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# Selecting experiments to better inform predictive models for the Mars rover

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11/4/22

# Los Alamos mentors

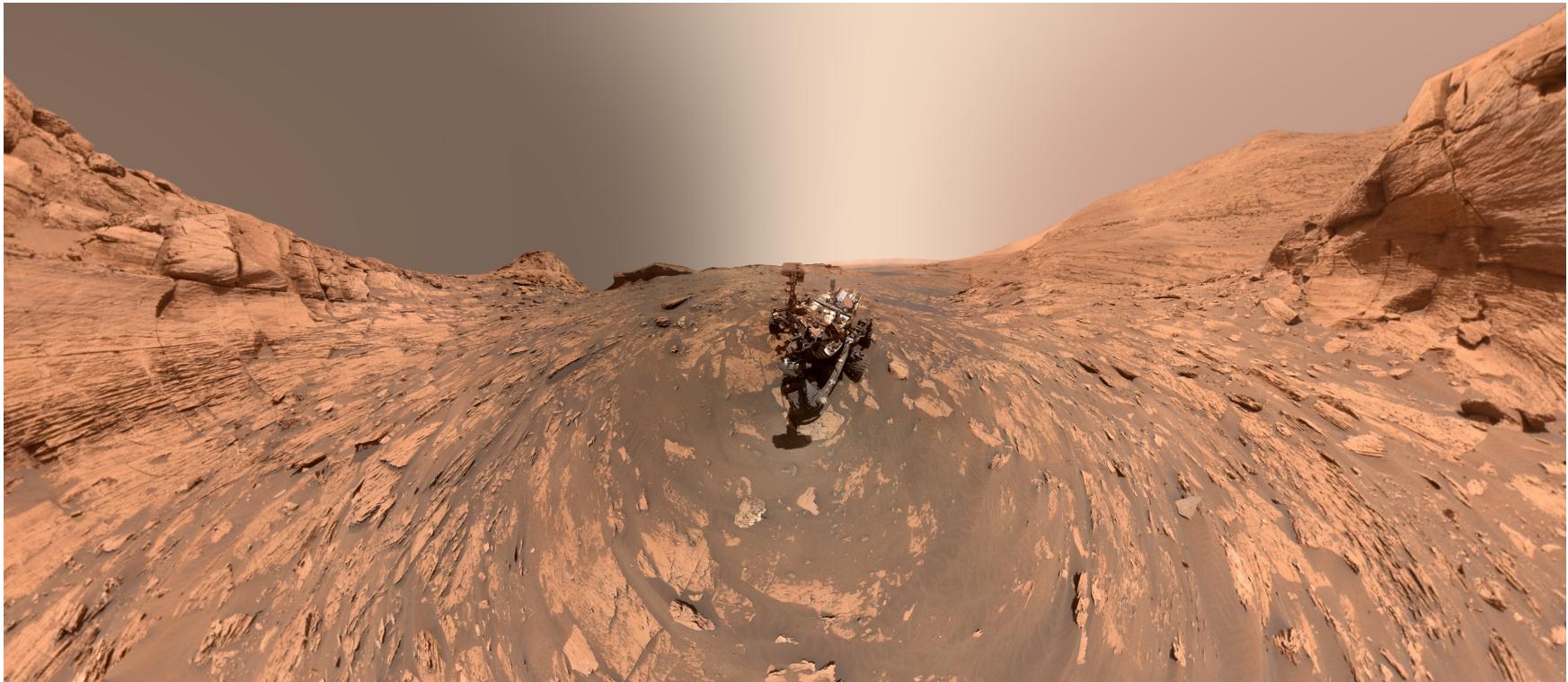


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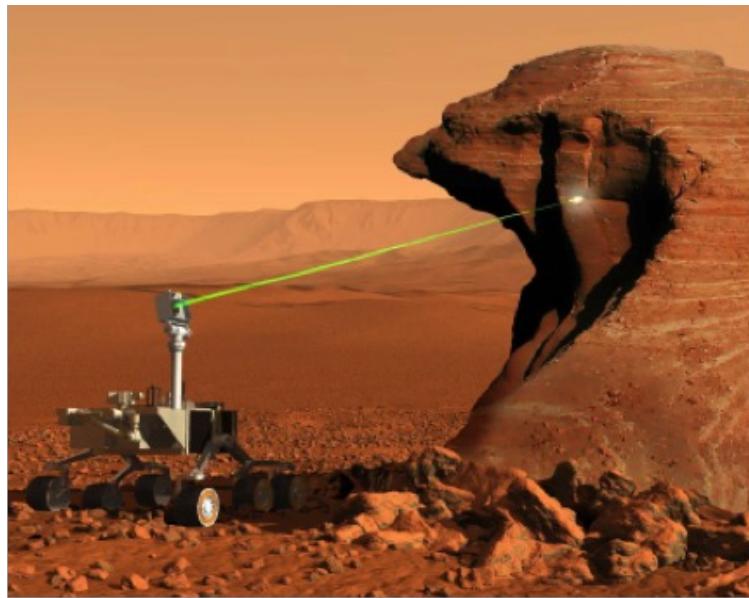
We want to explore and characterize Mars geologically, but we can't go there or send back samples. (Yet.)



