IDENTIFICATION AND CHARACTERIZATION OF NEW FELDSPAR-BEARING ROCKS IN THE WALLS OF VALLES MARINERIS, MARS

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ABSTRACT EGU2020-13377

"VNIR spectroscopy has previously led to many discoveries pertaining to Mars geologic history (e.g., the discovery of hydrated minerals associated to ancient terrains with OMEGA, Bibring et al., 2006). Plagioclase feldspar minerals can also be identified with spectroscopic techniques thanks to a 1.3 microns absorption in the VNIR domain (e.g., Adams and Goullaud, 1978). Previous lunar analog studies show however that when mixing powders of Ca plagioclase and a mafic component (olivine or pyroxene), the feldspars absorption band is quickly masked (e.g., Cheek and Pieters, 2014). This study further demonstrates that the 1.3 micron feature is only detectable if the plagioclase abundance is > 90 %. Based on this observation, previous feldspar absorptions on Mars have been interpreted as evidence for nearly pure anorthositic rocks (e.g., Carter and Poulet, 2013). A recent study by Rogers and Nekvasil (2015) however suggests that phenocryst basalts with less than 90% plagioclase could reproduce the 1.3 micron feature if large crystals are involved, although no whole rock measurements were made.

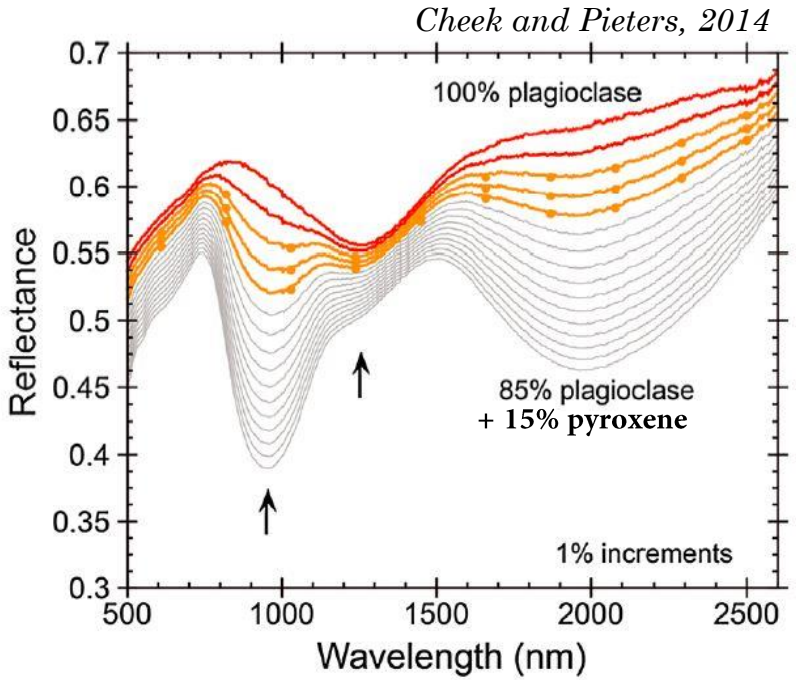
In the present study, we describe new feldspar signatures detected with the CRISM VNIR spectral-imager in the walls of the Valles Marineris grand canyon, on Mars. The associated rock textures and elevations were assessed from CTX and HiRISE images and DTMs**. In parallel, we are collecting VNIR spectra of various (uncrushed) terrestrial rocks containing a large range of feldspar abundances and grain sizes.** Analyses are carried out between 0.35 and 2.5 microns with an ASD Fieldspec at CRPG Nancy, France, and will be presented at the conference time. **By combining laboratory measurements of a range of possible terrestrial analog rocks with the study of Mars feldspar-bearing outcrops, we should bring more clues on the nature and origin of these feldspathic rocks."**

PLAGIOCLASE SIGNATURES IN THE VNIR

- Plagioclase with minor Fe displays **an absorption band centered at 1.25-1.30 µm.**

- Lunar and laboratory measurements (on powders) show that **plagioclase can only be detected in a mixture with mafic minerals (olivine, pyroxene) if > 90 wt%**

→ Therefore previous detections on the Moon and Mars (e.g., Carter et al. 2013) were intepreted as evidence for nearly pure anorthosite made of the Ca-feldspar plagioclase.

