

5. Expected Rover Capability

- [64] Using models of the system engineering performance, a **surface mission of 90 sols** has been planned, demonstrating the capability of the system to achieve the MER mission objectives. The engineering and science requirements on mission return capability for the MER mission have been defined as a set of observations and mission achievements. **At any given landing site, a MER rover will likely be capable of the following:**
- [65] 1) Returning **2 color stereo Pancam** and 2 Mini-TES panoramas.
- [66] 2) **Driving to at least 4 distinct locations** and performing in situ measurements at each location.
- [67] 3) Returning measurements using the full instrument suite of at least **1 soil sample, 4 rocks, and 1 abraded rock.**
- [68] 4) **Driving at least 600 m.**
- [69] 5) **Lasting for 90 sols** with full use of the complete instrument suite.
- [70] 6) Performing one soil mechanics experiment and returning the associated measurements necessary for characterizing soil physical properties.
- [71] 7) Returning the supporting calibration measurements, imaging and Mini-TES measurements that enable characterization of the context and diversity of the landing sites.
- [72] **This is not the list of required achievements on Mars for mission success, which is a smaller subset.** Instead, this

Fig. 1: MER mission objectives. From *Crisp et al.* (2003).

The 2003 Mars Exploration Rover Mission (MER) was designed to last 90 sols (martian days; see Fig. 1); team members expected to collect data for a few months and then analyze it. But Spirit and Opportunity outlasted all expectations and acquired far more data than the team could analyze (see Fig. 2). Only the “low-hanging fruit” has been studied – there’s plenty of new science for **you** to do!

...if you can find the data that interests you, and learn how to analyze it.  
That’s where we come in ☺

