

Mars Target Encyclopedia: Mars Target Encyclopedia:

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Third Planetary Data Workshop

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Mastcam image from the Mars Science Laboratory rover

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Thousands of Mars surface targets

Yellowknife Bay

Point Lake

Gillespie Lake

Sheepbed

Cumberland drill site

John Klein drill site 50 cm

Image credit: NASA/JPL-Caltech/MSSS

ChemCam: Target composition



But... no searchable repository of target compositional information
Which targets contain fluorine?
Which targets contain plagioclase?
Is there consensus on target X's composition?





Manual composition annotations



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Compositional information from publications about MSL ChemCam surface targets Publications currently indexed: abstracts from LPSC 2015 and 2016

Enter target or component name

Q,



Mars Target Encyclopedia

Compositional information from publications about MSL ChemCam surface targets Publications currently indexed: abstracts from LPSC 2015 and 2016

Dillinger

1 target found



Dillinger 7 properties

3 publications



Map display of search results

Thanks: Fred Calef (MMGIS)





I. Named Entity Recognition

- CoreNLP Machine learning [Finkel et al., 2005]
- Find and classify all "entities"
 - Default entities:
 - Person, Location, Organization
 - You can define your own!
 - Element, Mineral, Target

Entity extraction performance

Performance (train LPSC 2015, test LPSC 2016)







Relation extraction performance

Performance (train/val LPSC 2015, test LPSC 2016)





Mars Target Database

Content type	Manual (LPSC15+16)
Documents	118
Elements	1742
Minerals	888
Targets	824
Relations	481



Mars Target Database

Content type	Manual (LPSCI5+I6)	Automatic (LPSCI4,I5,I6)		
Documents	118	5,920		
Elements	1742	63,984		
Minerals	888	38,937		
Targets	824	3,053		
Relations	481	348		



Mars Target Database

Content type	Manual (LPSC15+16)	Automatic (LPSC14,15,16)		
Documents	118	5,920		
Elements	1742	63,984		
Minerals	888	38,937		
Targets	824	3,053		
Relations	481	348		
Time (per document)	~30 mins	~5 seconds		





- Connect data to (published) knowledge
- Enable searches not previously possible
- Facilitate scientific progress and exploration using IE and ML methods
- Next steps
 - Integrate with PDS Analyst's Notebook
 - Extract information from journal articles

Thank you: JPL AMMOS program, the Planetary Data System, and the MSL mission. 19



Example extractions

- Link contains potassium
 - "Link, which was one of the first K-rich conglomerate targets observed with ChemCam, whereas felsic group 5 shows a higher Na/K ratio."
- Link contains hydrogen
 - "Both of these are good candidates since, in Link at least, the hydrogen signature is relatively prominent."



[BOOK] Cavalier in **Buckskin**: George Armstrong Custer and the Western Military Frontier

RM Utley - 2001 - books.google.com

George Armstrong Custer. The name evokes instant recognition in almost every American and in people around the world. No figure in the history of the American West has more powerfully moved the human imagination. When originally published in 1988, Cavalier in ... Cited by 71 Related articles All 3 versions Cite Save More No

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Q

Yes

No

High-Temperature, Perhaps Silicic, Volcanism on **Mars** Evidenced by Tridymite Detection in High-SiO2 Sedimentary Rock at Gale Crater, **Mars**

RV Morris, DT Vaniman, DF Blake, R Gellert... - 2016 - oro.open.ac.uk

... Curiosity at Gale Crater: The **Mars** Science La- boratory (MSL) rover, Curiosity, has been exploring sedimentary rocks within Gale crater since landing in ... of Aeolis Mons (aka Mount Sharp), drill powder was collected from a high-silica (74 wt% SiO2) outcrop named **Buckskin** (BK ... All 3 versions Cite Save

Alteration Mineralogy and Geochemistry at Swansea, Arizona: A Potential Analog for Brine-Basalt Interaction on **Mars**