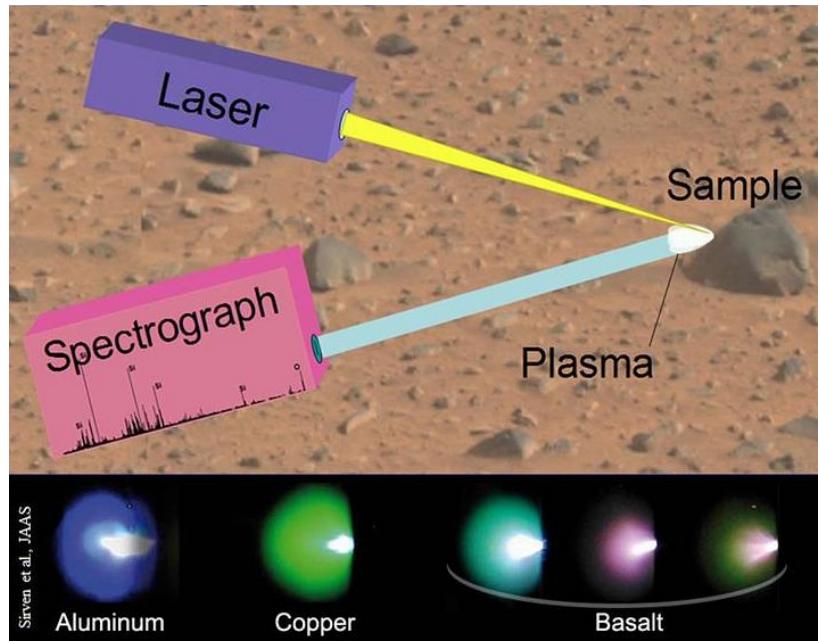
NASA/JPL-Caltech/MSSS

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# ChemCam is a laser-induced breakdown spectroscopy instrument deployed on Mars for over 3,600 sols.

