Using PDS Geosciences Node Analyst's Notebooks

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52nd DPS Meeting
29 October 2020
3:00 – 4:00 pm EDT

https://an.rsl.wustl.edu

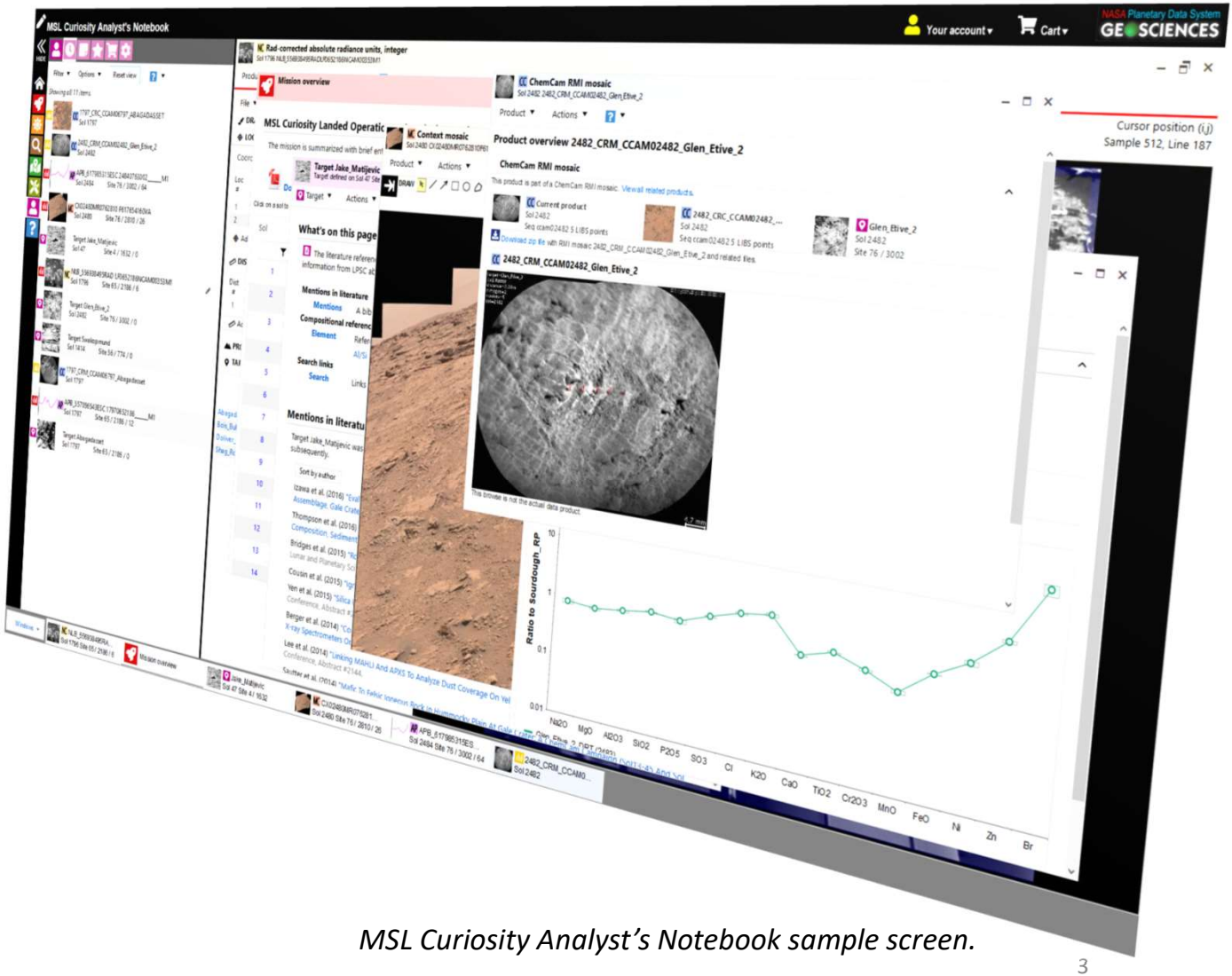
Agenda

- Analyst's Notebook introduction
- Use cases
  - Creating the MER Spirit and Opportunity contact science target database
  - Working with the MSL Curiosity AN
- Open demo and discussion

Analyst's Notebook

https://an.rsl.wustl.edu

- Provides integrated access to data, documentation, observation planning and targets for data from landed missions InSight, MSL, MER, Phoenix, LCROSS, and Apollo
- Mars 2020 Rover and Dragonfly to be added
- Public version accesses released data
- Team-only version ensures capture of science intent and operational context
- Data may be searched, displayed and downloaded via a shopping-cart model



MSL Curiosity Analyst's Notebook sample screen.