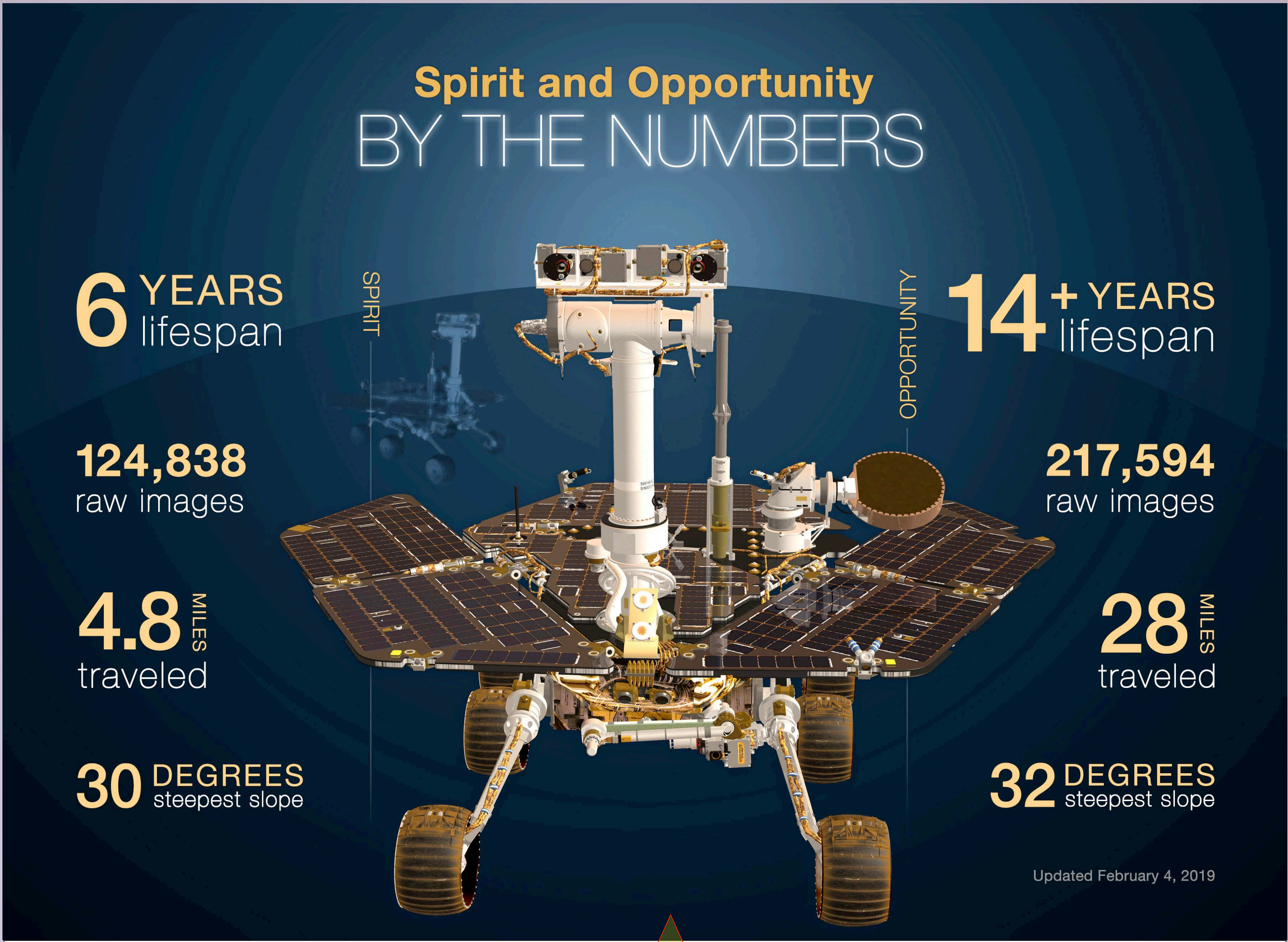
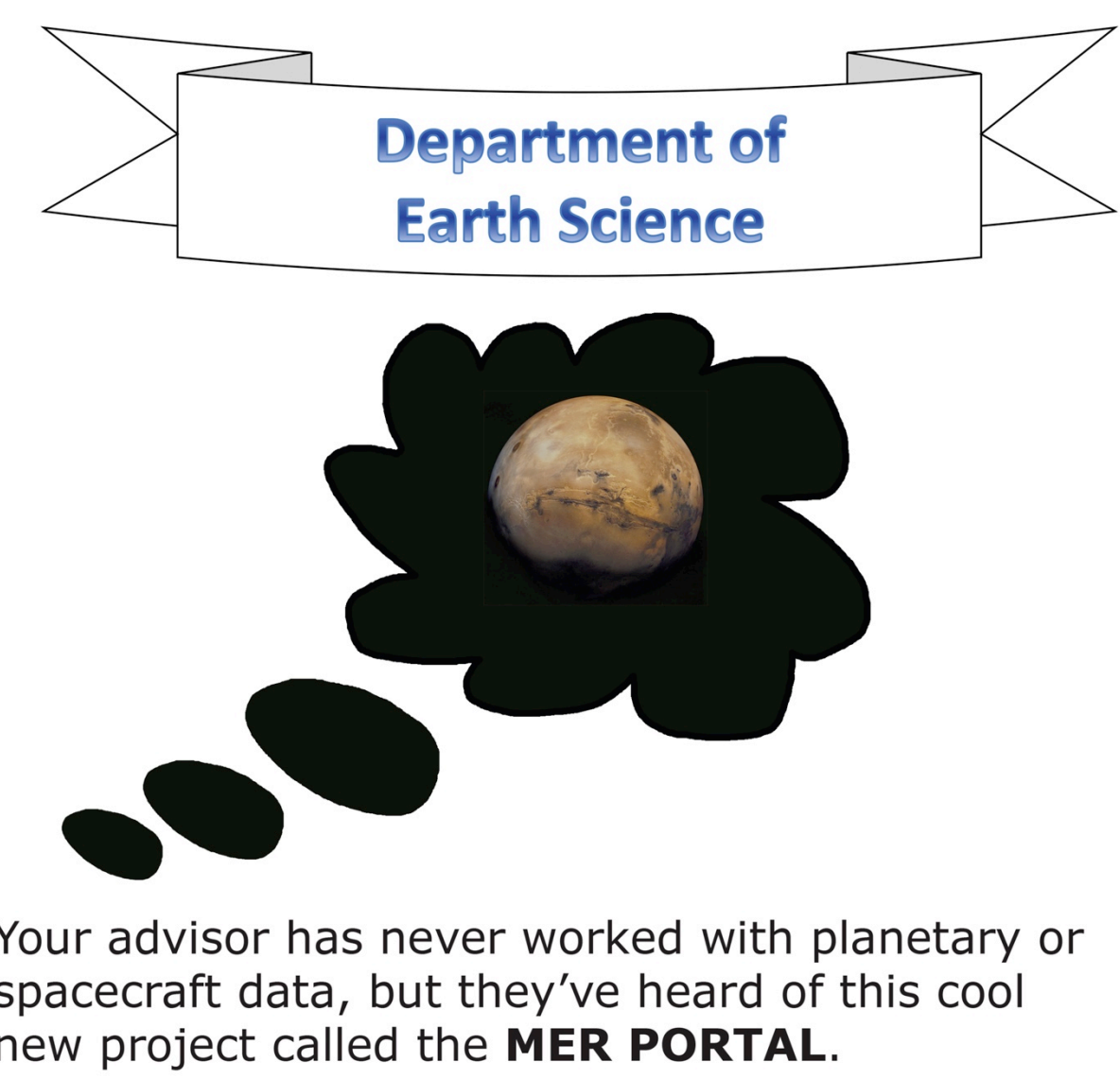


