

Solid Materials of Mineral and Rock on the Solar System: X-ray Unit and Mixed Status

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Introduction: Solid materials of all celestial bodies on the Solar System (with technical limits of whole observation and collection by man-made satellites) should be *defined clearly* as main purpose of this paper based on academic data of those solids from the Earth's definition relatively.

Academic definition: All *mineral crystals* on Earth are defined with *X-ray determination* (as arrangement of 0.1nm unit) and *chemical composition* (as stoichiometric compound) with its occurrence on the academic material database (as *Earth's mineral*), where *the rock* is composed on many mineral crystals or mineral with mixed irregular solids (with light or heavy elements) usually. This *Earth's definition* is easily applied to investigate and determination to unknown samples including extraterrestrial samples on Earth and visiting collections on the Moon (and Mars and Asteroids *etc.*). However, basic definition of *solid samples on extraterrestrial sources* is not enough to be defined (especially on its developed status as the Celestial bodies) as shown in Table 1.

New concept of the Solar System's material: Solid bodies of the Solar System have been accepted mainly from their movements from *the geo-centered theory* to the *Helio-centered theory* through many astrophysical investigators based on the Moon and nearest planetary *tracking data*. Therefore, we should investigate by solid *material database* (rock and/or mineral crystal) of *each Celestial body*. This is main reason why a) mineral spices are completely different with the water-planet Earth (three systems of rock, ocean water and atmosphere as the mineral differentiation) and other Celestial bodies (mainly rock and/or atmosphere systems as different generation of mineral and rock compared with the planet Earth), b) previous collected extraterrestrial rocks (without chondrules or not) shows different evolution of glass and mineral, c) final mineral grains (soils, carbonates and silica) of the Earth's sedimentary process cannot be obtained clearly on extraterrestrial samples so far, and d) various mineral deposits of light element of carbon (from extreme to lower conditions) are obtained from macroscopic to microscopically as shown in Table 1.

Table 1. Different concepts of the Solar System's materials discussed in this study.

| Celestial body | Mineral crystal | Rock |
|-------------------------|---|---------------------------------------|
| 1) Earth (water-planet) | X-ray atomic structure & stoichiometric chemistry | Its mixed texture (with glass etc.) |
| 2) The Moon | Shocked reformed minerals | Amorphous or mixed minerals |
| 3) Mars | Mainly shocked minerals (with fluid products) | Basaltic evolved rocks (with glasses) |
| 4) Asteroids | Mainly shocked minerals (with reacted vapors) | Shocked chondritic/growth grains |

Existence of fluid-related grains: Carbon-bearing grains show only *light element* to exist all phase states from solid to liquid to vapor condition with various compositions, texture and atomic structure. Therefore, it is *significant indicator* to detect its formed process with or without fluid on *water-planet Earth* (to form final *global carbonate minerals* and its rocks), the Moon (to form *global carbon distribution* rich in fine regolith soils on surface), Mars (to form *global carbon-rich grains* and deposits) and Asteroids (*carbon-rich in fine regolith grains* and/or *carbon-bearing grains* and rocks) as shown in Table 2.

Discussion: Earth's minerals formed as large mineral crystals are defined by atomic structure and chemistry based on X-ray analysis and EPMA-A TEM/SEM microanalyses in laboratory on Earth. On the other hand, extraterrestrial samples of the Moon, Mars and Asteroids have no large crystal of mineral grains (due to no global water system on these bodies). Therefore, Earth's mineral crystal cannot be obtained at any other planets and Asteroids without the global water system. Remote-sensing detectors by the IR and Visible wavelengths are mainly instant data obtained from mainly molecular data (atom-atom distances) which are different with Earth's mineral definition. This suggests that extraterrestrial mineral rocks (or rocky minerals) are considered to be *imperfect solids* compared with Earth-type mineral crystal, which means that *main X-ray peaks* of crystal planes (hkl) are mainly formed during the developed processes with short extreme condition of simple or multiple impact heating and cooling processes on the extraterrestrial bodies. In short, all celestial bodies at the Solar System are

completely different on its process and fluid contribution for rocky mineral or mineral rock formation (including the Hayabusa samples), which means that solid bodies of the Solar System might be the *Helio-centered theory-type* material rocks which are not used by the Earth-type mineral rocks to all other extraterrestrial bodies (not as the Earth (geo)-centered materials as used in the astronomical scale previously).

Table 2. Carbon-bearing and/or -rich grains and/or rocks of the Solar System's materials discussed in this study.

| Celestial body | Carbon-bearing and/or -rich grains and/or rocks |
|-------------------------|---|
| 1) Earth (water-planet) | Final global carbonate minerals and rocks and life/plant solidified rocks (shungite <i>etc.</i>) |
| 2) The Moon | Global carbon distribution rich in fine regolith soils on surface (with shocked grains) |
| 3) Mars | Global carbon-rich grains and deposits (with shocked grains) |
| 4) Asteroids | Fine carbon-rich regolith grains and/or carbon-bearing grains and its rocks |

Summary: The following data are summarized in this study. 1) Solid materials of all Celestial bodies on the Solar System are discussed on the solid data from the *Earth's definition* relatively to the extraterrestrial Celestial bodies. 2) All mineral crystals on Earth are defined with X-ray determination and chemical composition with its occurrence on the material database, though basic definition of extraterrestrial sample is not enough to be defined from *less crystalline* rocks. 3) The Earth's minerals show absolutely *huge numbers* of mineral species, *well differentiated* minerals, *various Earth's sedimentary* process, and *various mineral* deposits of *carbon-bearing* grains. 4) Carbon-bearing grains show various grains, texture and compounds which are indicators of the detailed *formation process* on each Celestial body including the Hayabusa samples. 5) The material data of the samples might indicate that all material data of mineral and rock are different from the Celestial bodies of the Solar System.

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