Notebook components

Standard PDS Release

Archived Data
- Standard EDR and RDR data products

Documentation
- Software Interface Specification
- Spacecraft and instrument reports

Calibration Data
- Calibration reports and data

Additional data and tools in the Notebook

Special Products
- Additional products of interest
- Science team supplemental products

Documentation
- Daily operations reports
- Science team reports
- Historical reports

Resources
- Historical mission overview
- Science paper references
- Links to additional resources

Value Added Elements

Suite of tools and data representations that enhance archive use
- Data, document, and target search
- Interactive maps
- Context mosaics
- Image measurement
- Data transformation
- Cross instrument data browsing
- Integrated plans / timeline

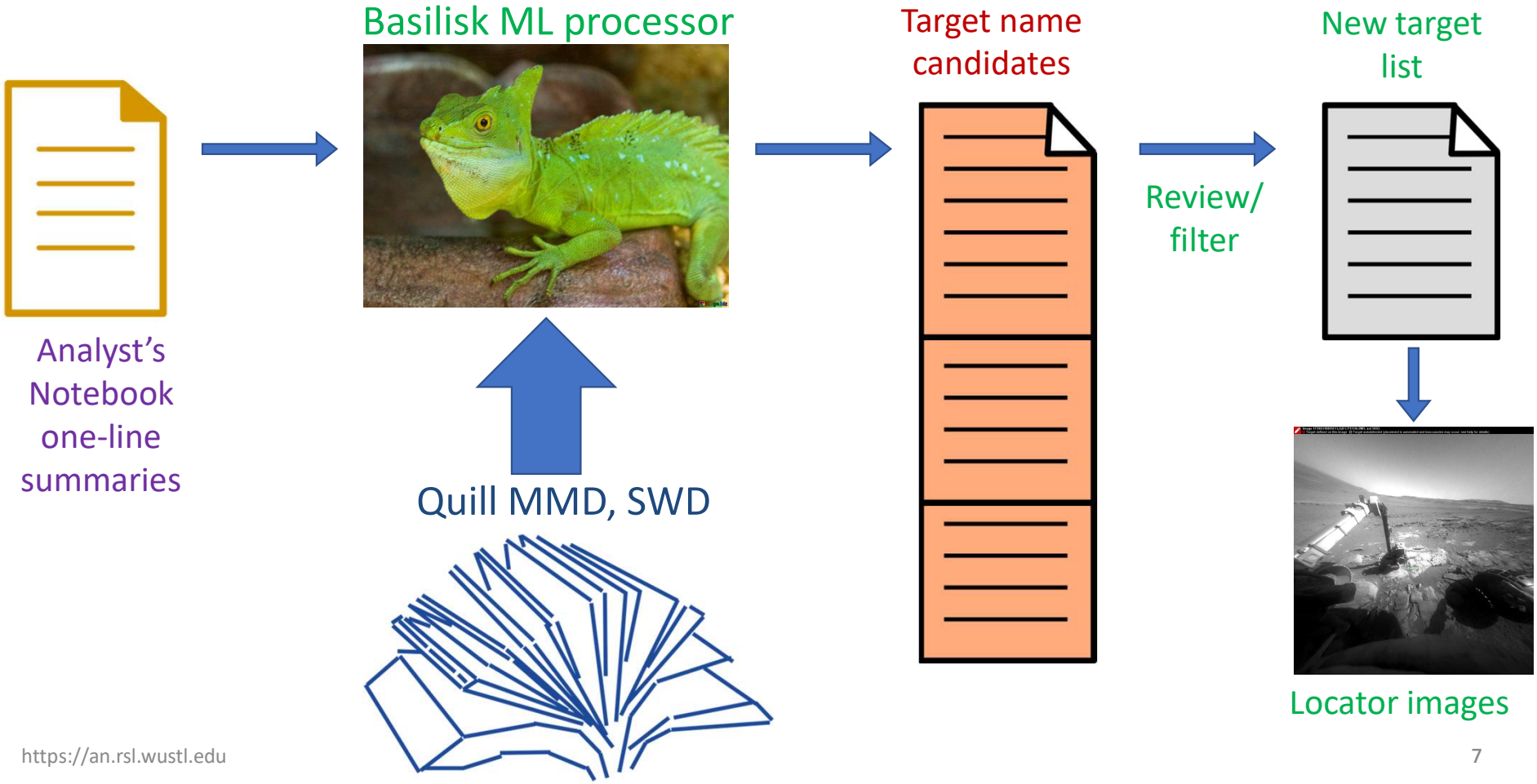
MER contact science target archiving and localization task

- At end of MER mission, target information was spread throughout the science team's Quill, Maestro, and rover planner files
- Task: develop an authoritative target name and location database
  - Capture any aliases:
    e.g., IceCream & OneScoop, RaspberryNewton & Filling
  - Retain geological context of contact science and remote sensing targets
  - User friendly
  - Available to the public

Task process

- Generate a preliminary list of target names using team instrument lists and plan summaries from the Analyst's Notebook (AN)
- Utilize machine learning:
  - Search for target names not referenced in the preliminary list
  - Annotate instances of target names in Mission Manager reports
- Review of machine learning results
- Derive coordinate information from team reports and rover planner files
- Add targets to MER AN
- Use AN target autodetect function to find best locator frames
- Archive target data in PDS

MER target archiving overview



Sample machine learning output for Opportunity rover

Quill typos or naming variants (OLS)

