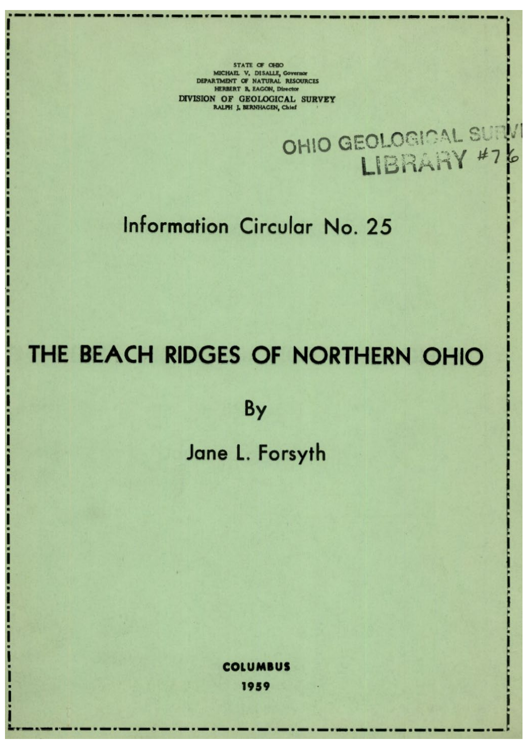
Ohio's Professional Soil Scientists

2021 Summer Newsletter
Volume 48, Issue 3 Part 2

Getting Ready for the Fall Workshop

For those of you who have not spent a lot of time in northwest Ohio, you are in for a geologic and soils treat. The Lake Plains region simply doesn't look like anywhere else in the state, but it does, interestingly, look a great deal like most of Denmark. Not as much rape seed grown and fewer modern windmills, but for those who are at home here, they could be easily transported and fit right in. Jeff Glanville has prepared a short summary of what to expect and a look back at many of the people we have to thank for what we know about the area. Much of the documentation comes from Jane Forsyth who was, for many of us, our geologic mother, aunt or cousin and teacher. I know for myself that without her contributions to the fields of geology and women in science, I never would have been here to share these field days with you all. Here is our textbook.

https://kb.osu.edu/handle/1811/80361



STATE OF OHIO
MICHAEL V. DISALLE, Governor
DEPARTMENT OF NATURAL RESOURCES
HERBERT B. EAGON, Director
DIVISION OF GEOLOGICAL SURVEY
RALPH J. BERNHAGEN, Chief

Information Circular No. 25

THE BEACH RIDGES OF NORTHERN OHIO

By

Jane L. Forsyth

COLUMBUS
1959

From Jeff:
Back when Ohio Soil Survey staff was doing initial mapping in the counties, they occasionally found it necessary to establish new soil series. Many samples were taken and analyzed during this time. And

they occasionally conducted what I call the "special studies", maybe when they were in a new area where there was not much existing detailed soil mapping, and they needed more information and better coordination between soil mapping in the counties.

One such special study was the "SE Ohio soil tour" in 1961. One stop in Monroe County on September 8 shows the group looking at Zanesville silt loam. Dr. Jane Forsyth, still a geologist with ODNR at the time, is standing second from left. One of the few pictures Jeff could find of her.

The caption on this slide below doesn't list any members of the group in this picture from September 13, 1962. Stop 10 on the "sandy soil tour" in northwest Ohio. I suspect Dr. Forsyth is the person in center background. The soil in the exposure is Spinks, which was established in Illinois in 1960. The sand deposit (a beach ridge or a dune?) appears to have been partly mined for its sand, leaving a good exposure for viewing.

I don't know how much original research Jane contributed to this publication, or if she only compiled existing information. She was the sole author. A classic, succinct overview of not only the beach ridges, but the whole glacial-lacustrine history of northern Ohio. It was one of our main references in my Pleistocene and glaciology course at OSU in 1987.

https://kb.osu.edu/handle/1811/80361

This picture shows Cecil Flesher, SCS, Ken Donaldson, ODNR, and Dan Crowner, SCS, at a Paulding site in Defiance County. Pedon CF-24 at this site was described and sampled as Paulding, but was later changed to Latty because laboratory analysis at OSU shows it has "only 56.4% clay in the particle-size control section". June 3, 1974. Another picture shows "percolation tests" in progress at the site 2 days later, with 2 Ohio Department of Health sanitarians and the SCS district conservationist

attending. Percolation tests occasionally accompanied soil describing and sampling in those days. (Defiance County and Monroe County slides from Jim Petro personnel slides. Sandy soil tour slides from unidentified source.)

