# GLOBAL IMCOMPLETE FORMATION OF LUNAR MINERALS WITHOUT SUCCESSIVE FLUID SYSTEM.

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**Introduction:** Analysis of lunar samples including the Apollo samples have been applied by analytical method and terminology based on terrestrial samples [1]. This is mainly because typical extraterrestrial samples of meteorites found and collected on the terrestrial surfaces show primordial formation of chondrules and shocked textures [2-9]. However, lunar samples of the Apollo and lunar meteorites contains larger rock-forming minerals of feldspar, olivine and pyroxene, which have been considered to be formed by some interior process of igneous rocks (without Earth-type sediment process of global fluids and related plate-movement). Therefore probable formation of lunar rock-forming minerals should be investigated comparatively. Main differences with formed processes of Earth's minerals compared with the extraterrestrial lunar minerals (including feldspar minerals) are less answered clearly by many investigators. In this paper, one of many evidences of the lunar rock formation (with limited data) is considered to be compositional data by "impact growth" of impact-heating and shocked cooling processes (with volatiles of carbon elements)[1-9]. Main purpose of the paper is to elucidate comparative differences with formed processes (including volatile components) of lunar rock-forming minerals (including plagioclases) compared with terrestrial rock-forming minerals.

**Rock-forming minerals analyzed by Electron probe microanalyzer (EPMA):** Large grains of lunar rock-forming minerals (olivine, pyroxene, feldspar and silica) can be analyzed with normal electron microanalyzer (EPMA) used for all Earth-type rock-forming minerals to obtain these compositional ranges [1, 4-9]. This is mainly because later stage minerals of lunar feldspar and silica minerals indicate lower temperature formation (formed as crust-minerals) from higher-temperature formation of olivine and pyroxene (formed as mantle minerals based on Earth-type database). Analytical EPMA data suggest limited compositional range of plagioclases (and less silica quartz) which is considered to be "local heating process" of impact melting produced by many impact craters on the lunar surface, though we cannot observe globally active volcanic activity on the Moon to form Earth-type feldspar and quartz minerals clearly [1, 4-9].

**Plagioclase feldspar minerals analyzed by FE-electron probe microanalyzer (FE-EPMA):** Large grains of lunar feldspar minerals can be analyzed with Field Emission electron probe microanalyzer (FE-EPMA) used for micro-grains with carbon volatiles to obtain quenched and solidified grains [1, 5-9]. This is mainly because later stage minerals of plagioclase feldspars indicate rapid cooled formation (from high-temperature vapor state including carbon volatiles), where lager plagioclase grains on the Moon (with less carbon) have been formed by prolonged heating process of larger impact process on the Moon. However short impact heating samples of lunar breccias contained higher carbon contents because of its rapid-cooled process. The FE-EPMA data suggest carbon-bearing plagioclases which is considered to be "local and quenched mixed process between vapor and solid states" of impact melting produced by many impact craters on the global lunar surface, though we cannot observe other quenched process of global fluids-water on the lunar surface [7-9].

**Difficult remained process to form fluid water on the Moon:** The impact process is largely difficult to form and kept fluid water during impact process, because it cannot be passed through liquid-state of intermediate phase-range between vapor and solid states by rapid decrease of temperature or pressure on airless surface of the Moon. Therefore, lunar underground caves might be relicts of vapor room during larger shocked processes remained at the interior followed evaporation from vapor or some fluids locally, which would be checked at the present quenched indicator of carbon-bearing solids remained on the rocks with the FE-EPMA method [7-9].

**Old lunar rocks remained on the Moon without Earth-type successive process:** Main difference with rock-forming minerals between young-aged Earth and old-aged Moon is macroscopic observation of *global fluids water* on active Earth [2-3]. Complicated Earth's activity of interior magmatic formation with Earth's shock-wave events of volcano, earthquake and asteroid impact has been produced continuously younger-aged rocks with larger crystals with clear composition through global Earth's systems separated to the ocean water and atmospheric systems above the rock system continuously [2, 3]. If there is no global water and active air-water system on the Moon and Exo-Earth, rock-forming minerals and surface outcrops show waterless-formation of primordial Earth planet [1, 4-5].

**Summary:** The present study is summarized as follows

1) Analytical evidences of the lunar rock formation (including plagioclases) can be discussed by two types of mineral analysis with macro- and micro-grains (with carbon elements) by the EPMA and FE-EPMA methods, where comparative compositional data formed by impact growth compared with terrestrial rock-forming minerals.

2) Impact process which is difficult to form and kept fluid water from phase changes can be explained lunar interior caves as probable relicts of vapor room during larger shocked processes locally, which can be checked clearly by present quenched indicator of carbon-bearing solids with the FE-EPMA method.

3) Young-aged Earth planet shows macroscopic existence of global fluids water, however the Moon without any global fluids can be explained as waterless-formation of primordial Earth planet, because of its definition of macroscopic existence generally.

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**References:** [1] Miura Y. (1983) *Lunar and Planetary Sci. XIV, Abstract* paper #1255. [2] Wilson J.T. (1965) *Nature*, 207 (4995), 343-347. [3] Grove T.L. (2012) *An. Rev. Earth & Planetary Sci.* 40 (1), 413-439. [4] French B. (1998): *Traces of Catastrophe* (LPI), 120 pp. [5] Miura Y. *et al.* (1997) *Shock Waves* (World Scientific), 20. 1473-1478. [6] Miura Y. *et al.* (1999) *J. Materials Proc. Tech.*, 85, 192-193. [7] Miura Y. *et al.* (2010) *LEAG2010*, Abstract #3005. [8] Miura Y. *et al.* (2017) *Planet. Science Vision 2050 Workshop 2017*, Abstract #8101. [9] Miura Y. (2018) International Mineralogical Association 2018 (Melbourne, Australia), Abstract #1189.