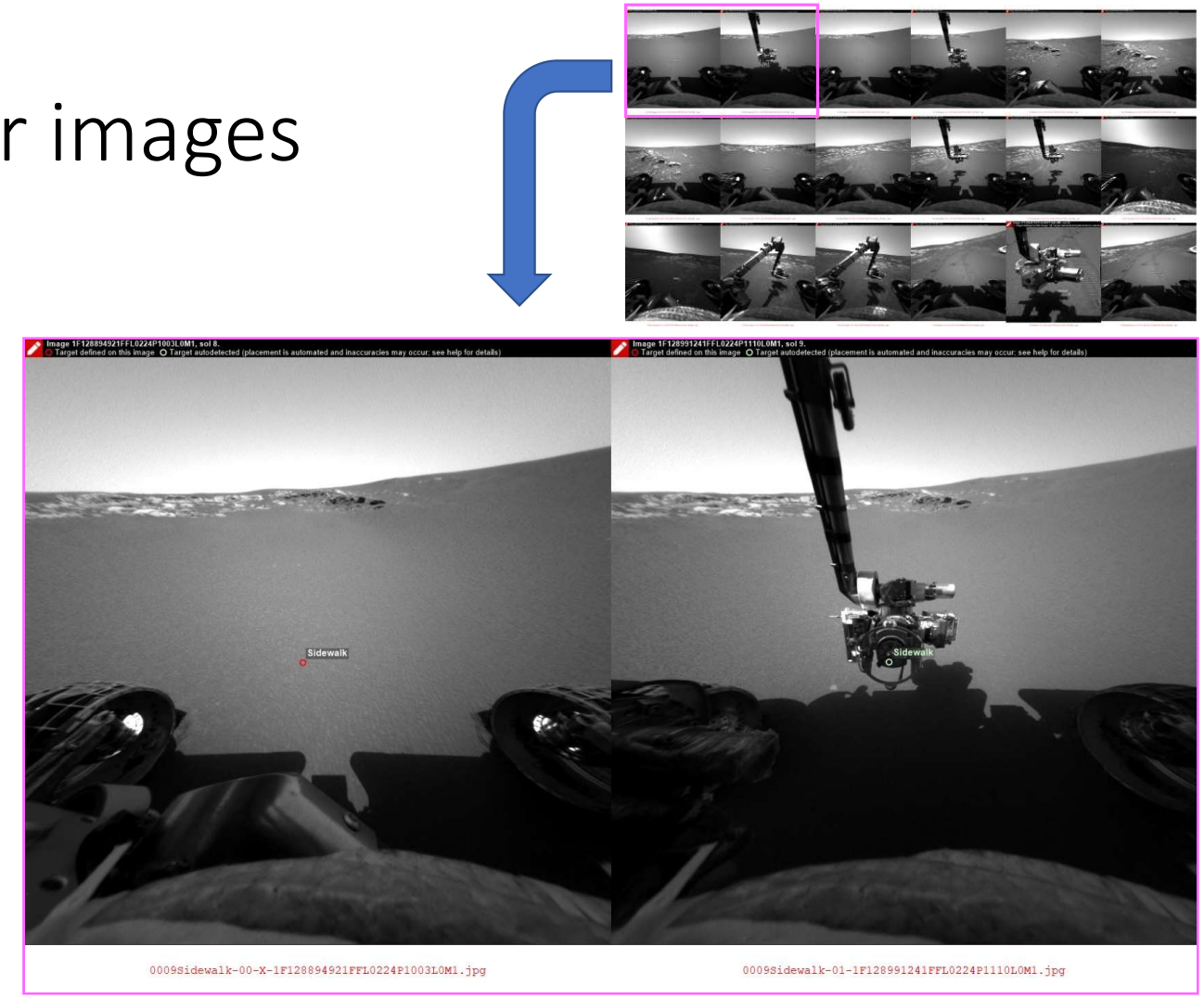
- Baobob, Boabab (Baobab)
- Bristol_Well, Bristol_Wells (Bristol Well)
- Chocolate_Chip, ChocolateChip
- Diamond_Jennes (Diamond Jenness)
- LaJolla, La_Jolla, LaJoya, La_Joya (LaJoya1)
- Lemon-Rind, Lemon_Rind (LemonRind)
- Maestre_Diago, Maestre_Diego
- Pierre_Penault, Pierre_Penaut, Pierre_Pinaut (for Pierre Pinaut)
- Siahs_Swamp, Siah's_Swamp (for Siahs Swamp)
- Stewart_Island (for Stuart Island)

Reviewed the first 1000 candidates

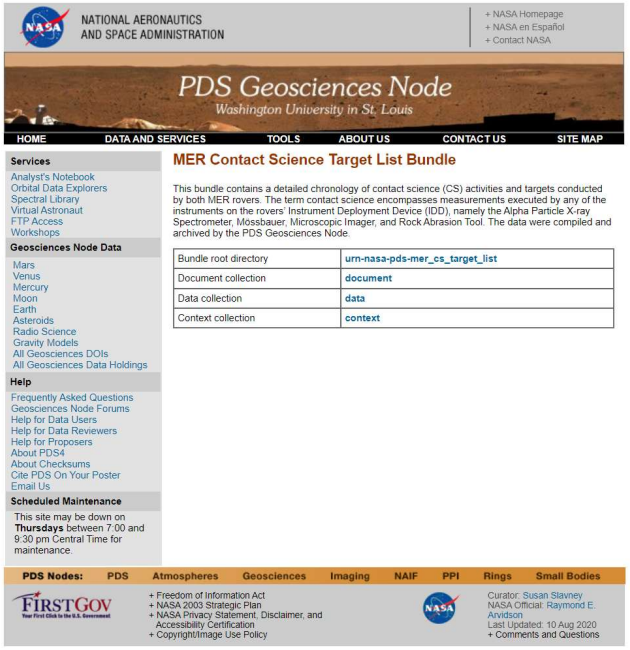
- Kept 643, with some edits:
  - Ash-meadows -> Ash Meadows
  - Bounce-Rock-Rag -> Bounce Rock
  - …
- Omitted e.g.:
  - Buckland(12
  - Calibration_Target
  - Diagnostics_Continuing
  - Eating_Johnson
    (target is "Liver Eating Johnson")

