EPSC Abstracts
Vol. 7 EPSC2012-843-1 2012
European Planetary Science Congress 2012

Absolute model ages of volcanic deposits around the lunar farside craters Rosseland and Bolyai

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Abstract

We mapped and dated several small volcanic deposits in and around Rosseland and Bolyai crater, by performing crater size-frequency distribution measurements (CSFD). We found ages between 1.6 and 3.7 Ga with peaks around 2.0 Ga and 3.7 Ga.

1. Introduction

To understand the thermal evolution of the Moon it is essential to investigate the volcanic history of both the lunar near- and farsides. While the lunar nearside is dominated by mare volcanism, the farside shows only some isolated mare deposits in the large craters and basins, like the South Pole-Aitken basin or Tsiolkovsky crater. This big difference in volcanic activity between the near- and farsides is one of the most important issues for understanding the volcanic evolution of the Moon. The extensive mare volcanism of the lunar nearside has already been studied in great detail by numerous authors [e.g., 1-5] on Lunar Orbiter and Apollo mission data. New high resolution data obtained by the Lunar Reconnaissance Orbiter (LRO) and the SELENE Terrain Camera (TC) allow us to now investigate the lunar farside in great detail.

Our study area is located between the Australe and South Pole-Aitken basins, south of Tsiolkovsky crater at the southern lunar farside (Fig. 1). According to the geological map of Wilhelms and El-Baz from 1977 [6], this region is dominated by craters and basin materials of Pre-Nectarian and Nectarian age. The most prominent mare basalts are located inside Pauli crater to the east and Tsiolkovsky crater to the north. The geological map of Wilhelms and El-Baz [6] also shows some small mare patches in Roche and Bolyai crater and west of Rosseland crater in the center of our study area (Fig. 2). We chose this area to investigate the volcanic history of a relatively old area with a presumably thick crust. In addition, the volcanic deposits of this area are much smaller than most of the mare basalts on the near- and farsides. This gives us a good opportunity to investigate the history of small scale volcanism on the lunar farside.

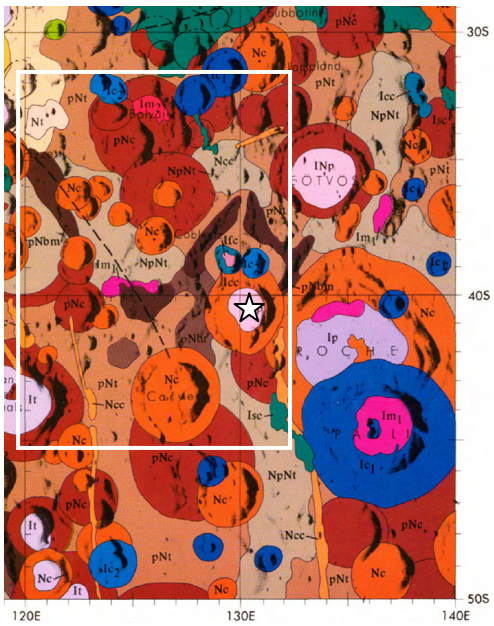

Figure 1: Our study area, shown as a white box on the geological map of [6], encompassed small mare deposits in and around the Rosseland and Bolyai craters. The floor of Rosseland crater (white star) is mapped as light plains.

2. Data

We used data from the LRO Wide Angle Camera (WAC: 100 m/pixel), Narrow Angle Camera (NAC: 1 m/pixel) and the Kaguya Terrain Camera (TC) (10 m/pixel) to identify and map individual volcanic deposits and to perform CSFD measurements. The combination of the global WAC mosaic with the FeO content map of Lucey et al. 2000 [7] (100 m/pixel)

based on Clementine data, was used to identify and map individual basaltic deposits.

