

**IECMS  
2020**

# The 2nd International Electronic Conference on Mineral Science

16–30 NOVEMBER 2020 | ONLINE



## Spectral response (VNIR-SWIR) associated to isomorphic substitutions in the octahedral sheet of the smectites.

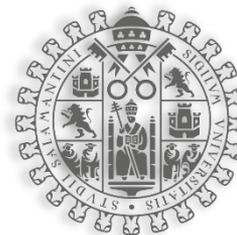
Adrián Lorenzo <sup>1\*</sup>, Andrea García <sup>1</sup>, Juan Morales <sup>1</sup>, Emilia García <sup>2-3</sup>, and Mercedes Suárez <sup>1</sup>.

<sup>1</sup> Departamento de Geología, Universidad de Salamanca. Plaza de la Merced, S/N, 37008 Salamanca

<sup>2</sup> Departamento de Mineralogía y Petrología. Universidad Complutense de Madrid. C/. José Antonio Novais. 28014 Madrid.

<sup>3</sup> Instituto de Geociencias (UCM-CSIC), 28040 Madrid.

\* Correspondence: [adrianlorenzo@usal.es](mailto:adrianlorenzo@usal.es)



**VNiVERSIDAD  
D SALAMANCA**

CAMPUS DE EXCELENCIA INTERNACIONAL

**Abstract:**

A mineralogical characterization of a group of bentonites samples was done by X-ray diffraction (XRD), chemical analysis by inductively coupled plasma mass spectroscopy (ICP-MS) and visible-near infrared and short-wave infrared spectroscopy (VNIR-SWIR). As tested by XRD, all samples are very pure, composed mainly by smectites with very small amounts of impurities like quartz and feldspar. The results of the chemical analysis show high contents of  $\text{Al}_2\text{O}_3$  in all the samples except COU(V), which has high contents of  $\text{Fe}_2\text{O}_3$ , and R4 which is a trioctahedral smectite. Within VNIR-SWIR spectra, absorption features characteristics of the smectites due to the presence of Fe are observed at lowest wavenumber, while at the SWIR region the absorptions are related to the M-OH bonds, and there are differences among the samples according to their octahedral content.

**Keywords:**

dioctahedral smectites; trioctahedral smectites; Fe-rich smectite; XRD; VNIR-SWIR spectroscopy.

# Materials and Methods

## Materials

Samples	Localization
APA	Arizona, USA (Clay Repository)
COU(V)	Washington, USA (Clay Repository)
PUT	Putifigari, Italy
R4	Esquivias, Spain
SAN	Arizona, USA (Clay Repository)
SUD	Cabo de Gata, Spain
CGA	Cabo de Gata, Spain