Selecting locator images

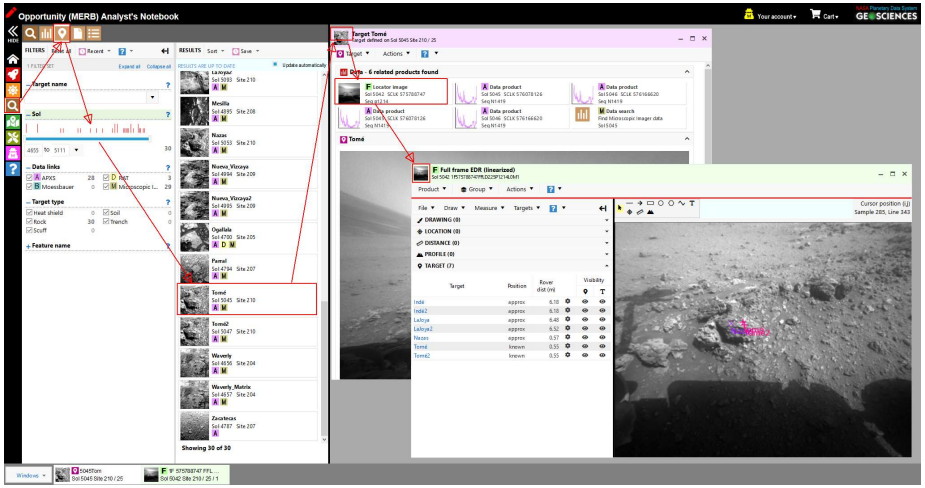
- Use AN target autodetect function to find best locator frames



MER contact science target database released



PDS Geosciences Node web site
https://pds-geosciences.wustl.edu/missions/mer/mer_cs_targets.htm



MER Opportunity Analyst's Notebook sample screen.

MSL Curiosity rover Analyst's Notebook demo

- Getting started with the Notebook
- Target search
- APXS concentration data
- ChemCam RMI mosaics
- Literature references
- Images of targets

Targets

- Defined by science team during operations planning.
- Captured within planning tool.
  - Metadata include position in image coordinates on finder frame.
- May be used in science operations plan.
- Actual target position may vary from plan.
  - Possible repositioning due to instrument reachability.
  - Target name may be modified in plan.
  - Target definition in planning tool is not updated.

