I JORNADAS DE DIFUSION DE LOS CENTROS
DE APOYO A LA INVESTIGACION UCM
24/10/2016

Investigación aplicada en Ciencias de la Tierra: Técnicas y tecnologías de interés

María Josefa Herrero Fernández
Dpto. de Petrología y Geoquímica
Facultad de Ciencias Geológicas, UCM

NOT CROSS CRIME SCENE - DO NOT CROSS CRIME SC

Concreciones en edificio de San Sebastian

Análisis de Actividad de Fallas

2

3

Trabajo de Campo

Del Clima del Pasado al Clima del Futuro

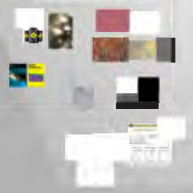
Análisis de Laboratorio

Y una vez resuelto el misterio...

4

ATC:
Almacén Temporal Centralizado de Residuos Nucleares

Exploracion de hidrocarburos



1

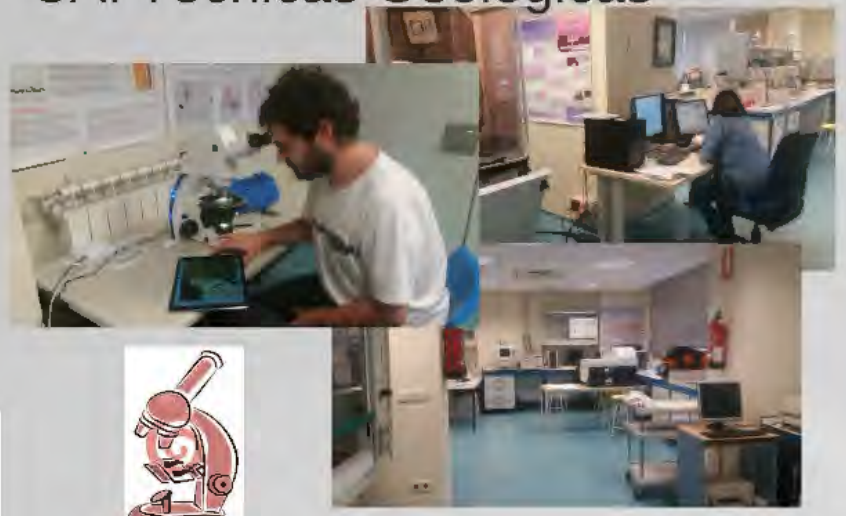

CSI:
CRIME SCENE INVESTIGATION

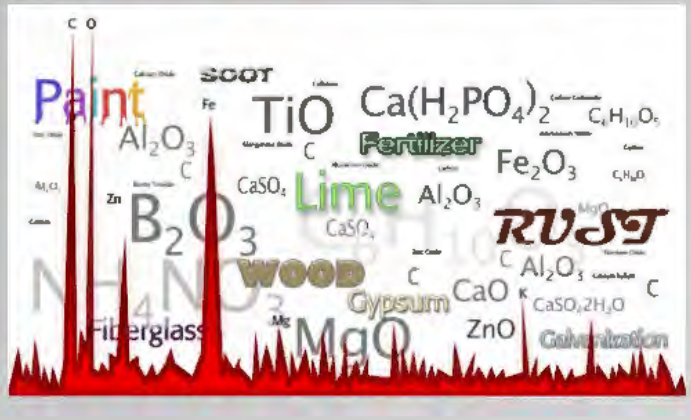

CRIME SCENE DO NOT CROSS

Trabajo de Campo

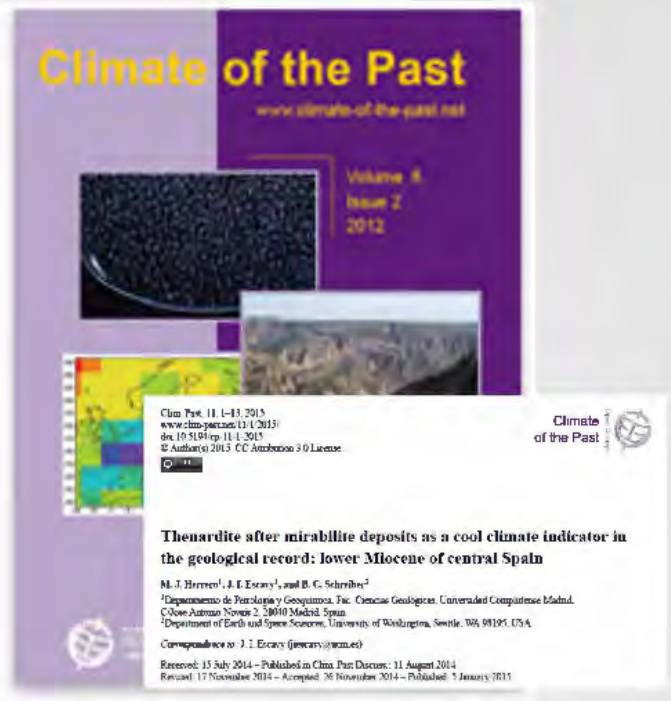
Análisis de Laboratorio

CAI Técnicas Geológicas

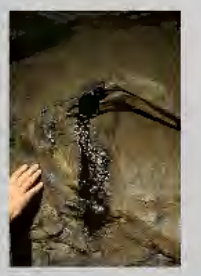


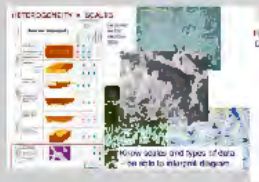


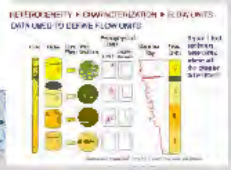
Y una vez resuelto el misterio...

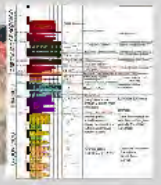


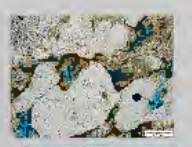
Exploración de hidrocarburos

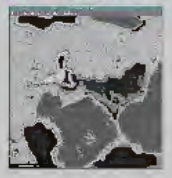


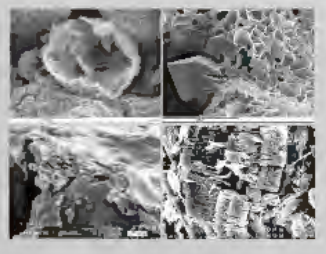


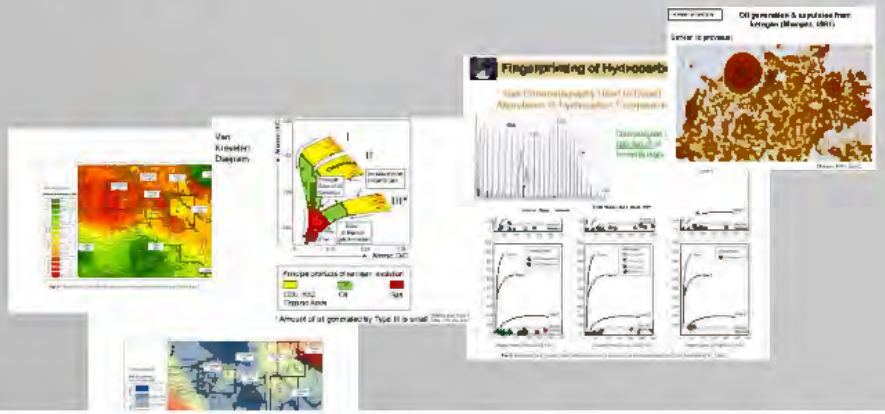


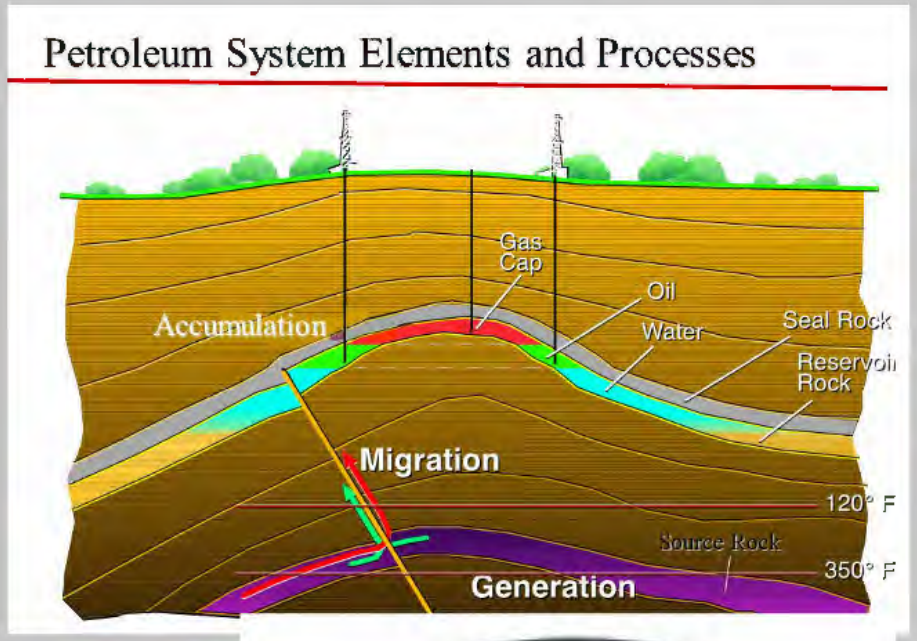




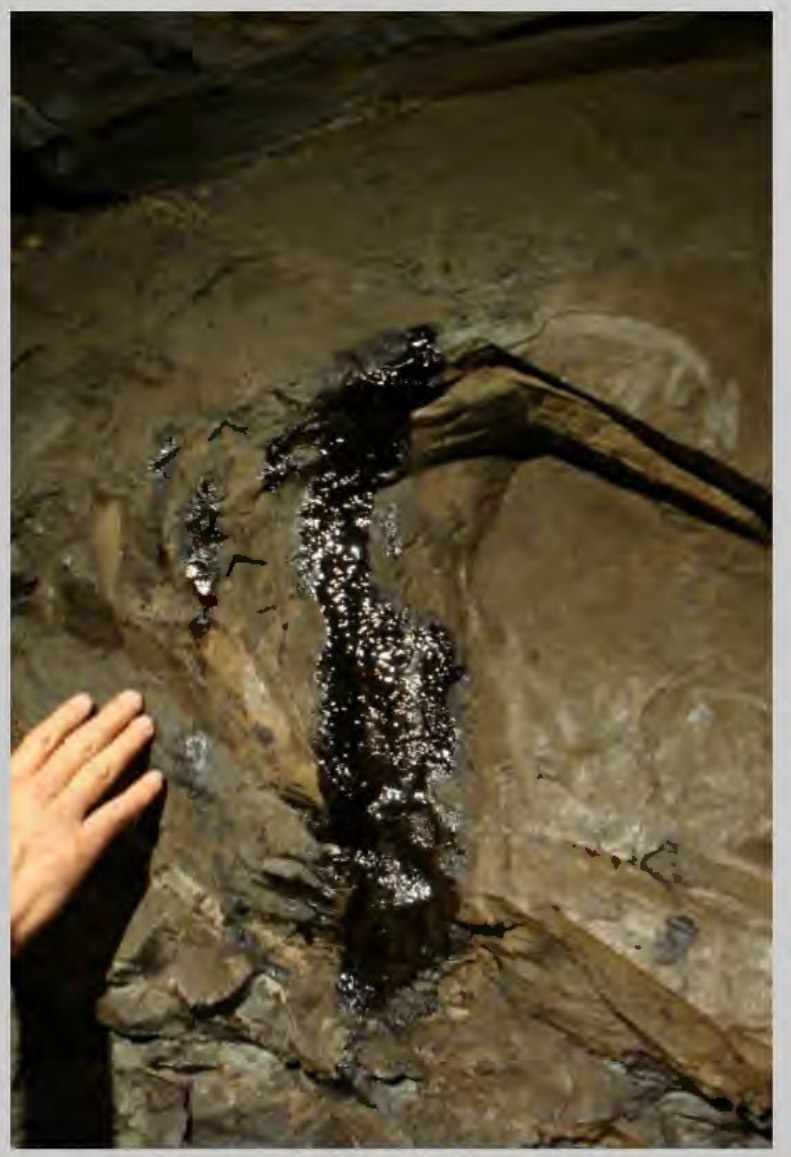




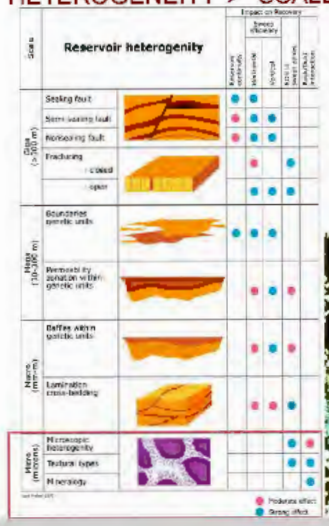



Petroleum System Elements and Processes
Gas Cap
Oil
Accumulation
Water
Seal Rock
Reservoir Rock
Migration
120° F
Source Rock
350° F
Generation


