MSL ANALYST'S NOTEBOOK: IMPROVED CONNECTIONS BETWEEN TARGETS, DATA, AND PUBLISHED LITERATURE. T. C. Stein[1], R. E. Arvidson[1], K. L. Wagstaff[2], F. Zhou[1], [1]Washington University in St. Louis, 1 Brookings Drive, CB 1169, St. Louis, MO 63130, tstein@wustl.edu, arvidson@wustl.edu, zhou@wustl.edu, [2]Jet Propulsion Laboratory, California Institute of Technology, kiri.l.wagstaff@jpl.nasa.gov.

Introduction: The PDS Analyst's Notebook (AN) [1] for the Mars Science Laboratory (MSL) Curiosity rover [2] provides integrated access to peer-reviewed, released data delivered by the instrument teams, supported by documentation describing context for the observations, together with processing methodology and data formats.

New data products, documentation, traverse data, and support files are incorporated daily into the science team's version of the AN. This approach assists with data validation and builds on strong collaboration between data producers and PDS archivists that begins soon after mission selection with creation of the project data management and archive plans. The public version of the AN (http://an.rsl.wustl.edu) contains peer-reviewed, released data and is updated coincident with PDS data releases as defined in mission archive plans. All content has been ITAR cleared.

Observation planning and targeting information is extracted from mission science plans. Source commands are linked with resulting data products where possible, albeit with limits due to the absence of round-trip data tracking.

In this paper, we focus on improved association of science team-defined targets, archive data, and published literature.

Science targets within the Notebook: The MSL Analyst's Notebook contains targets selected by the MSL science team for planning and operations purposes. Names are given to aerographic features by the team and are not formally recognized by the International Astronomical Union. Target names used do appear in documentation captured in the Notebook as well as in scientific literature.

Although identifying and naming targets are integral to landed operations, an automated mechanism to link observations with targets during data acquisition does not exist.

Linking data to targets: Supplementary APXS and ChemCam data include links to specific targets (Fig. 1). APXS concentration data are chemical concentration results derived from archived data by the MSL APXS team. Each composition is associated with a specific target (i.e., a soil or rock labeled by the science team). [4]

ChemCam Remote Micro-Imager (RMI) mosaic images include annotations that denote locations of ChemCam LIBS data elemental abundance acquisition. The RMI image taken after LIBS acquisition is on top to show the laser pits. In addition, some mosaics have accompanying locator images called "contour images" that show the mosaic footprint drawn on a Mastcam image to provide context. Each mosaic is associated with a specific ChemCam target. [5]

Linking targets to publications: The Mars Target Encyclopedia (MTE) is a reference database containing compositional information about MSL ChemCam targets extracted from publications [6]. The initial set of literature references in the MTE has been updated and now includes references from nearly 6,000 abstracts from LPSC 2014-2016. Named entity recognition was used to find targets, elements, and minerals within the abstract text, and a machine learning model determined whether a statement about the geochemical composition of the target was present. Manual review of the extracted relations ensured high quality.

MTE results have been integrated into the MSL AN

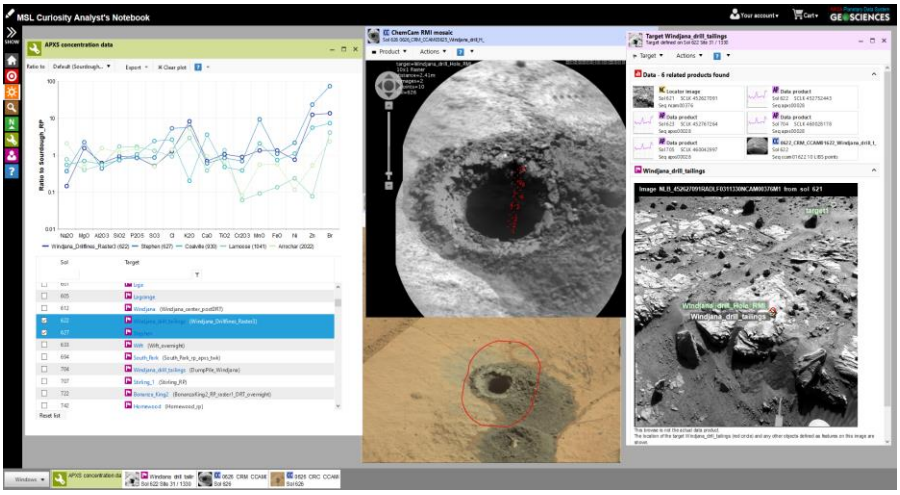

Fig. 1. MSL Analyst's Notebook screen shot showing interactive chart with ratios of APXS concentration data from selected targets plotted. Additional windows show views of one of the targets, Windjana, including the finder frame, a ChemCam mosaic annotated with the locations LIBS observation points and a contour image with the mosaic location.

