SIGNIFICANCE OF NANO-SIDERITE FORMATION FOR LUNAR MAGNETIC CHANGE FROM IRON METALS. Y. Miura1, T. Tanosaki2 and M. Udagawa3, 1Yamaguchi University, yasmiura@yamaguchi-u.ac.jp (Contact address: Chuou 4-1-23, Yamaguchi, 753-0074, Japan. dfb30@yamaguchi-u.ac.jp). 2Ritsumeikan University, Kyoto, Japan. 3Yamaguchi Prefectural University, Yamaguchi, Japan.

Introduction: Terrestrial magnetic iron-bearing minerals are mainly iron-oxides (magnetite etc.) due to higher oxidation states on air and water planet of the dynamic Earth. The Moon has a few magnetic minerals by oxidation states (Fe-metal from impact sources; weakly magnetic ilmenite only heated in the Mare basalts; unknown sources of strong magnetites) [1]. However, high magnetic Apollo samples are considered to be formed by oxidation status (as in the Earth) so far, though there are not so high magnetic minerals (as in the previous Earth-type) on the Apollo magnetic samples. The present new concept of lunar magnetic change by formation of iron and carbon-bearing minerals from magnetic iron metals or magnetite are controlled by carbon and/or oxygen-bearing reactions on the Moon, which are main purposes of this paper [1-5].

Terrestrial type magnetic properties: Magnetic minerals on the Earth include 48 minerals as 18 sulfides, 12 oxides, 7 metals, 3 silicates and 8 others, which indicate that dynamic Earth produces various iron-bearing metallic minerals with magnetic properties on the surface difficult find the clear origin of magnetism. Strong magnetic minerals (ca.41% of all magnetic minerals on the Moon) can be found still on three groups of sulfide, oxide and metal on the Moon (as shown in Fig.1). This suggests that weak magnetic properties on the Moon can be explained by any reaction to produce metallic iron and magnetic oxides ( magnetite etc.) even in minor grains.

Sulfur and carbon contents of lunar samples: In order to find elemental behaviors of anion elements with iron (Fe) cations, major anions of S, H, He, C, N and Cl are compared with three types of the Apollo lunar samples reported as follows (shown in Fig. 2):
1) Sulfur (S) contents are higher in the Mare basalts and polymict breccias [1], which suggests two S sources of the lunar interior and impact remnants.
2) Hydrogen (H) and Helium (He) contents are the highest in the lunar regolith and less in the basalts and breccias [1], which suggests main source direct from the solar winds on the surface.
3) Carbon (C), nitrogen (N) and chlorine (Cl) contents are higher in the polymict breccias (in C and Cl) and regolith (in N, and some in C and Cl) and less in the Mare basalts [1], which suggests main sources (C, N and Cl) from extra-lunar materials of asteroids (also by supply from the solar airs as mixed the solar winds) [5].

Lunar type magnetic properties: Magnetic minerals on the Moon of the Apollo samples show 11 minerals as 5 sulfides, 3 oxides, 1 metal, 1 silicate and 1 carbonate [1], which indicate that silent Moon has iron-bearing metallic minerals with weak magnetic properties on the surface. Strong magnetic minerals (ca.27% of all magnetic minerals on the Moon) can be found still on three groups of sulfide, oxide and metal on the Moon (as shown in Fig.1). This suggests that weak magnetic properties on the Moon can be explained by any reaction to produce metallic iron and magnetic oxides ( magnetite etc.) even in minor grains.

Fig. 1. All and strong magnetic minerals reported in the Earth (48 samples) [3, 4] and the Apollo lunar samples (11 samples) [1]. High magnetic Earth has various types of all and strong magnetic minerals, compared with less magnetic Apollo lunar sample on the Moon.

Lunar magnetic sample of composition and age: Reported data of the eight Apollo samples (10050, 10057, 15498, 60015, 62235, 68416, 70019 and 42nd Lunar and Planetary Science Conference (2011) 1373.pdf
order to estimate carbon in the Moon, the Kuga iron meteorite in Japan has been checked carbon and iron-bearing grains of cohenite and siderite obtained by the FE-ASEM, which can be applied to the Moon (Fig. 5).

**Nano-grains of lunar meteorite NWA4483:** In order to obtain nano-grains with the FE-ASEM immediately, lunar meteorite NWA4483 sample is used in this study to find iron and carbon-bearing nano-grains (shown in Fig. 4). There are carbon and iron-bearing nano-grains of siderite (with Oxygen peak in the ASEM spectra), together with troilite FeS with carbon, which suggests formation of nano-siderites [3, 4].

**Cohenite and siderite in the Kuga meteorite:** In order to estimate carbon in the Moon, the Kuga iron meteorite in Yamaguchi, Japan [3, 4] has been compared to find the origin of lunar magmatic sources [1, 2], comparative analyses show that bulk compositional data cannot show direct relation, but the iron- and carbon-bearing nano-grains [3, 4] which are found in lunar and iron meteorites, can be applied to the lunar magnetism discussed in this study.

**Summary:** In order to find the origin of lunar magmatic sources [1, 2], comparative analyses show that bulk compositional data cannot show direct relation, but the iron- and carbon-bearing nano-grains [3, 4] which are found in lunar and iron meteorites, can be applied to the lunar magnetism discussed in this study.