Fig. 2: Spirit and Opportunity’s achievements far surpassed the mission objectives. NASA/JPL-Caltech.

Imagine you’re an undergrad in an Earth Science department and you want to do a summer project on Mars

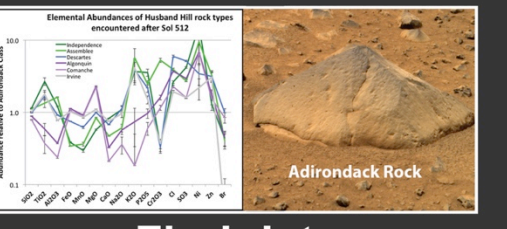


They’ll supervise your summer project if you use the PORTAL to learn how to analyze MER data


### Welcome to the MER PORTAL

What would you like to do?

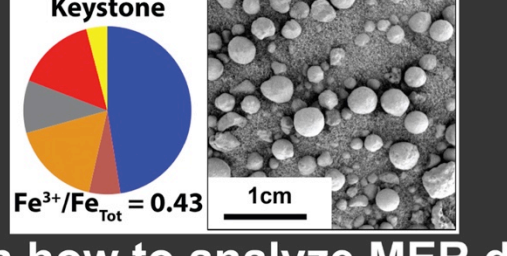
Find data



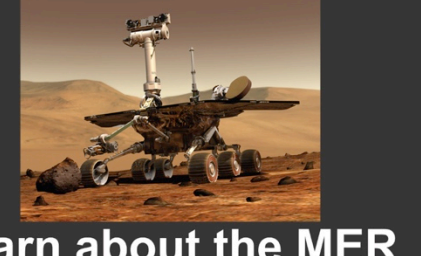
Find pretty pictures




Learn how to analyze MER data




Learn about the MER vehicle and instruments



Find tools and websites relevant to analyzing MER data



Find websites and publications relevant to the MER mission

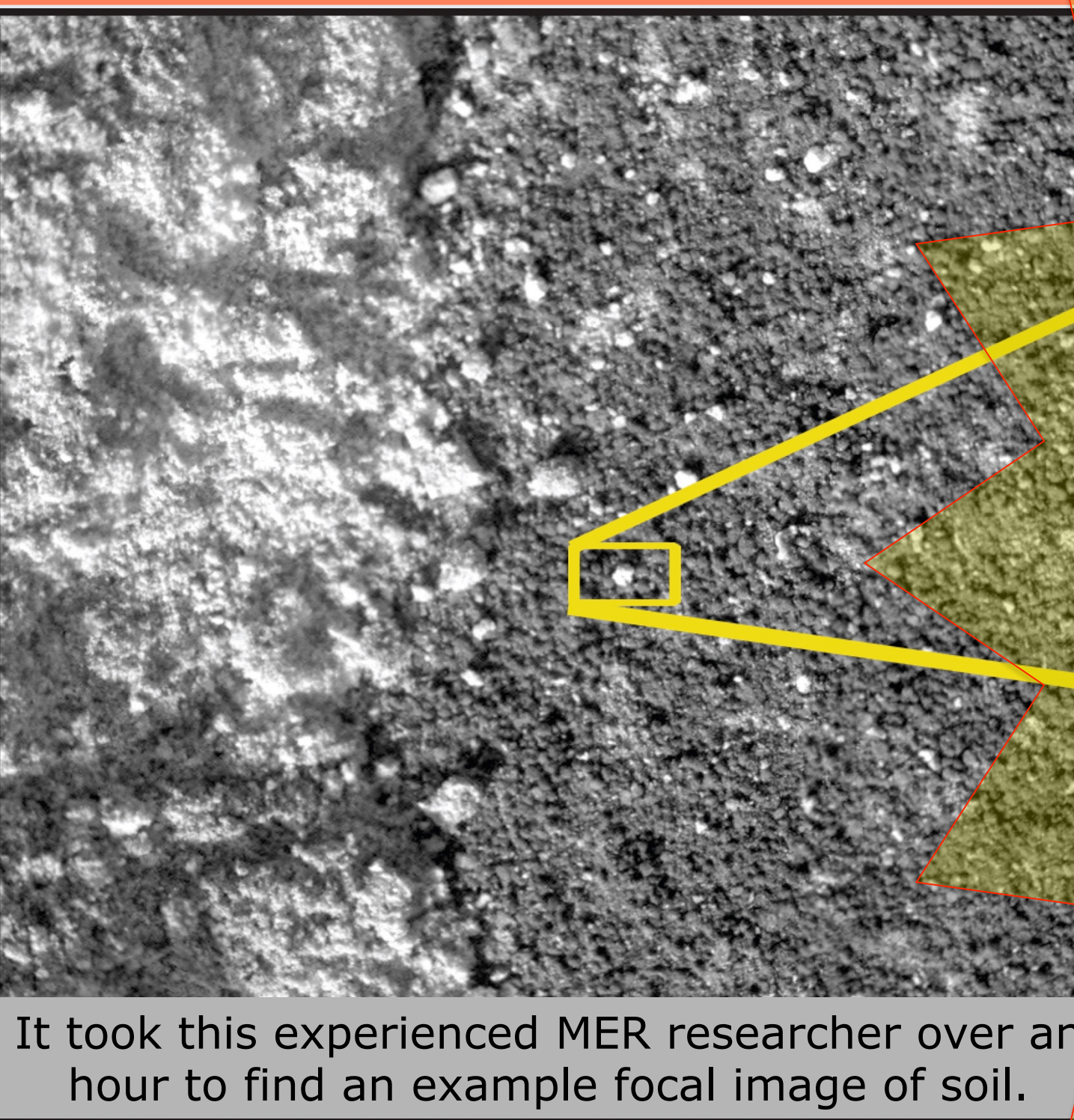


You go to the MER PORTAL website and click on “**Learn how to analyze MER data**”. You discover User Guides, based on interviews with MER