<u>JR Michalski</u>, SJ Reynolds, TG Sharp... - AGU Fall Meeting ..., 2002 - adsabs.harvard.edu ... has been documented in the Harcuvar Mountains to the east, where deep (~10 km) crustal brines that migrated along the Tertiary **Buckskin**-Rawhide detachment fault ... Future work will include the development of a model for alteration of basalt by brine on the Earth and **Mars**. ... Cite Save

Silicic volcanism on **Mars** evidenced by tridymite in high-SiO2 sedimentary rock at Gale crater

RV Morris, DT Vaniman, DF Blake... - Proceedings of the ..., 2016 - National Acad Sciences ... Tridymite, a low-pressure, high-temperature (>870 °C) SiO 2 polymorph, was detected in a drill sample of laminated mudstone (**Buckskin**) at Marias Pass in Gale crater, **Mars**, by the Chemistry and Mineralogy X-ray diffraction instrument onboard the **Mars** Science Laboratory ... Cited by 2 Cite Save

Is Tridymite at Gale Crater Evidence for Silicic Volcanism on Mars? RV Morris, DT Vaniman, DW Ming, TG Graff, <u>RT Downs</u>... - 2016 - ntrs.nasa.gov

... The X-ray diffraction (XRD) instrument (CheMin) onboard the MSL rover Curiosity detected 17 wt% of the SiO2 polymorph tridymite (relative to bulk sample) for the **Buckskin** drill sample (73 wt% SiO2) obtained from sedimentary rock in the Murray formation at Gale Crater, **Mars**. ... Cite. Save. More

[HTML] pnas.org Get-It @JPL Library

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Scholar	About 95 results (0.05 sec)		Any time 👻 12

Sol 1320 (Site 54, 746) -4429.05 m

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[PDF] Cataloguing the **Lubango** Bird Skin Collection: towards an atlas of Angolan bird distributions

MSL Mills, U Franke, G Joseph, F Miato, S Milton... - Bull. ABC, 2010 - birdsangola.org ... Les spécimens du musée de **Lubango** proviennent d'une zone de contact des deux taxons et pourraient servir pour une étude ... haut) et femelle (en bas) du Tisserin à menton noir Ploceus nigrimentus, collectés à Huambo (auparavant Nova Lisboa) en **mars** 1966 probablement ... Cited by 5 Related articles All 5 versions Cite Save More

Groupes nouveaux de Mimosacées et Caesalpiniacées

G Gilbert, R Boutique - Bulletin du Jardin botanique de l'Etat, Bruxelles/ ..., 1952 - JSTOR ... 1914, Bequaert 2325; La Kulu, juin 1931, Vanden Brande 508; Nala, 1907, Seret 819; Buta, foret secondaire, fleurs blanc jaunatre, **mars** 1931; Lebrun 2472; entre Niangara et Wamba, anciennes cultures, juin 1931, Lebrun 3197 ... Lubango, chaine Ouest du lac tdouard, alt. ... Cited by 3 Related articles All 2 versions Cite Save

Observations critiques sur quelques Composées du Congo belge

H Humbert, P Staner - Bulletin du Jardin botanique de l'Etat a Bruxelles, 1936 - JSTOR ... 2,500 m. d'alt., arbuste de 2 m., fleurs centrales lilas, fleurs p6ripheriques blanchhtres, **mars** 1929, Humbert 7576; region S.-W. de Lemera, vall&e de la Ruzizi, vers 2,500 m. d'alt., buisson de 2 m., fleurs mauve clair, juill. 1927, Chapin 487; entre Kasindi et **Lubango**, chaine 'I ... Cited by 1 Related articles Cite Save More

ACTIVITfiS EXTfiRIEURES

A sur le Planalto - Cambridge Univ Press

... Activites dans le sud de VAngola A l'occasion de sa mission en Angola, le delegue general du CICR pour l'Afrique, MJ-M. Bornet, s'est rendu a **Lubango** les 18 et 19 **mars** et s'est entretenu directement sur le terrain avec les autorites provinciates et militaires. ...

All 2 versions Cite Save

[PDF] birdsangola.org

No

No

No