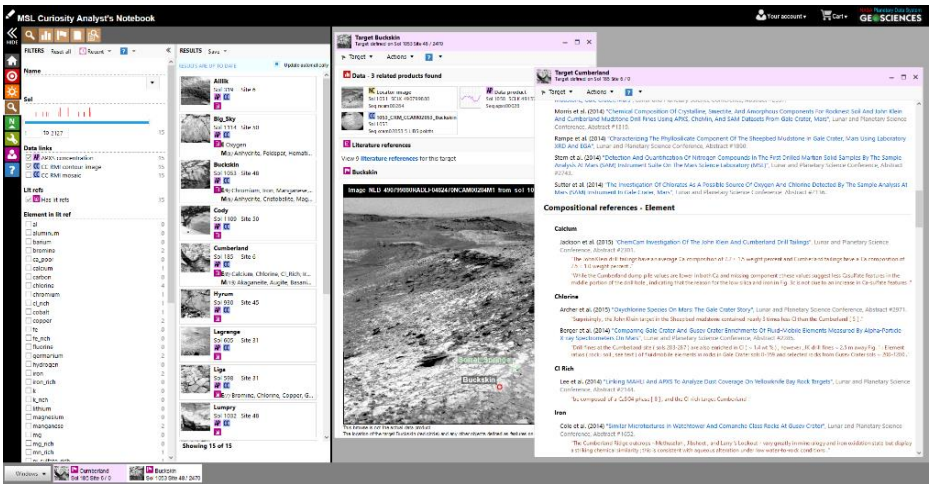

Fig. 2. Search results for targets with literature references, APXS concentration data, and ChemCam RMI contour images. Detail windows of two targets, Buckskin and Cumberland, are shown. Literature references for target Cumberland are visible in the rightmost window.

to allow users to find what has been published about targets, elements, or minerals of interest. Literature references can be found in the AN using the Target search (Fig. 2). Once a target is selected from the results list, a link to references will appear on the target detail page. Each reference includes the document lead author, year, title, and publication. Links to the source documents (PDFs) are included as well. A "Mentions in literature" list contains all identified references in bibliography form, both compositional references and simple mentions within the text. A "Compositional references" list includes the abstract reference along with excerpts from the text.

Finding targets with links to data and published literature: Updates to the MSL Analyst's Notebook target search has been updated to support finding data and literature references linked to targets. The search can be refined by specifying a sol range or entering a partial or complete target name, or by selecting specific filters related to data and literature references (Fig. 3). Upon selecting a target from the results list, details about the target and a link to the concentration data will appear.

Future Development: Work continues to incorporate additional features, including data transformation and improved data searches. User feedback can be submitted to an@wunder.wustl.edu or by using the online form. The MTE will expand to include information extracted from other venues and journal publications.

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References: [1] Stein, T.C. et al. (2010), LPS XLI, Abstract #1414. [2] Grotzinger, J. et al. (2012) doi:10.1007/s11214-012-9892-2. [3] Gellert, R. et al. (2015) doi:10.2113/gselements.11.1.39. [4] Stein, T.C. et al. (2019), LPS L, Abstract #1820. [5] Stein, T.C. et al. (2018), LPS IL, Abstract #1248. [6] Wagstaff, K.L. et al. (2018) IAAI-18.

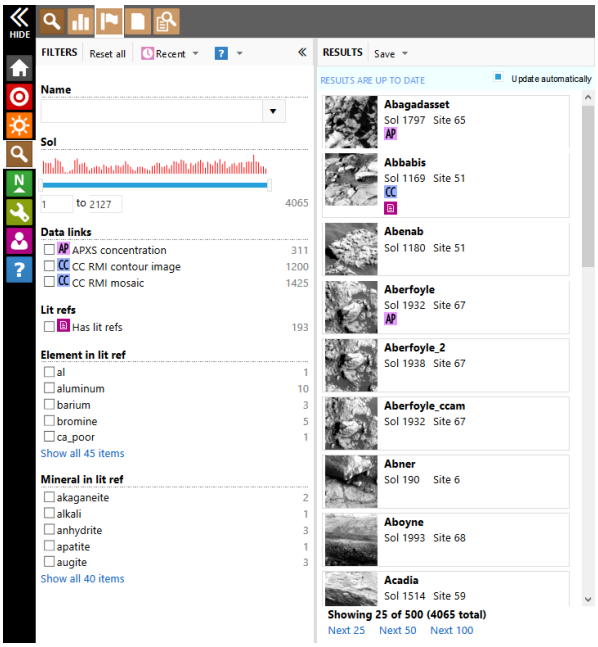

Fig. 3. Target search in the MSL AN. Search results are updated as filters are set by the user. Details are available by clicking on a target of interest.