OIL
OIL
OIL



HETEROGENEITY ➤ SCALES

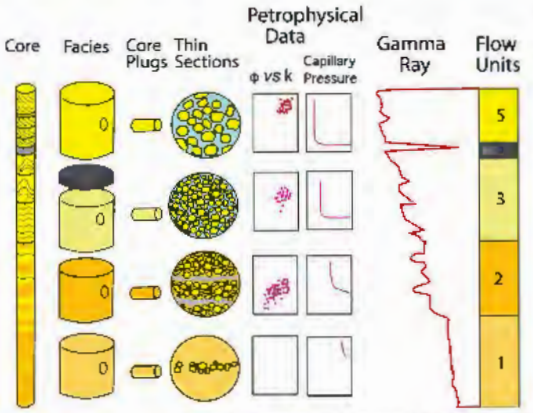


Data such as thin sections, SEM

Know scales and types of data – be able to interpret diagram

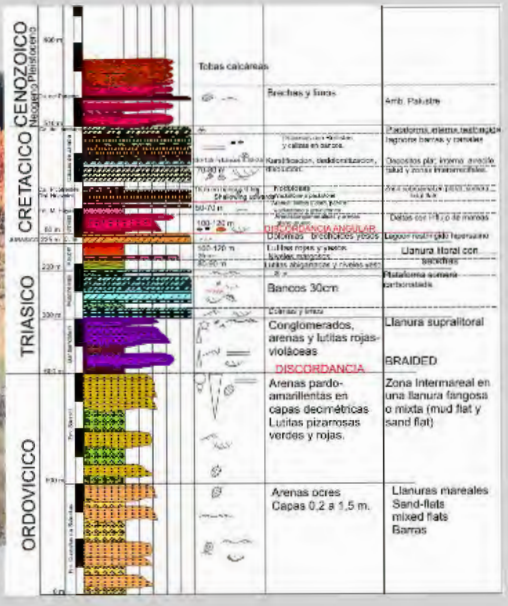
HETEROGENEITY ➤ CHARACTERIZATION ➤ FLOW UNITS

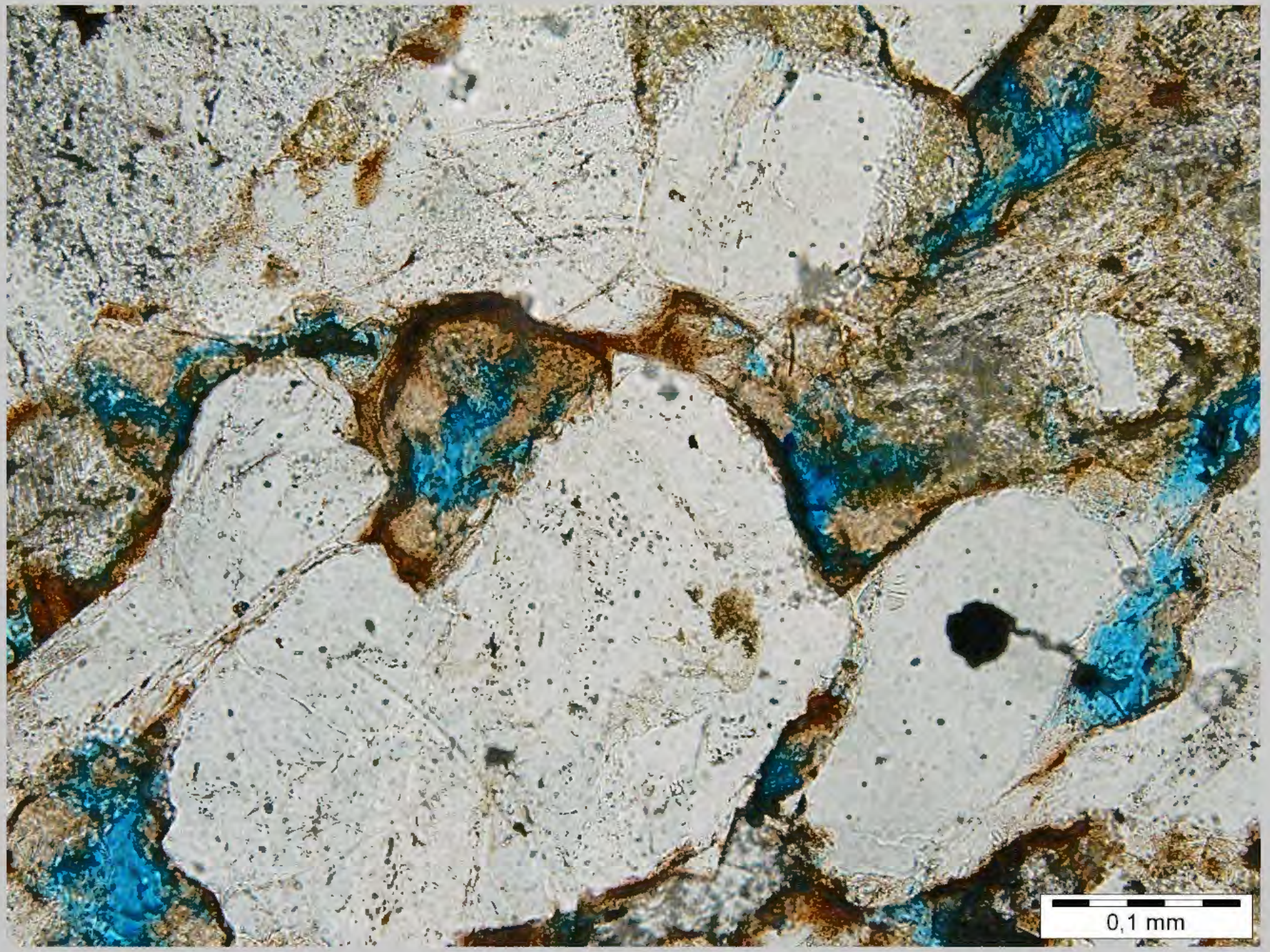
DATA USED TO DEFINE FLOW UNITS

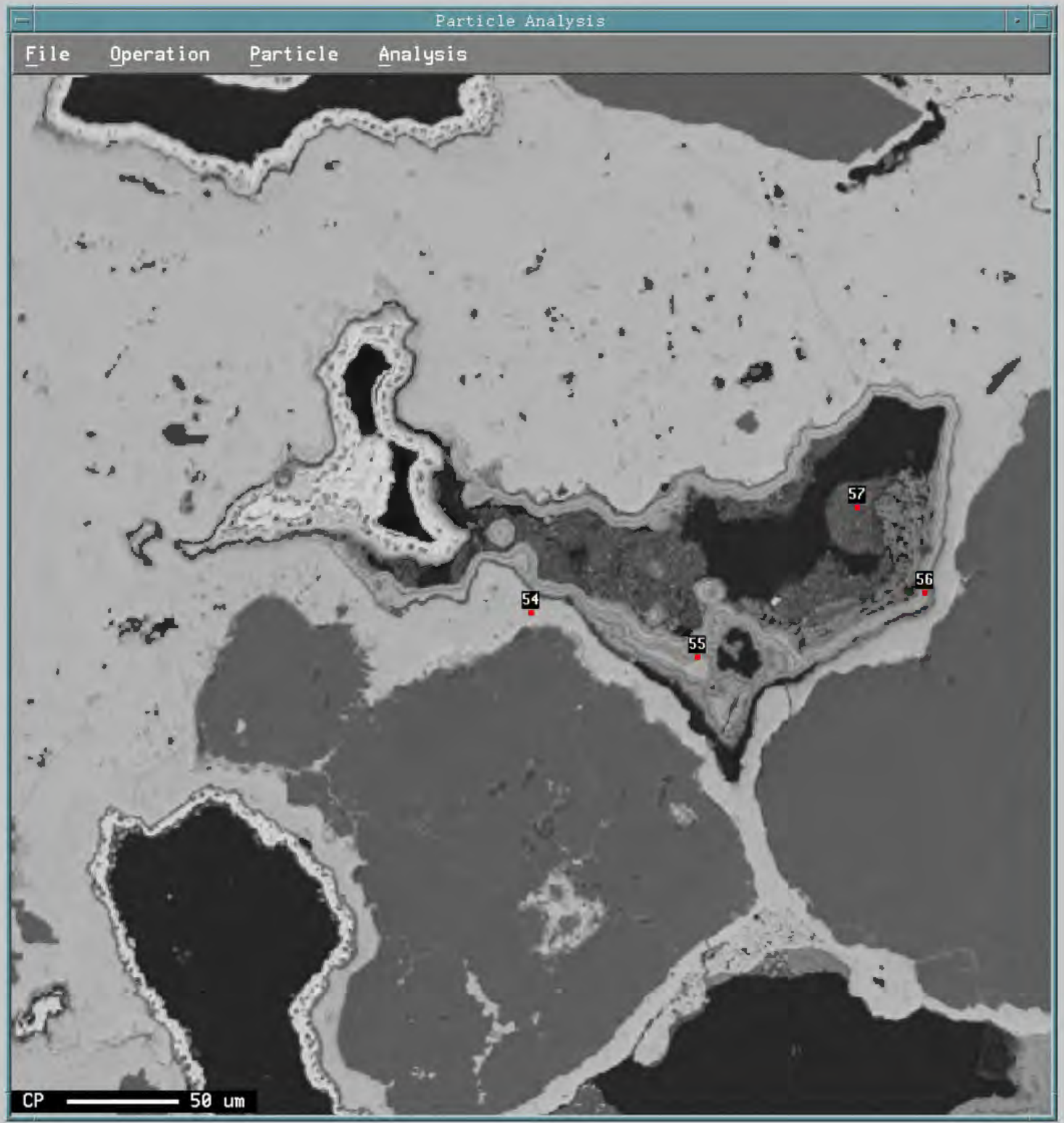


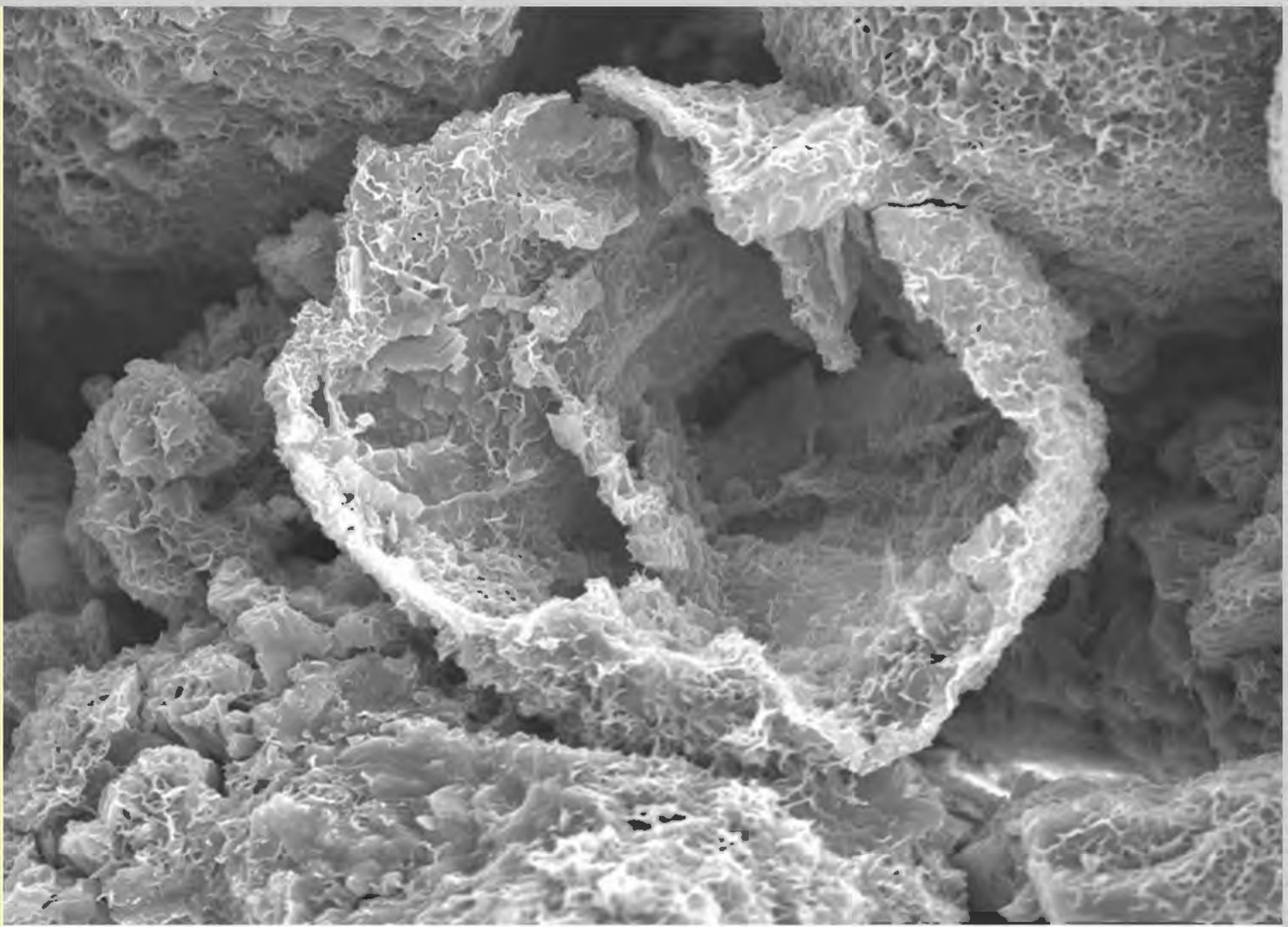
Modified from Ebanks et al. 1992, Fig 1, AAPG Dev. Geol. Rpt. Manual

If your 1 foot section is heterolithic, where will the plug be taken from?