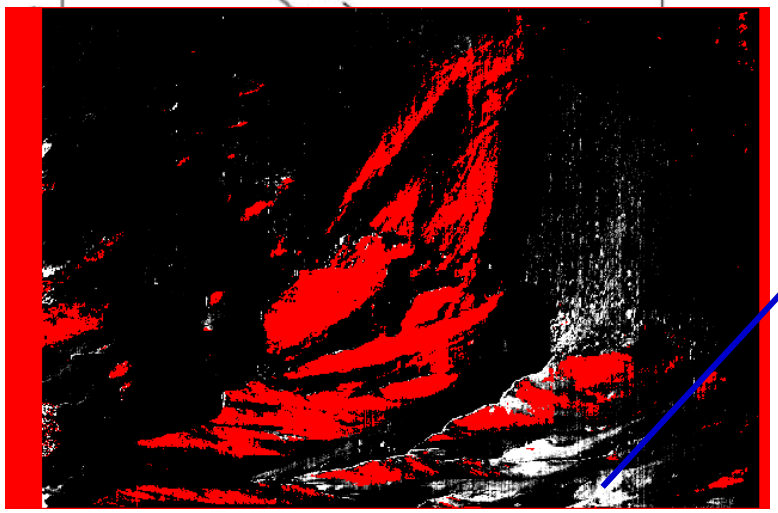


→But what about … the effect of grain size?
… the effect of plagioclase composition?
… the effect of other minerals?

→Mars is much more diverse than the Moon! Therefore more reference measurements of feldspar-bearing rocks, as potential analogs to the detections recently made on Mars, are needed.

DETECTING FELDSPARS WITH CRISM

Unprojected CRISM obs. in VM walls



BD1300 criteria: white means > 0
Areas of negative slope (LCP) are overlain in red

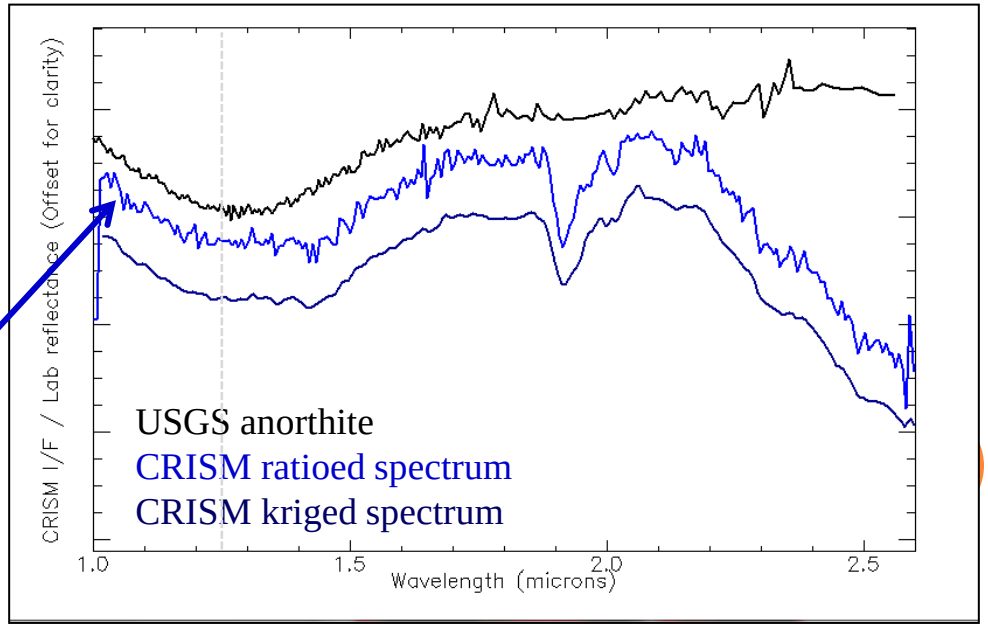
Approach similar to that of Carter et al. (2013) for Valles Marineris (VM) CRISM observations:

