AGE DETERMINATION OF MARE BASALTS SURROUNDING THE CRATER LICHTENBERG: PRELIMINARY RESULTS USING SELENE (KAGUYA) / TERRAIN CAMERA DATA. T. Morota[1], J. Haruyama[1], M. Ohtake[1], T. Matsunaga[2], Y. Yokota[1], C. Honda[1], M. Torii[1], Y. Ogawa[2], M. Abe[1], and LISM Working Group, [1]Institute of Space & Astronautical Science, Japan Aerospace Exploration Agency, 3-1-1 Yoshinodai, Sagamihara 229-8510, Japan (morota.tomokatsu@jaxa.jp), [2]National Institute for Environmental Studies.

Introduction: Young mare basalts must be dated to place constraints on the ending of lunar volcanism. In this study, we present results of age determination of mare basalts overlaying the rays of the crater Lichtenberg. The mare basalts are expected to be one of the youngest basalt flows; e.g., Wilhelms [1] mapped the unit as a Copernican system, and Hiesinger et al. [2] estimated an age of about 1.7 Gyr.

Crater counting is a well established technique to derive relative and absolute ages of planetary surfaces. Based on the simple idea that older surfaces accumulate more craters, we can infer relative ages by measuring the crater frequencies with remote-sensing image data. The lunar cratering chronology formulated by relating crater frequencies to the radiometric ages of Apollo and Luna samples [e.g., 3-6] enables us to convert the crater frequencies into absolute ages.

Japanese lunar explorer SELENE (KAGUYA) was launched on September 14, 2007. The Terrain Camera (TC) installed on SELENE will take images of the surface of the whole Moon with a nominal spatial resolution of 10 m/pixel [7-9]. The extensive high-resolution images enable statistical studies of crater distribution. In this study, the TC data are used for new measurements of crater frequencies.

We count craters in two areas, Area 1 southeast of the Lichtenberg crater and Area 2 southwest of the Lichtenberg crater (Fig. 1). The areas are parts of units P53 and P9 of Hiesinger et al. [2].

Results and Discussion: Figure 2 plots the cumulative size-frequency distributions. The distributions can generally be well fitted by the Neukum's standard crater size-frequency distribution [5, 6]. However, the distribution < 250 m for Area 2 deviates from the standard distribution. This is not due to the image resolution since the diameter of 250 m is much larger than the TC image resolution (10 m/pixel). A possible cause is a resurfacing by thin lava flows or ejecta from the crater Lichtenberg; smaller craters are preferentially flooded by lava flows or blanketed by ejecta and cannot be seen any more [10, 11]. The thickness of the possible layer is estimated to be about 7 to 10 m based on the scaling law between crater diameter and rim height [12]. On the other hand, the the Lichtenberg ejecta in Area 2 is estimated to be thinner than 5 m based on the expression of ejecta thickness of McGetchin et al. [13].

Figure 3 depicts relative size-frequency distributions. In a diameter range of 150 to 250 m, the crater density of Area 2 is equal to that of Area 1. This implies that small craters in Area 2 would have been flooded by the lava flow covering Area 1.

The least square fits give $N(1) = 1.85 \times 10^{-3}$ for Area 1 and $N(1) = 3.31 \times 10^{-3}$ for Area 2, where N(1) is the value of the Neukum's standard distribution at 1 km diameter. Using the Neukum's cratering chronology curve [6], we derive ages of 2.20 Gyr (Area 1) and 3.32 Gyr (Area 2). These ages differ from estimates of Hiesinger et al. [2]. They derived ages of 1.68 Gyr for unit P53 and 3.47 Gyr for unit P9.

Morota and Furumoto [14] studied the spatial distribution of 222 rayed craters and concluded that the cratering rate near the apex (0, 270E) of lunar orbital motion is about 1.5 times higher than that around the antapex (0, 90E). The influence of the cratering asymmetry on the cratering chronology can be corrected using the following relative cratering rate Γ,

$$\Gamma = \left(1 + 0.078 \cos\beta\right)^{2.74} \qquad (1)$$

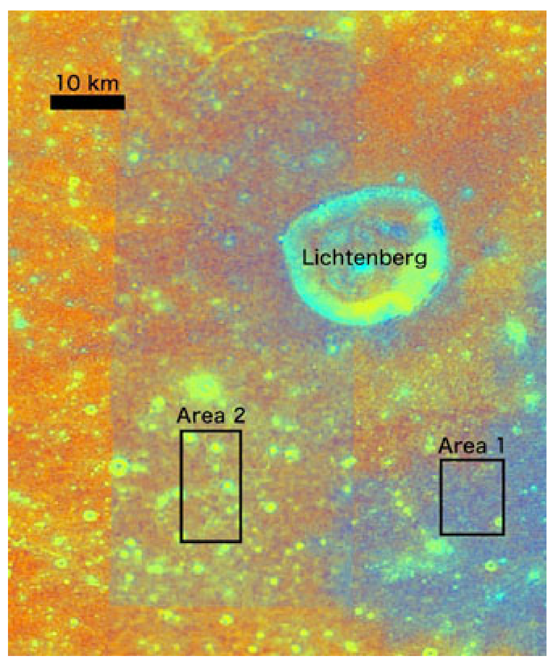

Fig. 1. USGS Clementine UVVIS ratio map of the crater Lichtenberg area (http://www.mapaplanet.org/). The study areas are outlined by black lines.

where β is the angular distance from the apex [15, 16]. For the areas of this study, we derive Γ = 1.06 from β = 36.6°. The corrected ages are 2.34 Gyr for Area 1 and 3.36 Gyr for Area 2 (Table 1).

