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Regions with the Oldest Crust for Future Sample Return Missions as Inferred from Lunar Meteorites and the Kaguya Data.

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In the preface of his textbook, J. Wood [1] wrote that Men have always wondered about the beginning of things. One of the goals of our lunar missions is to explore the oldest anorthositic lunar highland crust. Nyquist et al. [2] performed Sm-Nd and Ar-Ar studies of pristine ferroan anorthosites (FANs) of the returned Apollo samples and showed that a whole rock Sm-Nd isochron for selected FANs yields an isochron age of 4.47 Ga. These ages are not as old as the oldest cumulate eucrites of the Vesta-like crust [3]. Mineralogical and chemical data of the Dhofar 489 group [4] and Yamato (Y-) 86032 [5] are different from common lunar rocks.

In order to deduce the ejection site of the Dhofar 489 group, we have investigated three common olivine-bearing crystalline anorthositic clasts in these groups [7]. Dhofar 307 PTS [8] contains a fine-grained magnesian granulitic clast (GR), and Dhofar 309 [9] contains many crystalline clasts with rapid growth features, suggesting crystallization from an impact melt pool (IM). Mineral chemistry and modal abundances of these clasts are similar to the spinel troctolite (ST) clast in Dhofar 489 [4]. A large impact, which excavated a basin might have produced impact melts at the basin floor and crystallized an IM-like clast by rapid cooling. Granulites were produced by thermal metamorphism at the floor of a large basin or in deep ejecta of a smaller impact. Other small impacts within the basin produced breccias of ST, IM and GR materials. Among a few large basins of the farside, the Dirichlet-Jackson (DJ) basin (Diameter 480km) has a few large craters on the floor, and the formation age by Morota et al. [9] is 4.25 Ga, which agrees with the Ar-Ar age (4.23 Ga) of Dhofar 489 [4]. The Th concentration of the d2 anorthositic clast of 0.011 ppm of Dhofar 489 [4], are lower than those of the lowest-Th region (ca.0.5 ppm, 450km x 450km average) found in the Th map of Kobayashi et al. by the KGRS [10], where the D-J basin is located. Anorthosites composed of nearly pure anorthite (PAN) at many locations in the farside highlands [11] and a map of the Mg numbers [12] deduced from the Kaguya multiband imager and spectral profiler also showed that the region around the D-J basin is consistent with the Mg numbers (70 to 76) of the magnesian anorthositic clast of Dhofar 489, and showed that the earliest crustal anorthositic rocks may be preserved there.

Although a sample return mission to bring back such samples from the above region is the most desirable mission, we will land on a region of the extension of the low-Th region by the SELENE 2 mission to prove the presence of such region. The proposed region is north east of the Bailly basin, especially the Zucchius crater with the central peak and the Pingre crater. Lunar Magma Ocean (LMO) model deduced from the Apollo samples is not be able to explain the dichotmy of the Moon. Tilted Convection model based on fluid dynamics [13], or a putative Procellum basin impact hypothesis may explain the problems resulted from the above new findings.

References: [1] Wood J. A. (1968) Meteorites and the Origin of Planets, 117pp., McGraw-Hill Book, New York. [2] Nyquist L. E. et al. (2010) LPSC41, Abstract #1383. [3] Nyquist L. E. et al. (2011) Antarct. Meteorites XXXIV, 64-65, NIPR. [4] Takeda H. et al. (2006) Earth Planet. Sci. Lett., 247, 171-184. [5] Yamaguchi A. et al. (2010) GCA 74, 4507-4530. [6] Korotev R. L. et al. (2006) GCA, 70, 5935-5956. [7] Takeda H. et al. (2007) LPS XXXVIII, Abstract #1607. [8] Takeda H. et al. (2008) LPS XXXIX, Abstract #1574. [9] Morota et al. (2011) JGU Meeting, PPS024-10. [10] Kobayashi S. et al. (2010) LPS 41, Abstract #1795. [11] Ohtake M. et al. (2009) Nature, 461, 236-240. [12] Ohtake M. et al. (2011) Abstract of Fall Meet., Japan Planet. Soc. [13] Loper D.E. and Werner C. L. (2002) JGR, 107, 10.1029/2000JE001441, 13-1-7.

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