## Methods

Mineralogical characterization

Chemical characterization

X-Ray diffraction

VNIR-SWIR spectroscopy

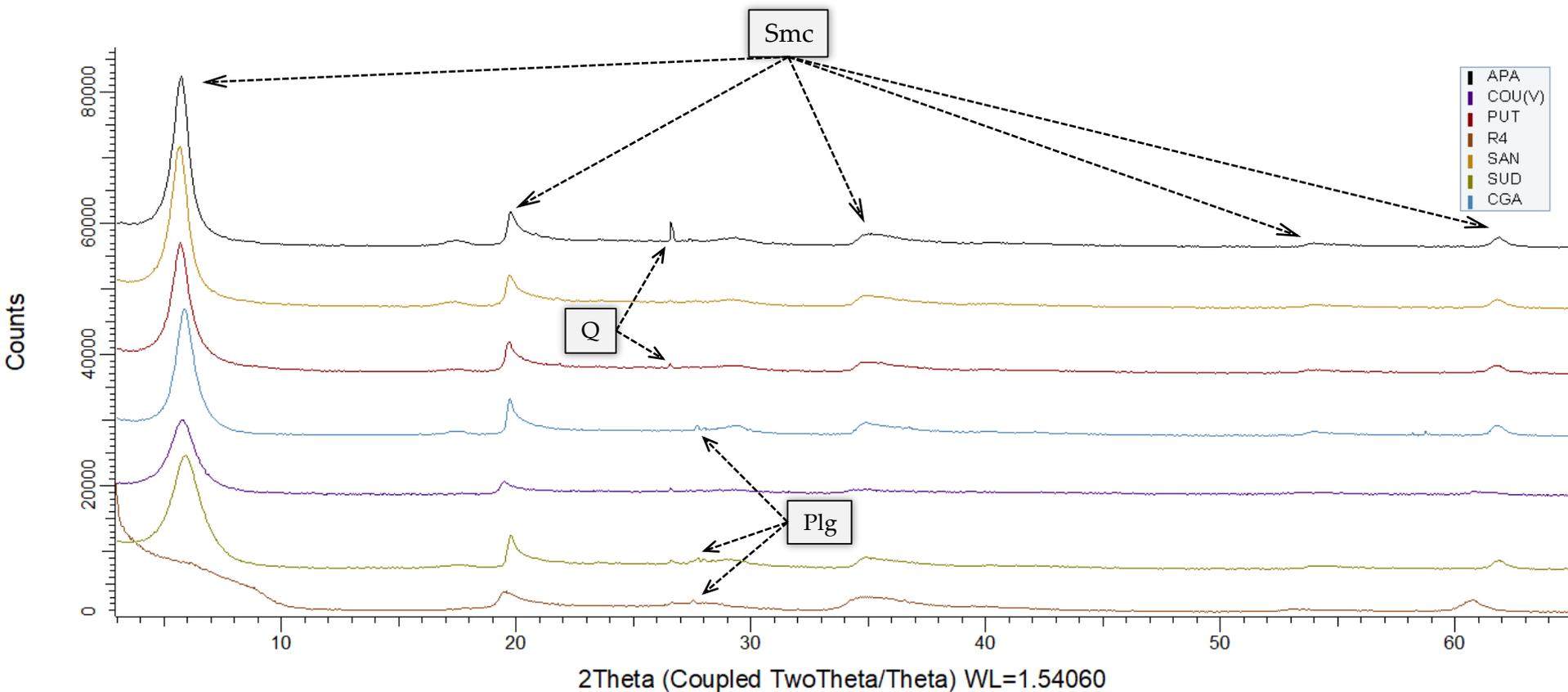
Chemical analysis by FUS-ICP

Bruker D8  
Advance ECO

ASD FieldSpec 4  
Standard-Res

# Results and Discussion

## X-Ray diffraction

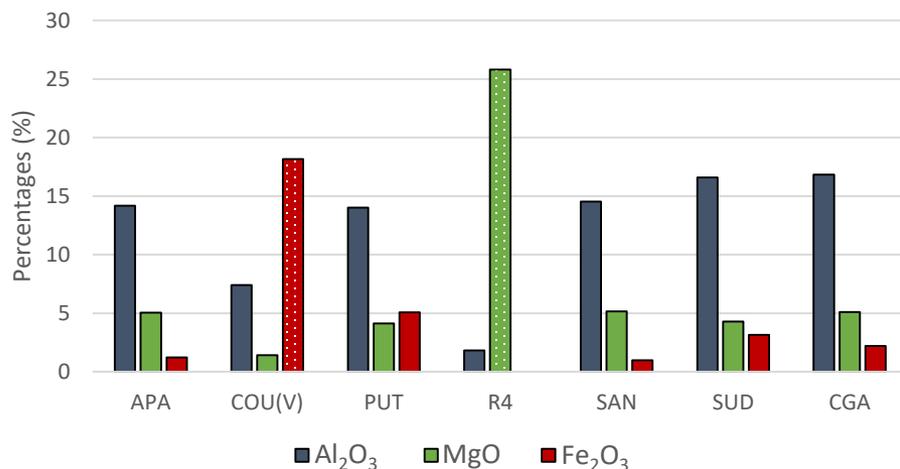


# Results and Discussion

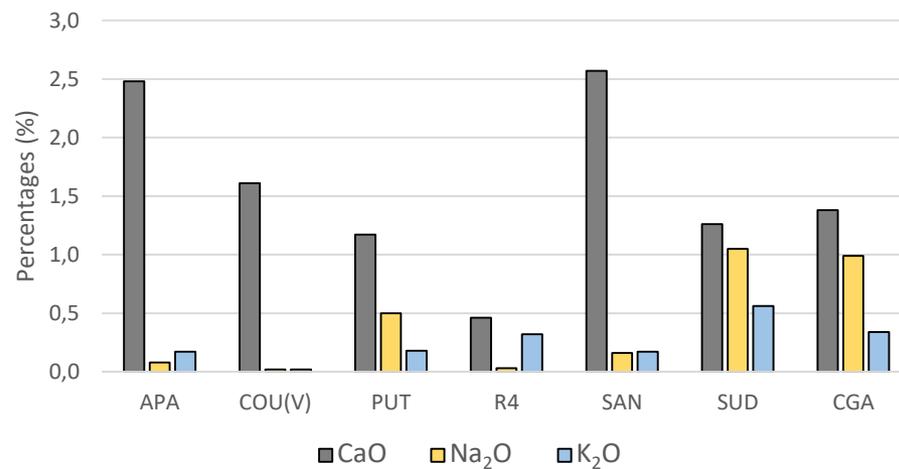
## Chemical analysis

	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	FeO	Fe <sub>2</sub> O <sub>3</sub>
APA	51.95	14.18	0,08	5.04	2.48	0.08	0.17	0.00	1.23
COU(V)	49.90	7.41	0.02	1.41	1.61	0.02	0.02	0.50	18.17
PUT	50.52	14.02	0.07	4.11	1.17	0.50	0.18	0.00	5.06
R4	52.91	1.83	0.01	25.81	0.46	0.03	0.32	1.00	0.00
SAN	53.71	14.52	0.09	5.16	2.57	0.16	0.17	0.40	0.98
SUD	53.82	16.60	0.02	4.27	1.26	1.05	0.56	0.40	3.15
CGA	53.03	16.82	0.06	5.10	1.38	0.99	0.34	0.20	2.20

