

Constraint of a potential launch crater for lunar meteorite group, Northwest Africa 032 group

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Lunar meteorites can play the role of more-representative geochemical datasets for evaluating global lunar evolution, because they were ejected from random locations by impacts of celestial bodies. Nagaoka et al. (2021) have identified the launch crater of young basaltic lunar meteorites, Northwest Africa (NWA) 773 clan, based on the geochemical, petrological, and geochronological lunar-meteorite datasets and remote-sensing datasets. By identifying the launch craters of the lunar meteorites with those datasets, the ultimate goal of our work is to obtain geochemical and geological information about those launch sites in details as if the samples were recovered from those sites.

In this work, we focus on the Northwest Africa (NWA) 032 and the paired meteorites. NWA 032 is an unbrecciated lunar mare basalt which consists predominantly of olivine, pyroxene and chromite phenocrysts in a crystalline groundmass of feldspar, pyroxene, ilmenite, troilite and trace metals (Fagan et al. 2002). This mare basalt is one of the youngest among the lunar samples (the Sm–Nd age is 2.9 Ga; Borg et al. 2009). NWA 479 is a lunar meteorite that is paired with NWA 032 on the basis of petrological and geochemical studies (Barrat et al. 2005). The four basaltic lunar meteorites from Antarctica, LAP (LaPaz Ice field) 02205, LAP 02224, LAP 02226, and LAP 02436 are mineralogically and chemically similar to NWA 032, and NWA 4734/10597 is also similar, these meteorites have experienced similar impact history indicating that they might have been launch-crater paired (e.g., Mijajlovic et al. 2020; Zeigler et al. 2005). Their launch crater has not been identified yet. In this work, we refer to these meteorites as the NWA 032 group, and aim to constrain the launch crater for the meteorite group by comparing their geochemical composition and crystallization age with those obtained from remote sensing.

The analytical method has been described in Nagaoka et al. (2021). Firstly, the source regions (60 × 60 km² in pixel size) which have similar elemental compositions with the lunar meteorites have been investigated by using their bulk composition (e.g., Fagan et al. 2002), the LP-GRS data (TiO₂, FeO, Th; Prettyman et al. 2006), and the SELENE GRS data (CaO; Yamashita et al. 2012). We compared the crystallization ages of the lunar meteorites determined by radiometric dating with the model ages determined from crater-size–frequency distribution measurements obtained from remote-sensing data (e.g., Hiesinger et al. 2000). We selected pixels that included lava flows with model ages equivalent to, or younger than, their radiometric crystallization ages. Furthermore, we constrained the diameter of launch crater based on the pi-scaling rule of their impact history (e.g., Miyahara et al. 2013; Kubo et al. 2015) and investigate their putative launch craters with the features (e.g., bright ejecta ray) of young launching age of ~50 ka (Nishiizumi and Caffee 2001).

As a result, we constrained locations of several potential launch craters with bright ejecta rays within the basalt units in Mare Serenitatis, which have similar elemental composition and eruption age with those of NWA 032 group. In this presentation, I will determine the launch crater of NWA 032 group by using high resolution data obtained by SELENE multi-band imager and discuss the geochemical and geological

features of them by comparing with their features of NWA 032 group meteorites reported in the previous works.

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