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# Spectroscopic and minero-petrological investigation of boninites from Cyprus as potential analogues of Mercury lavas

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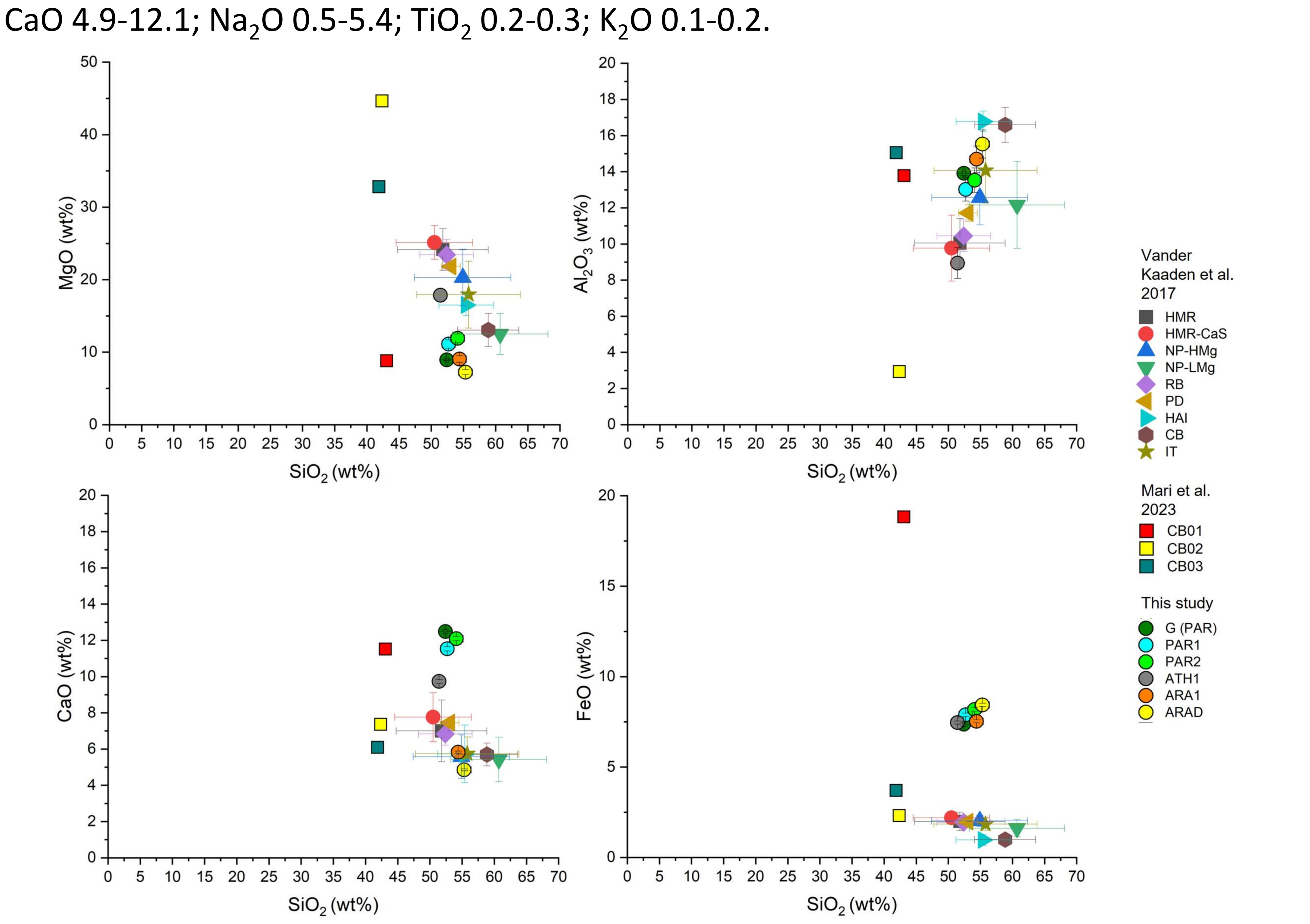
## INTRODUCTION AND OBJECTIVES

