National Aeronautics and Space Administration

Development of an Automated Long-Lived Gas Sampling System

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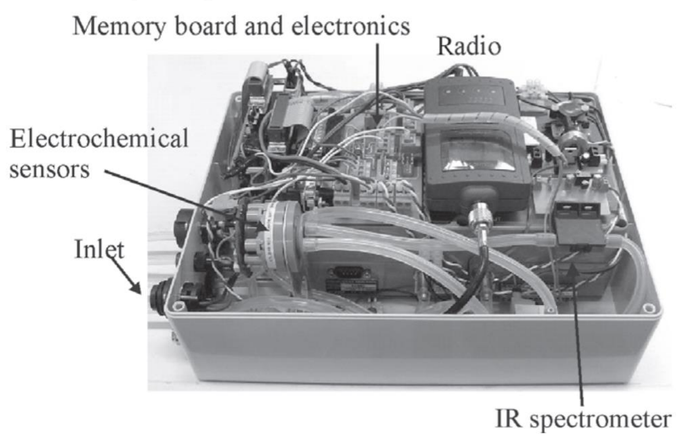
Program: Innovative Spontaneous Concepts R&TD

Existing Gas Sampling Methods



Project Objective: Measuring the trace gas and isotopic composition of mantle-derived gasses over time to better understand magmatic processes occurring deep underground. This is relevant both for forecasting future volcanic activity and to further our general understanding of geological processes on Earth. However, time series measurements are currently limited to the gasses that can be measured by in-situ sensors (primarily CO2, H2S, and SO2) or by how frequently scientists can visit the volcano to collect samples for detailed analysis. Therefore, we have developed a self-contained system capable of automatically collecting gas samples at preprogramed intervals for future laboratory analysis.

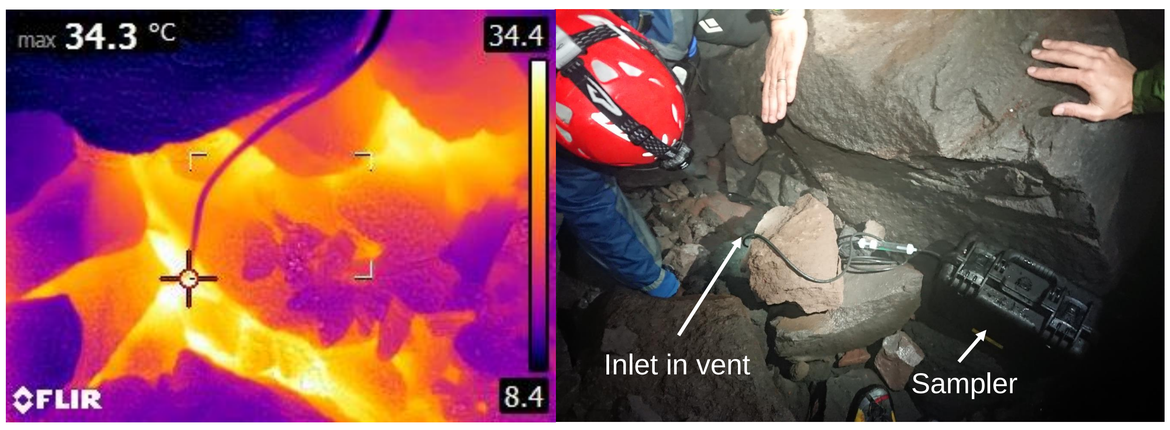
Moa autonomous gas sampler

Approach: We have developed a compact (14" x 11.5" x 6.5"), light weight (<10 kg), low cost (<$5,000), low powered (0.014 W average) autonomous gas sampling system that automates the sampling process. It will allow researchers to collect a series of samples (currently 12) for future analysis between field visits.

The sampler is positioned near the fumarole to be sampled and a tube is run from the fumarole to the sampler's inlet port. To collect a sample, the purging pump draw fresh gas into the sampler and then a solenoid valve is opened to fill one of the evacuated sample tubes with a sample. This process is then repeated at the desired interval until all of the sample tubes are full and the system is collected.

Salton Sea Mudpot Field Test

Mt. St. Helens Fumarolic Ice Cave Field Test



FY18/19 Results:

- Prototyped gas sampling system
- Completed hermeticity test of sample tube to measure leak rate
  – $2.6*10^{-7}$ cc/sec of helium equivalent to ~3 cc/year of air
- Conducted a single day field test at the Salton Sea mudpots
  – collected six gas samples
- Conducted a three day field test in Mt. St. Helens fumarilic ice caves
  – collected ten gas samples

Future Work:

- Analyze samples collected from the Salton sea and Mt. St. Helens
- Conduct longer duration deployments at geologically interesting field sites

Benefits to NASA and JPL:

- Use of our system to collect long duration time series samples from active and dormant volcanoes on earth will advance our understanding of volcanic-hydrothermal-magmatic systems and has the potential to improve our ability to predict volcanic eruptions, thereby *safeguarding and improving life on earth*, as identified in the NASA strategic plan.
- The gas sampling techniques that we have developed may also enables more advanced analytical techniques for interplanetary missions that involve intermittent gas release or time varying processes distributed across a large area as identified in the Planetary Science Decadal Survey. It could be used to:
  – Investigate atmospheric methane on Mars
  – Explore active organic synthesis and search for signs of methanogenic organisms on Titan
  – Conduct more detailed investigations into the atmosphere and climate on Mars, Venus, and Titan

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Poster No. RPC-190