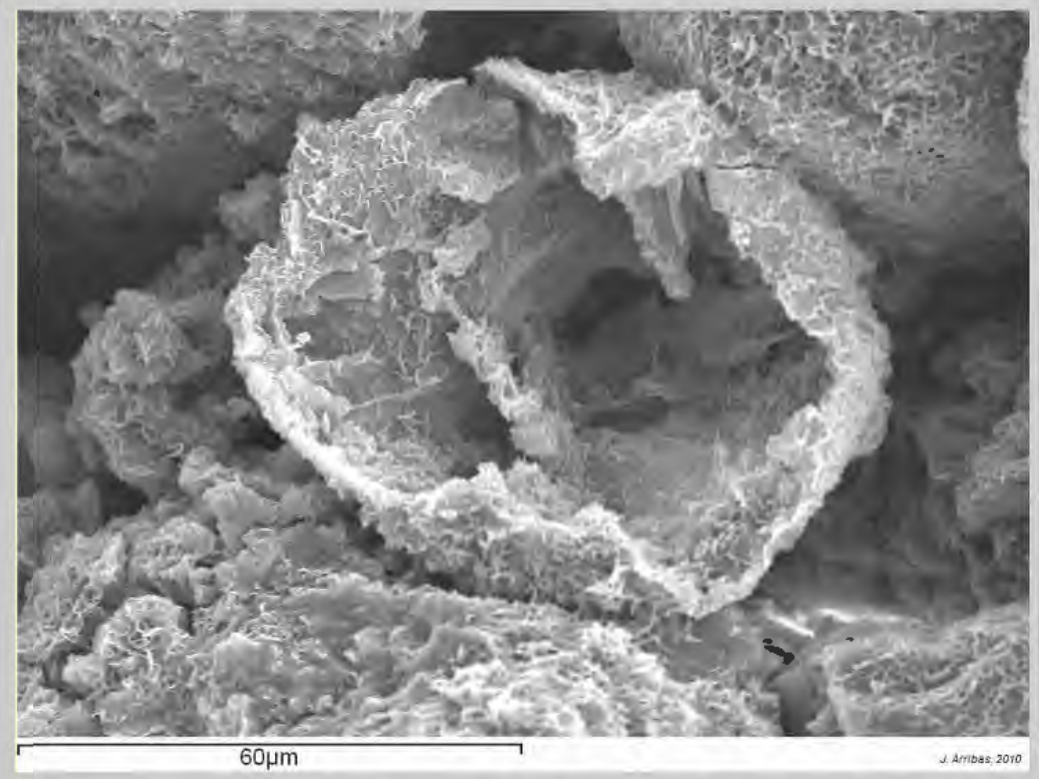


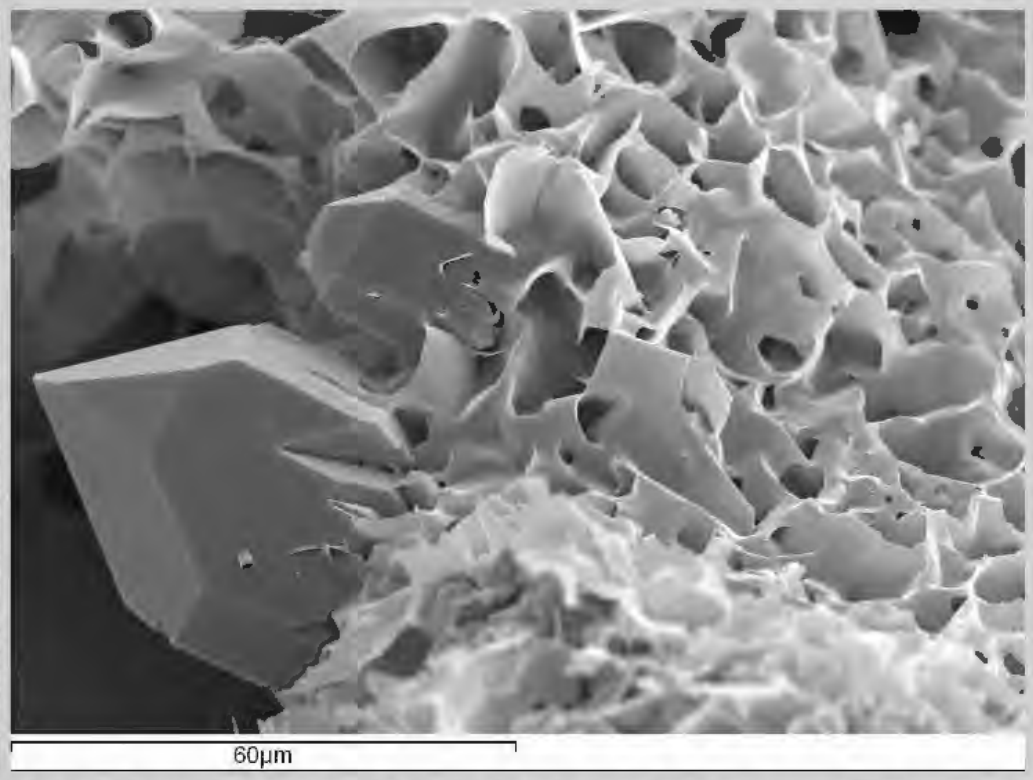

0,1 mm

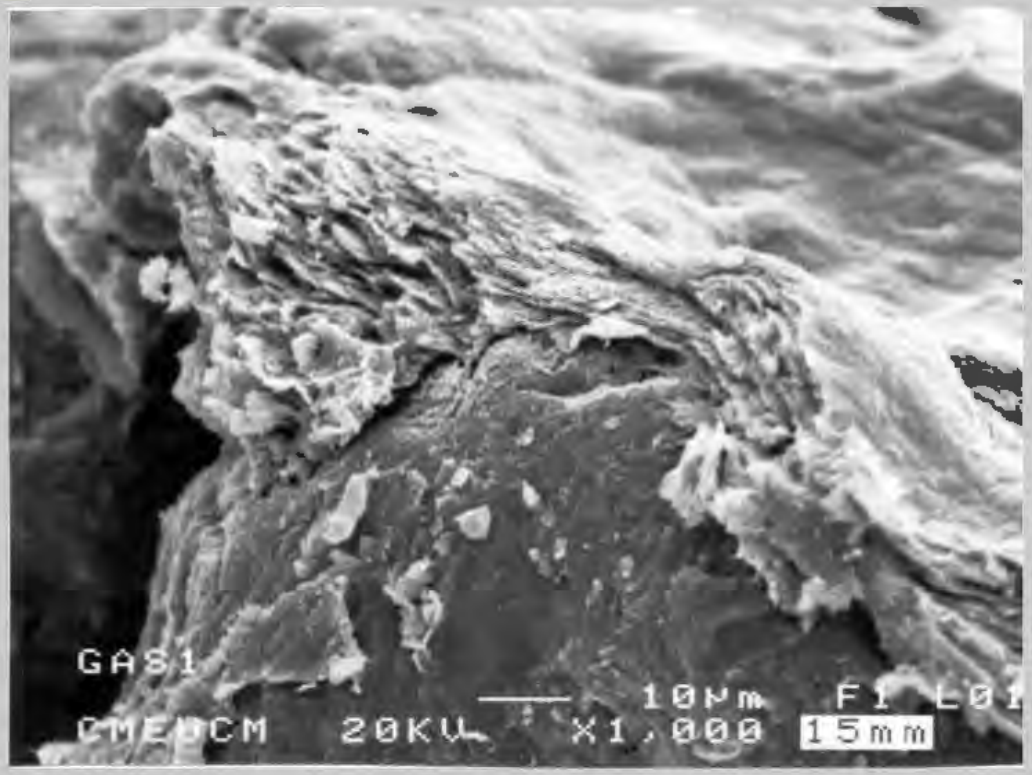

Particle Analysis
File
Operation
Particle
Analysis
57
56
54
55
CP
50 um

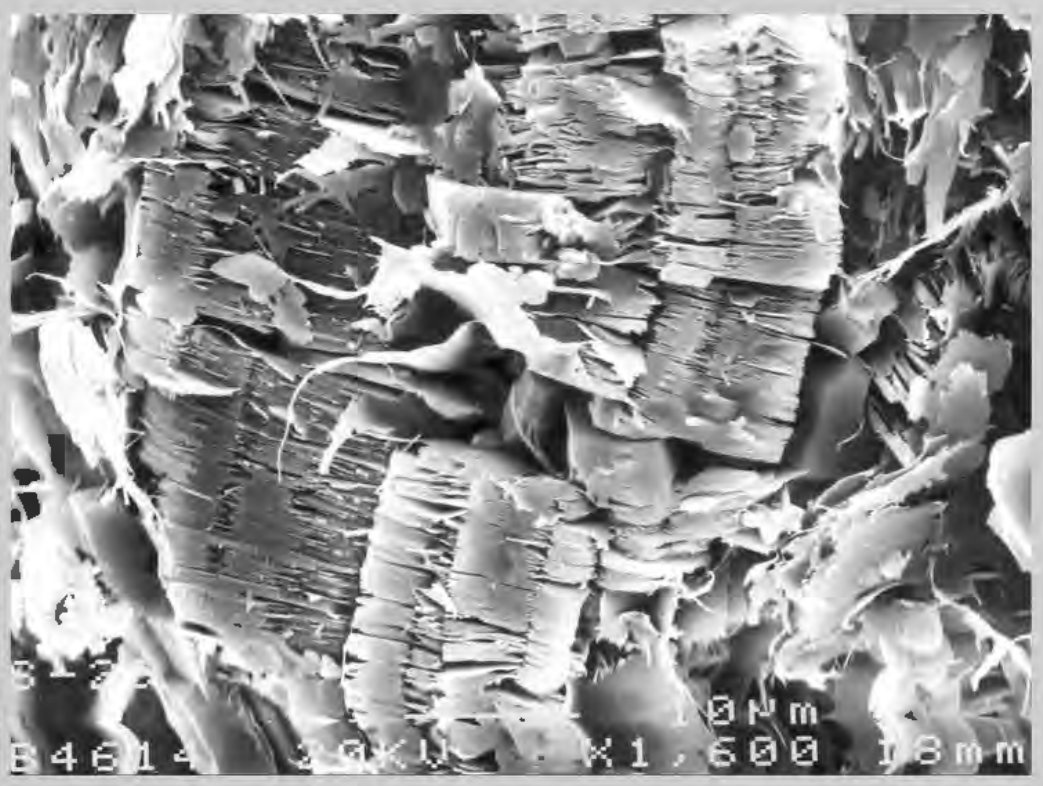


J. Arribas, 2010


60µm
J. Arribas, 2010


60µm

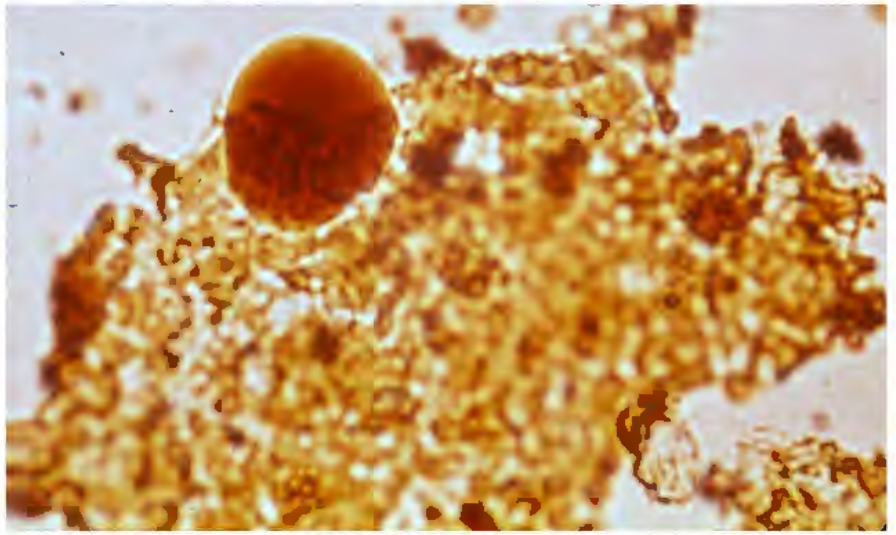

GAS1
10µm
X1,000
15mm


X1,600

PRIMARY MIGRATION

Oil generation & expulsion from kerogen (Momper, 1981)

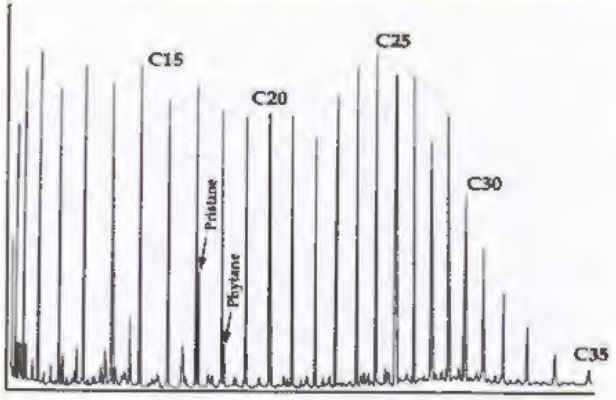
Similar to previous;



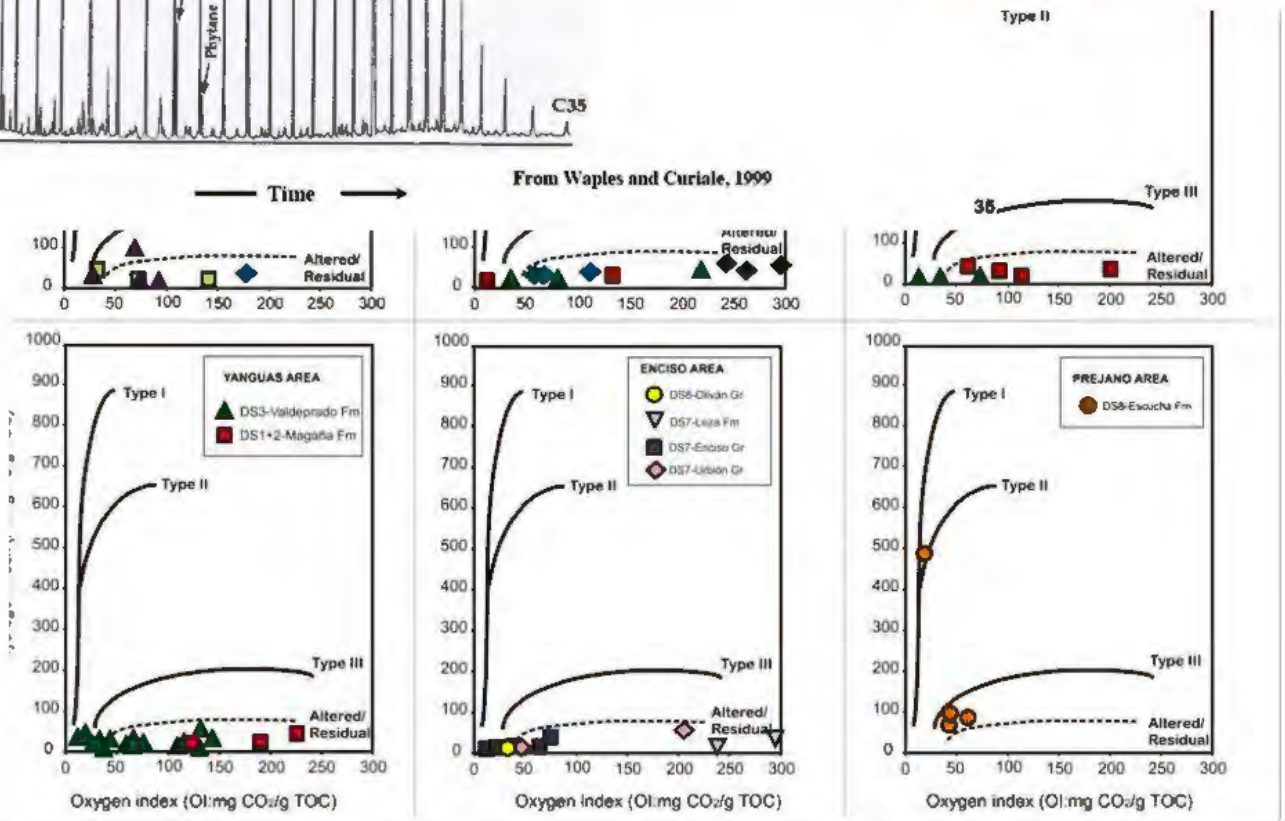
Momper, 1981, fig. 42

Fingerprinting of Hydrocarb

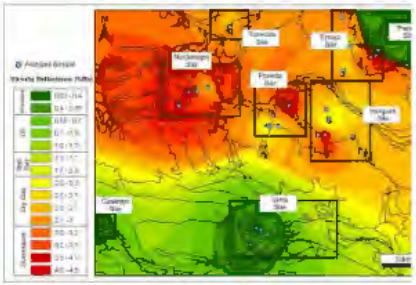
Gas Chromatography Used to Detect Abundance of Hydrocarbon Compounds



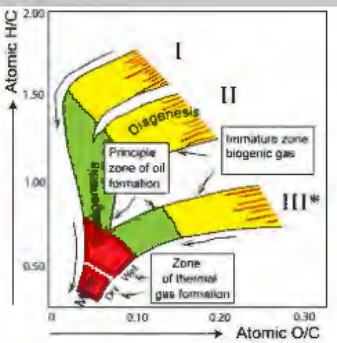
Chromatogram c
high-wax oil of
terrestrial origin



d from Tissot &
978, Fig. II.6.2



Van Krevelen Diagram



Principle products of kerogen evolution

CO_2, H_2O, Organic Acids	Oil	Gas

* Amount of oil generated by Type III is small

Modified from Tissot & Welte, 1978, Fig. II-6-2

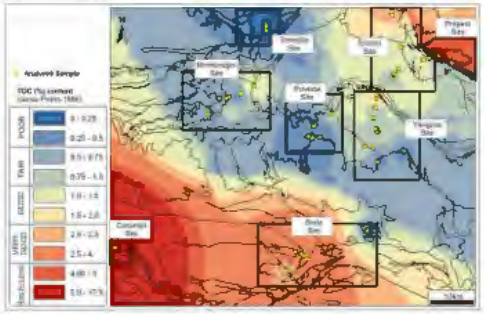
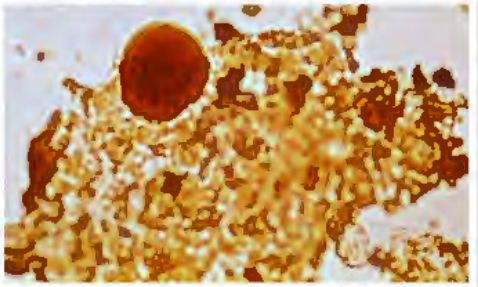