1- Standard CRISM processing with the CRISM Analysis Toolkit (CAT) – Use of 1 – 2.7 microns range,

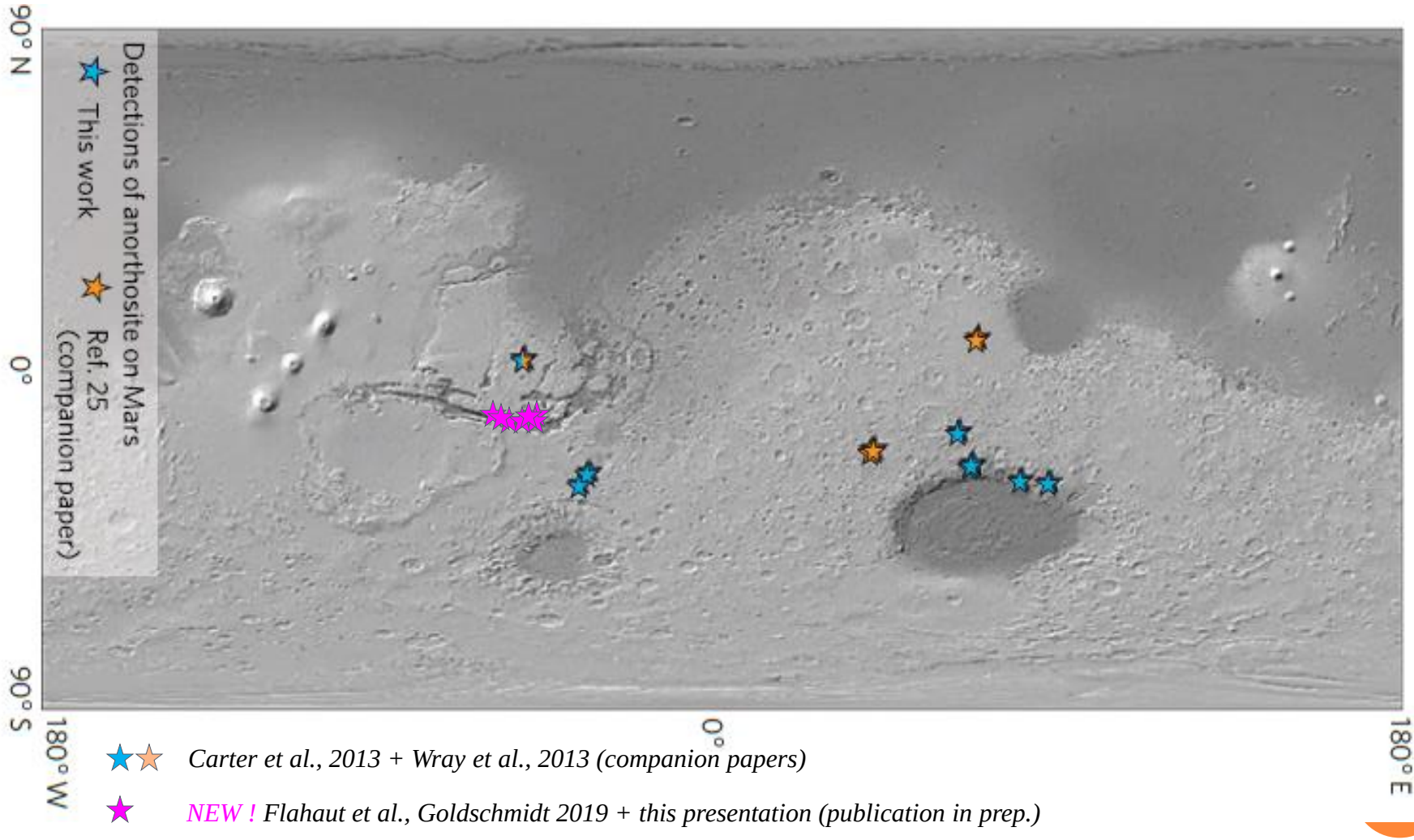
2- Custom-made de-noising by applying ordinary kriging with a linear variogram to each spectrum (pixel by pixel),

3- Calculation of spectral parameters (Viviano-Beck et al., 2014),

4- Manual check of pixels with BD1300>0 on both raw and kriged data, + spectral ratios.