Octaedral cations



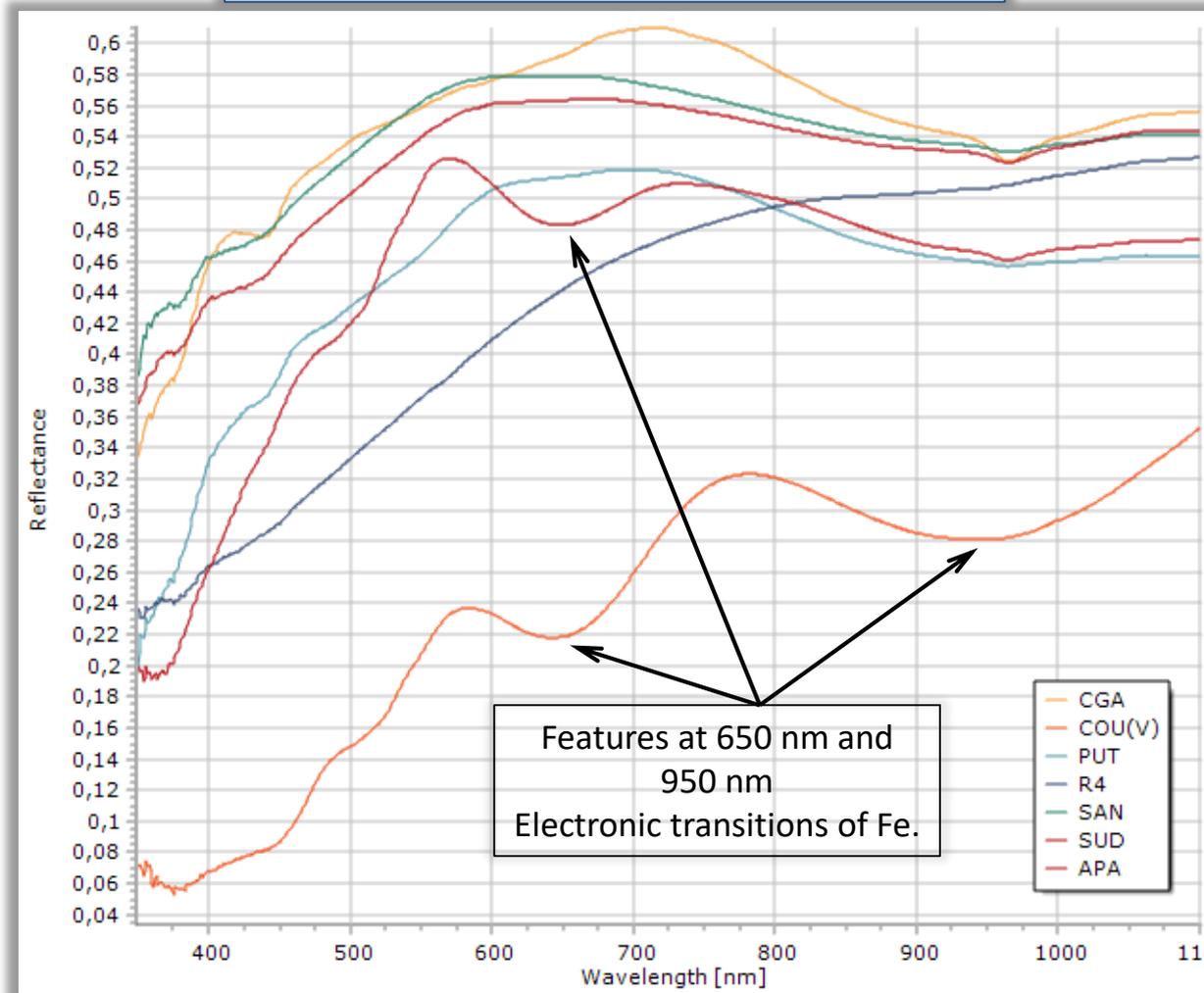
Interlaminar cations



# Results and Discussion

## VNIR-SWIR spectroscopy

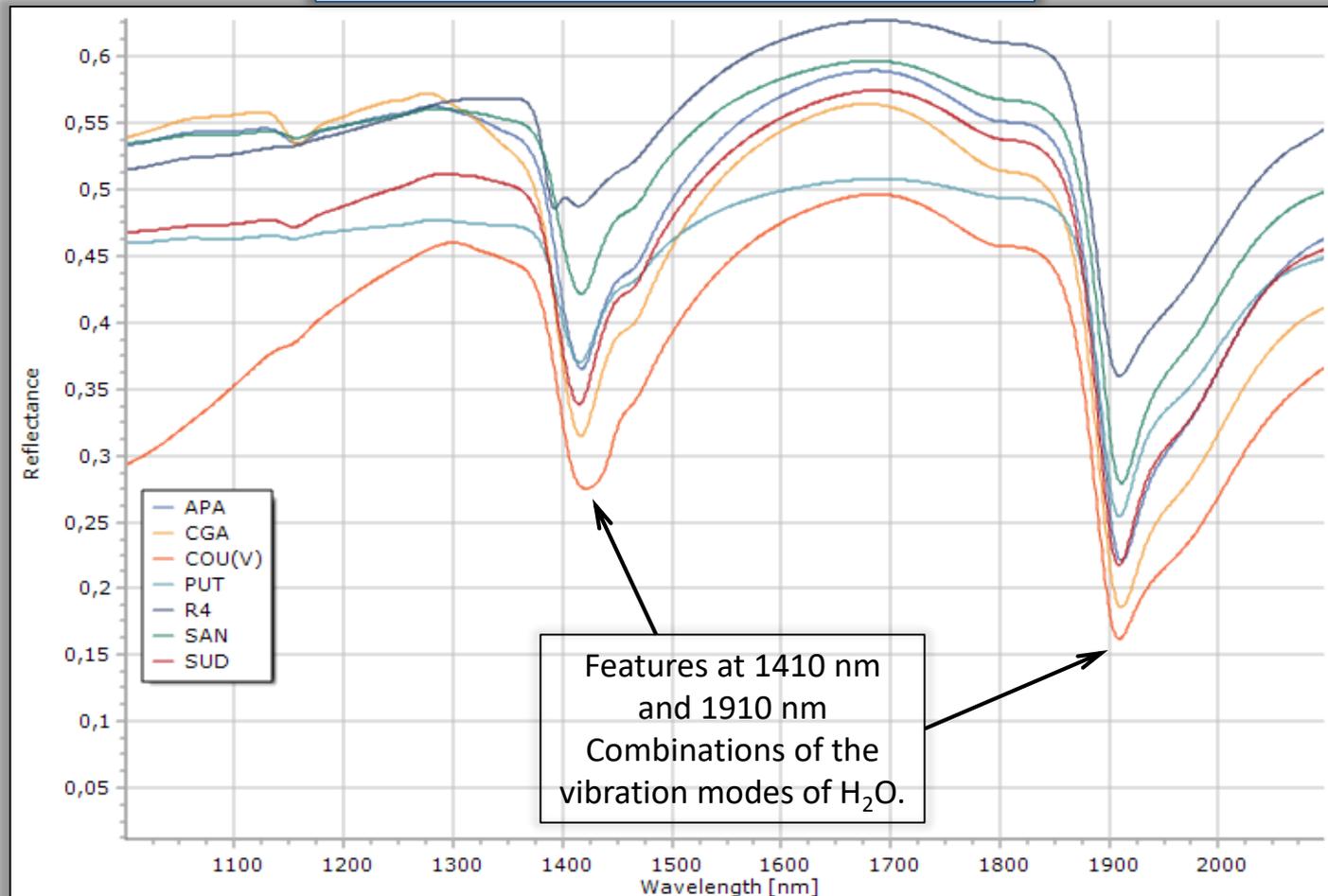
Visible and near wavelength range



# Results and Discussion

## VNIR-SWIR spectroscopy

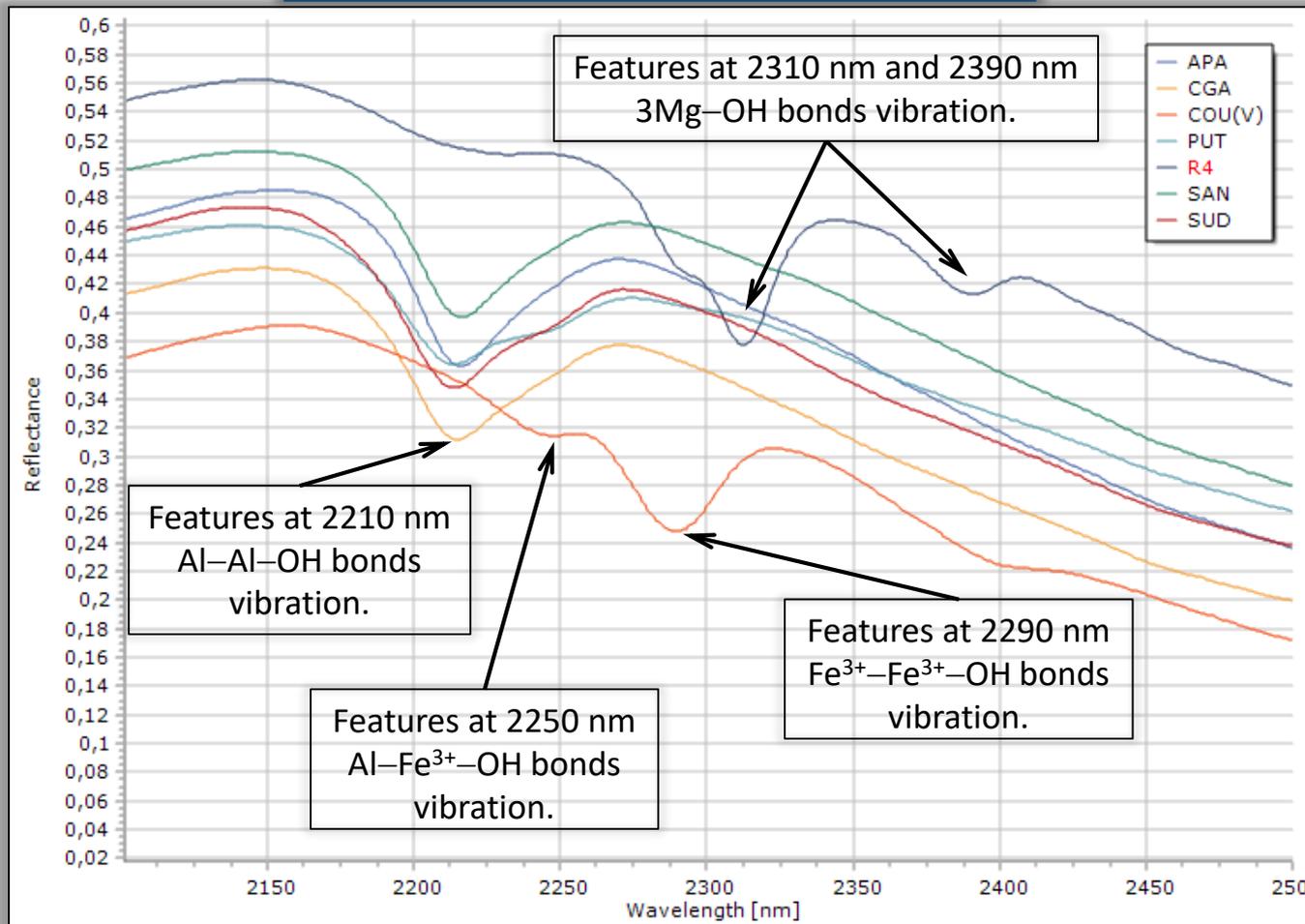
Short-wave zone of the spectra (I)



# Results and Discussion

## VNIR-SWIR spectroscopy

### Short-wave zone of the spectra (II)



# Conclusions

1. The samples present clear and discriminatory absorption bands related to the octahedral content of the smectites:
  - a) Dioctahedral Al-rich smectites are characterized by the absorption at 2210 nm
  - b) Fe-rich dioctahedral smectites present the most intense absorption at 2290 nm.
  - c) The presence of dioctahedral Al-Fe<sup>3+</sup>-OH bonds causes an adsorption located at 2250 nm.
2. Trioctahedral 3Mg-OH bonds produce significant absorption bands located at ~ 2310 nm and ~ 2390 nm.
3. These discriminatory absorptions allow to identify the smectite type by means of the field spectroscopy.

# Acknowledgments



VNiVERSIDAD  
D SALAMANCA

CAMPUS DE EXCELENCIA INTERNACIONAL

IECMS  
2020