MULTIPLE EXPLOSIONS DURING CRATERING AT CARANCAS METEORITE HIT IN PERU. Y.Miura, Earth Sci., Graduate School of Sci. & Eng., Yamaguchi University, Yoshida 1677-1, Yamaguchi, 753-8512, Japan. yasmiura@yamaguchi-u.ac.jp

Introduction:The Carancas meteorite fallen at high plateau of Cenozoic continental sedimentary rocks on September 15, 2007 in Peru, South America produce impact crater of 13.3~13.8m in width with pond of 7.4~7.8m in width [1]. Main purpose of the paper is to make clear formed materials ejected powdered meteorites offered by INGEMMET (Peru's Geological, Mining and Metallurgical Institute)[1] and to elucidate explosion process of meteoritic and ground materials.

Samples for FE-ASEM study: Samples are three kinds soils in the crater (two greys and one red color)and one powdered meteorite (grey color) found at 200m from impact crater[1]. Magnetic fragments of four samples including the powdered Carancas meteorite fragments are selected to observe meteoritic magnetic pieces formed at meteoritic bombardment [2,3,4] by high-resolution scanning electron microscopy with the EDX analyzer (FE-ASEM, model as JEOL-JSM-7001F) in Yamaguchi, Japan. All magnetic fractions of the samples less than about 1mm in size are analyzed by the EDX spectra [4].

Meteoritic origins of powered fragments: Analytical data by an in-situ observation with the FE-ASEM indicate that melted fragments are considered to be derived from original chondritic meteorite as follows. 1) Fe-Ni-Si compositions as Fe-Ni and Fe-Si relations are from kamacite metal and silicates of original meteorites [2,3,4,5,6]. 2) "Fe-Ni-rich flow texture" and "Fe-rich spherules" melted from original meteoritic minerals.

First explosion process by texture and elements: Meteorite melted in atmosphere shows 1) fusion-crust with Fe-rich and/or carbon-rich composition, and 2) melt flake("rosettes") texture of Fe-Ni-O-rich composition (less than 1μm in width, cf. Fig.1) during first cratering [7]

Second explosion process at cratering with groundwater: Second explosion process at cratering with wet-ground is considered to be existed by 1) high-temperature meteoritic body (probably at high-plateau and direct hit to the ground by morning type (i.e. " head-on collision") [8,9] of 11:45a.m.[1], and by 2) "phreatic (steam) explosion" [10] between hot meteorite metal and cold groundwater molecules at impact site (as listed in Table 1).

Table1.Two steps of the Carancas meteorite melting and cratering.

Step	Major process	Evidences
First	Melting, Excavation	Fusion crust composition, Broken meteorites, Flake texture of Fe-Ni-O
Second	Wet-ground	Flake Fe-Ni-rich texture, Needle Fe-Cl-rich texture, Powdered meteorite, Fe-S-rich micro-grains

Fe-Cl-rich phases of quenched needle fibers: Although few considerable heavy elements cannot be detected except meteoritic ions, however, local concentration of light elements (C, Cl and S) reacted direct with meteoritic Fe-Ni-Co elements are obtained in this study. Sulfur (S) phases with Fe are found as 1~43%SO_3 in composition, and chlorine (Cl) phases with Fe are obtained as trace contents at all sample as 0.1~3.5%Cl contents to form Fe-Cl-rich phases of quenched needle fibers [7]. Main sources of these S and Cl ions are considered to be minerals of original meteorites (troilite or lawrencite etc.) as various chemistry and textures as localized concentration.

Abrupt explosion with wet-ground: Volcanic explosion with wet-ground is considered to be found at second explosion during cratering by the following observations in this study. 1) various change of Ni contents from kamacite to taenite composition, 2) various sizes (0.2 to 10μm in size) of Fe-Ni-O-rich flake textures, 3) formation of needle-shaped Fe(Ni)-Cl-rich materials, 4) formation of micro-grains of Fe-S-rich phases, 5)formation of complex brecciate textures at all selected grains in this study., However, the present meteoritic explosion with soft ground is very short-time reaction of shock wave and separated to Cl-rich and S-rich samples.

Health problem during cratering: Such quasi-volcanic explosion reported at initial report as many witnesses [1] can be explained for health problem of ill people mainly as abrupt explosion step with wet-ground of groundwater. Anomalous phenomena of boiling water, pond in the crater filled with groundwater, and smell with some gasses, can be explained by rapid reaction by meteoritic bolides against wet-ground with cooled groundwater [1,10].

Summary: First description of quenched texture of flake and needle grains between meteoritic elements and target wet-ground at Carancas meteorite hit in Peru, South America indicates two steps of explosions as

first excavation and second explosion against cold wet-ground similar with steam explosion of volcanoes or magmatic explosion at multiple explosions.

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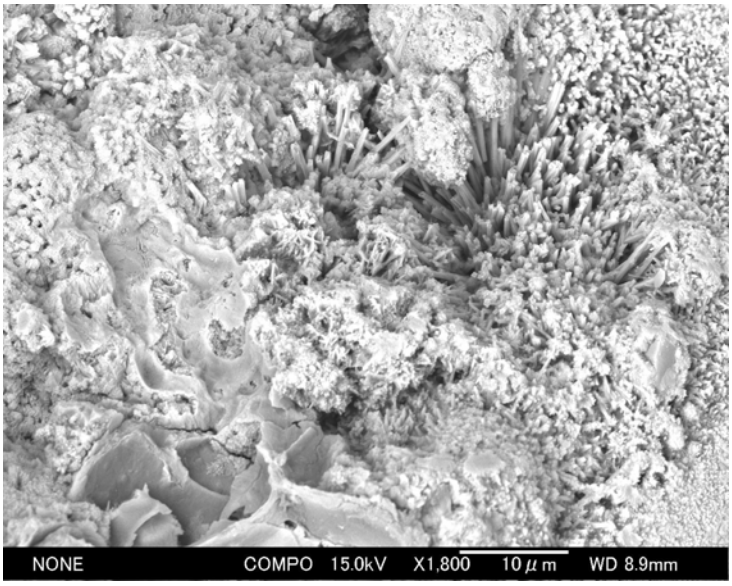

Fig.1. FE-ASEM electron-micrograph of flake (“rosettes”) texture of Fe-Ni-O-rich composition (non-crystalline Phases in the lower-left) and needle-fibers of Fe-Ni-Cal-O-rich composition (aragonite phase in the middle-right). Taken by author. Minor fiber-shaped texture in upper-left is S-bearing grains.