Mars feldspar detections as of May 2020



Carter et al., 2013 + Wray et al., 2013 (companion papers)

NEW ! Flahaut et al., Goldschmidt 2019 + this presentation (publication in prep.)

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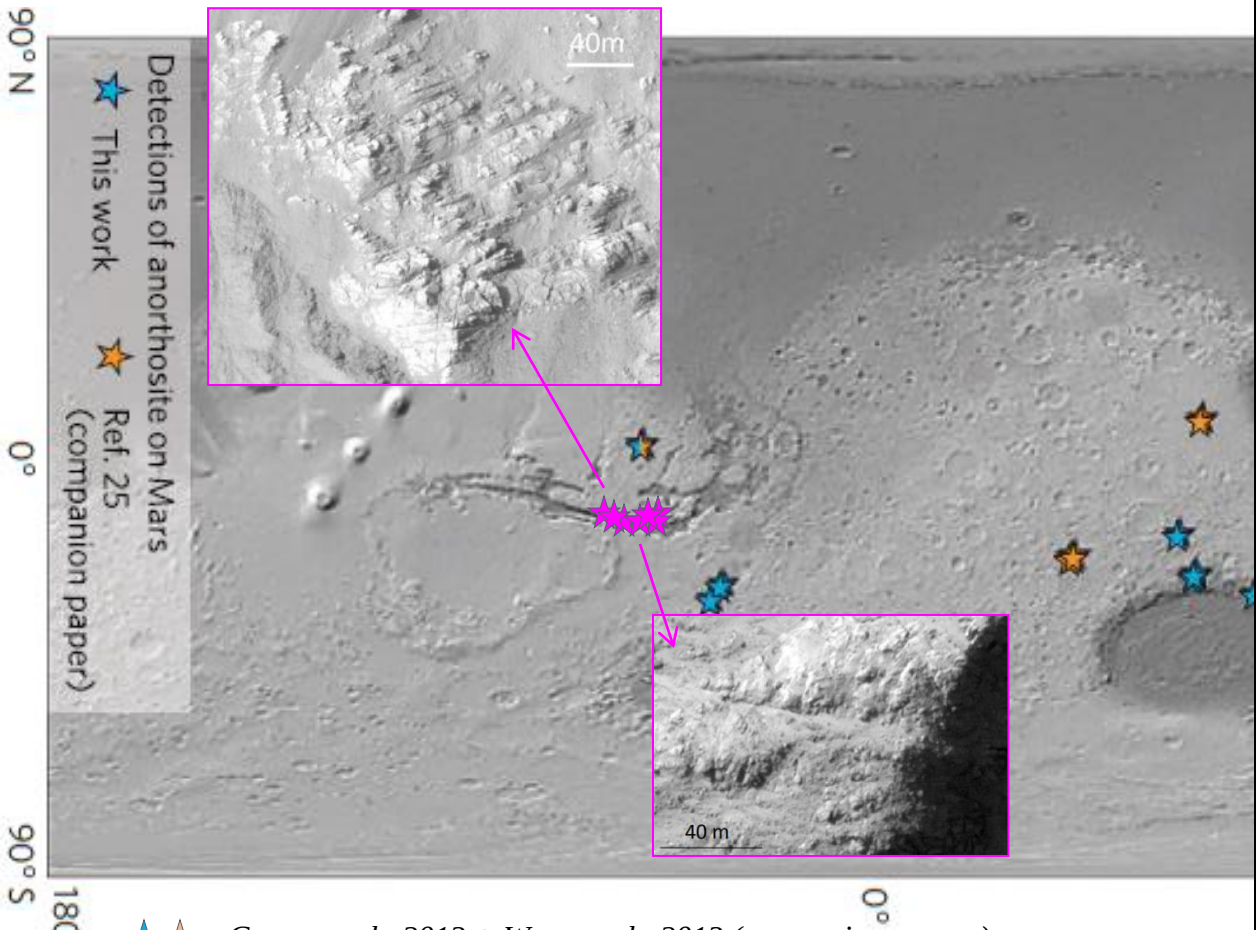