Fig.3 - Interpolation of the TOC index values (%) recorded in the pyrolysis Rock-eval analysis in the studied area

PRIMARY MIGRATION

Oil generation & expulsion from kerogen (Momper, 1981)

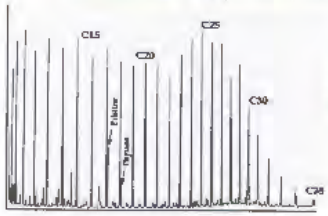
Similar to previous;



Momper, 1981, fig. 42

Fingerprinting of Hydrocarb

Gas Chromatography Used to Detect Abundance of Hydrocarbon Compounds



Chromatogram o
high-wax oil of
terrestrial origin

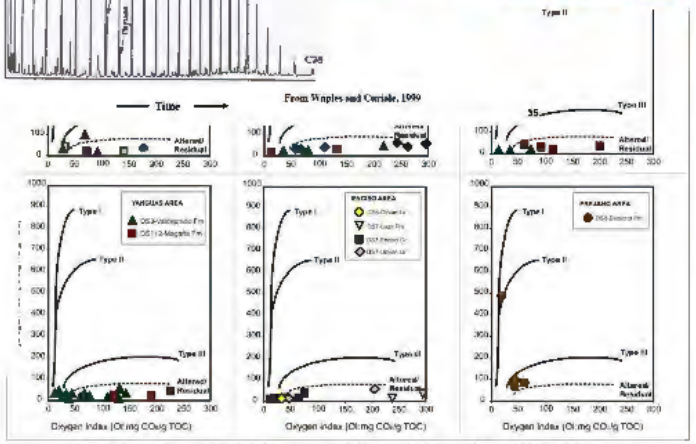
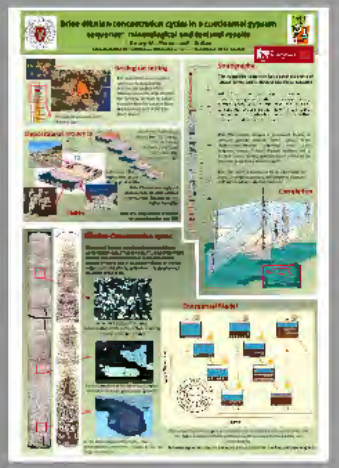


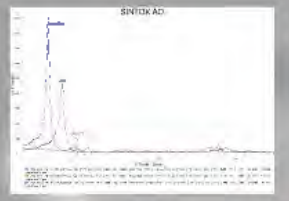
Fig.6- Hydrogen and oxygen index data plotted on a pseudo-Van Krevelen diagram (from Espitalie et al., 1986)

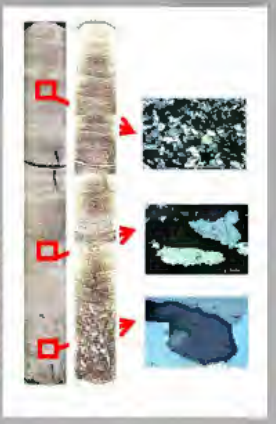

MARINE AND
PETROLEUM
GEOLOGY

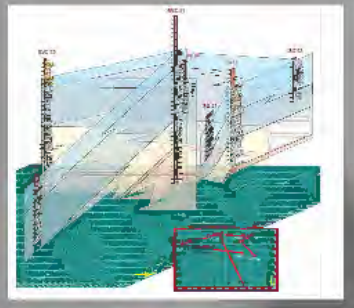

Basin
Research

ATC
Almacén Temporal Centralizado de Residuos Nucleares

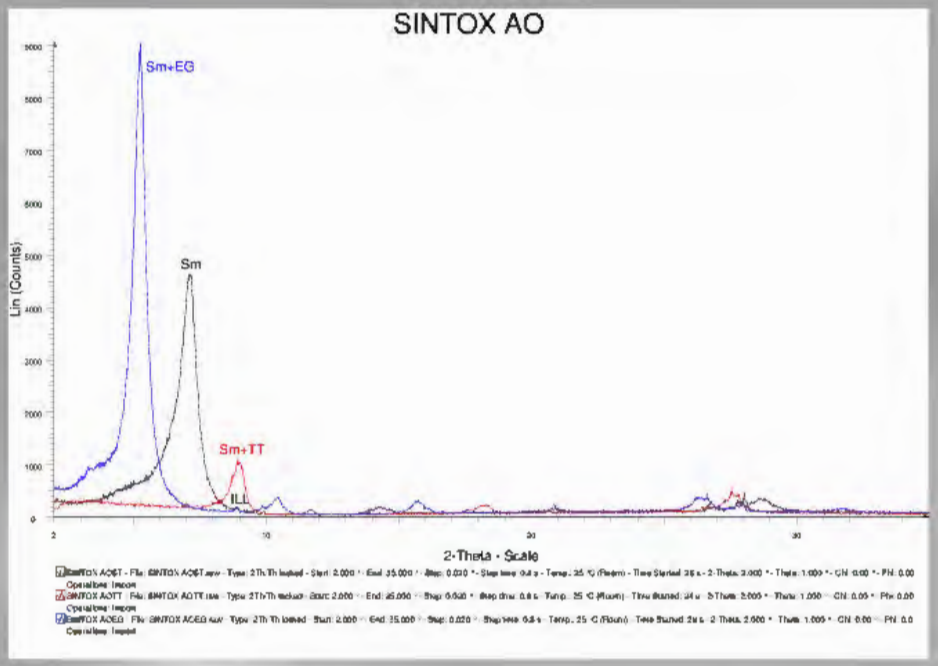


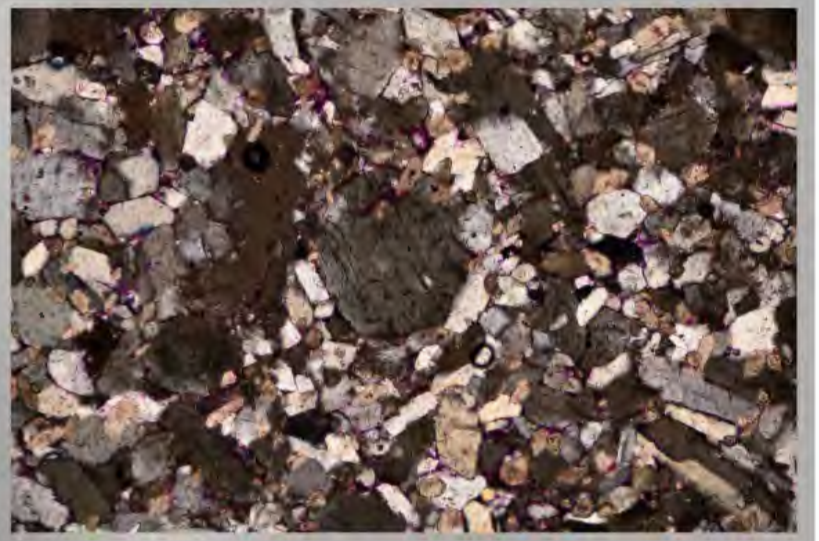


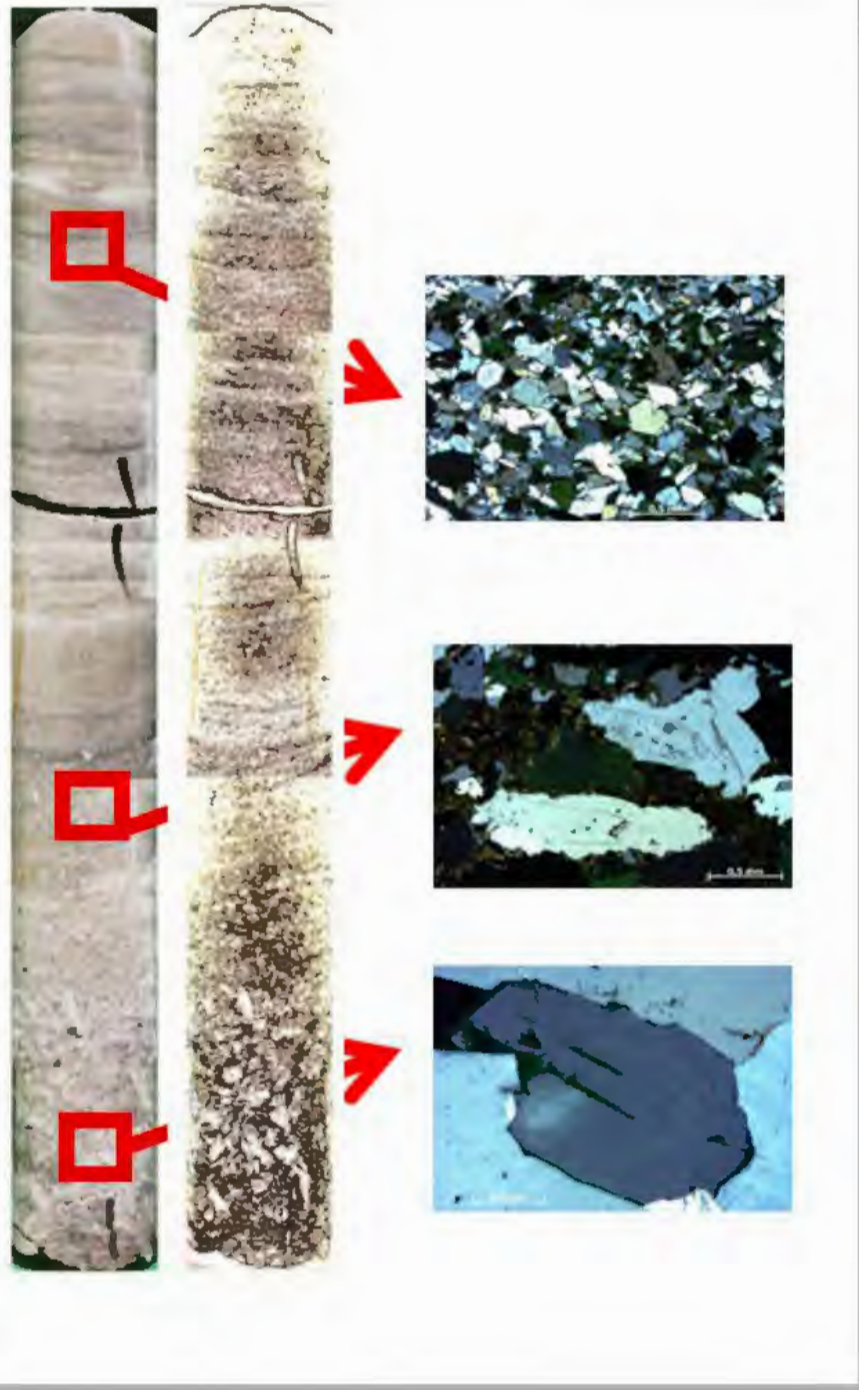





Profundidad de 3'00 Mts. A 6'00 Mts. Caja N° 2
3'00
6'00


SINTOX AO
Sm+EG
Sm
Sm+TT
ILL
Lin (Counts)
2-Theta - Scale



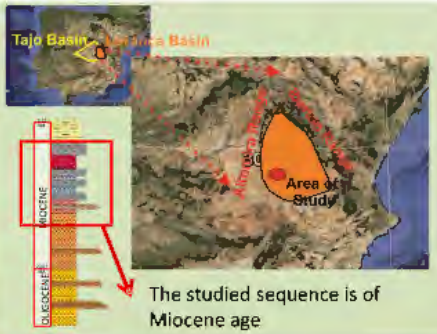


Brine dilution-concentration cycles in a continental gypsum sequence: mineralogical and textural results

J. Escavy, M.J. Herrero and J. Arribas
Departamento de Petrología y Geoquímica, Fac. CC. Geológicas, UCM. Madrid

IMS2015
KRAKOW, POLAND
22-25 JUNE 2015

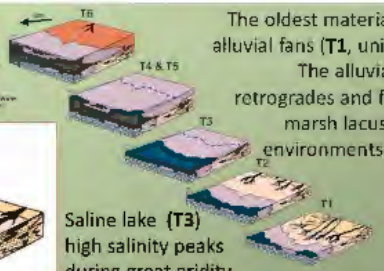
Geological setting



The studied sequence is of Miocene age

The research herein presented concerns the depositional systems and cyclicity of the Miocene evaporite units found in the "Sinclinal de Villar de Cañas", located within the Loranca Basin (westernmost part of the Tajo Basin, Spain).

Depositional sequence



The oldest material are alluvial fans (**T1**, unit UI). The alluvial fan retrogrades and forms marsh lacustrine environments (**T2**).

Saline lake (**T3**) high salinity peaks during great aridity.

T4 to T5 formed by cycles of dilution-concentration within a perennial lake. Towards the top higher humidity.

Final new progradation of alluvial fan deposits in this area (**T6**)

Facies

Dilution-Concentration cycles

The textural features permit to characterize dilution-concentration cycles that compose the evaporitic middle subunit. The characterization of these cycles in the geological record appear as a good indicator of shallow water depth and climate control over the geochemical character of the brine.

Stratigraphy

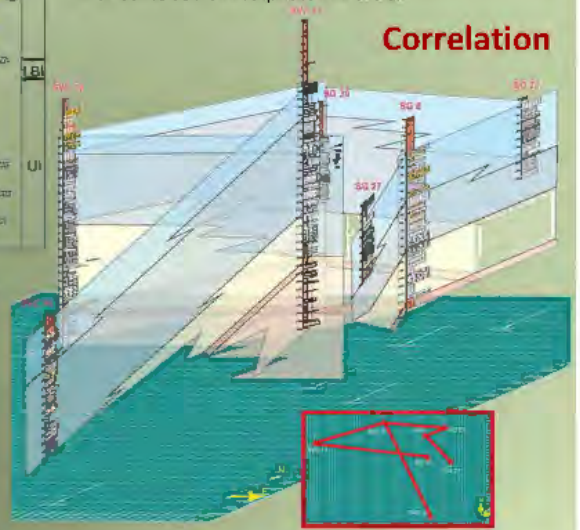
The evaporitic sequence has a total thickness of about 120 m and is divided into three subunits

YB3: The uppermost evaporitic subunit is characterized by an alternation of shale and primary gypsum beds, and in this case the dilution-concentration cycles start with the entrance into the basin of detritic materials transported by water that produced the dilution of the brine.

YB2: The second subunit is composed mainly of primary gypsum deposits where several brine dilution-concentration sequences occur. Each sequence reveals a basal dilution surface and a marked crystal finning upwards trend produced by the brine progressive concentration.

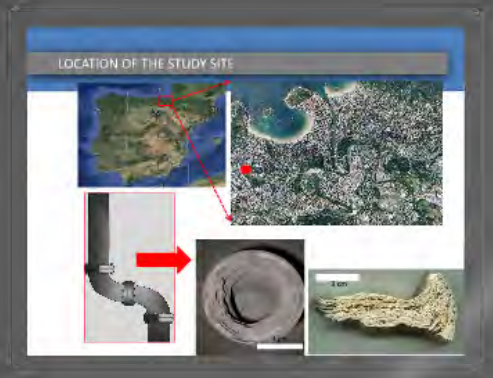
YB1: The lower is composed by an alternation of shales, secondary gypsum, and anhydrite deposits with some sodium sulphate minerals.