Our First AOP Website Educational Training PowerPoint

https://www.ohiopedologist.org/education.html - I do not find this program to be seamless, if others struggle, we are going to have to work on this linkage. I can download it to my iPad but not to my old Dell Desktop. There may be age and program incompatibilities that we need to sort out.

GPR and EMI Soil Investigations at an Historic Homestead in Worthington, Ohio, U.S.A.

Barry Allred, Research Agricultural Engineer
USDA/ARS – Soil Drainage Research Unit
Columbus, Ohio

Julie Weatherington-Rice, Sr. Earth Scientist
Bennett & Williams Environmental Consultants Inc.
Westerville, Ohio

Ground penetrating radar (GPR) and electromagnetic induction (EMI) geophysical surveys were conducted on the grounds of an historic homestead in Worthington, Ohio, U.S.A to provide information on the shallow subsurface. This information could potentially prove useful in planning of any future preservation or construction activities at the site. Ozem Gardner came to central Ohio in 1817. He was a brickmaker by trade, and in 1821, he had saved enough funds to purchase 65 acres of farmland where this historic Worthington, Ohio homestead site is located. A kiln for producing bricks and a log cabin were built first, but in the late 1830s, Ozem Gardner began construction of the home shown in Figure 1. Prior to the American Civil War, Ozem Gardner was very active in the abolitionist movement through operation of an Underground Railroad waystation that provided escaped slaves a safe haven in their travels from slave-holding southern states to freedom in Canada. Local oral history suggests that a tunnel existed at the homestead, which was later backfilled, but originally employed when needed to temporarily hide escaped slaves.

Geophysical surveys using GPR and EMI methods were carried out from August 2018 through May 2019 to delineate shallow subsurface features, and in particular, find the tunnel location if possible. The GPR system used had 250 MHz antennas and was mounted on a pushcart. The EMI ground conductivity meter employed for this study was operated at 21030 Hz, in vertical dipole mode, had a 1.66 m spacing distance between transmitter and receiver coils, and by being positioned either 1 m or 0.36 m above the ground surface, thereby provided soil investigation depths of 1.5 m or 2.1 m, respectively. For this study, geophysical survey grids were set-up both directly west and directly south of the house, because these were the areas considered to be of greatest interest.

The GPR maps in Figure 2 show two major anomalies (enclosed within peach colored ovals) where there was a greater amount of reflected radar energy from depths of around 0.8 m to 1.4 m. The Grid 2A GPR anomaly detected west of the house trends southwest-northeast and is aligned with a collapsed storage cellar (marked with a green X in Figure 2) that was built into the side of the Flint Run ravine, the property's western boundary. Because of its southwest-northeast trend that a aligns with the collapsed cellar, which was constructed around the same time as the house, the Grid 2A GPR anomaly was first interpreted as possibly being the response due to the backfilled tunnel. However, soil augers proved this anomaly to instead be representative of a buried midden (i.e. refuse heap) containing broken bricks and pottery, that in retrospect is not unexpected, since a kiln was operated on the property. The GPR profiles from Grid 1A and Grid 2A show a surface soil layer 0.7 m thick having a chaotic response that may be indicative of fill material. The Grid 1A GPR profiles show an inclined soil interface that deepens towards the south. The east-west trending Grid 1A GPR anomaly in Figure 2 occurs at locations along this inclined soil interface. The reason for the Grid 1A GPR anomaly is at present unclear, and is still being investigated, but could be related to glacial processes in the geologic past. The Grid 1A EMI map depicted an east-west trending low soil apparent electrical conductivity trough roughly in the same location of the Grid 1A GPR anomaly. Interestingly, the EMI survey carried out west of the house did not find an anomaly coinciding with the Grid 2A GPR anomaly, thereby implying that the midden materials had an electrical conductivity similar to the surrounding soil. Consequently, even though the tunnel was not found, that study clearly shows that GPR and EMI can be useful tools for archeological soil investigation.

