Mineralogy of Martian meteorites: Discovery of new samples from deserts and Antarctica

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Martian meteorites are important samples that have offered direct clues to understand igneous processes and the mantle composition of the planet Mars.　The total number of Martian meteor-ites known to date is drastically increasing in these ten years with the discovery of many Martian meteorite samples from African and Arabian deserts as well as from Antarctica. Thanks to these discoveries, the variation of Martian meteorites has become larger, which has offered us better pictures of Martian meteorite groups.

Among Martian meteorites, nakhlite and chassignite are olivine-pyroxene cumulates sharing identical crystallization and ejection ages (1.3 Ga and 10-11 Ma, respectively).　Only three nakhlites were known until 2002, but now the total number of nakhlites is seven.　All of them show similar mineralogy and petrology, clearly suggesting a common origin from the same igne-ous body.　However, each nakhlite sample is slightly different from one another, and considered that the formation at different areas (or burial depths) in the same cumulate piles (probably thick lava flow) caused systematic mineralogical changes (olivine and pyroxene compositions, abun-dance of mesostasis, and plagioclase size).　The estimated burial depths range from shallower than 1 m (NWA817 and MIL03346) to deeper than 30 m (Lafayette).

Although Chassigny was the only sample of the chassignite group, the second chassignite (NWA2737) has been just discovered.　Because the petrology of NWA2737 is nearly identical to that of Chassigny, they are likely to have followed similar formation history.　However, all the chemical compositions of mafic minerals (olivine, pyroxenes, chromite, and kaersutite) in NWA2737 are slightly more Mg-rich than those of Chassigny.　Probably, all these minerals were equilibrated with more mafic surrounding melt or they originally crystallized from more mafic parent melt than Chassigny.　Since the olivine cooling rate of NWA2737 (30 degrees/year) is close to that of Chassigny (28 degrees/year), their burial depths (~15 m) should have been similar.　The de-tailed mineralogy of chassignites suggests unlikely that they originated from the Martian mantle.

The discovery of new Martian meteorites has greatly increased the number of shergottites.　In these a few years, the third subgroup of shergottite (olivine-phyric shergottites) has been accepted and has widened the variation of shergottites.

These Martian meteorites will be very important samples especially when they are combined with geological and mineralogical results obtained by recent Mars exploration missions.