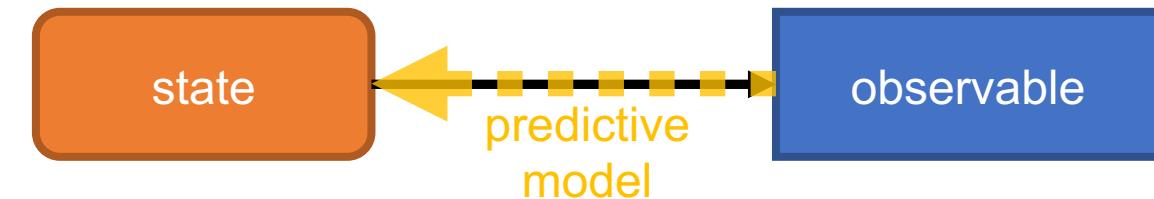


Images: NASA/JPL-Caltech/LANL; Sirven et al 2007

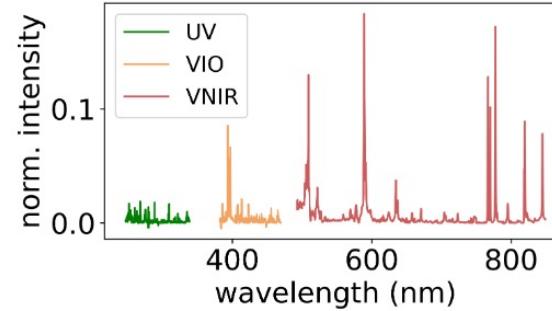


# Statistical learning models are trained to predict composition from spectral observations.

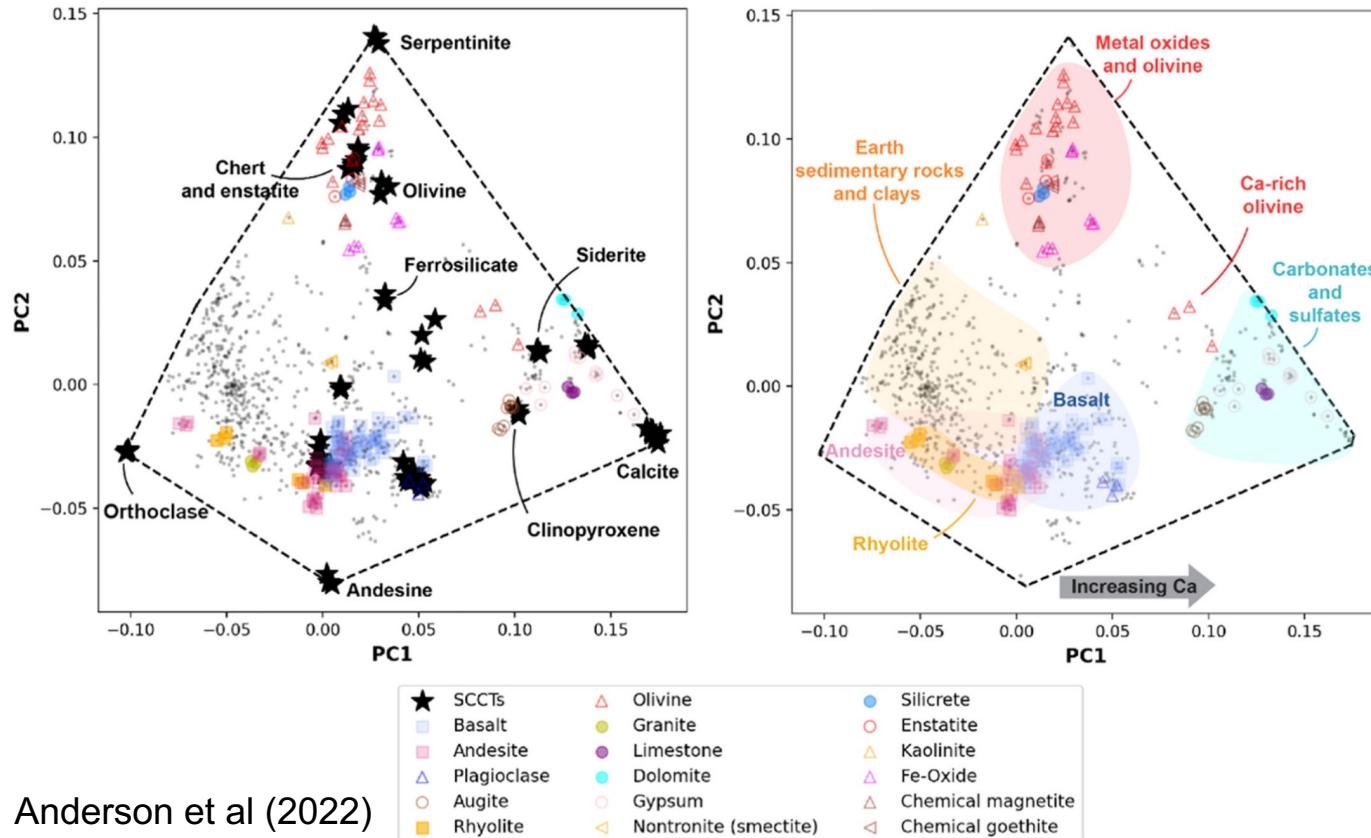
But what is the training data???