Figure 1. Gardner homestead viewed from the southwest. GPR and EMI survey grids were set-up both directly west and directly south of the house.

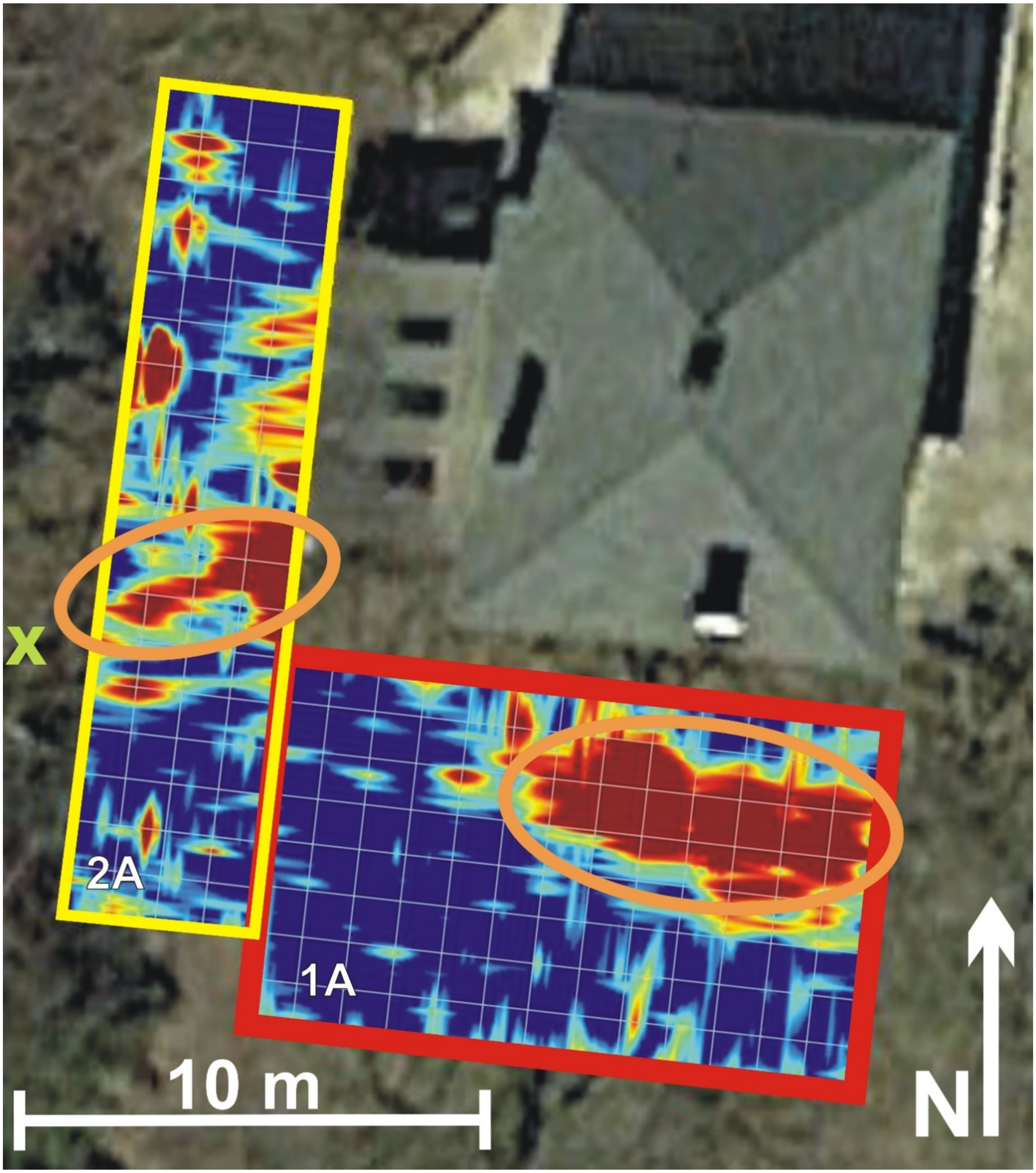


Figure 2. Grid 1A and Grid 2A GPR maps showing highlighted anomalies (enclosed in peach colored ovals) where there was greater reflected radar energy. These anomalies occurred at depths ranging from 0.8 m to 1.4 m. The green X marks the location of the collapsed storage cellar.

