The relative and absolute age determination of rilles in southwest Aristarchus region

Bo Li, Xueqiang Wang, Jiang Zhang, Zongcheng Ling, Jian Chen, Zhongchen Wu, Yuheng Ni

PII: S0032-0633(15)30066-0
DOI: http://dx.doi.org/10.1016/j.pss.2016.02.008
Reference: PSS4144

To appear in: *Planetary and Space Science*

Received date: 15 October 2015
Accepted date: 23 February 2016

Cite this article as: Bo Li, Xueqiang Wang, Jiang Zhang, Zongcheng Ling, Jian Chen, Zhongchen Wu and Yuheng Ni, The relative and absolute age determination of rilles in southwest Aristarchus region, *Planetary and Space Science,* http://dx.doi.org/10.1016/j.pss.2016.02.008

The relative and absolute age determination of rilles in southwest Aristarchus region

Bo Li[1], Xueqiang Wang[2], Jiang Zhang[1], Zongcheng Ling[1*], Jian Chen[1], Zhongchen Wu[1], Yuheng Ni[1]

1 Shandong Provincial Key Laboratory of Optical Astronomy and Solar-Terrestrial Environment; Institute of Space Sciences, Shandong University, Weihai, China.

2 Engineering Technology Research Institute, Petrochina Southwest Oil & gasfield Company, Guanghan, China.

Abstract: In this paper, we estimated the relative and absolute ages of the seven rilles (1-7) in southwest Aristarchus region in order to know when these lunar rilles formed and how they fit into lunar volcanic history. According to their superposition relationships and colors in the color-ratio composite, the geological units and features in the study area were sorted in an order from old to young: the highland materials, the glassy Fe^{2+} rich pyroclastics (DMD), the rille 1, 2, 3, 5, and 7, the mature and fresh basaltic units in the east and south of the Aristarchus plateau, the rille 4 and 6, the youngest Aristarchus Craters and its ejecta deposits. Buffered Crater Counting (BCC) method provides a chance to determine ages of linear features that don't have enough surface areas for the traditional crater counting method. The BCC analysis of seven rilles had shown that five of them probably formed in the Imbrium Period and the other two formed in Eratosthenian Period. The absolute age of oldest rille is $3.77^{+0.03}_{-0.04}$Ga and the youngest rille's age is $1.49^{+0.26}_{-0.26}$Ga. Because their formation is interpreted to lava flowing and eroding of magma eruptions, we can see that the volcanic activities in Aristarchus region lasted for a long time from Pre-Nectarian Period (DMD materials) to Eratosthenian Period (rille 6) and weakened gradually to form small scale rilles as times went on. This may be because of the basaltic volcanic eruptions produced by heating elements in Aristarchus region to partially melt the underlying lunar mantle, which become the materials and source of these rilles.

keywords: buffered crater counting, lunar rilles, relative and absolute model ages, volcanic activities, Aristarchus Plateau

E-mail address: zcling@sdu.edu.cn

Acknowledgements: This work was supported by the National Natural Science Foundation of China (41373068, U1231103), the national science and technology infrastructure work projects (2015FY210500), the Natural Science Foundation of Shandong Province (ZR2015DQ001, JQ201511), Young Scholars Program of Shandong University, Weihai (2015WHWLJH14) and the Fundamental Research Funds for the Central Universities (2015ZQXM014).

1 Introduction

Rilles are obvious features on lunar surfaces which characterized by channels of varying depths and widths with parallel-striking, laterally continuous walls. The early studies of lunar rilles were carried out by Oberbeck et al., (1969, 1971), then, Hurwitz (2013) updated the catalog of lunar sinuous rilles (SRs), which contained more than 200 SRs. We can better know when and how lunar rilles fit into the lunar volcanic history by studying the rilles' distributions, compositions and ages. The previous researches about lunar rilles can mainly be classified into two aspects:

(1) Determining ages of lunar rilles. The most SRs were found in the western part of the lunar