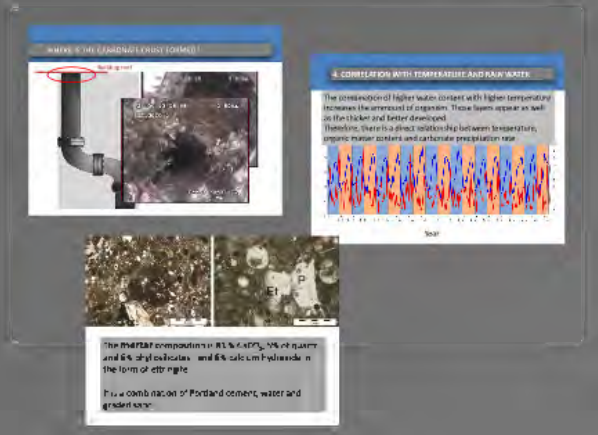
Correlation

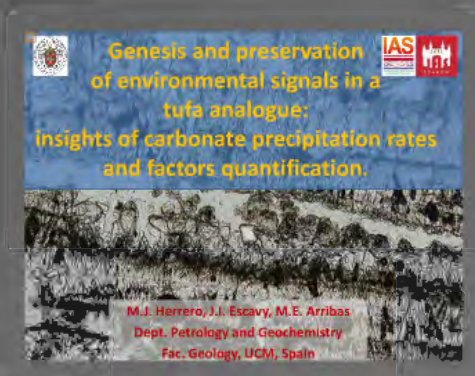


Conceptual Model

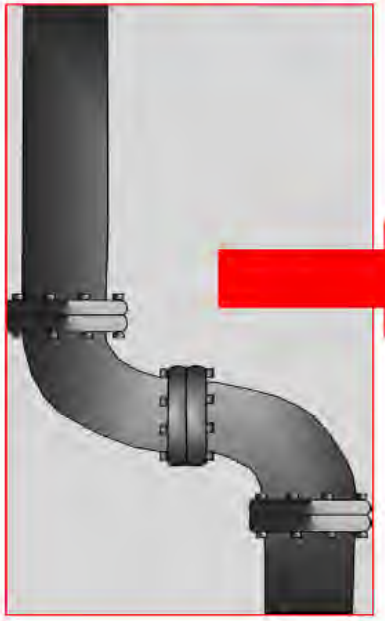
Concreciones en edificio de San Sebastian

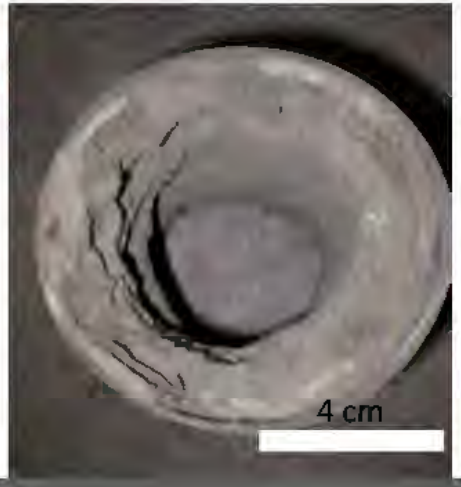


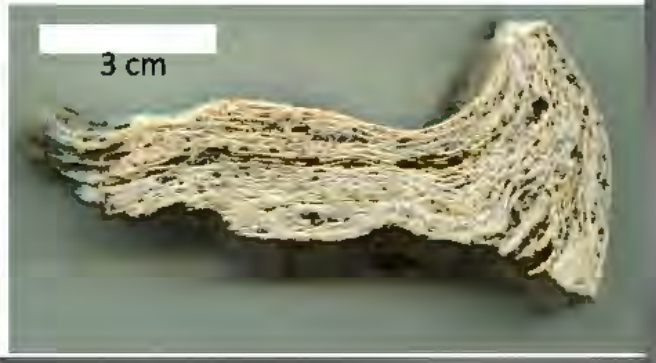


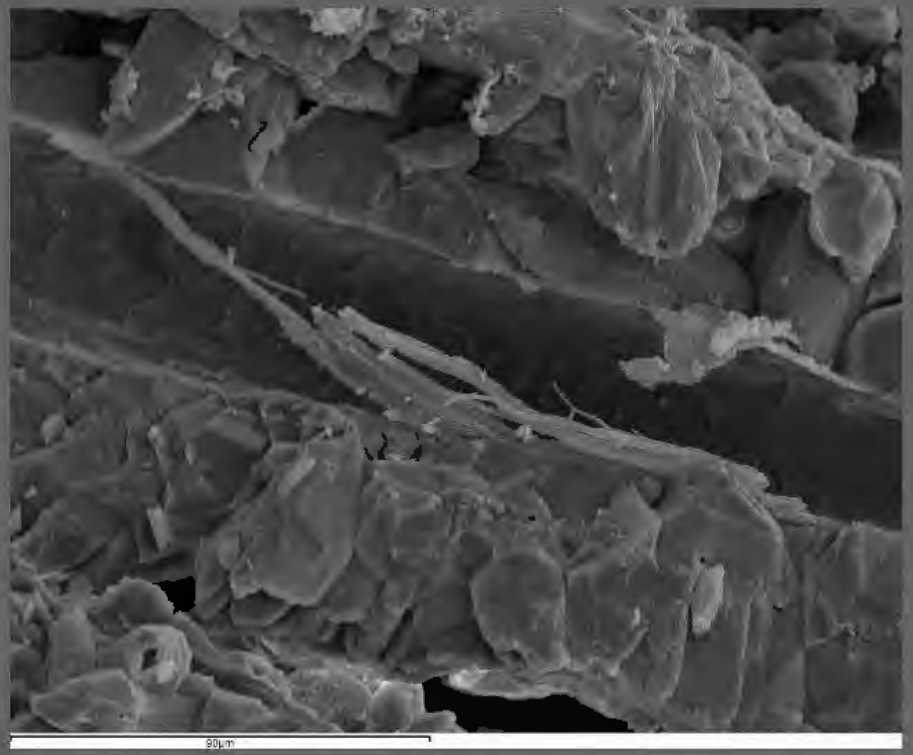


LOCATION OF THE STUDY SITE

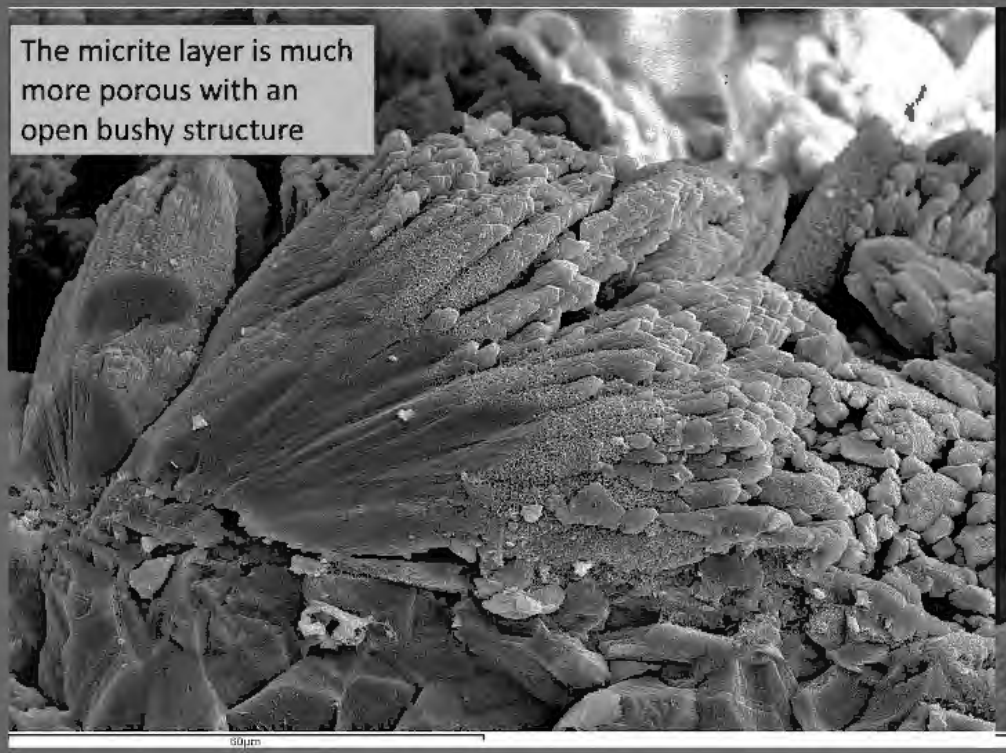







90µm


50µm

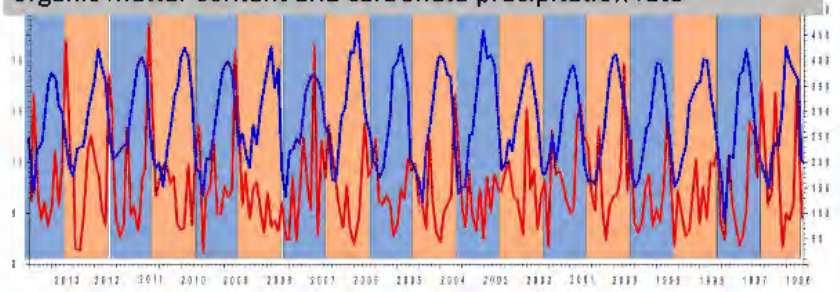

The micrite layer is much more porous with an open bushy structure
50µm


10µm

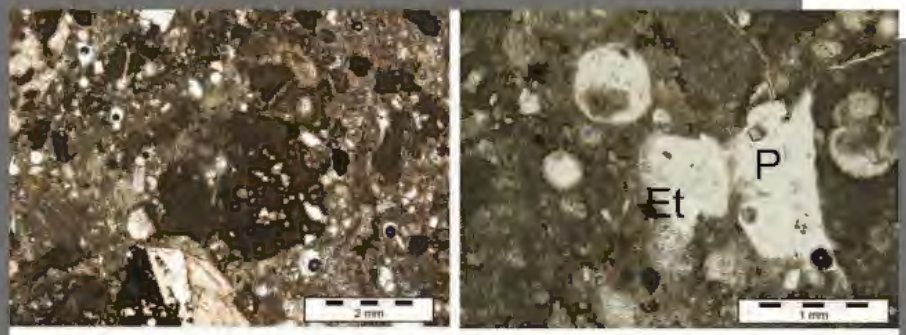
WHERE IS THE CARBONATE CRUST FORMED?

4. CORRELATION WITH TEMPERATURE AND RAIN WATER

The combination of higher water content with higher temperature increases the ammount of organism. Those layers appear as well as the thicker and better developed.
Therefore, there is a direct relationship between temperature, organic matter content and carbonate precipitation rate



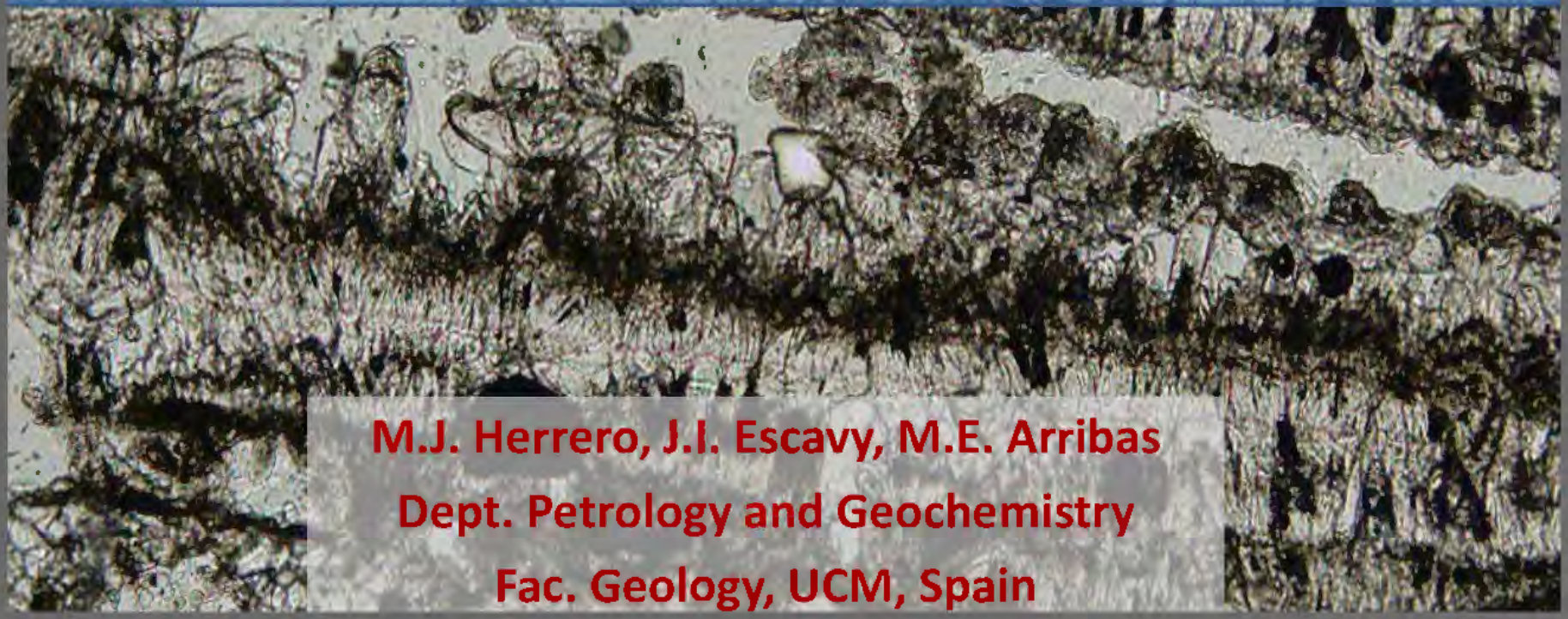
Year



The **mortar** composition is 83 % $CaCO_3$, 5% of quartz and 6% phyllosilicates, and 6% calcium hydroxide in the form of ettringite

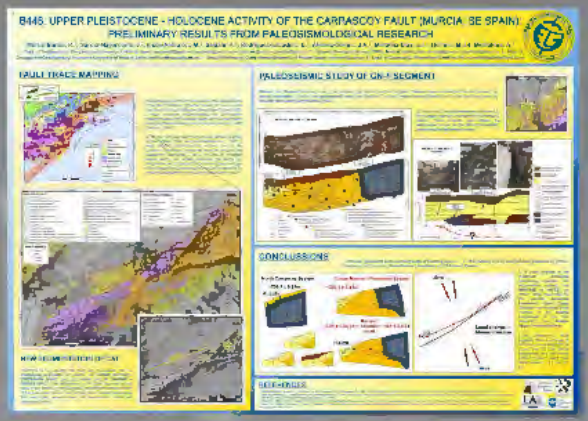
It is a combination of Portland cement, water and graded sand

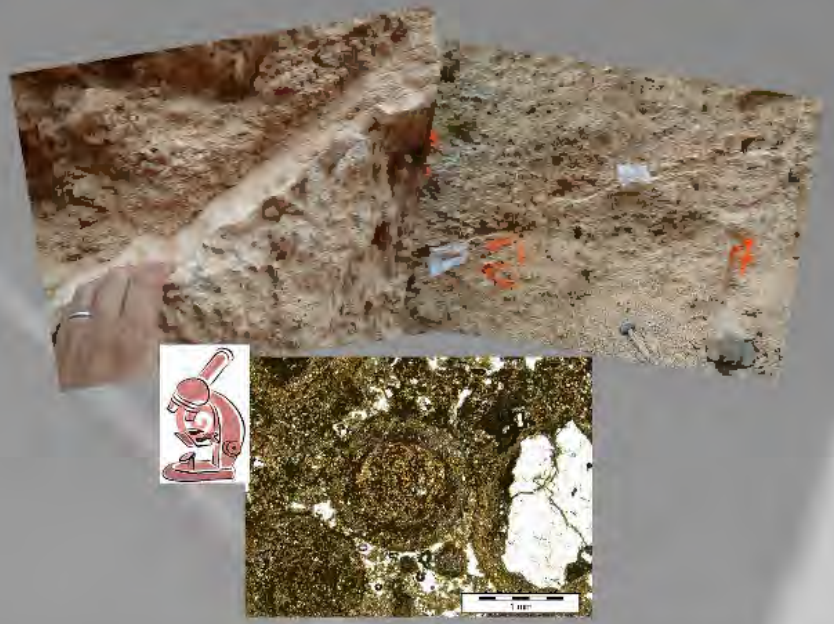
Genesis and preservation of environmental signals in a tufa analogue: insights of carbonate precipitation rates and factors quantification.