We have since visited the site in 2019 with several soil scientists where we conducted soils borings in the anomalies and again just last week with Barry and his staff for more borings. This additional research will be featured in the Fall 2021 newsletter.

2021 AOP Annual Winter Meeting Summary – Morning Session Coming to the AOP Web Site soon

While we were unfortunately not able to meet in person, the AOP Annual Winter Meeting still went ahead and was held virtually via Zoom on February 25th, 2021 with 56 people attending. The day's program was divided into a morning technical session and an afternoon business meeting. We captured the morning session on YouTube and it is archived. We are planning to create YouTube Videos of the morning sessions and hang them on the new Educational portion of the AOP Web site in the near future. This new section can be found at https://www.ohiopedologist.org/education.html.

For your references of the meeting's morning program. For the first session, **Dr. Ira D. Sasowsky** (Professor of Geosciences, University of Akron) gave an overview of his work "Hydrology of an unusual karst landscape in north-central Ohio". Dr Sasowsky's provided a nice introduction on the topic for the next two speakers. **Trevor Dwyer, B.S**. (University of Akron) presented on his ongoing graduate research work "Physical and chemical properties of water from karst springs in NC Ohio." **Dr. George S. Bullerjahn** (Distinguished Research Professor, Biological Sciences, Bowling Green State University) followed up with a talk on "Characterization of the submerged springs in Sandusky Bay, and relevance to their biogeochemistry."

After a short question/answer and break, **Ashly Dyck, B.S., M.A. (**OSU) introduced her ongoing graduate research "Making Ohio Soil MEM-orable: using the Microbial Efficiency-Matrix Stabilization Model to explain C storage in Ohio Soils." Followed by **Dr. M. Scott Demyan** (OSU, Assistant Professor, Soil & Environmental Mineralogy) "Monitoring, recording, and verification; How should soil carbon characterization and modeling play a role in soil carbon markets?" After a short break **Dr. Sakthi Subburayalu**, (Central State University, Assistant Professor, Soil Science and Agronomy) presented his work "What about remote sensing? Could it play a role in the carbon market world?"
The technical session was rounded out by **Dr. Brian Slater (**OSU, Associate Director and Professor), who gave us a virtual tour through the "Soils and Landscapes of Iceland."

New AOP display (Kathy Sasowsky): Kathy presented the new PowerPoint form of the AOP display that both communicates what AOP is as an organization and also the types of work our members are involved in. This PowerPoint presentation takes the places of the static tabletop display that was previously used for meetings. Kathy solicited the membership for pictures showing either their work or Ohio soil landscapes.

Journal Articles etc. of note

Jerry Bigham recommends we take some time to watch this trailer from 2020 for the movie "Kiss the Ground". It can be downloaded at https://youtu.be/K3-V1j-zMZw. The movie is on the web at kissthegroundmovie.com which gives us four options of how to watch it if you have not done so already. It's certainly on my list of films to watch.

Duane Wood shares this link to a fascinating article from Soils Matter, Get the Scoop! about the soils on Mars. http://ow.ly/QR2w50FLmXh

What has been discovered about the Mars surface? How does that relate to human missions?

Scientists have been studying the Martian surface with spacecraft since 1965 when the Mariner 4 spacecraft collected the first images. Since then, there have been additional flyby missions, as well as orbiting and landed missions. You might recall the movie, The Martian, and the attempt by the **character Mark Watney to grow crops to survive on Mars**. We're not close to sending humans to Mars, but we have collected a lot of information about Mars and its surface in the past several decades.

