CRYSTAL SIZE DISTRIBUTION OF LUNAR HIGH-AL BASALT NORTHWEST AFRICA 4898

Shao-Lin Li[1] and Zhu-Qing Xue[2], [1]State Key Laboratory of Lunar and Planetary Sciences, Macau University of Science and Technology, Macau, China (slli@must.edu.mo), [2]Center of Deep-Sea Research, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China.

Introduction: High-Al basalts are among the oldest volcanic products returned from the Moon (up to 4.3 Ga), but they also appear at the end of the first peak of mare volcanism [1]. However, no high-Al basalts with intermediate ages have been discovered in Apollo collections. Among all lunar meteorites, Northwest Africa 4898 is the only unbrecciated high-Al basalt found so far [2], although the remote sensing data suggest their occurrence on the moon is quite common [3]. The preliminary isotopic dating results of NWA 4898 suggest it crystallized at ~3.5 Ga [4,5]. Therefore, it could serve as a bridge between the pre-mare and mare high-Al volcanism, and its petrogenesis may give insight into the transformation of the pre-mare to mare igneous environment on the early Moon. However, due to the high Al_2O_3 nature of high-Al basalts, they have been suggested to be formed by impact mixing of anorthositic and mafic lithologies rather than through endogenous igneous processes [6]. Crystal size distribution (CSD) has been proven to be an efficient tool to distinguish between pristine mare basalts and impact melts, and among different basalt types [7-11]. In this study, we analyzed the CSD of plagioclase in NWA 4898 to investigate its formation mechanism, cooling rate, and crystallization process. We also compared the plagioclase CSD of NWA 4898 and other lunar basalts and impact melts.

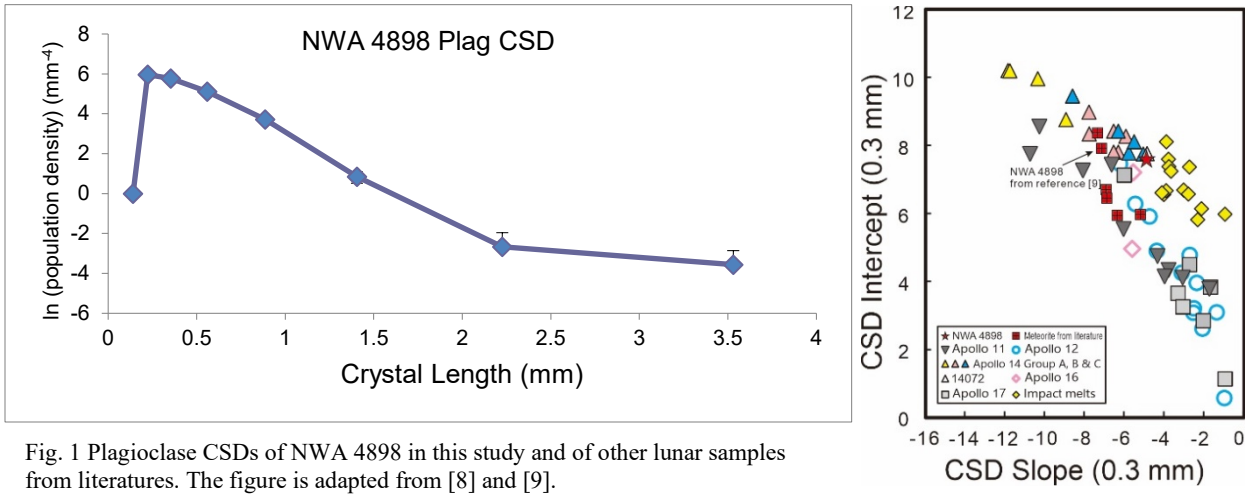

Fig. 1 Plagioclase CSDs of NWA 4898 in this study and of other lunar samples from literatures. The figure is adapted from [8] and [9].

Result and Discussion: CSD data of plagioclase are collected using the same procedure described by [8]. The CSD of plagioclase in NWA 4898 is sub-linear, indicating a nearly constant cooling rate. The slope and y-intercept are slightly different from those of the reference [9], but both of the data fall within the range of Apollo 14 high-Al basalts. Compared to Group A high-Al basalts, textures of plagioclase from NWA 4898 is more like those from Apollo 14 Group B, C and 14072. The lowest slope-intercept of NWA 4898 may indicate the slowest cooling rate among the high-Al basalt database. The CSD slope-intercept plot also proves NWA 4898 to be an endogenous basalt rather than an impact melt. This is consistent with evidence from the olivine composition [2]. In conclusion, textural analyses show NWA 4898 is a pristine high-Al basalt, and future chemical analyses will help uncover the formation and fractionation of this sample.

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