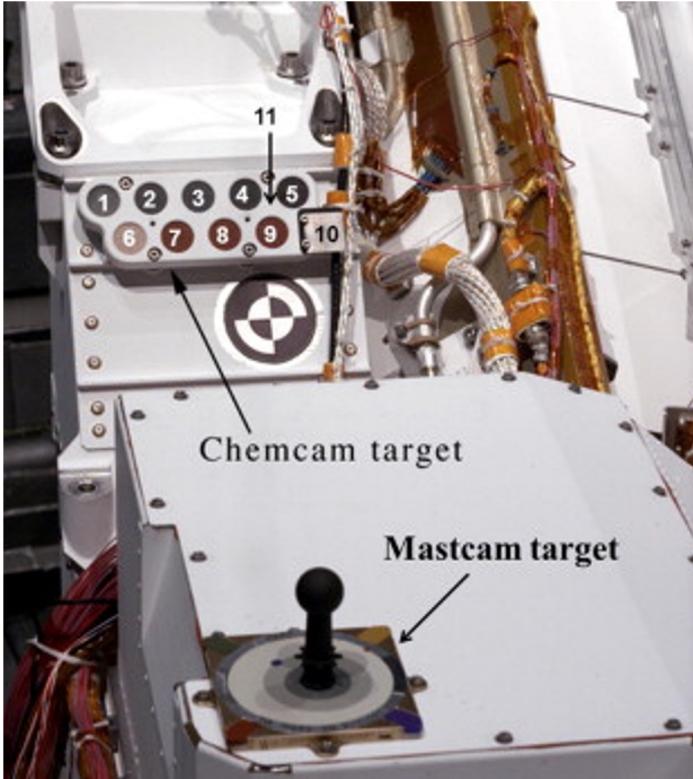
Oxide	Weight %
SiO <sub>2</sub>	58.2
MgO	9.8
CaO	5.1
...	...



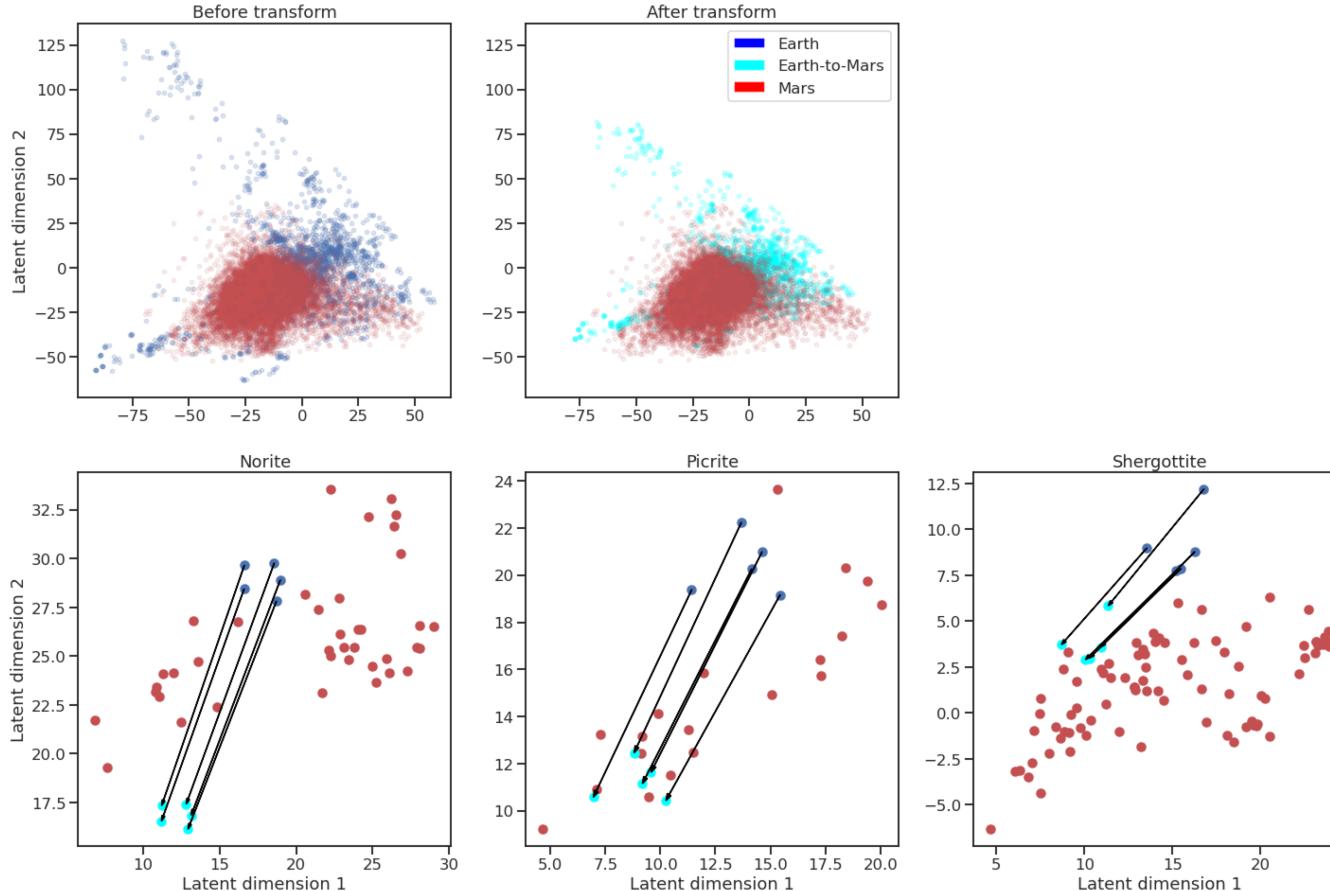
# Spectral training sets are created by measuring known targets in the laboratory on Earth.