Mariner 4 collected images showing a desolate-looking planet with a cratered surface like that of the Moon. Later missions, however, demonstrated that ~3-4 billion years ago, Mars had abundant rivers and lakes of liquid water. In addition, we know now that the Martian surface has active wind-driven processes. Current observations show localized dust devils and Mars' global-scale dust storms. Scientists have also determined that Mars has an active cryosphere with surface and near-surface water ice at mid-to-high latitudes.

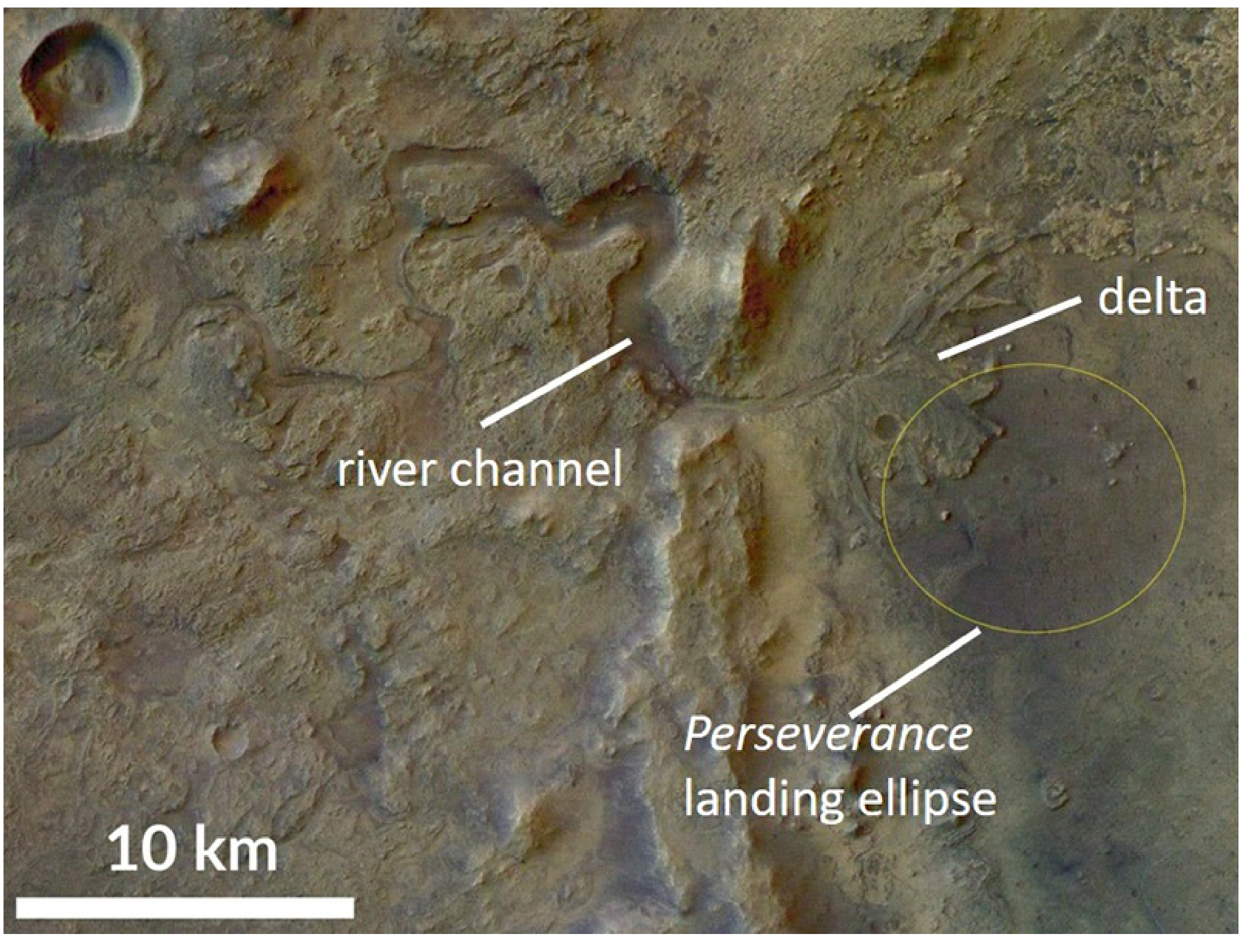
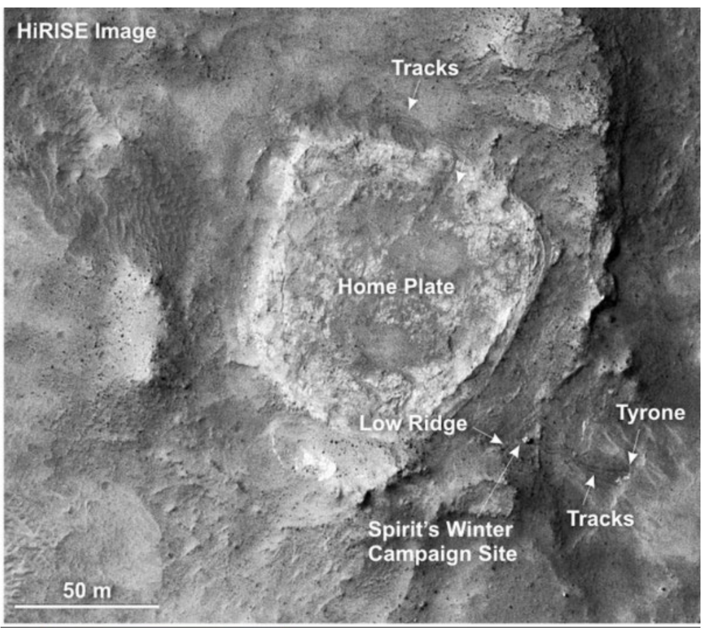


