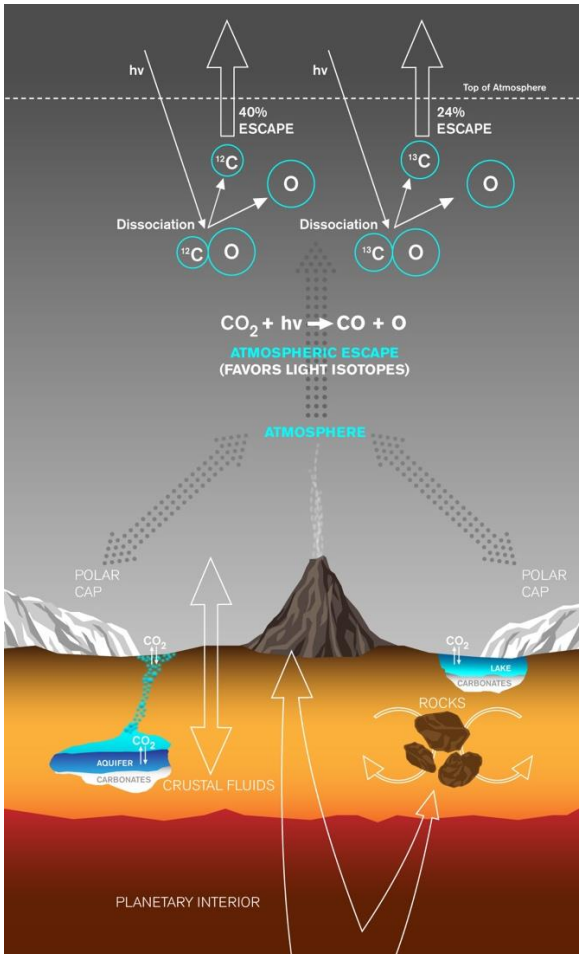
Converting Mars CO_2 Atmosphere to O_2



Name of Technology:
Mars Atmosphere CO2 Processing into Oxygen

Participating NASA Centers:
JSC (Lead); ARC, GRC, JPL, KSC, LaRC, MSFC

Technological Area:
H1.01Mars Atmosphere Acquisition, Separation, and Conditioning for ISRU

Vision for the Technology:
Mars missions will require the production of Oxygen (O_2) from the Martian atmosphere containing Carbon Dioxide (CO_2). Oxygen is a primary propellant for propulsion systems. Oxygen production for fuel will be a critical for return flights to Earth as it is not feasible to transport fuel to Mars.

Challenges:
NASA has a small experiment on Mars called the Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE). The following are initial performance factors:

- MOXIE Solid Oxide Electrolyzer (SOE) with 10's of hours of operating life qualified
- 10's of start/shutdown cycles
- MOXIE flow rate is ~1/200th of what is needed for human mission

MOXIE will require scale up for large production. See the Reference section below for MOXIE's recent press releases of accomplishments on Mars.

NASA is also interested in alternative techniques/technologies to accomplish large scale production of Oxygen. One such technology of interest is Reverse Water Gas Shift/Water Electrolysis.

NASA Seeks to Meet the Following Specs:

- Large-scale production of oxygen propellant
- Environmental compatibility and processing at almost any location on Mars, throughout the year and day/night cycle
- Operation >435 days continuously
- Time average production of O2 at 2.2 kg/hr
- Oxygen purity and dryness to propellant grade specifications (or agreed upon with propulsion)

Overview of Student Project:
NASA seeks innovative technologies that can mass produce Oxygen (O_2) from the Mars atmosphere that contains Carbon Dioxide (CO_2). Technologies need to collect CO_2 from the atmosphere and produce highly pure O_2 for fuel propellant.

Innovative Areas Student Projects Can Address:

- Improve upon the MOXIE experiment for large scale production
- Develop alternative technologies to accomplish NASA's goals

Project Phases

I. Conceptual and feasibility study with characteristics

II. Proof of Concept/Prototype in lab environment

Research Funded by NASA on this Topic:

Proposal Number: 18-1- H1.01-3023
Room Temperature Electrolyzers For Oxygen Generation On Mars

Proposal Number: 14-1 H1.01-9966
Plasma Extraction of Oxygen from Martian Atmosphere

Proposal Number: 10-1 X1.02-9266
Novel CO2 Separation and Methanation for Oxygen and Fuel Production

References:

H1.01Mars Atmosphere Acquisition, Separation, and Conditioning for ISRU

H1.01In-Situ Resource Utilization - Mars Atmosphere/Gas Chemical Processing

X1.02Gas, Liquid, and Solid Processing to Produce Oxygen and Fuels from In-Situ Resources

Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE)

Mars Oxygen ISRU Experiment (MOXIE)—Preparing for human Mars exploration