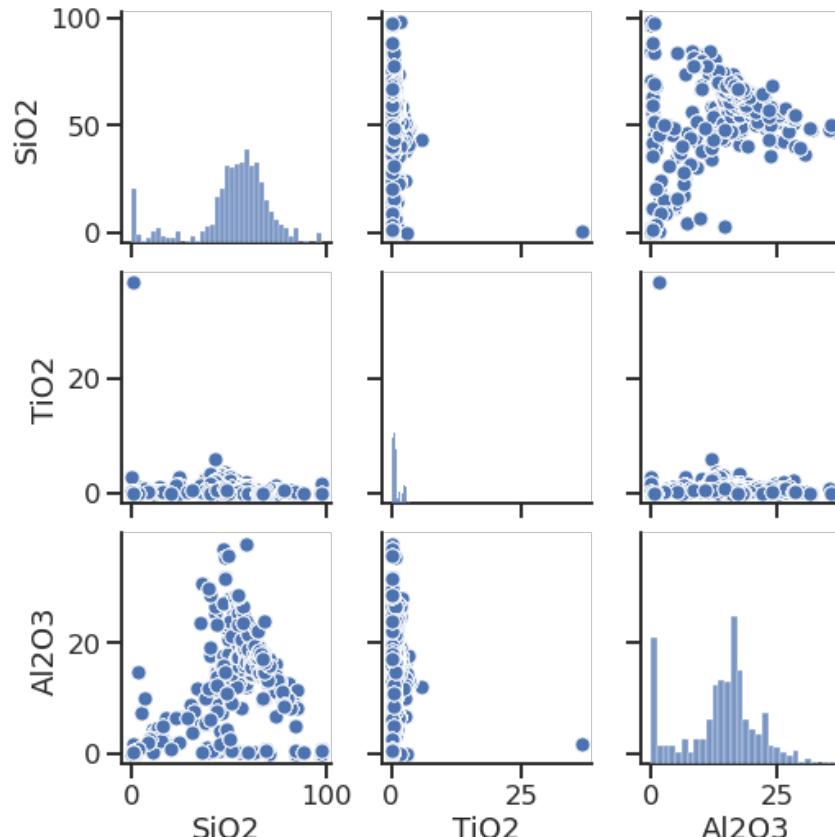
We have very little labeled data from Mars, limited to a set of calibration targets mounted on the rover.



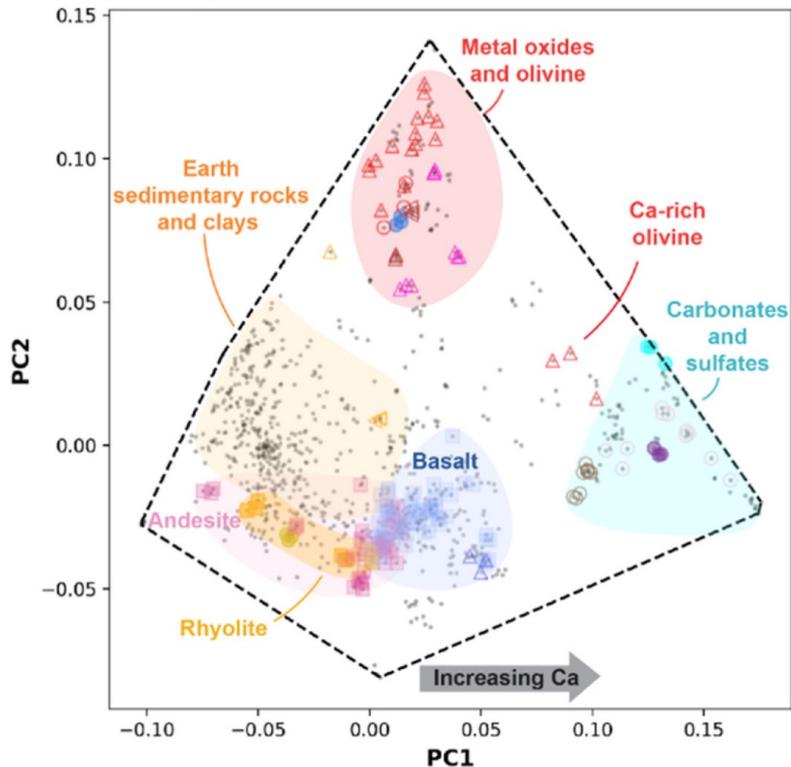
# Question 1: how well do the current Earth and Mars samples align?



