**CARBON AND RARE-EARTH ELEMENTS CONTENTS ON THE MOON: AS NEW RESOURCES.** Yas. Miura, Yamaguchi University, Chuou 4-1-23, Yamaguchi753-0074, Japan (yasmiura@yamaguchi-u.ac.jp;moonyas@hotmail.com)

**Introduction:** Carbon, chlorine and rare-earth elements (REE) are remained in impact breccias on the Moon [1-4]. Although there are no "Earth-type mineral deposits" on the Moon due to few dynamic plate movements without sea-water and few dynamic convection process to transportation of light volatiles to the interior to produce multiple melting concentration of Earth-type mineral deposits, main melting process to produce elemental concentration of "Moon-type deposits" is considered to be" impact process" with vapor-liquid (fluid)-solid state changes [2-4]. The main purpose of the paper is to elucidate the Moon-type elemental concentration on carbon, chlorine and the REE anomalous Ca-rich plagioclase compositions with carbon, which will be one of main target for lunar space exploration [3, 4].

**Carbon and REE deposits in the lunar rocks:** In order to discuss the "impact process "of the rock types, the Apollo lunar rocks are only valuable samples to discuss the sampling points and thin-section textures in wide area. Figure 1 shows that carbon, chlorine and REE (Y, Ce and Nd etc.) contents are increased largely at the lunar polymict breccias among the highland troctolite, volcanic basalt, regolith soils and impact breccias as follows (Table 1).

1) All contents of carbon, chlorine and the REE are the most deficient in the highland rocks. This indicates that crystallized minerals do not include so much due to slower crystallization than other rocks.

2) Volcanic basalts shows lower contents, though the REE contents of Y elements are higher contents.

3) Regolith soils show higher contents of carbon, chlorine and the REE (especially Y element). This suggests that regolith soils are mainly originated from basaltic rocks (at the Apollo sampling sites of the near side with major Mare basalts).

4) Polymict breccias shows the highest contents of these elements, especially the REE of Ce and Nd. This indicates that Ce contents is considered to be significant indicator of impact mixing , though high Nd contents has contribution for magnetic properties around the impact craters due to its high magnetic properties.

Table 1. Anomalous data of lunar plagioclases .
*1) Carbon, chlorine and the REE:*
The highest contents in the polymict breccias.
*2) Y and Ce contents of the REE:*
Clear increase of Y contents in polymict breccias .

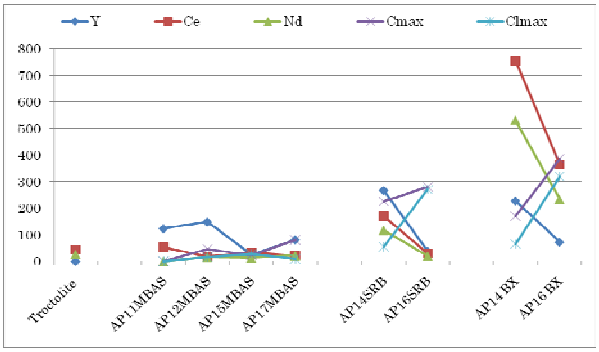


Fig.1. Average contents of carbon, chlorine and the REE-Y, Ce and Nd in the Apollo samples of the troctolite, basalts, regolith soils and breccias [1-4].

**Estimated amounts of the REE deposits**: Significant deposits of the REE (17 elements) contents are estimated as ca. 20 million ton (in regolith soils in 10 m thickness) and ca. 13300 million ton (in breccias in 2km thickness) on overall surface of the Moon. This large amounts of the REE are considered to be new resources in the airless Moon with impact surface.

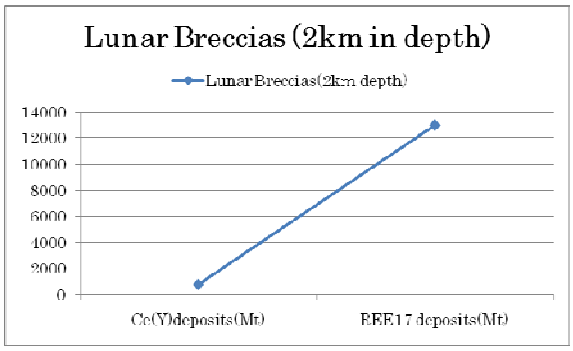


Fig. 2. Estimated amounts of the lunar REE (Ce, Y) deposits in the reported data of the Apollo samples.

**Summary:** The lunar Apollo breccias contain the highest amounts of the REE (esp. Ce) deposits, which will be strong candidate for the lunar resources.

**References:** [1] Heiken G., Vaniman D. & French B. (1991): L*unar source book* (Cambridge Univ.Press). 468-474. [2] Miura Y. (2009). LPI Contrib. No. 1515 (LEAG 2009), 2042, 2043. [3] Miura Y. (2011): PTMS-2 (Ottawa), pp.2 (in press). [4] Miura Y. et al. (2011): Report of ISAS-JAXA Plasma Research, pp.4 (in Japanese; in press).