- boninites are good candidates as analogues of Mercury lavas [1]
- in this work, we make a comparison between terrestrial boninites and Mercury lavas, taking into account mineralogical, geochemical and petrological features
- a preliminary investigation of VNIR reflectance properties has begun

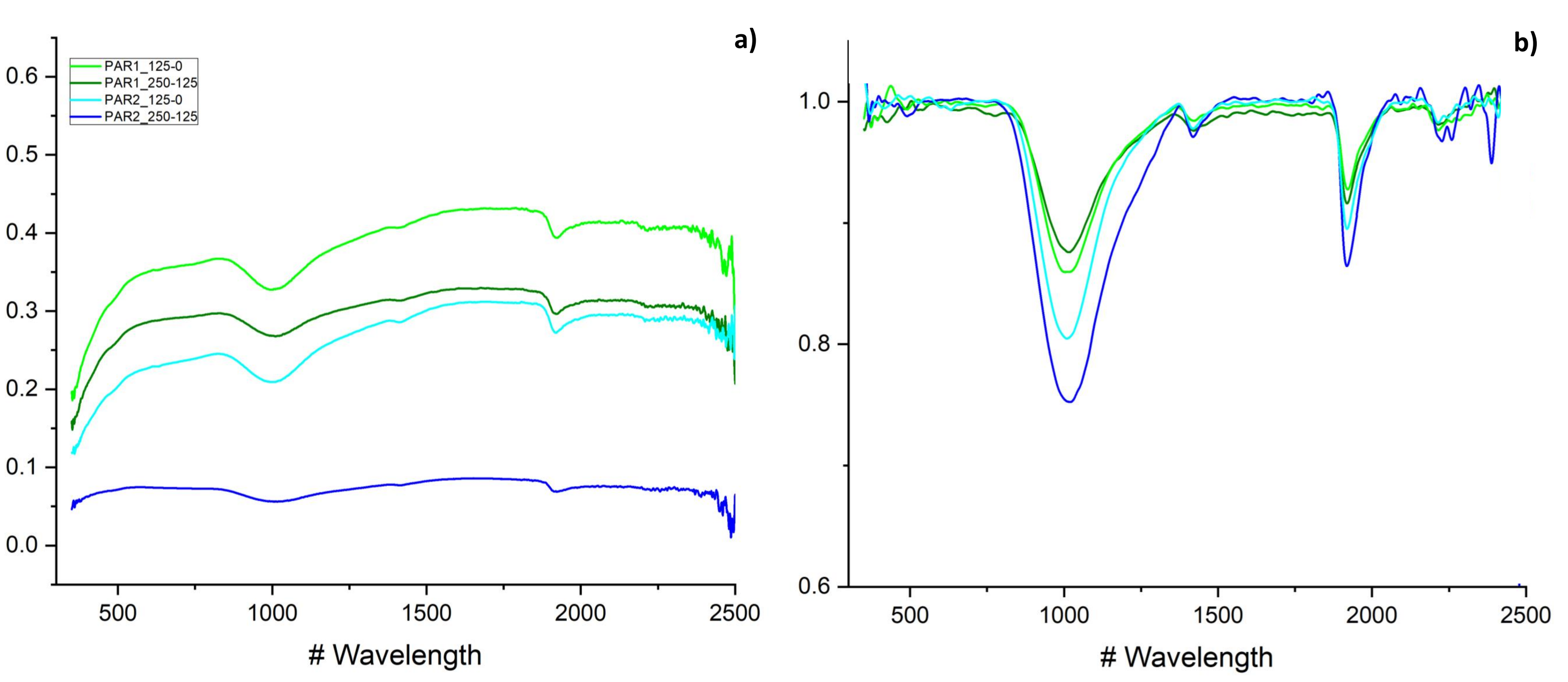
## BULK COMPOSITION – COMPARISON WITH MERCURY'S TERRANES

Compositional ranges (wt%): $SiO_2$ 51.4-54.4, $Al_2O_3$ 8.9-14.7; FeO 7.2-8.4; MgO 7.3-17.8; CaO 4.9-12.1; $Na_2O$ 0.5-5.4; $TiO_2$ 0.2-0.3; $K_2O$ 0.1-0.2.