## Question 2: how do empirical distributions of the training library in composition space affect the models?



# Question 3: if we could collect more training data on Earth, which samples would most impact the models?



Anderson et al (2022)



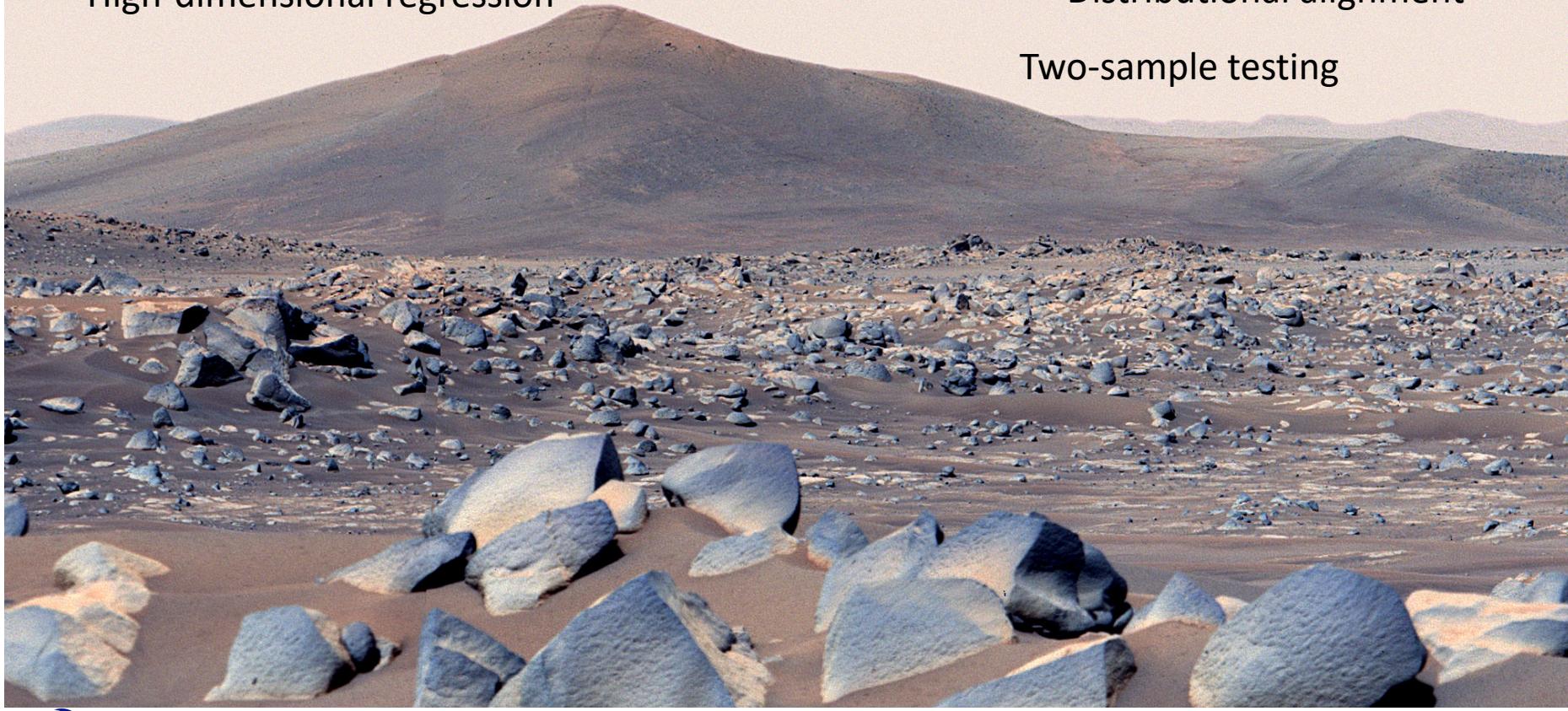
Statistical learning

Active learning and experimental design

High-dimensional regression

Distributional alignment

Two-sample testing



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