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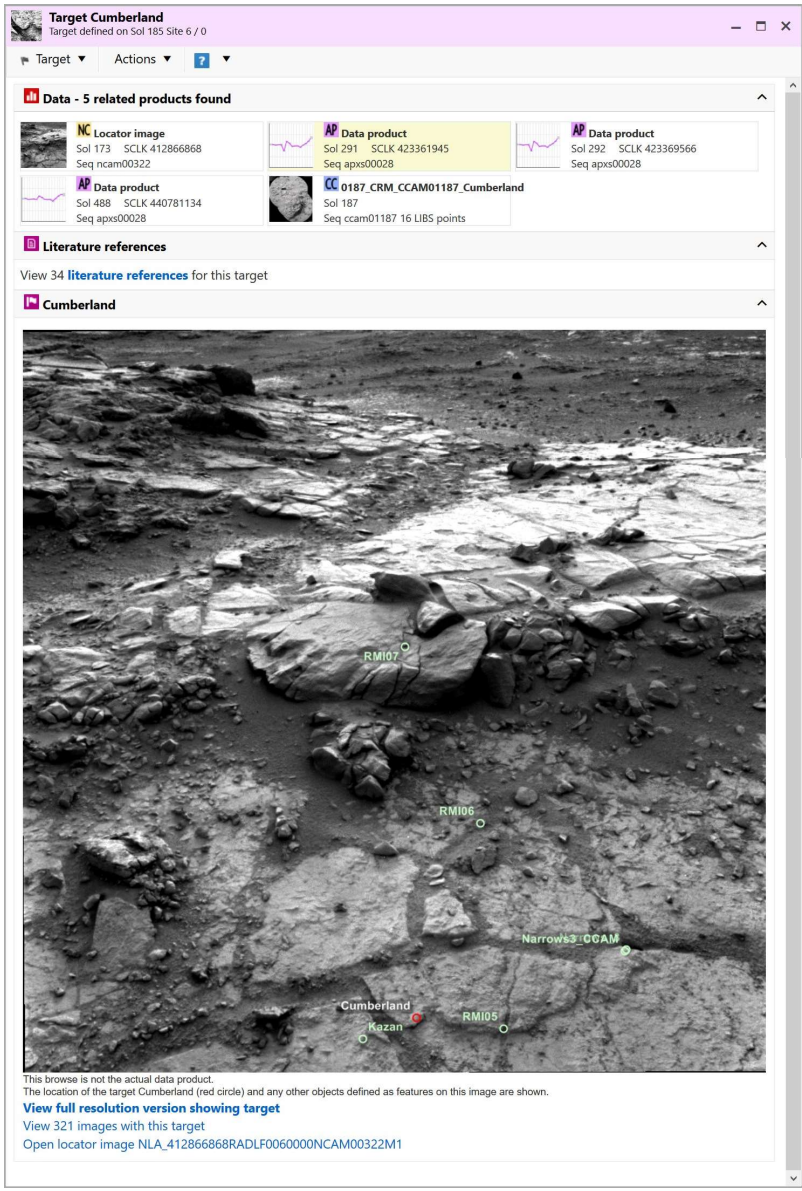
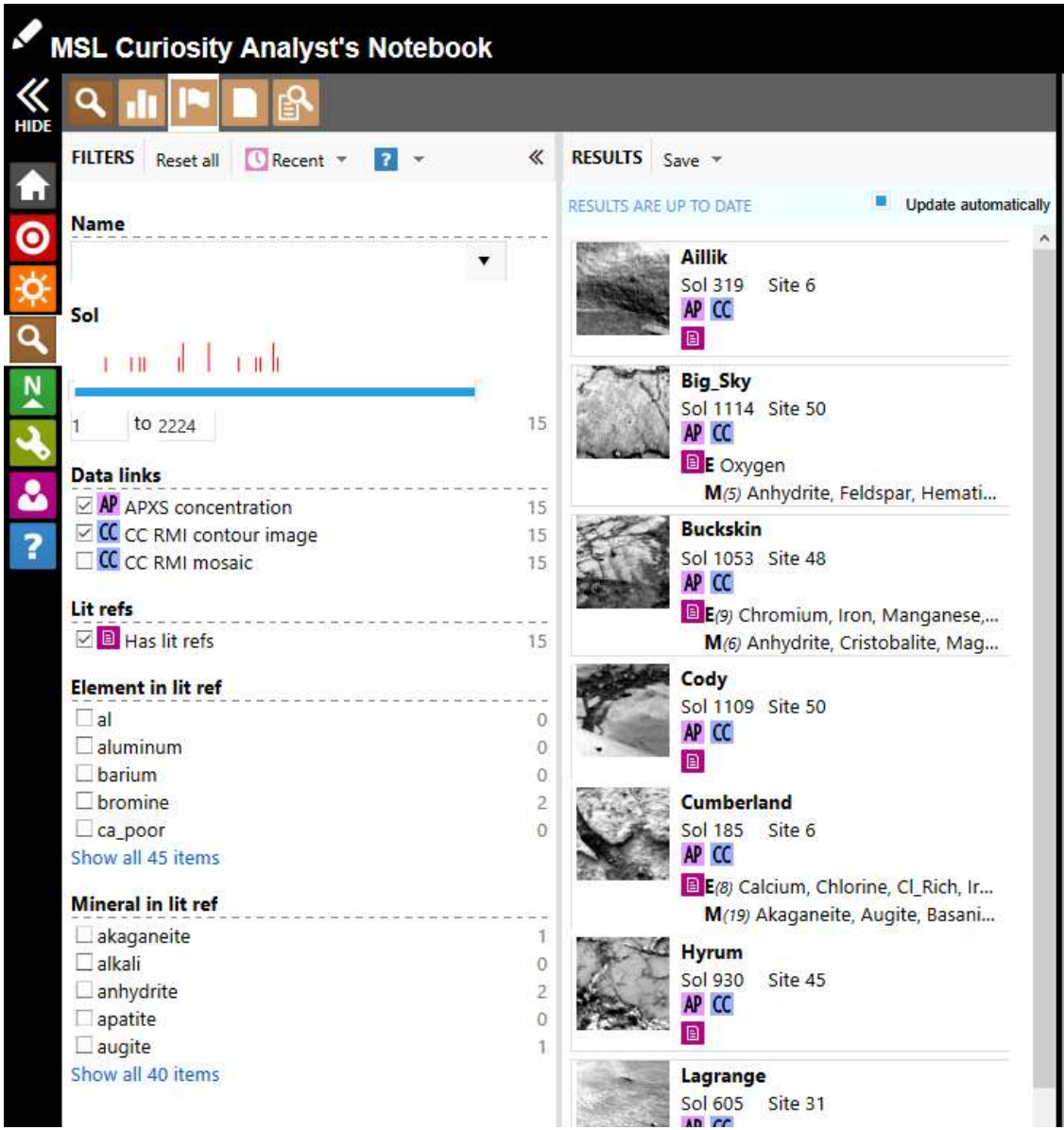


Target-data links

- MSL AN target search includes filters for
  - Name, sol
  - Data: APXS concentration and ChemCam RMI mosaic
  - Literature references: elements and minerals, mentions



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APXS concentration data

- Chemical concentration results derived from archived data by the MSL APXS team.
- Each composition is associated with a specific target.
- The APXS determines the bulk chemistry of targets on Mars through the complementary use of particle-induced X-ray emission and X-ray fluorescence.
- AN users can plot and then download the data for the current plot or obtain the set of all APXS concentration data.