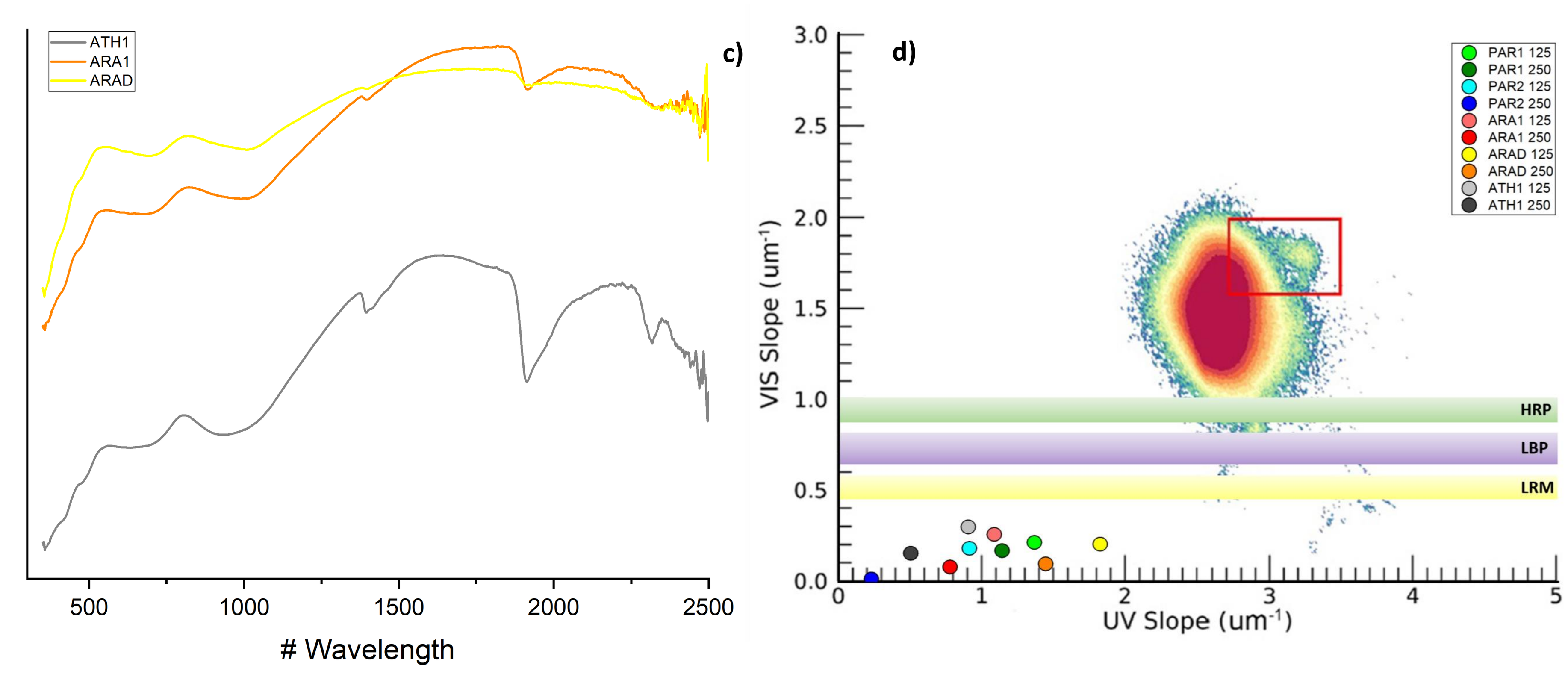

HMR= high-Mg region; HMR-CaS= high-Mg region with highest Ca and S; NP-HMg= northern volcanic plains with high Mg; NP-LMg= northern volcanic plains with low Mg; RB= Rachmaninoff Basin (RB); PD= pyroclastic deposits; HAI= high-Al region; CB= Caloris Basin; IT= intermediate terrane. G= EPMA analysis on a glass sample from Parekklisia. CB01, CB02, CB03 samples from different localities in Cyprus.