M.J. Herrero, J.I. Escavy, M.E. Arribas
Dept. Petrology and Geochemistry
Fac. Geology, UCM, Spain

Análisis de Actividad de Fallas





B448. UPPER PLEISTOCENE - HOLOCENE ACTIVITY OF THE CARRASCOY FAULT (MURCIA, SE SPAIN): PRELIMINARY RESULTS FROM PALEOSISMOLOGICAL RESEARCH

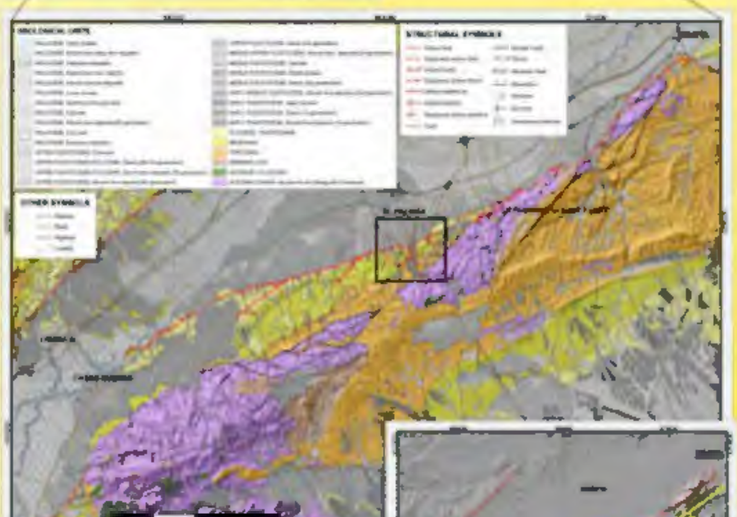
Martín-Banda, R.[1], García-Mayordomo, J.[2], Insua-Arévalo, J.M.[1], Salazar, A.[2], Rodríguez-Escudero, E.[3], Álvarez-Gómez, J.A.[1], Martínez-Díaz, J.J.[1], Herrero, M.J.4, Medialdea, A.[5]

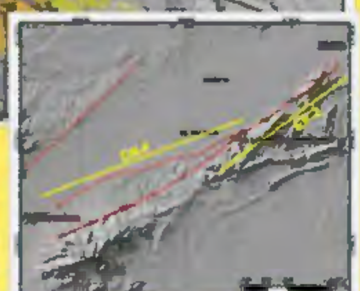
1 - Dept. of Geodynamics. Complutense University of Madrid. Spain. [illegible] 2 - Spanish Geological Survey (IGME). Madrid. Spain. [illegible] 3 - Dept. of Geology and Geochemistry. Autonoma University of Madrid. Spain. [illegible] 4 - Dept. of Petrology. Complutense University of Madrid. Spain. [illegible] 5 - Dept. of Geography. University of Sheffield. UK. [illegible]

FAULT TRACE MAPPING

The Carrascoy Fault (CAF) is located in the Internal Zones of the Betic Cordillera (Southern Spain). It is one of the main faults forming the Eastern Betic Shear Zone (EBSZ), a major structure accommodating the convergence between Nubian and Eurasian plates at the westernmost part of the Mediterranean sea (Larouzière De et al., 1988; Silva et al., 1993).

So far, the CAF has been defined as a left-lateral strike-slip fault (Silva, 1994; Sanz de Galdeano et al., 1998). It trends NE-SW, controlling the northern front of the Carrascoy Range and, towards the west, the linkage to the Guadalentín Depression. This is an area of moderate seismic activity, but densely populated, the Murcia city being settled very close to the fault. Hence, the knowledge of the structure and kinematics of the CAF is essential for a reliable assessment of the seismic hazard of the region.



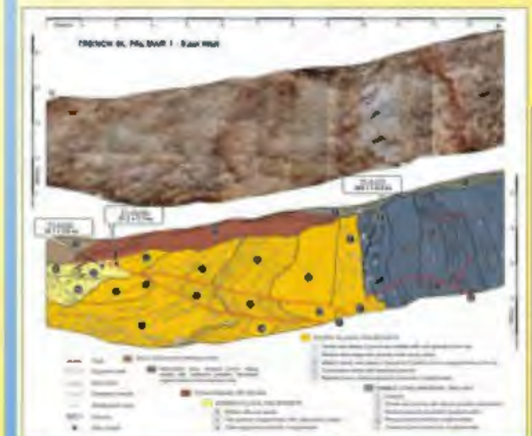


NEW SEGMENTATION OF CAF

According to our studies, the fault can be divided into two overlapping segments: the western one, **CASAS NUEVAS – FUENSANTA (CN-F)** and the eastern one, **EL PALMAR – ZENETA (EP-Z)**. The deformation in the CN-F segment [illegible] splits in two strands: North Carrascoy (forming the northern border of the main relief) and a new formed strand located basinwards. This new strand shows a [illegible] fault [illegible] with associated [illegible].

PALEOSEISMIC STUDY OF CN-F SEGMENT

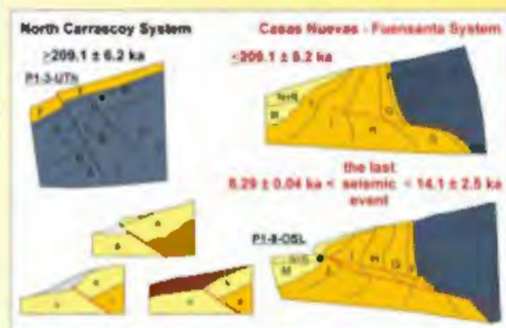
Palmar-1 and **Palmar-2** are the names of two trenches dug across the CN-F segment. **Palmar-1 trench** intercepted the fault, showing its **reverse kinematics**. At least, **one paleoseismic event** was identified. The most recent deposits **affected by the fault** have been dated by **Optically Stimulated Luminescence (OSL)**.



On the contrary, **no deformation** was observed in the youngest deposits excavated in the **Palmar-2** trench. These deposits were **dated** by **radiocarbon** as [illegible] **Cal BP 8330 to 8260** postdating the last seismic event.

CONCLUSSIONS

• **Detailed geological and geomorphological mapping** suggests: 1. **The division of CAF into two new segments** of different kinematics and geometry: **Casas Nuevas - Fuensanta** and **El Palmar - Zeneta**.



2. A local change in the maximum horizontal shortening direction that progressively evolved from NNW-SSE to NW-SE, the former being responsible for the sinistral strike-slip kinematics since Upper Tortonian and the latter for an increase in the reverse component of the fault movement from Middle-Upper Pleistocene times.

• The paleoseismic study suggests that a change in Shmax occurred about 209 ka (upper part of the Middle Pleistocene) and that the last surface rupture event took place between 14.1 and 8.3 ka.

REFERENCES

- Larouzière De, F., Bolze, J.J., Larouzière De, F.D., Montenat, C., Ott d'Estevou, P., 1988. [illegible]
- Sanz de Galdeano, C., López-Garrido, A.C., García-Tortosa, F.J., 1998. [illegible]
- Silva, P.G., 1994. [illegible]
- Silva, P.G., Harvey, A., Zazo, C., Goy, J.L., 1993. [illegible]

Pleistocene calcrete deposits from southern Spain as indicators of climatic conditions and tectonic activity

Maria J. Herrero (1), Juan M. Insua-Arevalo (2), Julian Garcia-Mayordomo (3), Raquel Martin-Banda (2)

(1) DPT. PETROLOGIA Y GEOQUIMICA (UCM); (2) DEPT. GEODINAMICA (UCM); (3) INSTUTO GEOLOGICO Y MINERO (IGME)

1. INTRODUCTION

2. GEOLOGICAL SETTING

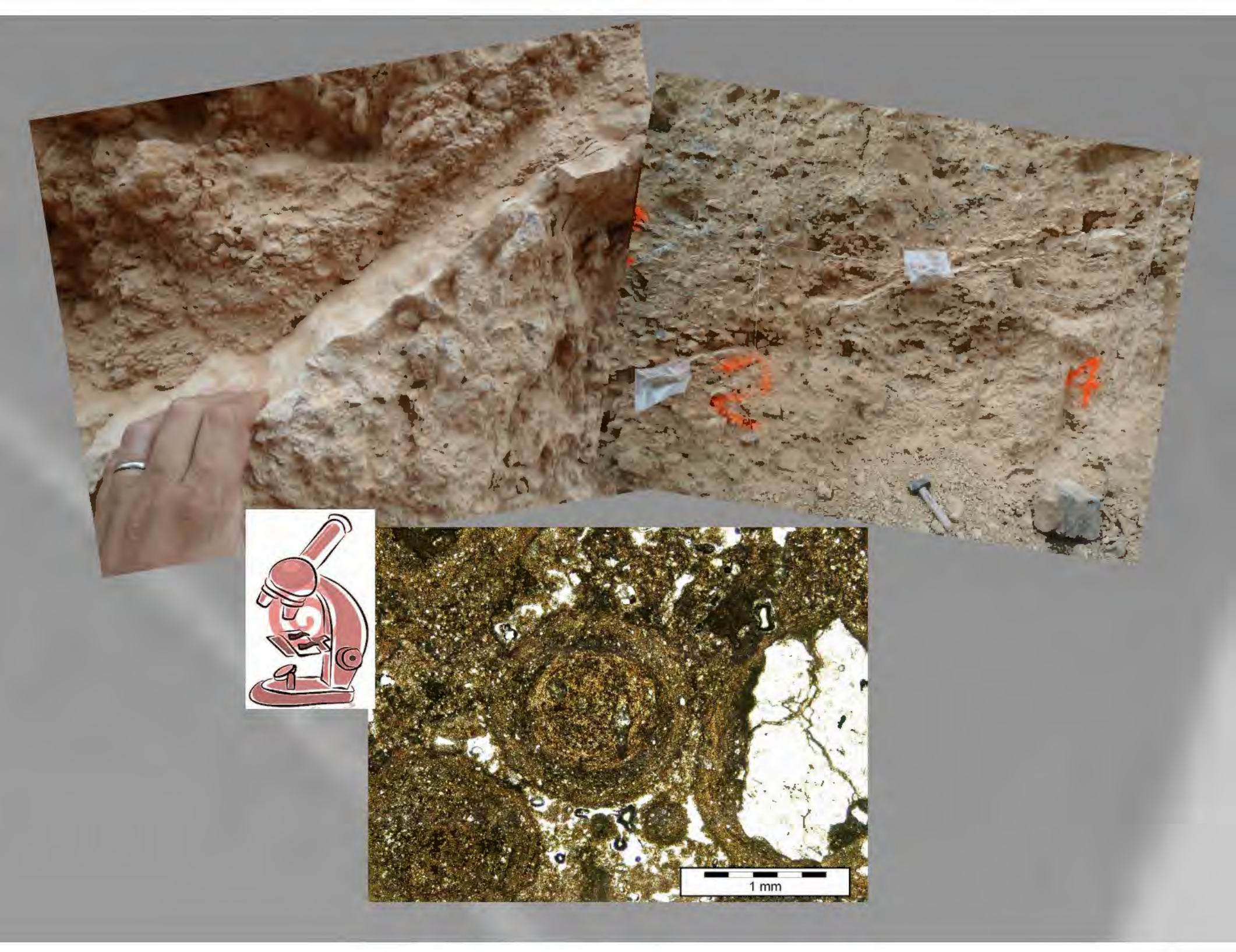
3. OUTCROP ANALYSIS

4. PETROLOGY AND XRD ANALYSES

5. GEOCHRONOLOGY

6. CONCLUSION

BIBLIOGRAPHY


1 mm

AGU PUBLICATIONS

Tectonics

RESEARCH ARTICLE
10.1002/2015TC003997

Key Points:
- Paleoseismicity in the Eastern Betics Shear Zone (Carrascoy Fault SW segment)
- Migration of active faulting away from the main range (foreberg)
- Nine to 11 Mw ~6.7 events in the last 30.2 kyr and a slip rate of 0.37 m/kyr

Supporting Information:
- Tables S1–S5 captions
- Table S1
- Table S2
- Table S3
- Table S4
- Table S5

Correspondence to:
R. Martín-Banda,
raquem08@ucm.es

Citation:
Martín-Banda, R., J. García-Mayordomo, J. M. Insua-Arévalo, Á. E. Salazar, E. Rodríguez-Escudero, J. A. Álvarez-Gómez, A. Medialdea, and M. J. Herrero (2016), New insights on the seismogenic potential of the Eastern Betic Shear Zone (SE Iberia): Quaternary activity and paleoseismicity of the SW segment of the Carrascoy Fault Zone, *Tectonics*, *35*, 55–75, doi:10.1002/2015TC003997.