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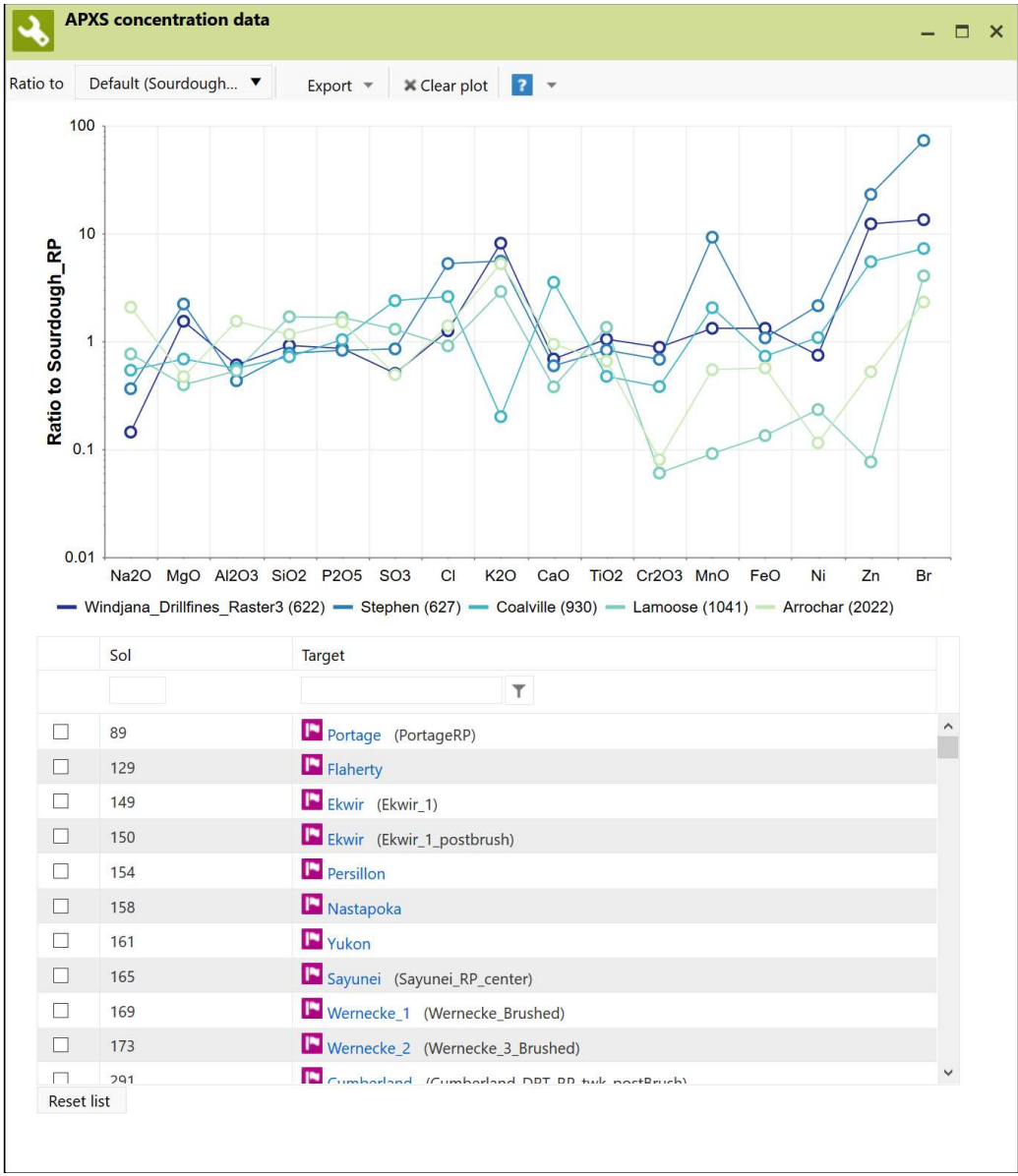
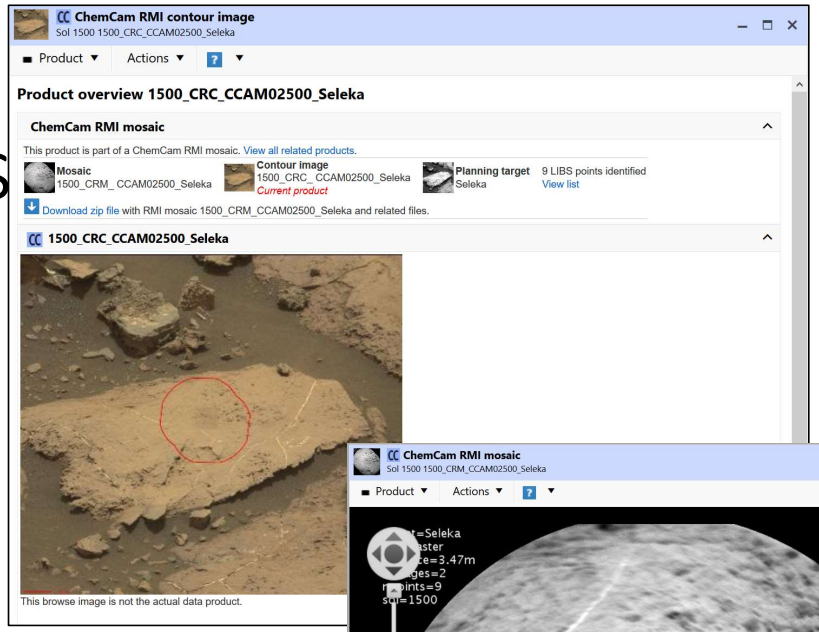
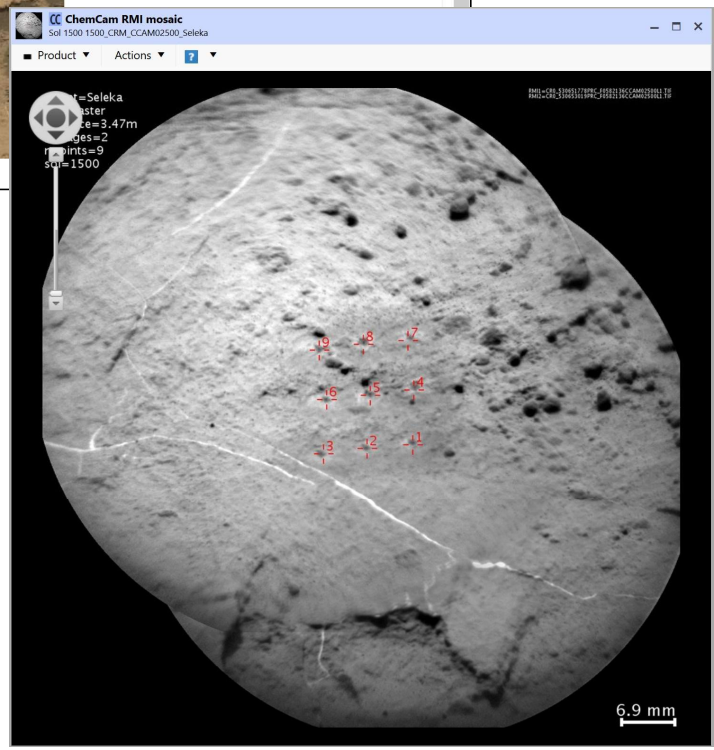