## VNIR SPECTRA




a) reflectance spectra of PAR sample considering two grain sizes: 250-125 µm and <125 µm

b) continuum removed spectra to underline absorption bands. Main band at ~1 µm associated with mafic mineralogy (olivine and pyroxene)




c) reflectance spectra of ARA and ATH samples (<125 µm) showing stronger ~1.4 µm, ~1.9 µm and 2.3 µm bands due to hydrated minerals (aqueous alteration)

d) comparison of UV slope and VIS slope values of all the samples (two grain sizes) with the values calculated for different Mercury regions (plot after [8]; high-reflectance red plains (HRP), low-reflectance blue plains (LRP) and low reflectance material (LRM) VIS slope range after [9])

Preliminary comparison between laboratory reflectance spectra of boninite samples and MASCS/MESSENGER Mercury data, taking into account:

- slope calculation for our samples is affected by the presence of absorption bands
- fine particle sizes produces slope data more similar to Mercury
- higher slope values for the altered samples could be influenced by the presence of $Fe^{3+}$
- increasing phase angle leads to a slightly bluer olivine spectral slope [10]
- terrestrial samples are not affected by space weathering which increases the VISNIR slope (spectra reddening) [11]→ ongoing studies [12] are investigating spectral variation on irradiated samples

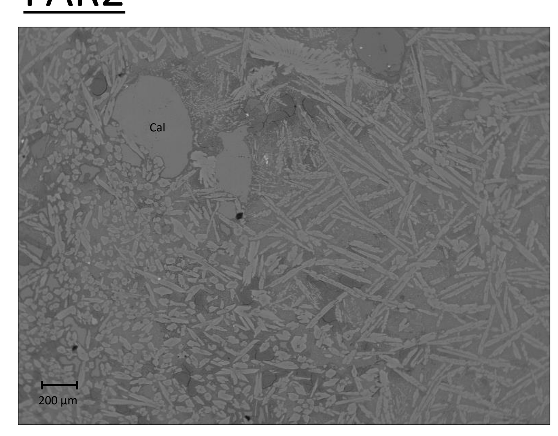
## MATERIALS AND METHODS

The boninite samples under investigation come from three localities of the Troodos massif, Cyprus, corresponding to different geological units [3,4]. We chose some representative samples, with a relatively low weathering, for each locality (labeled **PAR**, **ARA** and **ATH**).

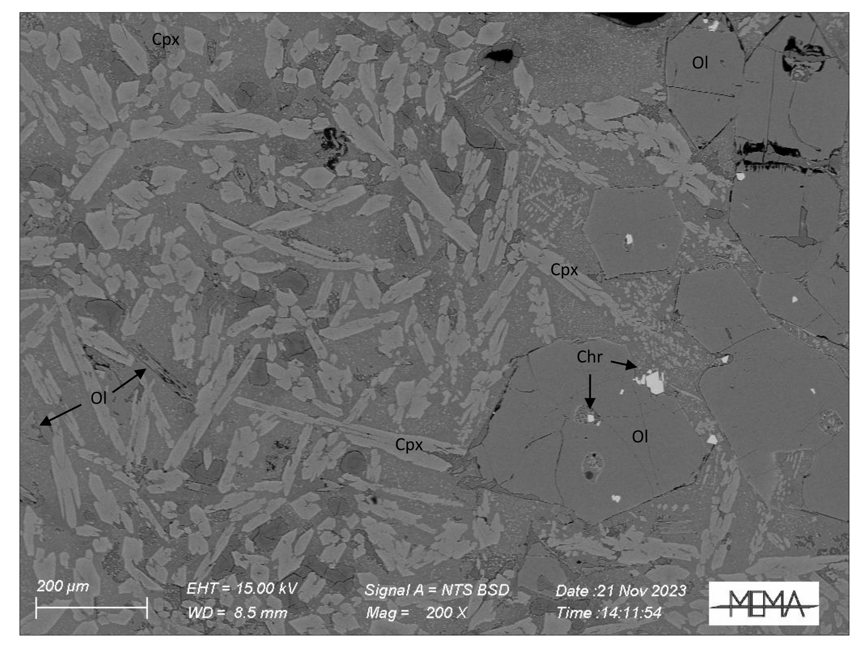
Analytical methods used so far: XRF, SEM, EPMA, VNIR spectroscopy.