Image of a portion of Jezero crater on Mars, showing an ancient river channel flowing into the crater and a delta deposit, indicating the river flowed into a lake on the crater floor. The Perseverance rover landed in Jezero on February 18, 2021, and the landing ellipse is in yellow. Image credit: ESA/DLR/FU Berlin/Emily Lakdawalla.

The evidence for liquid water in Mars' distant past and water ice today suggests soils may have formed on the Martian surface over its 4-plus-billion-year history. We know that Earth's soils form through a complex, **time-consuming process of biological, chemical, and physical processes**. Organic matter – rich in carbon that provides nutrients for the **abundant microbial life** in **Earth's soils** – is typically enriched in soils on Earth.

Mars is different, though. Active wind-blown sediments and ancient sedimentary rocks on Mars have very low abundances of organic molecules. So, when planetary scientists talk about "soils" on Mars, we don't mean soil like you could see here on Earth. We ignore the need for this organic component and are typically referring to modern-day, unconsolidated sediments or "regolith."

We have yet to unequivocally identify an ancient soil profile on Mars complete with **distinct soil horizons**. Measurements by orbiters, landers, and rovers show a variety of minerals that formed from interactions between rock and liquid water. These different "secondary minerals" tell us that the pH, temperature, and salinity of liquid water on ancient Mars changed over space and time.