3. Results

On the basis of WAC and TC images we were able to map the crater floor of Rosseland crater in more detail than Wilhelms and El-Baz [6] (Fig. 2). We found seven separate FeO-rich volcanic deposits (FeO: 5 - 18 wt%) inside Rosseland crater between the crater floor and the crater wall. The absolute model ages of 5 of these deposits vary between 1.6 Ga and 2.2 Ga (Fig. 2). We also identified FeO-rich volcanic deposits (FeO: 4 - 17 wt%) inside a crater north to Rosseland crater with an absolute model age of about 2.1 Ga (Fig. 2).

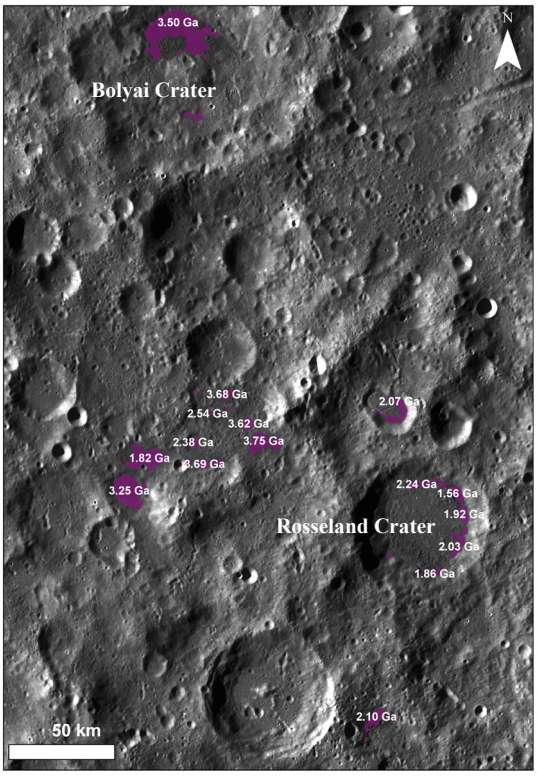

Figure 2: Mapped volcanic deposits within the study area.

The volcanic deposits in the center of the study area exhibit absolute model ages between 1.8 Ga and 3.7 Ga and vary in FeO content from 5 wt% to 18 wt%. Another FeO-rich (5 - 18 wt%) volcanic deposit identified south of Rossland crater. Our CSFD measurements show an absolute model age of 2.1 Ga, which is similar to the deposits inside Rosseland crater. The volcanic deposits inside Bolyai crater at the northern edge of our study area have an absolute model age of 3.5 Ga.

4. Conclusions

Our investigations show that the studied area was volcanically active over a very long time period (1.6 Ga to 3.7 Ga). In general, this is in good agreement with studies by [8, 9] of other volcanic regions on the farside. [8] and [9] found absolute model ages of farside mare basalts, such as those in Moscoviense and Apollo crater, to range from 2.1 Ga to 3.8 Ga. While the oldest volcanic activity in our study area is in the same range, the youngest activity is about 500 Ma younger. In addition, most of the mare basalts investigated by [8, 9] have ages of about 3.4 Ga, while the volcanic deposits in our study area have a bimodal distribution (Fig. 3), with peaks at about 2.0 Ga and 3.7 Ga.

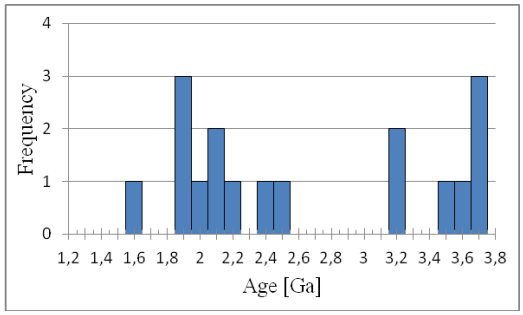

Figure 3: Histogram of the model ages of the volcanic deposits in our study area.

A young peak was also observed by [8, 9] at about 2.5 Ga, but not as strong as the oldest volcanic activity at 3.4 Ga. To understand the volcanic evolution of the lunar farside, it is necessary to explain how such young volcanism is possible on a part of the Moon that has a relatively thick crust.

References

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