

Report for the Joint Use/Research of Institute for Planetary Materials

2019 fiscal year first term

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Category: International Joint Research

Name of the research project: Mineralogy and Shock Effects in Martian Regolith Breccias

Principal applicant: Fengke Cao

Affiliated institution and department: Western University, Earth Sciences

Host faculty member of IPM: Matthew Izawa

Research report:

➤ **Research purpose:**

(a) Identification of mineralogy of various lithic and crystal clasts in NWA 8171 and NWA 11220 using μ XRD and Raman methods. (b) Quantitative assessment of shock-metamorphic effects in various breccia fragments. (c) Studying shock effects of pyroxene and feldspar clasts in Martian breccias using Raman spectroscopy. (d) Deciphering the complex shock history, of different grains in Martian breccias, which predates ejection impact, and the whole rock using microscopic observations, μ XRD, and Raman data.

➤ **Conducted research:**

1. Optical mappings of four slabs of Martian regolith breccia meteorites, i.e., three of NWA 8171 and one of NWA 11220 were acquired.
2. EMPA was used to study apatite minerals in NWA 8171. Chlorine and fluorine abundance were quantitatively acquired, and OH abundance was calculated based on charge balance.
3. Powder X-ray diffraction (pXRD) data of powdered sample NWA 11220 was acquired and all the possible phases in the meteorite were identified.
4. Raman spectral data of these four slabs were collected. Mineralogy in these meteorites was acquired using Raman data. The shock effects in different grains (e.g. plagioclase, enstatite, and augite) were evaluated using Raman. The Raman results were compared with the micro-XRD data acquired in Western University.

➤ **Research outcomes:**

1. Mineralogy of various lithic and crystal clasts in Martian breccias NWA 8171 and NWA 11220 have been determined using XRD and Raman methods.
2. We found that average water-equivalent hydroxyl concentration in apatite in NWA 8171 is much higher comparing to previous research.
3. Quantitative assessment of shock-metamorphic effects in various breccia fragments (e.g., plagioclase,

enstatite, and augite) has partially been finished through analyzing the micro-XRD and Raman data.

4. I gave an oral presentation during the Metsoc conference in Sapporo after my research in IPM. We also have submitted two abstracts for the GSA conference in USA. I will give a talk and a poster during the conference this fall. The details are as follows:

Cao, F., Flemming, R.L., Izawa, M.R.M., Moser, D.E. **2019.** Determination of mineral deformation in Martian regolith breccias using *in situ* micro x-ray diffraction and Raman spectroscopy. *2019 GSA Annual Meeting*, 51(5), 341234.

Cao, F., Flemming, R.L., Izawa, M.R.M., Moriguti, T. **2019.** Water abundance in apatite solid solutions in Martian regolith breccias and potential applications to Mars 2020. *2019 GSA Annual Meeting*, 51(5), 341352.

Cao, F., Flemming, R.L., Moser, D.E., Izawa, M.R.M. **2019.** Mineralogy and shock effects in Martian regolith breccias. *82nd Annual Meeting of The Meteoritical Society*, Abstract 6456.