Received 10 AUG 2015
Accepted 24 NOV 2015
Accepted article online 26 NOV 2015
Published online 6 JAN 2016

New insights on the seismogenic potential of the Eastern Betic Shear Zone (SE Iberia): Quaternary activity and paleoseismicity of the SW segment of the Carrascoy Fault Zone

Raquel Martín-Banda[1], Julián García-Mayordomo[2], Juan M. Insua-Arévalo[1], Ángel E. Salazar[2], Emilio Rodríguez-Escudero[3], Jose A. Álvarez-Gómez[1], Alicia Medialdea[4], and María J. Herrero[5]

[1]Department of Geodynamics, Complutense University of Madrid, Madrid, Spain, [2]Geological and Mining Institute of Spain, Madrid, Spain, [3]Department of Geology and Geochemistry, Autónoma University of Madrid, Madrid, Spain, [4]Nordic Laboratory for Luminescence Dating, Department of Geoscience, Aarhus University, Aarhus, Denmark, [5]Department of Petrology and Geochemistry, Complutense University of Madrid, Madrid, Spain

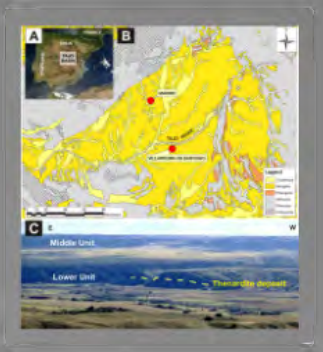
Abstract The Carrascoy Fault (CAF) is one of the main active faults that form part of the Eastern Betic Shear Zone, a 450 km fault system that accommodates most of the convergence between the Eurasian (Iberia) and Nubian plates in the Betic Cordillera, south Spain. Although the CAF represents a major earthquake threat to the nearby City of Murcia, studies on its Quaternary tectonics and seismogenic potential are scarce to date. We present evidence that supports the division of the CAF into two overlapping segments with contrasting tectonic structure, Quaternary activity, and landform control: a SW segment, characterized by a broad fold-and-thrust zone similar to the forebergs defined in the Gobi-Altai region, and a NE segment, characterized by a sharp mountain front controlled by strike-slip tectonics. We attribute the differentiation into these two segments to the stresses associated with topography, which in turn is a consequence of the shortening component, at the middle Pleistocene, after circa 217.4 ka. For the SW segment we infer the occurrence of 9 to 11, M_w 6.7 paleoearthquakes in the last 30.2 kyr, and a slip rate of 0.37 ± 0.08 m/kyr. We date the occurrence of the last surface rupture event after 2750 B.P., and we estimate an average recurrence period of major events of 3.3 ± 0.7 kyr.

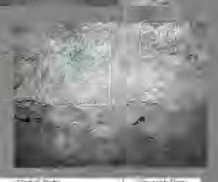
1. Introduction

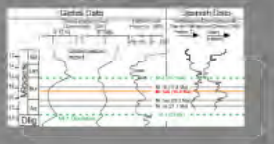
The Eastern Betic Shear Zone (EBSZ) is the main fault system accommodating the convergence between the Eurasian and Nubian plates in Iberia since late Neogene [*Bousquet*, 1979; *De Larouzière et al.*, 1988; *Sanz de Galdeano*, 1990; *Silva et al.*, 1993]. It shows a characteristic sigmoidal shape extending for more than 450 km from offshore Alboran Sea to NE of Murcia (Figure 1). Along the EBSZ many destructive earthquakes have taken place since historical times proving the seismogenic behavior of the faults that form the shear zone. From southwest to northeast, the EBSZ is formed by the following main faults: Carboneras, Palomares, Alhama de Murcia, Carrascoy, and Bajo Segura [*Instituto Geológico y Minero de España (IGME)*, 2012].

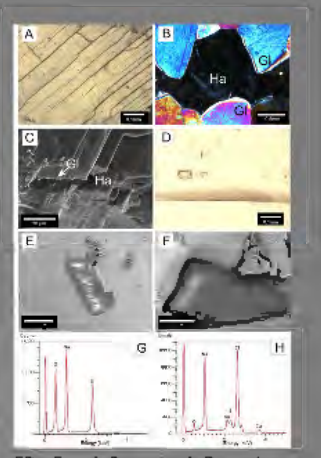
The Quaternary activity of the faults that form the EBSZ has been noticed and studied since the end of the 1970s decade [e.g., *Bousquet*, 1979; *Sanz de Galdeano*, 1983; *Boccaletti et al.*, 1987; *Montenat et al.*, 1987; *Vegas et al.*, 1987; *Masana et al.*, 2010; *Buontempo and Wuestefeld*, 2013]. Furthermore, most of these faults have been also studied from a paleoseismological point of view: Carboneras [e.g., *Bell et al.*, 1997; *Moreno et al.*, 2008; *Moreno*, 2010], Alhama de Murcia [e.g., *Hernández-Enrile and Martínez-Díaz*, 2001; *Ortuño et al.*,

Del Clima del Pasado al Clima del Futuro

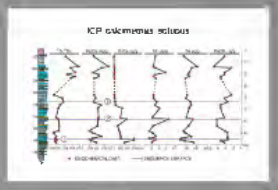


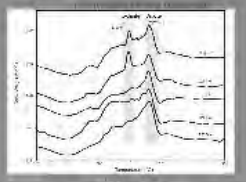


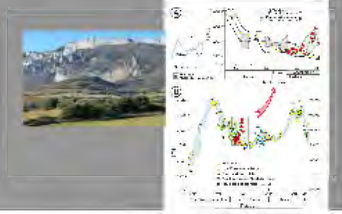


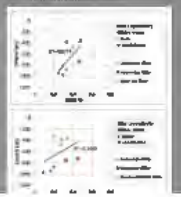


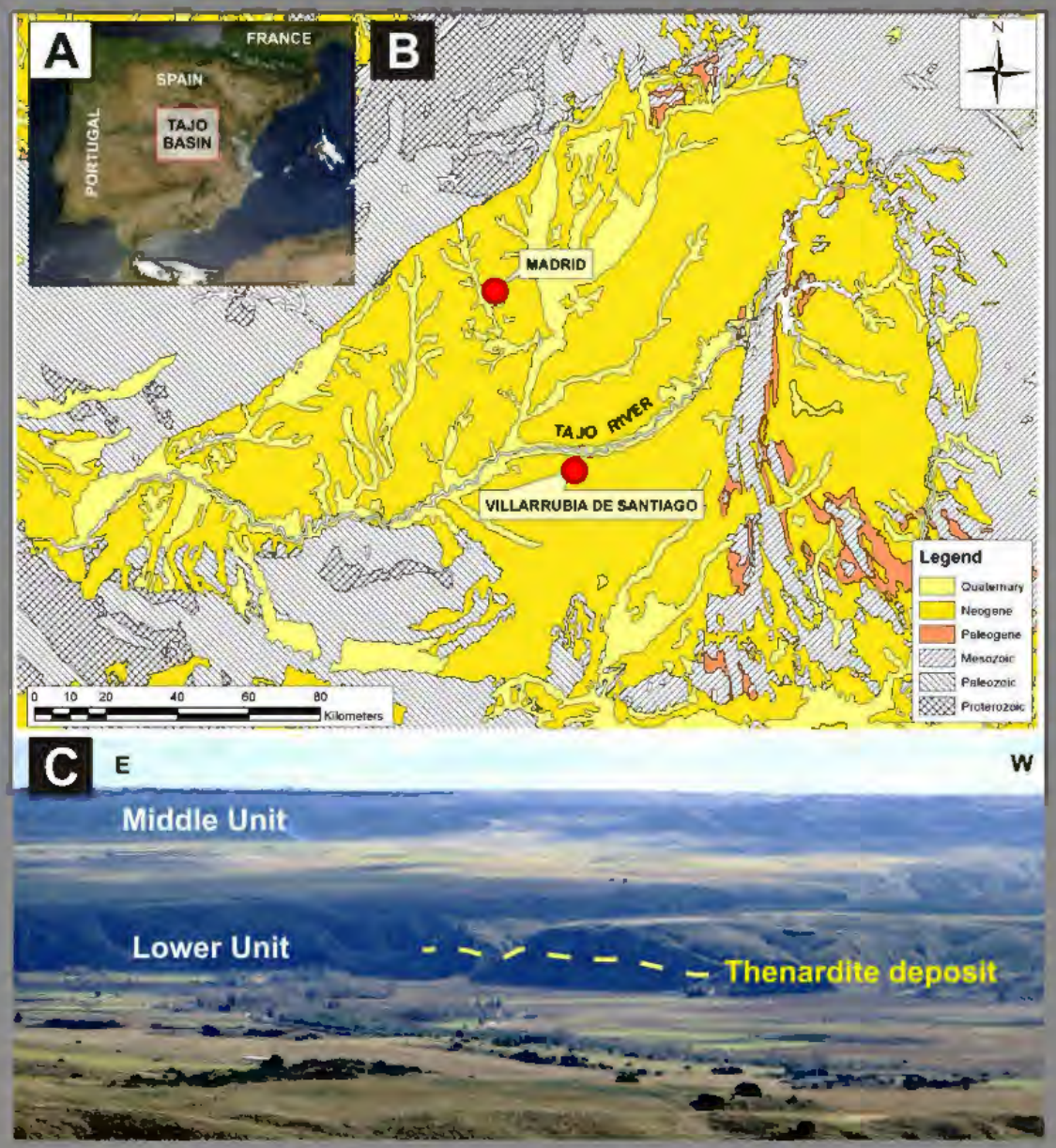
EDX Energía Dispersiva de Rayos X

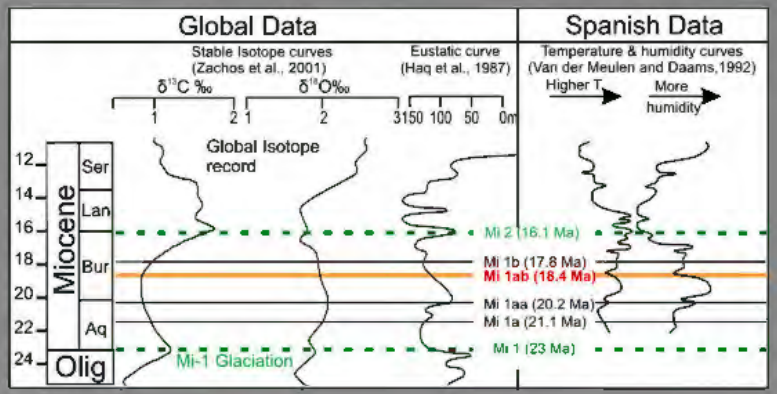


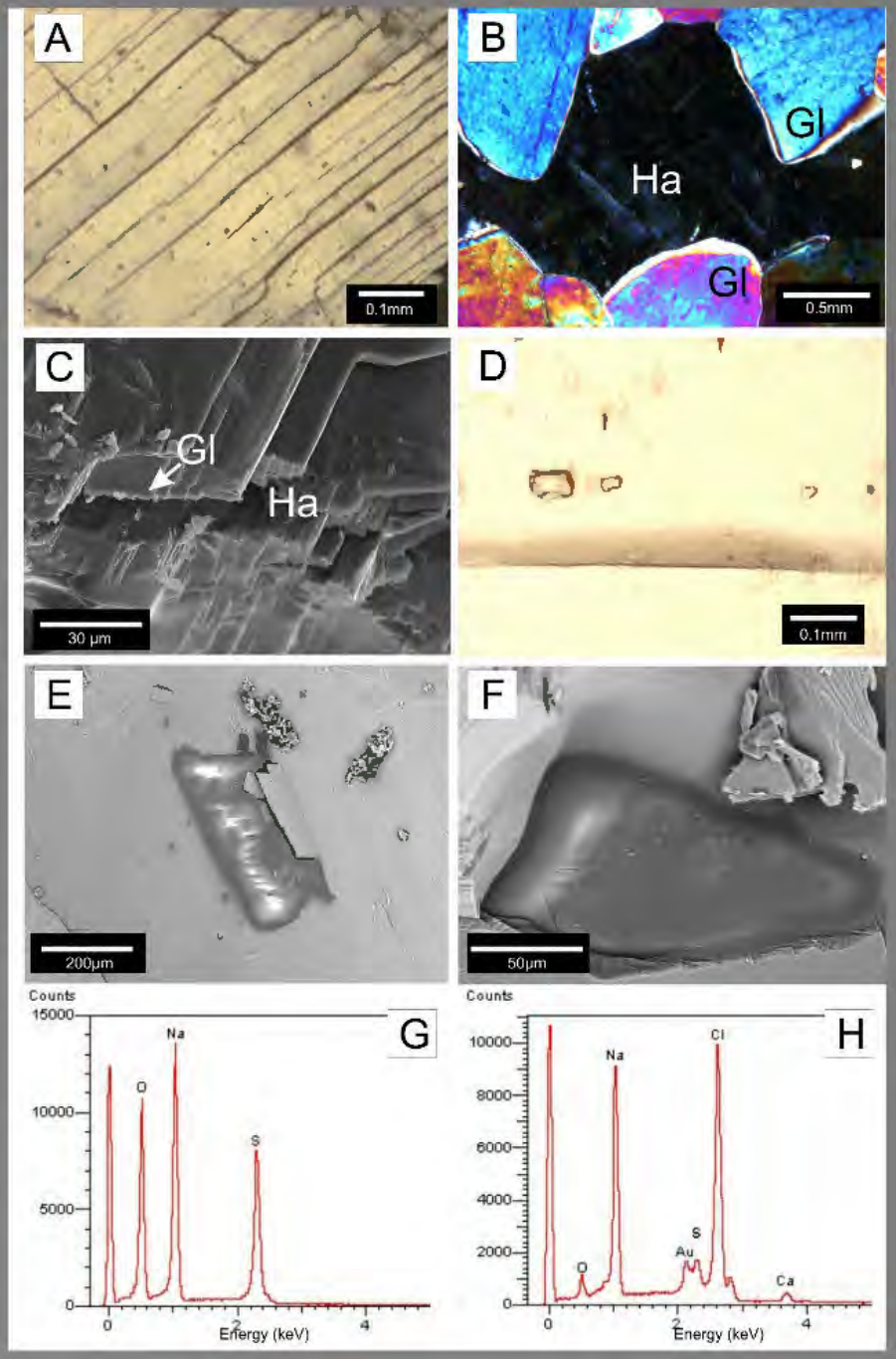






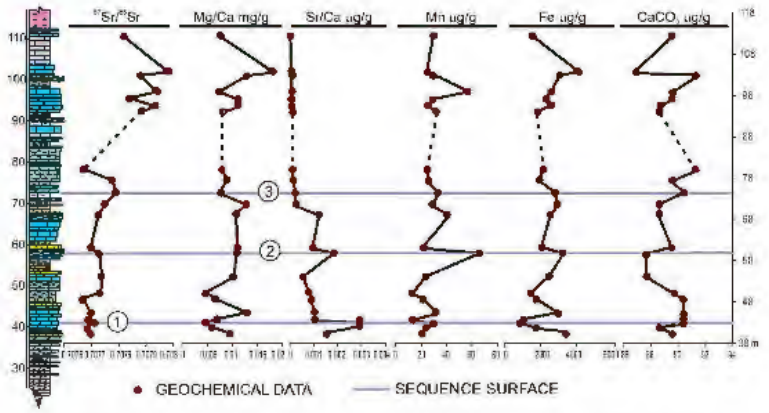

A
FRANCE
SPAIN
PORTUGAL
TAJO BASIN
B
N
MADRID
TAJO RIVER
VILLARRUBIA DE SANTIAGO
Legend
Quaternary
Neogene
Paleogene
Mesozoic
Paleozoic
Proterozoic
0 10 20 40 60 80
Kilometers
C
E
W
Middle Unit
Lower Unit
Thenardite deposit