Team members, designed to teach you how to analyze MER data. You realize that you don’t know which instruments might be appropriate for your project.

You switch to the “**Learn about the MER vehicle and instruments**” page and learn that the Microscopic Imager (MI) was like the rover’s handlens. You could spend your summer studying incredibly zoomed-in pictures of another planet!

You click on the “**Find data**” link, which takes you to a **user-friendly, interactive, science-based search**. You search for MI images in the Columbia Hills, and discover a soil called “Arad” that has a mixture of light and dark grains.

You read the MI User Guide and learn that in an MI “Merged Focal Image” data product, **each pixel represents ~30 microns on the target**.



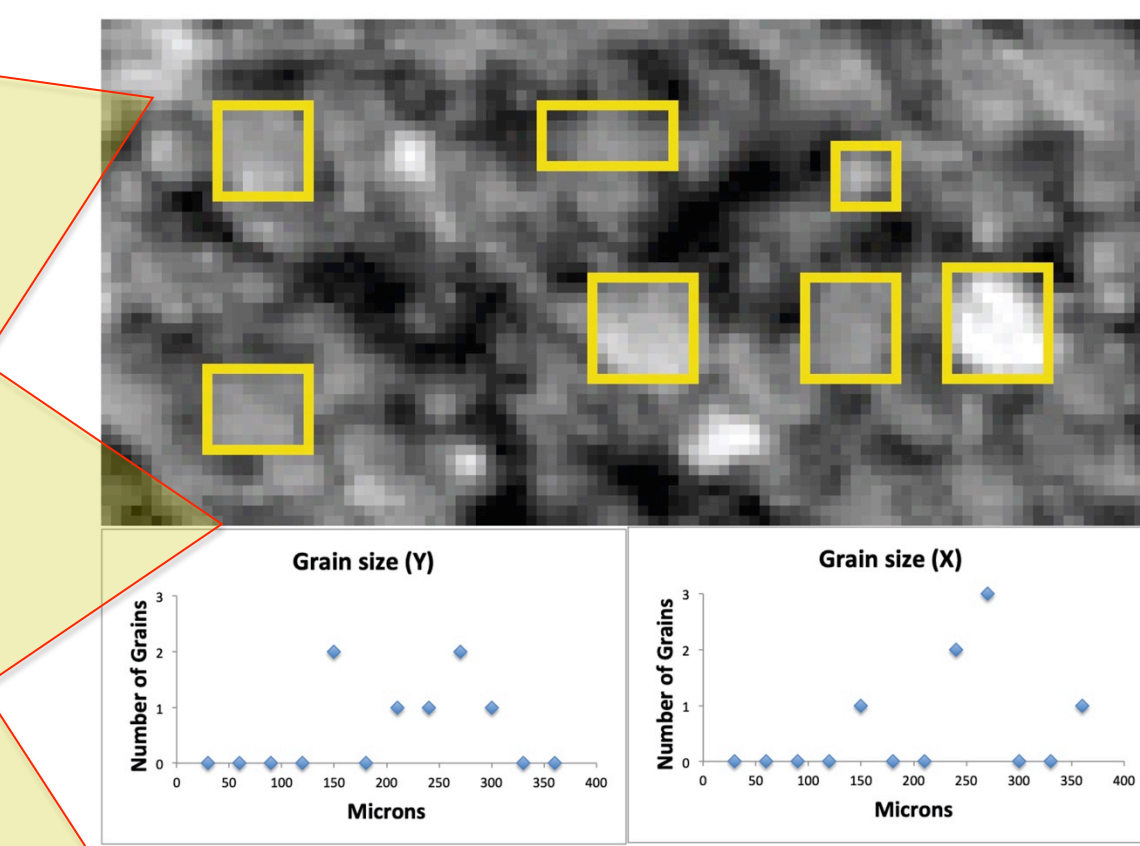
It took this experienced MER researcher over an hour to find an example focal image of soil.