ChemCam RMI mosaics

- RMI (Remote Micro-Imager) mosaics produced by the ChemCam team, each associated with a specific target.
- Annotations denote locations of ChemCam LIBS data elemental abundance acquisition.
- Accompanying locator images (“contour images”) show mosaic footprint drawn on a Mastcam image.
- AN users can download zip file containing all pertinent data: mosaic, contour image, PDS labels, and LIBS data for any given mosaic.





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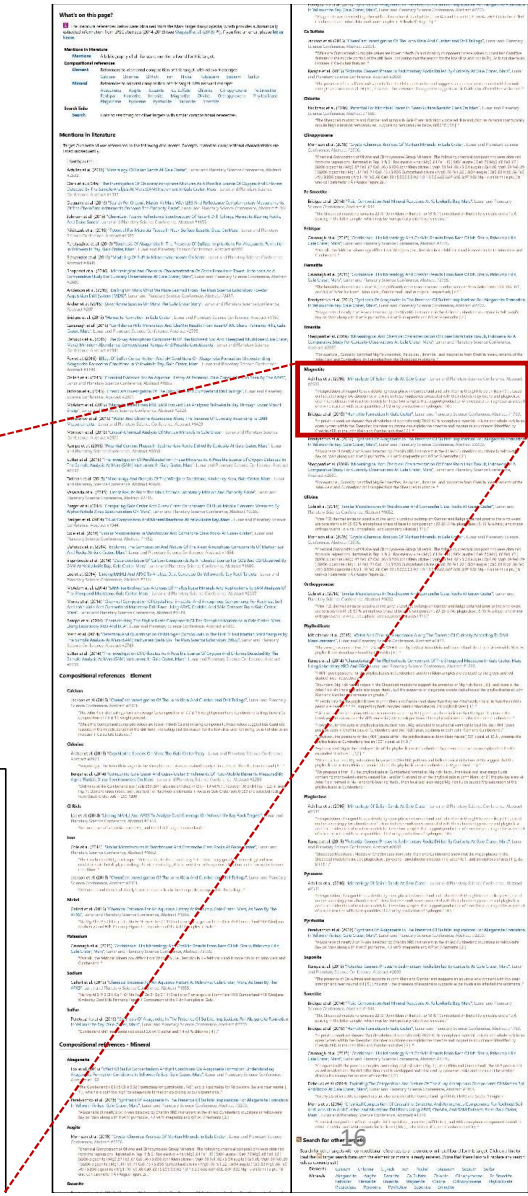
Target literature references

- From Mars Target Encyclopedia (Wagstaff, et al.)
- Links to the source documents are included.
- Mentions in literature, including simple mentions within the text.
- Compositional references to elements and minerals are listed, including excerpts of the text.



Magnetite

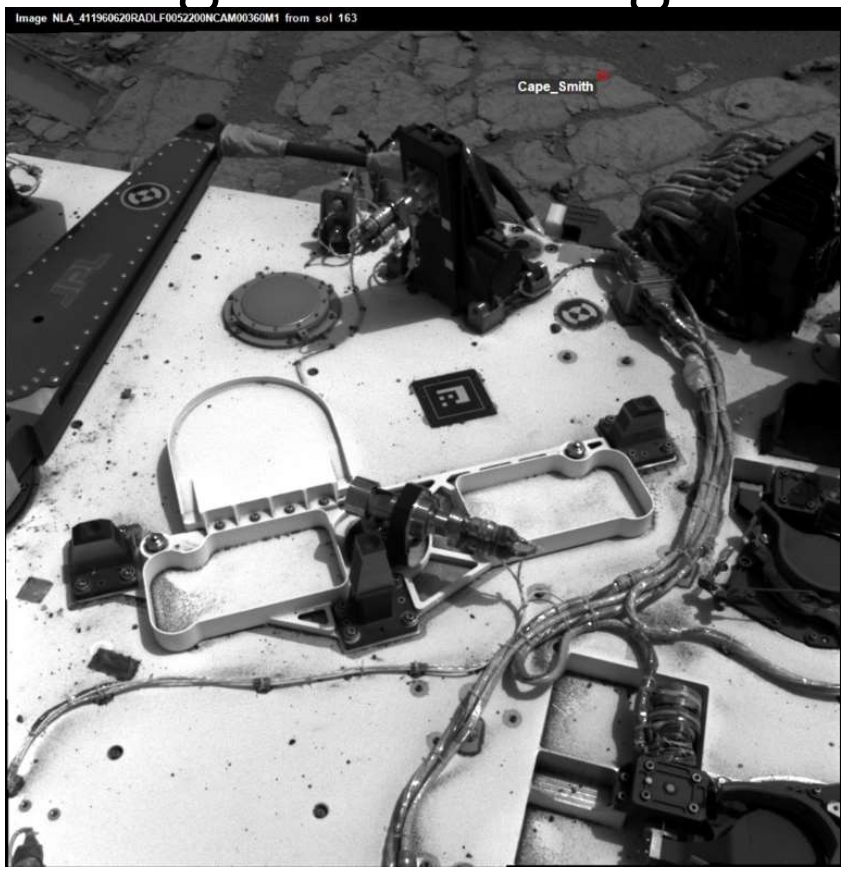
Achilles et al. (2016) "Mineralogy Of Eolian Sands At Gale Crater", Lunar and Planetary Science Conference, Abstract #2532.

