COMPOSITIONAL CHANGES BY MULTIPLE IMPACTS. Y. Miura, H. Kobayashi, S. Fukuyama, and A. Gusik, Graduate School of Science and Engineering, Department of Chemistry and Earth Sciences, Faculty of Science, Yamaguchi University, Yoshida, Yamaguchi 753-8512, Japan, (dfb30@po.cc.yamaguchi-u.ac.jp).

Abstract: Multiple impacts (i.e. progressive impacts) with reduction state produce characteristic compositions originated from target rock. Pure carbon can be obtained from limestone target rocks by multi-impact with reduction state which can be found in natural and artificial impact craters. Pure Fe spherules in lunar agglutinates can be obtained from FeO- rich basaltic rock by multiple impacts on the airless Moon.

Introduction: Compositions by impact are mainly considered to be mixed with elements from projectiles and target materials at melt and vapor conditions, and only maintained target element by changing to high-pressure type. Fe-rich composition in smaller impact crater can be explained by vapor condition of projectile materials. However, this interpretation cannot explain if there are isolated element from target rocks as purified composition [1,2,3,4].

The purpose of the present study is to make clear the purified iron or carbon formed by multiple impact processes.

Compositional Change by Multiple Impacts: Multiple impacts used in this study mean progressive impacts by many projectiles of meteoroids, whereas multiimpact means impact reaction with reduced condition inside the inside the larger impact crater. The multiimpact or multiple impacts produces fine-grained breccias with homogeneous composition (Fe or C) from target rock with reduction state, as follows [2,3,4]:

f(impact vapor-sold)=f(Pure element from target rock)

Examples of multiimpact can be found at shocked graphite from limestone target rocks of the Barringer Crater, USA, and artificial impact crater. This carbon element with stable even at high temperature is considered to be formed under vapor condition. The Fe-rich impact materials are considered to be produced by the two different processes, (a) Fe from projectile of iron meteroids found as fine-grained materials after breaking from Fe-Ni composition, and (b) reduced Fe from FeO-rich target rock under multiple impacts with vapor condition. Difference of elemental source from projectile or target materials should be checked by coexisting elements or texture [2,3,4].

New type impact reaction of lunar iron spherules: Previous formation process of lunar iron spherule (i.e. round shape formed by impact jetting) is that spherules with pure iron composition by simple reduction process mainly by the solar wind and micrometeoroids as follows [1,5].

(a) Micrometeorites hit lunar soils including solar wind (with H and He).

(b) Glassy was formed, and followed by Fe from FeO composition (with H).

(c) Micrometeorites hit the lunar soil to form pure iron spherules.

However, there are problems of pure iron spherule on the Moon [1,2,3,4].

(a) There are few Si or Ni compositions from target rock or iron meteroids.

(b) Glass is major materials state formed by impact (without recrystallization).

(c) No uneven texture of impact crater can observe on impact spherule.

(d) Iron spherule is found mainly in agglutinates of more basaltic type rocks.

(e) Matrix texture is flow lineation with iron-rich components.

Therefore, the following new type of multi-impact reaction is proposed to explain pure iron spherule with iron-rich flow texture [2,3].

(a) Meteoritic impact by direct and high speed on airless Moon is obtained on Fe-rich mare basalt (also on lunar highland anorthosite with few Fe).

(b) Progressive impacts (i.e. multiple impact) on the Fe-rich mare basaltic breccia form impact craters to make larger size of impact materials.

(c) Vapor and melted fragments by impact from quenched solid grains contain various pure iron spherule grains in jetting by impact.

(d) Reduction state by solar wind and rapid cooling condition on airless Moon can maintain such anomarous Fe-rich spherules in agglutinates on the Moon.

Purified After Multi-Impacts: Simple impact shows usually mixed and unpure compositions with target materials and projectiles which can be found at meteoritic craters, whereas multi-impact produced homogeneous and pure composition from the target materials inside the vapor plume with reduction state and ejecta as fine-grained breccias.

Carbon aggregates can be obtained at anomalous impact materials formed by multi-impact on limestone target rock, which produces the following carbon materials by impact:

(a) amorphous carbon (partly crystallized as shocked graphite) with vaporization of limestone,

(b) carbon aggregates, or micro-diamond formed by plasma beams with mixing growth under reduction condition inside the crater space.

The above impact reaction can be proved by mixing with high-pressure, high-density impact aggregates in the carbon aggregates as Fe-rich melt flow texture by quenching during jetting flow out of the crater [1,2,3,5].

Conclusions: The results in this study are summarized as follows.

1. Multi-impacts (i.e. progressive impacts) with reduction state produce characteristic compositions originated from target rock.

2. Pure carbon can be obtained from limestone target rocks by multi-impacts with reduction state which can be found in natural and artificial impact craters.

3. Pure Fe spherules in lunar agglutinates can be obtained from FeO- rich basaltic rock by multi-impacts on the airless Moon.

References: Miura Y. and Graham R. A. (1994) Shock Waves, 3, 293–298. [2] Miura Y., Takayama K., Kato T., Kawashima N., Imai M., Iancu G., and Okamoto M. (1995) Shock Waves Proc., 19, 399–410. [3] Miura Y., Takayama K., Kawashima N., and Kato T. (1995) Shock Waves Proc., 19, 405–410. [4] Miura Y. (1991) Shock Waves, 1, 35–41. [5] Housley R. M., Grant R. W., and Patton N. E. (1973) Proc. Lunar Sci. Conf. 4th, 2737–2749.