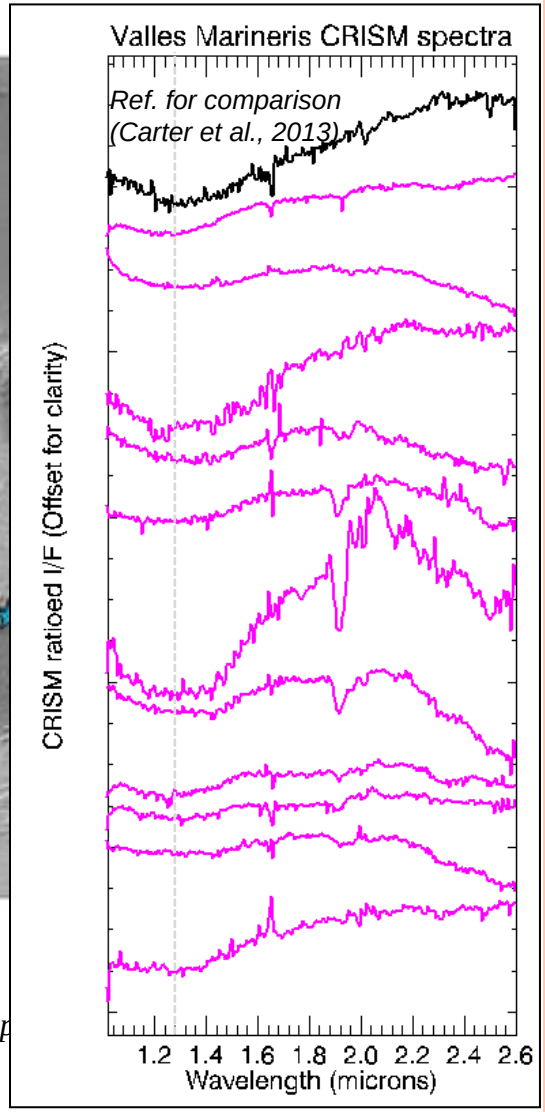

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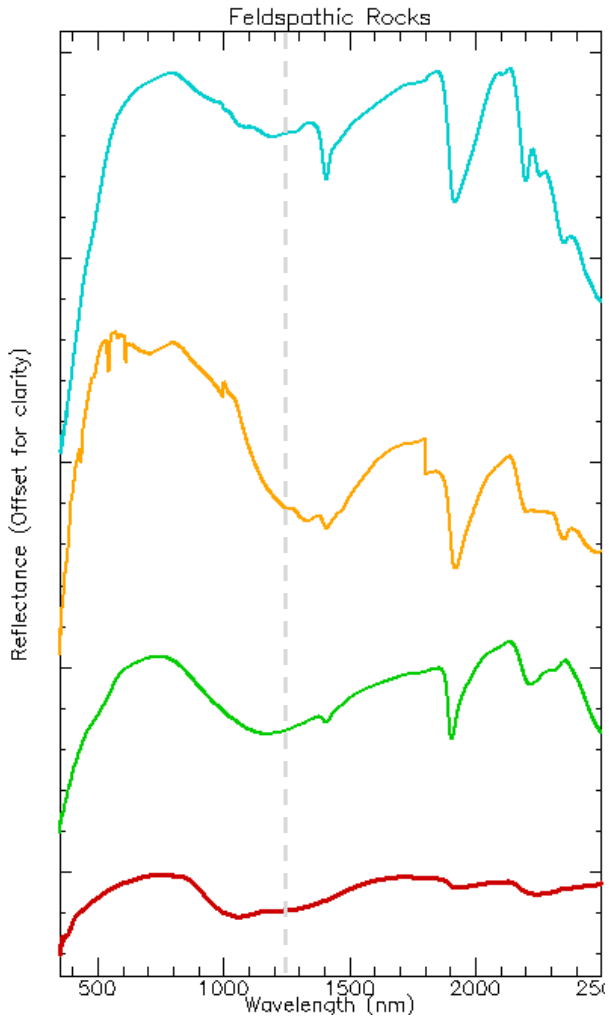
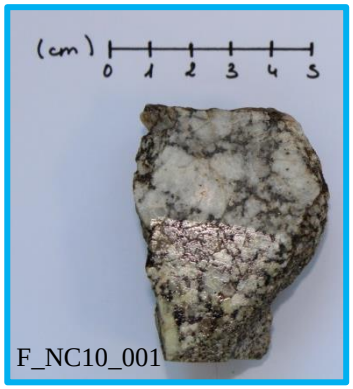
Investigating analog material in the laboratory