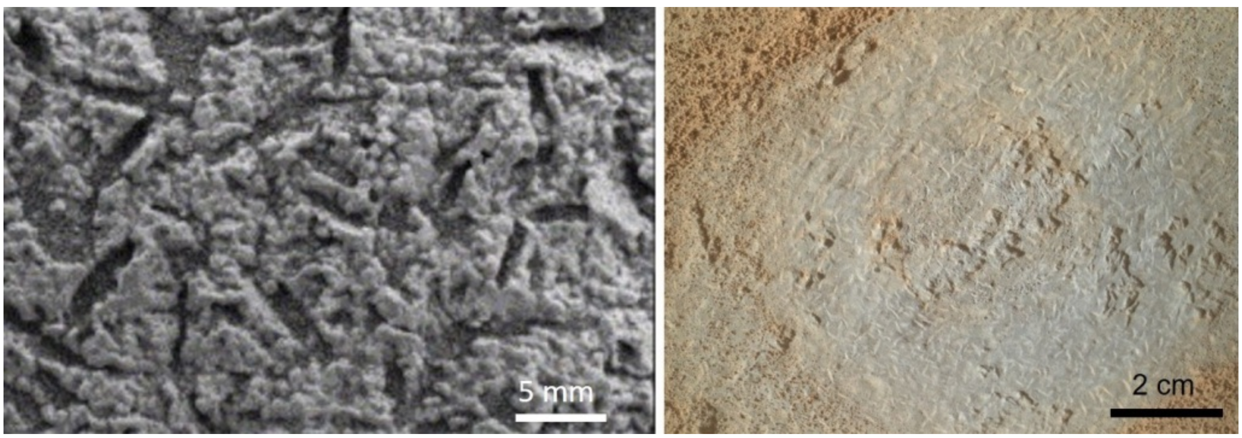


(Top) Home Plate volcanic feature imaged by the High Resolution Imaging Science Experiment (HiRISE) on the Mars Reconnaissance Orbiter. Image credit: NASA/JPL-Caltech/University of Arizona. (Bottom) "Tyrone" soil enriched in sulfate, churned up by Spirit's wheels. Image credit: NASA/JPL-Caltech/Cornell.

Some discoveries by Mars rovers:

- *Spirit* found rocks and soils enriched in silica and/or sulfate. This suggests that acidic fluids interacted with these rocks and sediments. In the process, these fluids removed sodium, potassium, magnesium, and calcium.
- *Opportunity* and *Curiosity* found shapes in ancient sedimentary rocks that looked like salt crystals formed from evaporation. This suggests that some ancient surface and ground waters on Mars were saline.
- *Curiosity* has been studying extremely thin layers of sedimentary rocks primarily deposited by lakes and rivers 3.5 billion years ago. Using specialized equipment, we have identified secondary minerals that suggest some sediments were altered in acidic and saline liquid water. We have also found evidence that other sediments interacted with fresh water. We think these ancient environments where freshwater dominated would have been habitable to microbes if they ever existed on Mars.

Multiple landed missions have studied the composition of modern soils on the Martian surface. These soils are composed of basaltic igneous minerals, like what would be in Hawaii or Iceland. They have found materials that are like volcanic glass.

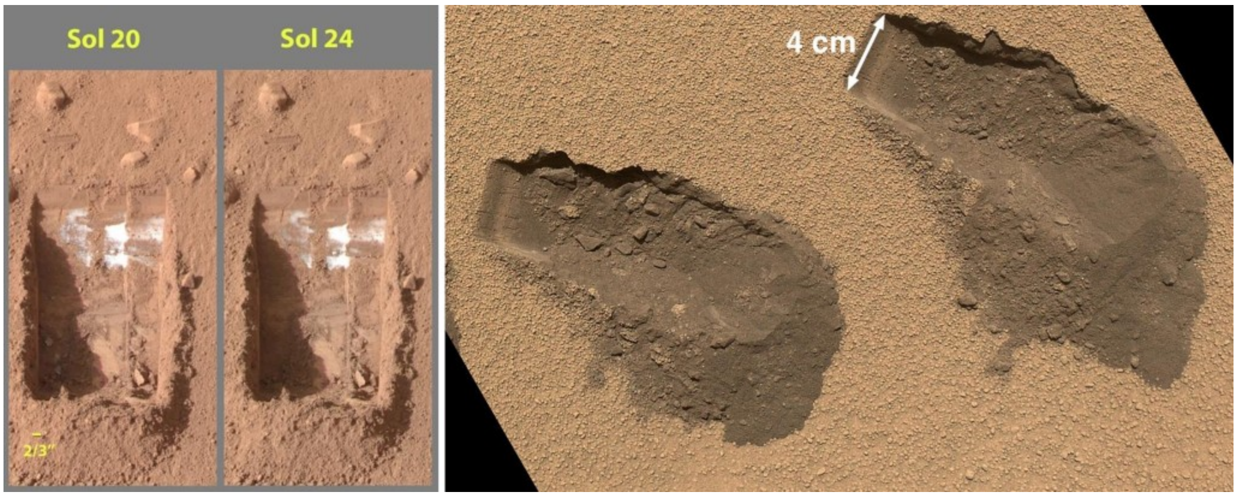


Evidence for evaporite crystals. (Left) Mosaic image of elongate crystal molds collected by Opportunity's Microscopic Imager. Image credit: S. M. McLennan et al. (2005) Earth and Planetary Science Letters, 240, 95-121. (Right) Elongate crystal forms in the "Mojave2" target collected by Curiosity's Mars Hand Lens Imager. Image credit: NASA/JPL-Caltech/MSSS.

