(T1.3-P10) Geologic Control on Noble Gas Migration

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Background

- Lab-scale experiment developed to test advective gas transport though rock samples at in-situ conditions.
- Tests performed at ambient conditions on rocks collected from the site of a field-scale gas experiment.
- Gas transport results are compared to pore and fracture networks of the same samples characterized by micro-CT and petrographic microscopy.
- Field experiment being conducted by NSTec, PNNL and LLNL.

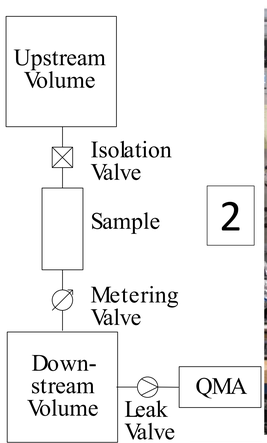
Figures
1. Sample of Rhyolitic Lava.
2. Schematic (left) and picture (right) of test system.
3a. Micro-CT image
3b. Micro-CT image sections
3c. Thin sections from Zeolitic Nonwelded sample.

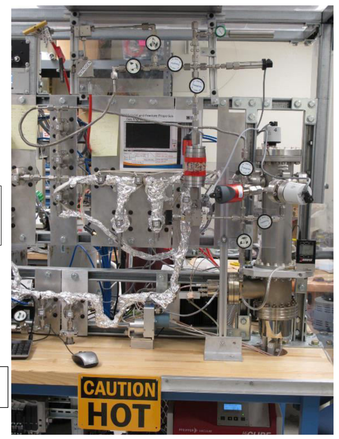
How it Works

- Pressurized gas mix (Ar, Xe, SF_6, and N_2) is released upstream into a 2.5" dia. X 2" long rock sample kept under vacuum. Using a quadrupole mass spectrometer (QMA), downstream gases are measured until steady state concentration is achieved.
- System modified to steadily measure real time arrival of gas mix through sample.

Limitations

- Advective transport does not give diffusive properties of material.
- Planning but have not yet modeled gas concentration curves.





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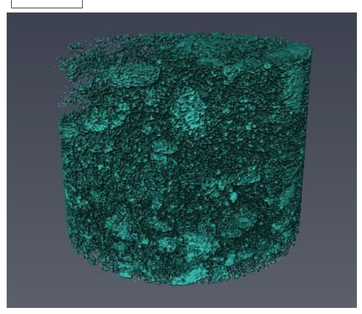

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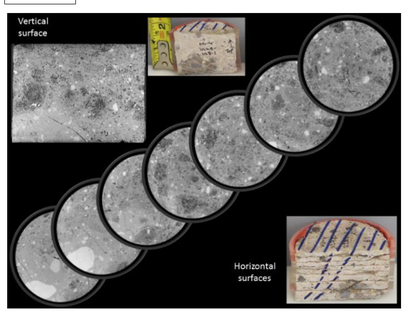
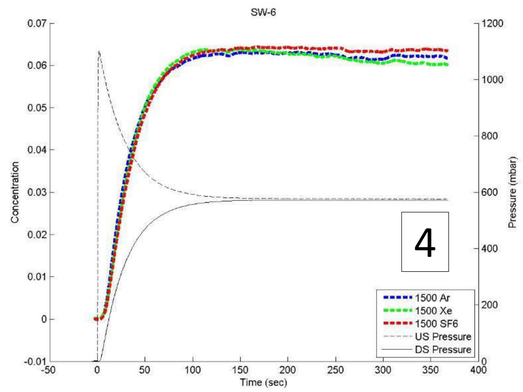


3c

Main Achievement

- Gas breakthrough curves measured on 5 lithologies from experimental field site.
- Arrival times are correlated to permeability of the 5 lithologies.
- Successful modeling of upstream and downstream pressure response to determine porosity and permeability.



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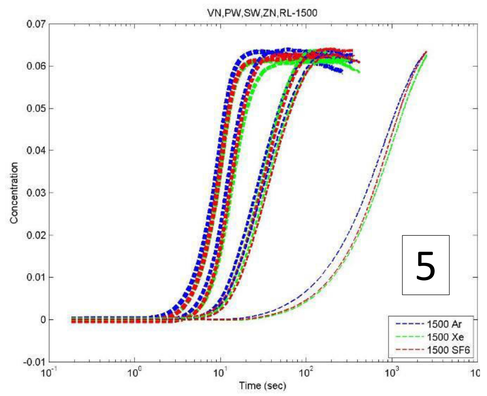

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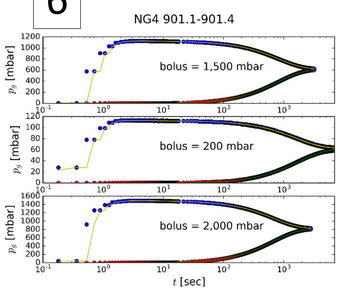


Impact

- Field gas migration experimentalists and gas migration modelers have shown great interest.
- Correlating gas arrival to other material properties such as porosity, permeability, microfracture density, and microscopic structure is an important tool to reach the goal of better understanding when noble gases may be detected from a possible Underground Nuclear Explosion.
- Poster was presented at Fall 2016 AGU conference and was well received by other DOE labs.

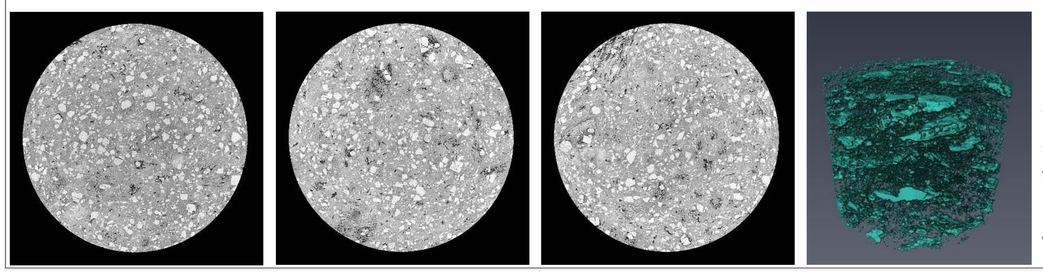
Current Work

- Diffusion line build in progress. Plan to determine diffusive properties on same lithologies of current work.
- Tortuosity will be calculated from known diffusion coefficients.

Future Work

- Test advective and diffusive properties on material under varying pressure, temperature and water content.

Figures
4. Gas breakthrough curves for Strongly Welded sample. 5. Breakthrough curves for all lithologies tested. 6. Modeling of upstream and downstream pressure response.



Bottom left to right: CT slice images and 3D CT view of Strongly Welded tuff.

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