunar meteorites as a test of the paradigms: Lunar meteorites have provided a wealth of new information, requiring revision to some specific scenarios arising out of studies of the Apollo sample collection. Studies of feldspathic lunar meteorites have revealed a rich compositional and petrologic diversity that is inconsistent with a simple picture of a flotation crust of ferroan anorthosite [3]. On the other hand feldspathic clasts from highlands breccias yield Sr and Nd isochrons of 4.4 Ga, providing evidence for an ancient LMO [4]. Evolved and young low Ti basalts provide evidence that the Moon maintained widespread active magmatism up to ~2.9 Ga [5,6]. Impact melt clasts from meteoritic breccias have yielded ages that do not confirm or disprove the lunar cataclysm hypothesis, pushing the resolution of this controversial topic to future sample return missions [7]. New high-resolution dating techniques have led to impact ages different from the cataclysmic spike at 3.85 Ga [8]. The idea that KREEP existing only in the early Moon (3.8 to 4.6 Ga) has been challenged by evidence from a new lunar gabbro with a 2.9 Ga age and KREEP connections [9].

Conclusions and future: Lunar meteorites have provided the opportunity to test models for the origin and evolution of the Moon, which were based largely on Apollo samples. In a few cases, models have survived intact, but in most cases, new data from meteorites have required revision. The random sampling of the surface represented in the meteorite collection has great potential in making the connection between sample suites and global lunar imaging efforts, and studies of terranes [10,11].

References

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