CALCIUM-RICH PLAGIOCLASES FORMED BY GIANT IMPACT EVENT TO THE LUNAR CRUST.

Yas. Miura, Inst. Earth Planet. Sci., Graduate School, Sci. & Eng., Yamaguchi University, Yoshida 1677-1, Yamaguchi, 753-8512, Japan. yasmiura@yamaguchi-u.ac.jp

Introduction: Ca-plagioclase minerals of the main lunar crust components on the Moon are considered to be formed by magmatic separation of crystal fractionation so far. Recently Ca-rich plagioclase (without K- and Na-rich feldspars) can be formed by hot carbon dioxides gas reaction in volcanoes on the Earth [1].

The present purpose of the paper is that lunar crust components with main Ca-rich plagioclases are originally from Earth planet at the giant impact process.

Sources of the lunar crust with Ca-rich plagioclases: The following items listed in Table 1 are affairs for estimation of original components of the lunar crust which is considered to be formation mainly by normal planetary accretion model so far. The present model can be explained energy sources (explained by impacts on airless Moon and heat sources of the giant impact and isotopic mixing from target Earth) [1] as shown in Table 1.

Table 1. Main problems for origin of the lunar crust.

1) Origin of light anothositic components:	
(previous model)	All rocks planetary bodies with light anorthositic rocks
(present model)	Separation from primordial Earth by the giant impact event
2) Origin of separated anorthositic crust:	
(previous model)	Normal planetary accretion and giant impact
(present model)	Main source of separated planet mainly from primordial Earth

Carbon-bearing impacted rocks: There are three characteristics of carbon-bearing impacted minerals and rocks on the Moon as follows:

1) Ca-rich plagioclases: Lunar Ca-rich plagioclases (without Na and K plagioclases) are explained as separation of magmatic ocean process on the lunar layering with evaporation of Na and K [1]. When role of carbon dioxides is used to formation of Ca-plagioclase, lunar Ca-rich plagioclase as large crystal can be explained by hot carbon dioxides gas during giant impact process from original K, Na and Ca-rich plagioclases (from old planets-projectiles) with loss of Na and K. In fact, large anorthosite crystals are formed at volcanic islands (Miyake-jima, Sakura-jima, Mutsure-jima, Japan etc. on the Earth) as reaction with hot carbon dioxides.

2) Carbon-and chlorine-bearing impact breccias: Gases with carbon and chlorine can be fixed during impact processes (with hot carbon dioxides) , which are found in the Apollo polymict breccias [1-6]. This indicates assemblage blocks of giant impact with planets-projectile can be remained irregularly at lunar interior with carbon- and chlorine-bearing breccias, and carbon dioxides fluids [2-6] (Fig.1)

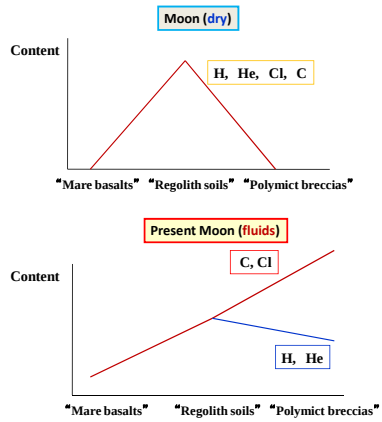

Fig.1. Carbon-bearing rocks of lunar brecciated rock [1].

3) Metamorphic carbonates from carbon dioxides-fluids: Third type carbonates (together with biogenetic and chemical reactions) can be formed by impact process of hot carbon dioxides gas from original Ca, Mg or Fe-rich materials and from carbon dioxides-rich fluids (probably in lunar interior with some water components) [2, 3, 4]. The anomalous fluids with carbon dioxides-rich components can be originally

Impact model of lunar crust with Ca-plagioclase: Figure 2 shows model of impact process to move lunar crust from old planetary bodies during giant impact with Ca-rich plagioclase formation, where Ca-rich plagioclases are re-formed during giant impact process with carbon-dioxides in impacted rockes on the lunar interior.

Evidence of Ca-plagioclase formation: Ca-rich plagioclase minerals are formed at volcanic process with hot carbon dioxide gas at Mutsure-jima, Yamaguchi, Japan as shown in Fig. 3.

