Towards understanding ore formation on Mars: new data from ExoMars/TGO and geochemical fingerprinting of meteorites

Description for the general public

Fifty years after the Cold War-driven race to the Moon between United States and Russia, we now face another space race to Mars with many more competing parties. Only in 2020, satellites with rovers to Mars will be launched by the European Space Agency (ESA), NASA, the China National Space Administration (CNSA) and the United Arab Emirates. In addition, Russia, Japan, and India currently develop their martian programs as many private companies do with the most successful SpaceX, and Boening.

One crucial challenge of future Mars colonization is the access to local metal deposits. Although we cannot yet plan any mining on Mars, scientific methods allow predicting which metals and how much and where could be expected. ExoMars Trace Gas Orbiter (TGO) launched by the ESA has recently started to track down methane and associated traces gases, such as H_2S, SO_2 and HCl, which are known from areas of volcanic and hydrothermal activity on Earth. Volcanic provinces on Earth host large sulfide deposits with precious metals such as copper, silver or gold. Martian volcanic provinces have not yet been investigated in terms of ore-forming processes but thanks to martian orbiters, rovers and meteorites we already know that martian ore minerals and ore-forming processes are almost the same as on Earth.

To date, however, little work has thoroughly examined how and where ore-forming processes would act on the martian surface and subsurface. As a result, the distribution and chemical composition of sulfide ores on Mars remains poorly understood. Without an adequate study of martian sulfide ores, we risk to underestimate or overestimate the feasibility of future martian missions, and to choose inappropriate targets for future exploration. Our project remedies this gap by analyzing ore minerals in martian meteorites together with larger-scale remote sensing data on martian volcanic trace gas emission, surface mineralogy, and surface topography.

Thanks to the formation of international research team composed of Polish, Chinese, Italian, Belgian, German, and American scientists we have access to the required variety of martian meteorites, as well as volcanic gas emission data and high-resolution color stereo images of martian surface collected by the ExoMars/TGO. We will use a combination of traditional techniques, such as optical microscopy, with the most modern and sophisticated techniques such as femtosecond Laser Ablation – Inductively Coupled Plasma Mass Spectrometry (fs-LA-ICPMS). Thanks to fs- LA-ICPMS we can determine the isotopic composition of common metals such as copper, nickel or iron, and measure the concentrations of even very rare metals such as gold or platinum. The laser beam allows determining chemical or isotopic composition of any mineral in a field of only five micrometers in diameter. The fruition of this project will help us to understand key processes controlling precious metal deposits on Mars.