The Mars *Phoenix* Lander studied the soils in the Martian arctic. It was able to perform wet chemistry experiments by mixing scooped soils with liquid water. The equipment identified pH and dissolved cations and anions in the scooped soil samples. When *Phoenix* scooped into the surface, it found water ice just beneath the surface and found the soils had a slightly alkaline pH of 7.7. *Phoenix* also discovered that perchlorate, a chlorine-based anion, was the dominant anion from the wet chemistry experiments.

Studies of the Martian surface are critical for preparing for future human missions to the Red Planet. Water, in the form of water ice in the mid-to-high latitudes, will be an important resource for future humans on Mars. Water (as various forms) in secondary mineral structures also will be important. The water can be used for drinking and watering crops. It can also be separated into oxygen and hydrogen molecules that could be used as rocket propellant for the return trip to Earth.

Based on the composition of modern Martian soils, they would be appropriate media for plant growth with a few modifications. Perchlorate can be toxic to humans but is highly soluble in water. That means the Martian soil would need to be “washed” to remove the perchlorate.



Images of soils on Mars. (Left) Image of a scoop into arctic soil on Mars collected by Phoenix’s Surface Stereo Imager on the 21st and 25th days of the mission, or sols 20 and 24. White material is subsurface water ice, which sublimates over time. Image credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University. (Right) Image of the “Rocknest” target showing two scoops into the surface collected by Curiosity’s Mast camera. Image credit: NASA/JPL-Caltech/MSSS.

Current Martian soils have some **phosphorus**, but very little nitrogen, which are essential nutrients for plants. Martian soils would have to be treated with **phosphorus and nitrogen**, and **plant-essential microbes** would have to be added to grow healthy plants on Mars.

Of course, plants will need to be grown in climate-controlled greenhouses. The Martian surface temperatures in Gale crater, near the equator, can swing between 32°F during the day to -94°F at night. The Martian atmosphere is also very thin – about one percent of the of Earth’s atmospheric pressure. There is little protection from galactic radiation, which would destroy any unprotected life on the surface.

The next NASA rover to Mars, named *Perseverance*, landed in Jezero crater on February 18, 2021. *Perseverance* will collect about twenty rock and soil samples for eventual return to Earth. Studying these returned materials in our laboratories on Earth will help us further characterize the composition of Martian rocks and soils and prepare for human missions to Mars.

Answered by Elizabeth Rampe, NASA

Dr. Rampe presented her finding at the ASA, CSSA, SSSA Annual Meeting held virtually in 2020. **Click this link to listen to her talk.**

To receive notices about future blogs, be sure to subscribe to Soils Matter by clicking on the Follow button on the upper right! Explore more on our **webpage About Soils**. There you will find more information about Soil Basics, Community Gardens, Green Infrastructure, Green Roofs, Soil Contaminants, materials for Teachers and more.

That's all I have been able to find that people sent to me to include in this newsletter. If you sent me something and I missed it, accept my apologies and send it again to AOPeditor2020@gmail.com so it does not get lost in my normal work email site. Thanks again for all the contributions.

The Technical Corner

This is a new column open to any and all members who want to discuss technical issues, equipment, new methodologies, observations, any of the discussions that we would typically have at field days and training sessions which, because of the Covid-19 Pandemic, have not been available to us at this point in time. The Executive Committee is hoping that this column will encourage the ongoing dialogue that has made AOP gatherings so very informative. We may also find that these materials can be used for training the next generation of soil scientists. Would you like to be next?