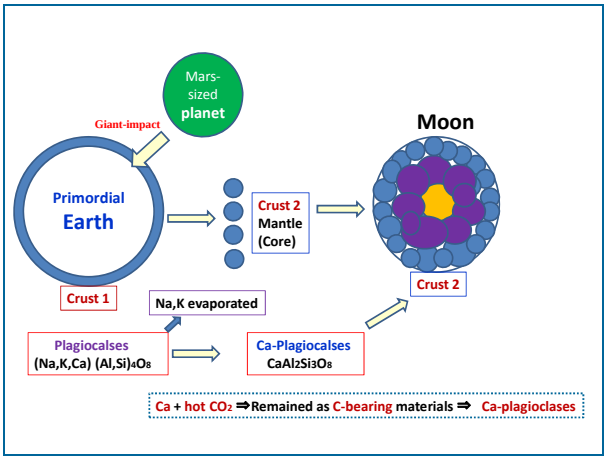

Fig.2 Model of lunar crust from old Earth during giant impact with formations of Ca-rich plagioclases and carbon-bearing basement rocks on the Moon [2].

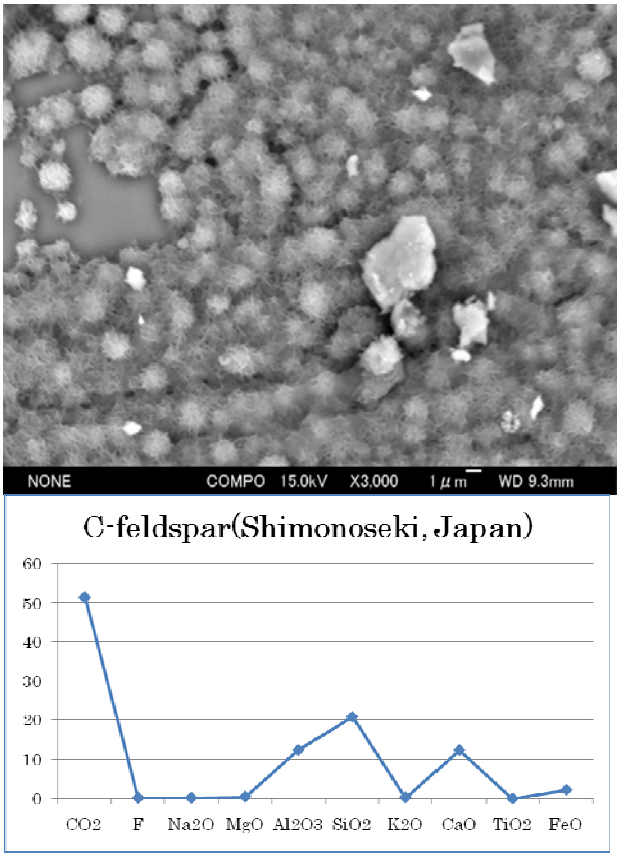

Fig.3. Electron micrograph (above) and in-situ chemical composition (below) of fine Ca-rich plagioclase fragments formed at hot carbon dioxides gas at Mutsure-jima, Yamaguchi, Japan [3].

Summary: The lunar crust with anorthositc compositions is considered to be derived from primordial Earth during impact, which is found in C, N and Cl elements of lunar basalts, and Ca-plagioclase formation at hot carbon dioxides gas at Mutsure-jima, Yamaguchi, Japan.

Acknowledgements: Author thanks to Drs. T. Kato and T. Tanosaki for discussions of carbon analyses of drilled samples and data analyses.

References:

[1] Heiken G., Vaniman D. & French B. (1991): *Lunar source book* (Cambridge Univ.Press). p.468-474.
[2] Miura Y. (2009): *LEAG-2009*, abstract #2049.
[3] Miura Y. (2009): *LPS XL*, Abstract #1090.
[4] Miura Y. (2009) : *LPS XL*, Abstract #1468.
[5] Miura Y. (2008): *LPI Contrib.* No. 1439.CD#3001.
[6] Miura Y. (2008): *LPI Contrib.* No. 1446.CD#4047.