## MINERALOGY

PAR2

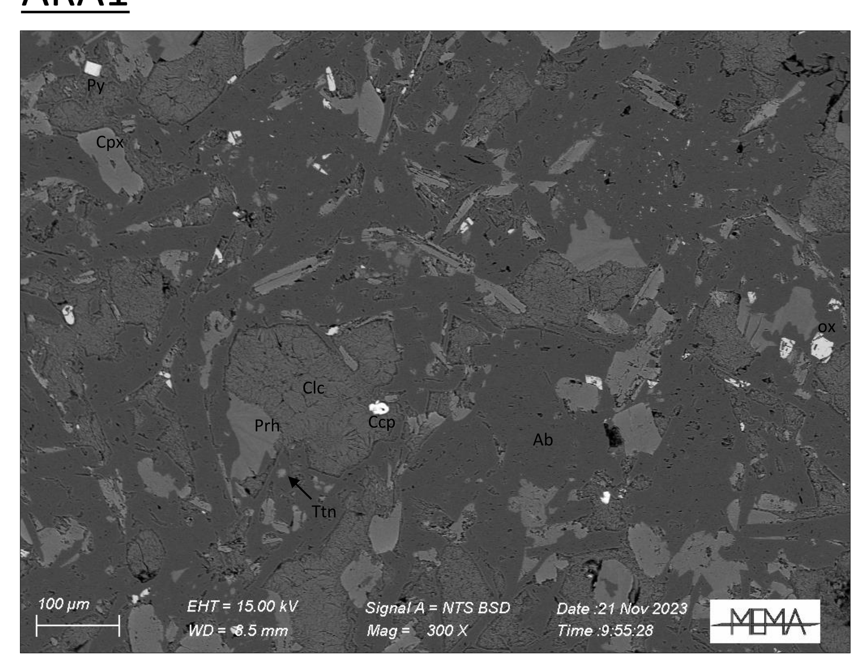


- vitrophyric texture
- glass (in wt%: $SiO_2$ 57; $TiO_2$ 0.3; $Al_2O_3$ 19; FeO 5; MgO 2; CaO; $Na_2O$ 1; $K_2O$ 0.2)
- olivine phenocrysts ($Fo_{89}$). Zoning: increase of FeO from core to rim or augitic rim ($En_{28}Wo_{51}Fs_{21}$)
- clinopyroxene phenocrysts elongated and often skeletal ($En_{48}Wo_{38}Fs_{14}$)

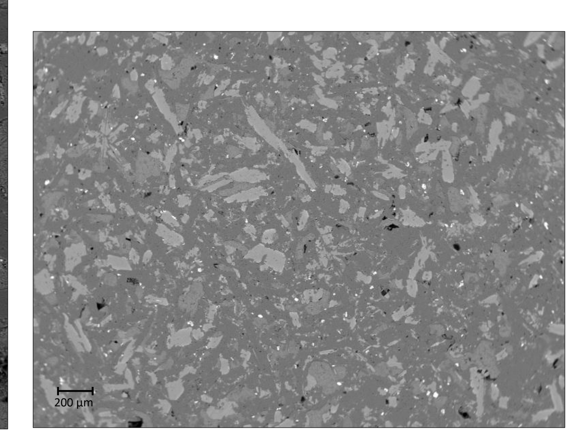


- clinopyroxene not elongated ($En_{64}Wo_{24}Fs_{12}$) Zoning: increase of CaO from core to rim
- clinopyroxene acicular microcrystals ($En_{34}Wo_{42}Fs_{24}$)
- orthopyroxene phenocrysts ($En_{82}Wo_5Fs_{13}$)
- no plagioclase crystals
- chromite
- pyrite
- minor weathering = calcite