"Interpretation of magnetite as a detrital igneous phase in Cumberland and John Klein is thought to be unlikely [9] , based on the surprisingly low abundance of olivine in these mudstones contrasted with their abundant pyroxene and plagioclase and in consideration of reaction models for these two samples that support production of smectite plus magnetite as a result of olivine reaction with trace quantities of O2 or by production of hydrogen [10] ."

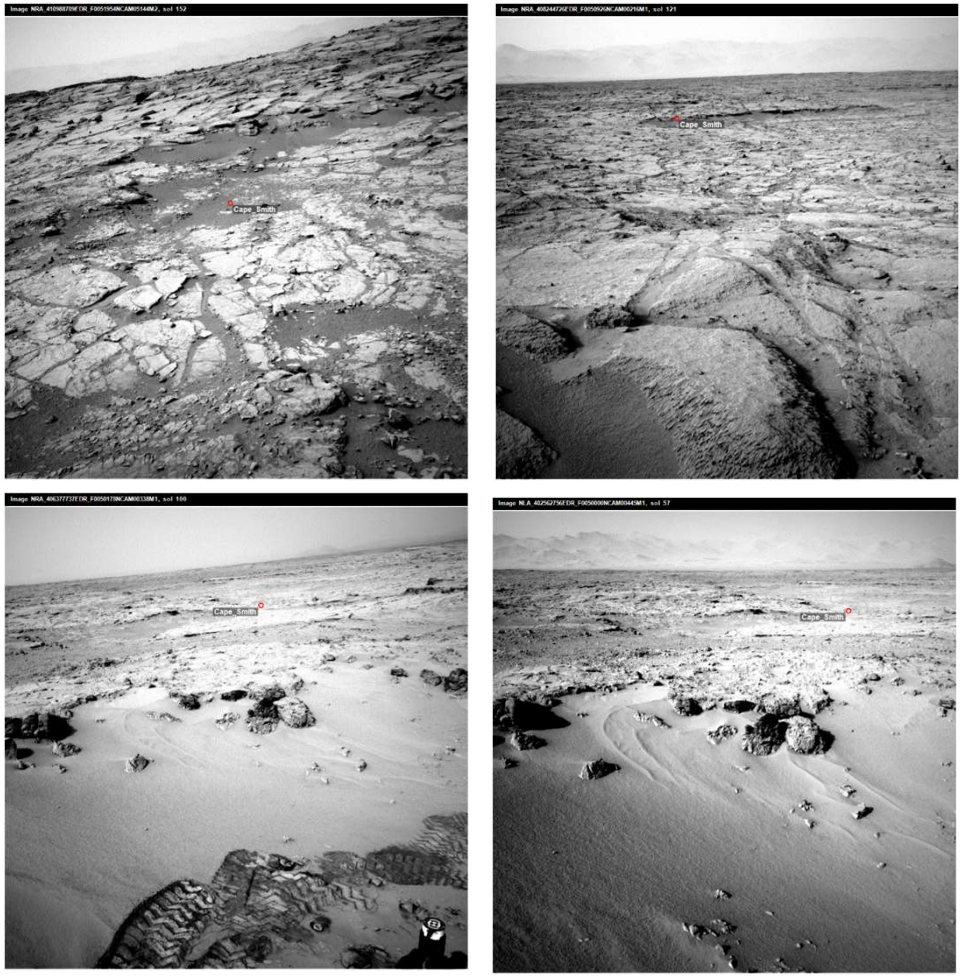
Bridges et al. (2015) "Hematite Formation In Gale Crater", Lunar and Planetary Science Conference, Abstract #1769.

"In previous work we showed that dissolution of approximately 70:20:10 % amorphous material , olivine and whole rock in an open system within the Sheepbed Member mudstone can explain the smectite and magnetite abundances identified by CheMin XRD at the John Klein and Cumberland sites [6] ."

Targets on images



MSL target Cape Smith, defined sol 163



Auto-located on images from previous sols

Links / contact

- PDS Analyst's Notebook
  - https://an.rsl.wustl.edu/
- Notebook online help
  - https://an.rsl.wustl.edu/help/Content/Home.htm
- Email
  - Tom Stein: tstein@wustl.edu
  - an@wunder.wustl.edu

an.rsl.wustl.edu

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