Spectra collected with the probe of the *ASD Fieldspec 4*

Dacite
(collection of J. Flahaut)

Labradorite
(collection of E. Thomassot)



Granite
(collection of CRPG)

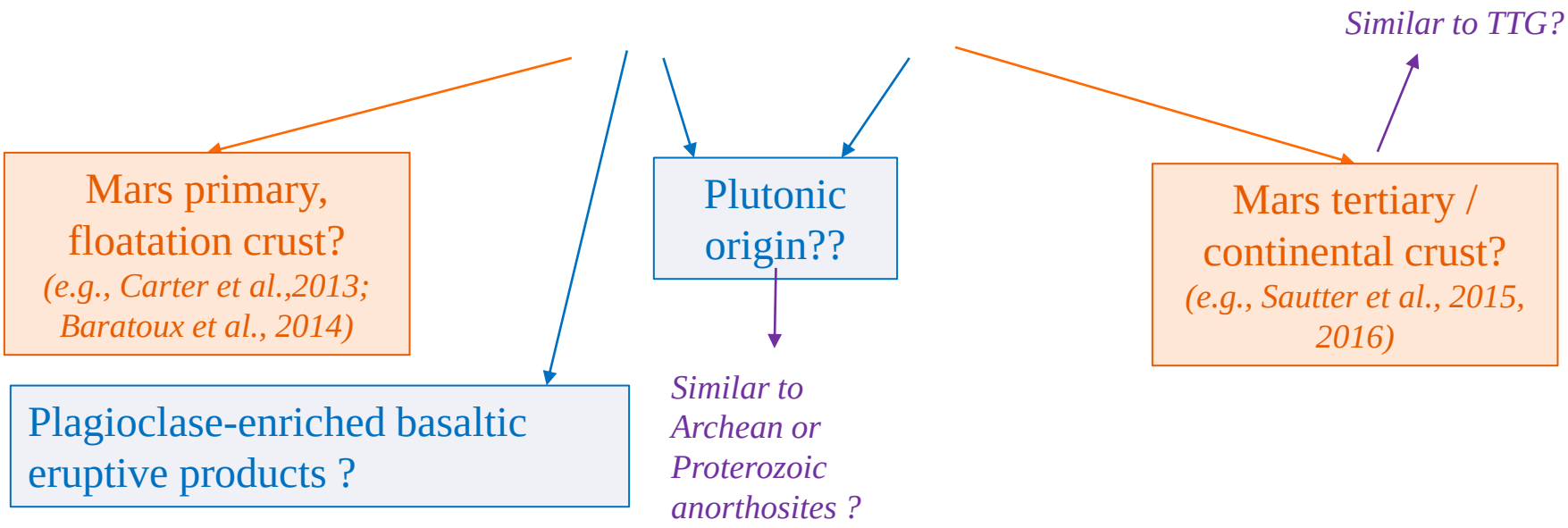
Basalt
(collection of R. Pik)

Measurements of rocks and slabs in the lab suggest that a range of feldspar compositions and feldspathic and felsic rocks can reproduce the 1.25µm absorption we observe on Mars.

DISCUSSION

Feldspar signals cannot simply be interpreted as a high plagioclase abundance /nearly pure anorthosite in extra-terrestrial crusts !

Here we present new possible feldspar detections in VM, over a distance > 600 km. A lot of possible interpretations: **feldspathic** or **felsic** rocks? Intrusive or extrusive?



Perspectives : more clues are needed regarding :

- The composition of the feldspars
- The possible presence of silica (TES/THEMIS? If the spatial resolution allows it))
- The precise elevation of the detections
- The spatial extent of the detections
- Possible terrestrial analogs (based on spectral analysis and context)