ARA1

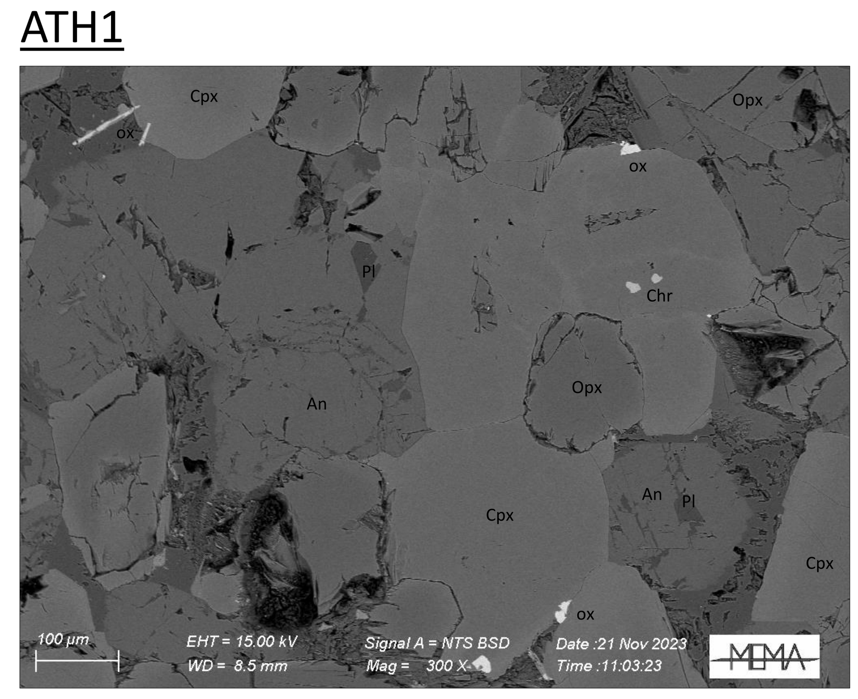


- clinopyroxene phenocrysts ($En_{47}Wo_{40}Fs_{13}$)
- albitic groundmass ($Ab_{98}An_2$)
- weathering clearly visible = clinochlore

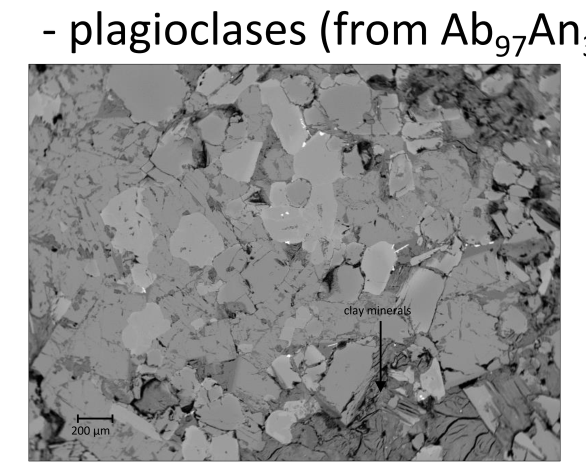


- prehnite
- titanite
- Fe-Ti oxides (ox)
- pyrite and chalcopyrite

ATH1



- holocrystalline
- clinopyroxene ($En_{48}Wo_{42}Fs_{10}$)
- orthopyroxene crystals ($En_{82}Wo_4Fs_{14}$)
- plagioclases (from $Ab_{97}An_3$ to $Ab_7An_{93}$)



- titanite
- Fe-Ti oxides (ox)
- chromite
- important weathering

## CONCLUSION

- bulk composition of boninite samples shows a good correlation with Mercury's surface, main difference: FeO content
- PAR samples present only minor weathering→ sample PAR2 has bulk composition, mineralogy and texture typical of boninites [7]
- ARA and ATH samples VNIR spectra show higher evidences of aqueous alteration, confirmed by the detection of hydrated minerals
- we have a good starting point to continue the comparison between reflectance spectra of boninites and Mercury data

## FUTURE WORK

- further investigations (**EBSD, LA-ICP-MS, UV/VNIR reflectance spectroscopy** acquired at several phase angles, **TIR emittance spectroscopy**) and study of more boninite samples from other localities are planned
- comparison between laboratory reflectance data on terrestrial samples and future **SIMBIO-SYS** and **MERTIS data**
- experimental petrology work: synthesis of analogous materials starting from natural boninites at the condition of formation expected for Mercury lavas

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