**The guide teaches you how to measure the size of a soil grain (or any in-focus object in an MI Merged Focal Image)**

**15 pixels x 30 microns/pixel = 450 microns**

1. Open a Merged Focal Image with Preview or a similar image viewing program
2. Zoom in on a grain until you see individual pixels
3. Count the pixels across the grain
4. Multiply that number by 30 microns

**You spend your summer studying images taken by Mars rovers!**



The MER PORTAL enables you to find MI Merged Focal Images and download them from the Planetary Data System (PDS). You use familiar software that came with your computer to zoom in on them and analyze soil on another world.

## BRINGING MER TO THE MASSES

Our goal is to make MER data fully accessible to:

- Experienced Mars, planetary science, and geoscience researchers
- Graduate students
- Undergraduate students
- School teachers
- Space enthusiasts
- Anyone who wants to find and/or use MER data

We will go beyond the requirements of the Americans with Disabilities Act (ADA) to enable people with a wide range of abilities, disabilities, and accessibility requirements to access and use the MER PORTAL.

## WHO WE ARE

Our 38-member team includes MER scientists and engineers; Mars scientists who were not on the MER team; a journalist chronicler; and experts in EDIA (Equity, Diversity, Inclusion, and Accessibility), spacecraft data catalog production by human catalogers and machine learning algorithms, website and software development, data archiving, education, and mentoring.

Team diversity:

- 53% of team members are women and/or people with feminine gender expression, including 3/5 of our leadership
- At least 13% of team members identify as having a disability and/or chronic illness(es)
- 2/5 of our leadership are People of Color

## GET INVOLVED!

If you

- Have any questions,
- Would like to beta-test our materials, or
- Are a MER team member who'd like to contribute

Please contact us!  
[scole@spacescience.org](mailto:scole@spacescience.org)

### REFERENCES AND ACKNOWLEDGEMENTS

Crisp, J. A., et al. (2003), Mars Exploration Rover mission, *J. Geophys. Res.*, 108(E12), 8061, doi:10.1029/2002JE002038.

Spirit and Opportunity by the Numbers infographic from <https://mars.nasa.gov/resources/spirit-and-opportunity-by-the-numbers/>

Mars globe image: Viking Orbiter 1 (Image credit: NASA/USGS), available at <https://photojournal.jpl.nasa.gov/catalog/PIA04304>

MI image: Enhanced merged focal image of the Zoar target on the Arad Feature, acquired by Spirit on Sol 724 (Image credit: NASA/JPL-Caltech/Cornell/USGS). Available on the MER Analyst's Notebook: <https://an.rsl.wustl.edu/mera/merxbrowser/an3.aspx>

Background image: “Sunset over Gusev” acquired by Spirit on Sol 489 (Image credit: NASA/JPL/Texas A&M/Cornell), available at [http://pancam.sese.asu.edu/sunset489\\_new2.html](http://pancam.sese.asu.edu/sunset489_new2.html)

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