References: [1] Wilhelms, D.E., (1987) The geologic history of the Moon, *USGS*, 1348pp. [2] Hiesinger, H. et al. (2003) *JGR*, *108*, doi:. [3] Hartmann, W.K. (1970) *Icarus*, *13*, 299-301. [4] Hartmann, W.K. (1972) *Astrophys. Space Sci.*, *17*, 48-64. [5] Neukum, G. et al. (1975) *Proc. Lunar Sci. Conf. 6th*, 2597-2620. [6] Neukum, G. and Ivanov, B.A. (1994) in *Hazards Due to Comet and Asteroids*, pp.359-416. [7] Haruyama, J. et al. (2003) *ISTS*, 1992-1996. [8] Haruyama, J. et al. (2005) *ISTS*, 857-862. [9] Haruyama, J. et al. (2007) *EPS*, in press. [10] Neukum, G. et al., (1975) *The Moon*, *12*, 201-229. [11] Hiesinger, H. et al., (2002) *GRL*, *29*, doi10.1029/2002GL014847. [12] Pike, R.J. (1977) *Proc. Lunar Sci. Conf. 8th*, 3427-3436. [13] McGetchin, T.R. et al. (1973) *EPSL*, *20*, 226-236. [14] Morota, T. and Furumoto, M. (2003) *EPSL*, *206*, 315-323. [15] Morota, T. et al. (2005) *Icarus*, *173*, 322-324. [16] Morota, T. et al. (2007) *Adv. Space Res.*, in press.

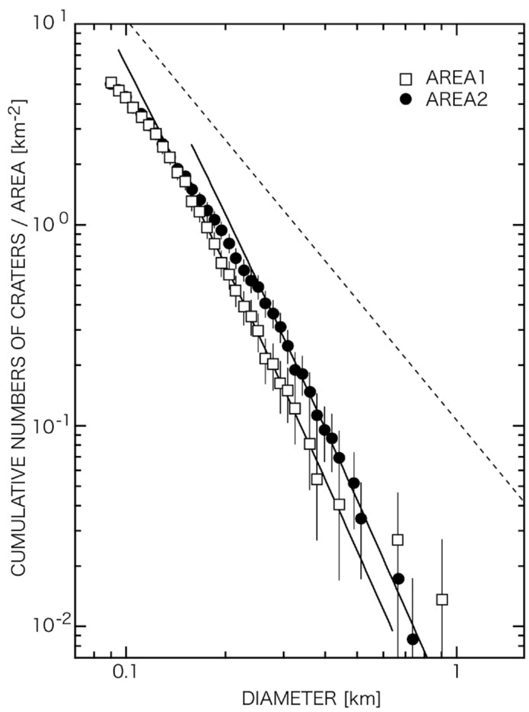

Fig. 2. Cumulative size-frequency distribution. Curves represent Neukum's lunar standard size-frequency distributions fitted to the distributions in diameter ranges of 0.15 to 0.4 km for Area 1 and of 0.25 to 0.6 for Area 2. Errors are calculated by ± $N^{1/2}$. Dashed line indicates a size distribution $N = 0.105D^{-2}$ corresponding to 7 % of the geometric saturation.

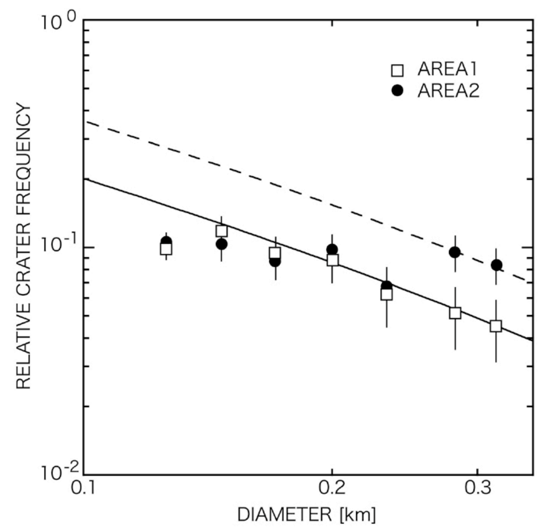

Fig. 3. Comparison of relative size-frequency distributions. The reference distribution is $N \propto D^{-3}$. Curves show the standard distributions fitted to the distributions in diameter ranges of 0.15 to 0.4 km for Area 1 (solid line) and of 0.25 to 0.6 km for Area 2 (dashed line).

Table 1. Comparison of ages for mare basalts.

	Area [km^2]	N(1) [x10^{-3} km^{-2}]	Age [Gyr]	Corrected Age [Gyr]
Area 1	74.0	1.85 (+0.01/-0.01)	2.20 (+0.02/-0.02)	2.34 (+0.02/-0.02)
Area 2	115.5	3.31 (+0.06/-0.06)	3.32 (+0.01/-0.01)	3.36 (+0.01/-0.01)