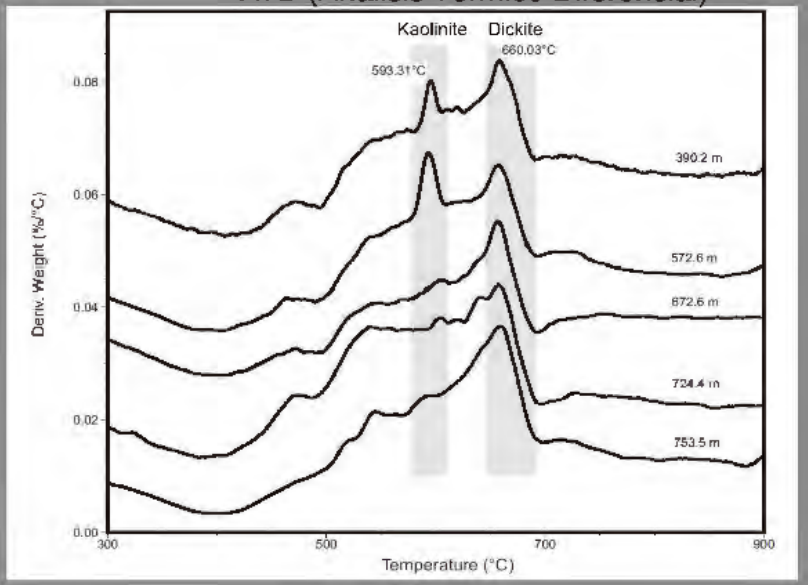


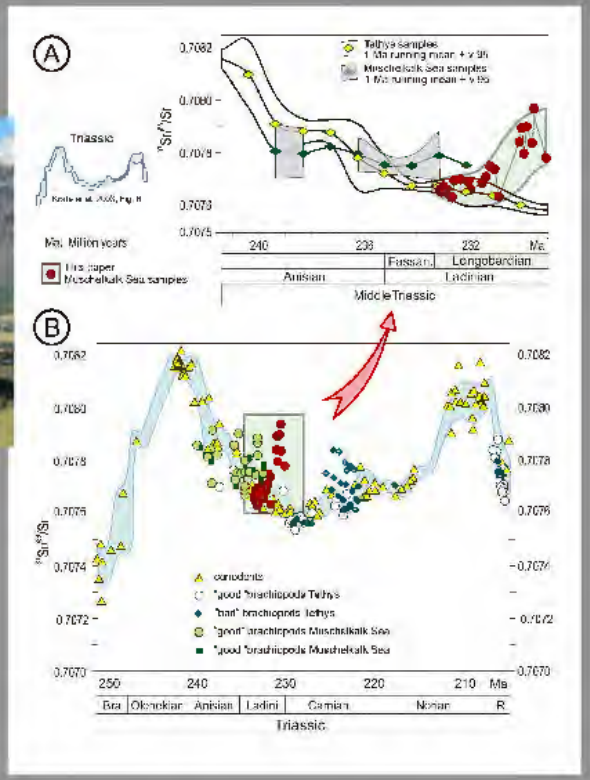
EDX: Energía Dispersiva de Rayos X

ICP, calcimetrias isótopos

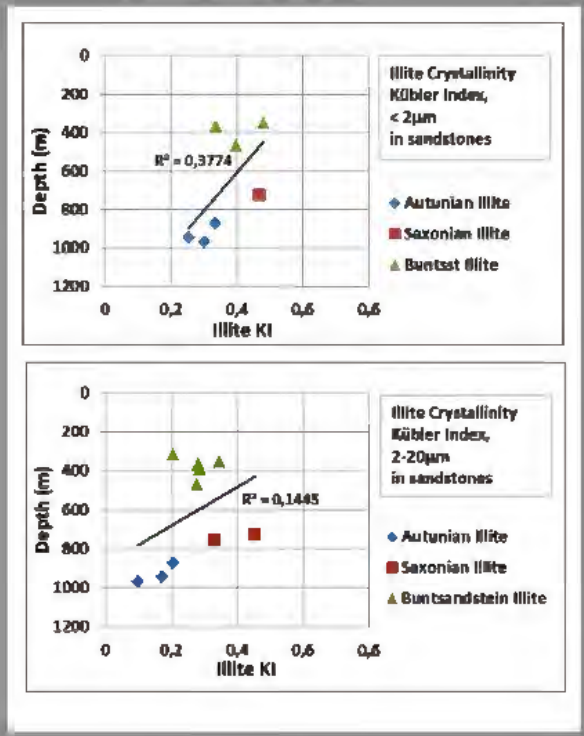


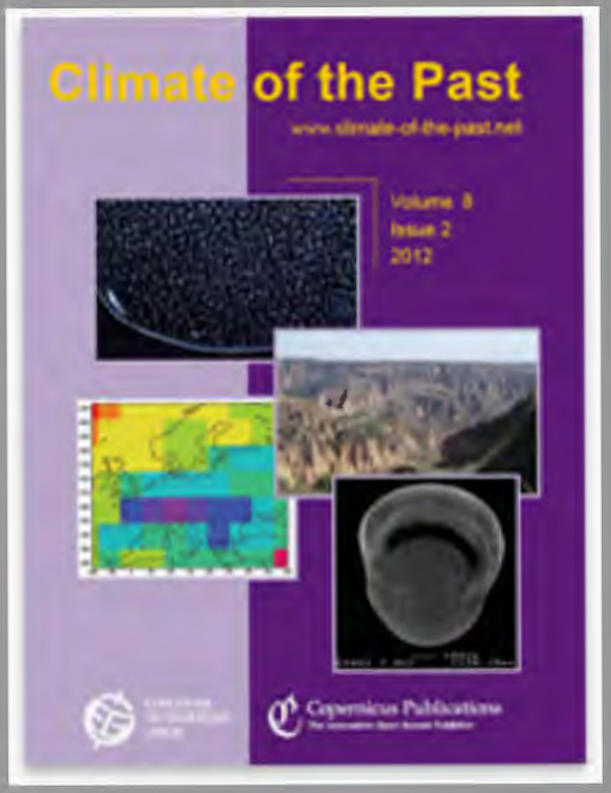
ATD (Análisis Térmico Diferencial)





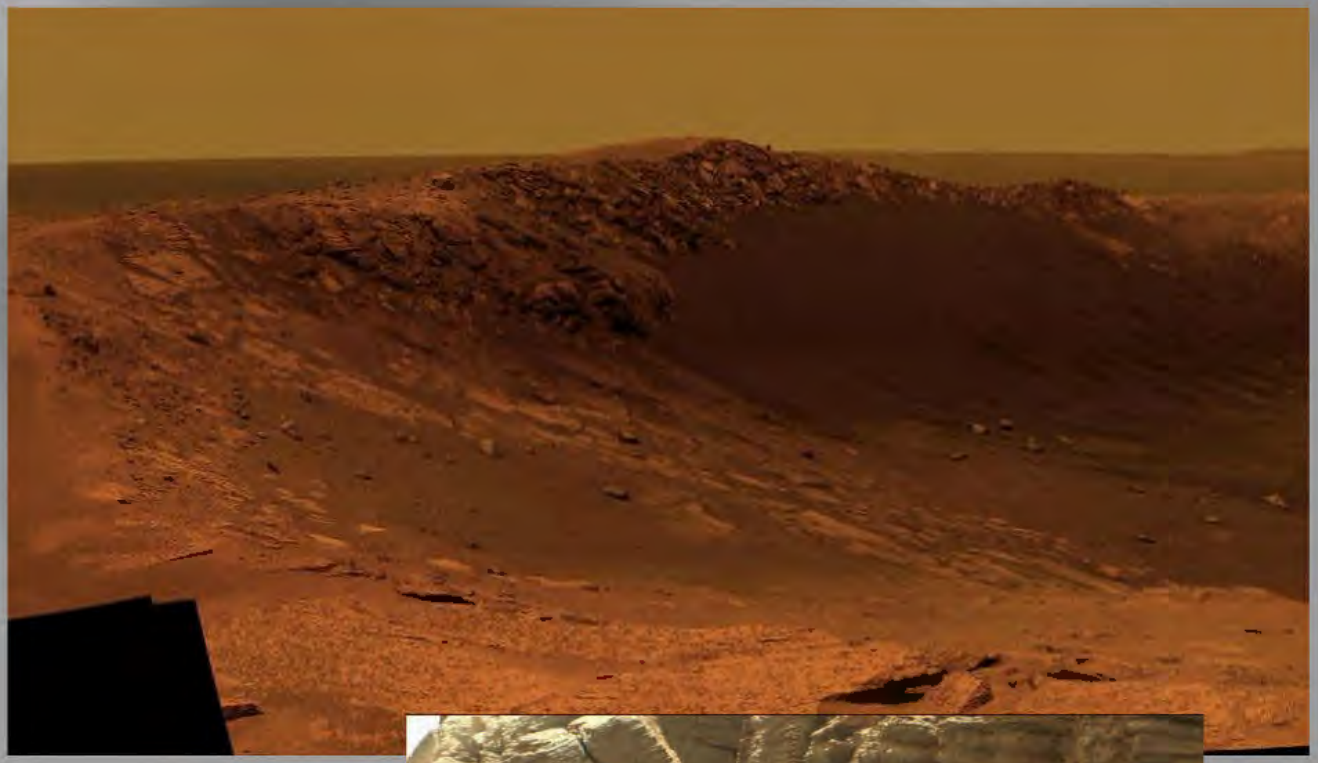
Cristalinidad de la Illita



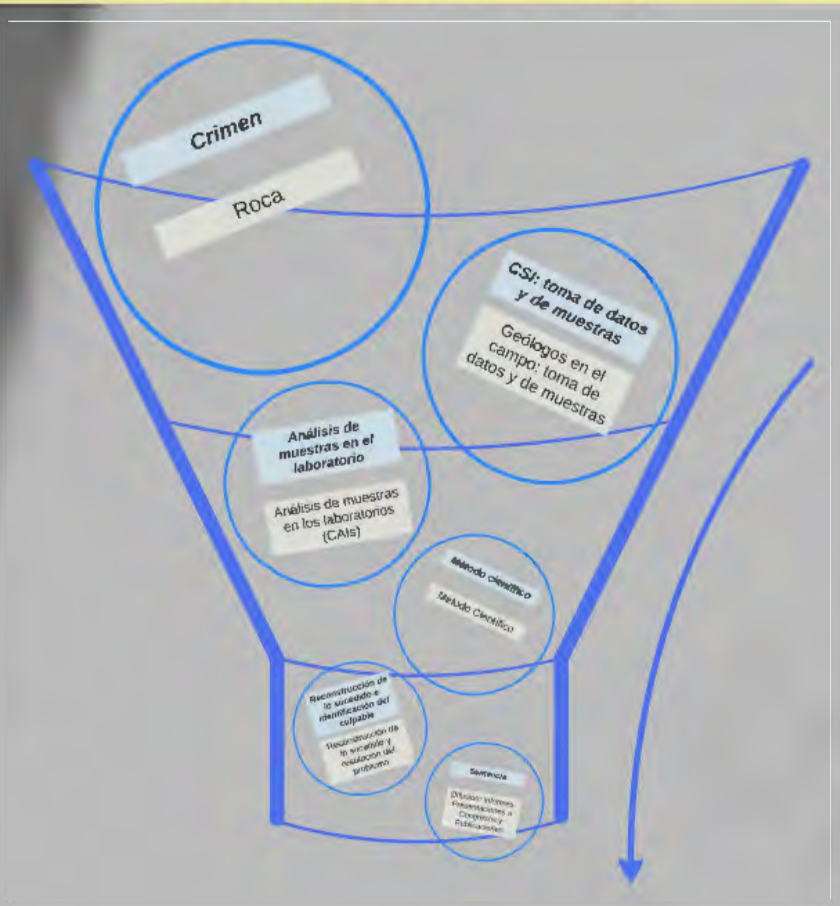

Climate of the Past
www.climate-of-the-past.net
Volume 8
Issue 2
2012
Copernicus Publications


Basin Research

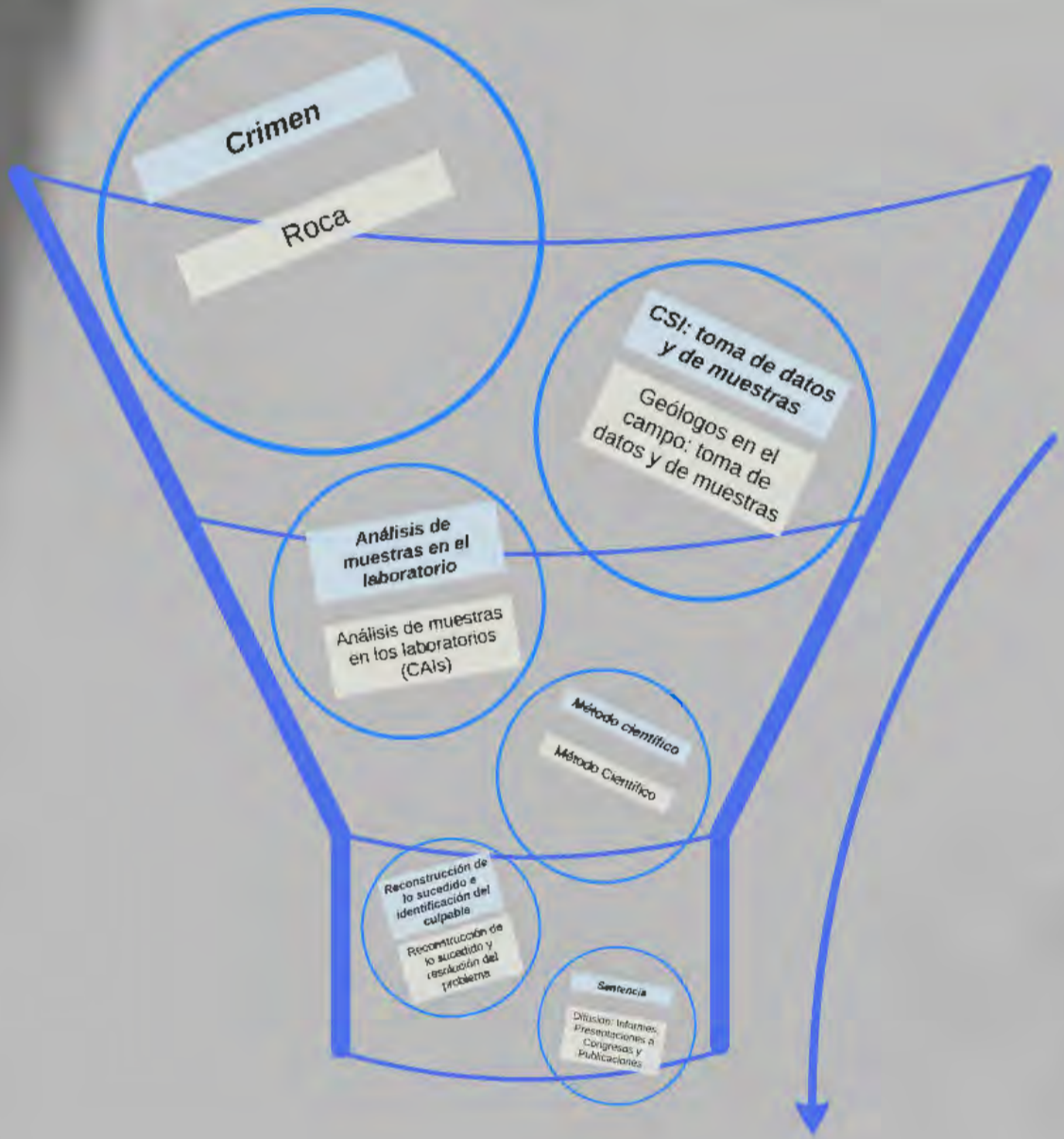

SEDIMENTOLOGY
IAS

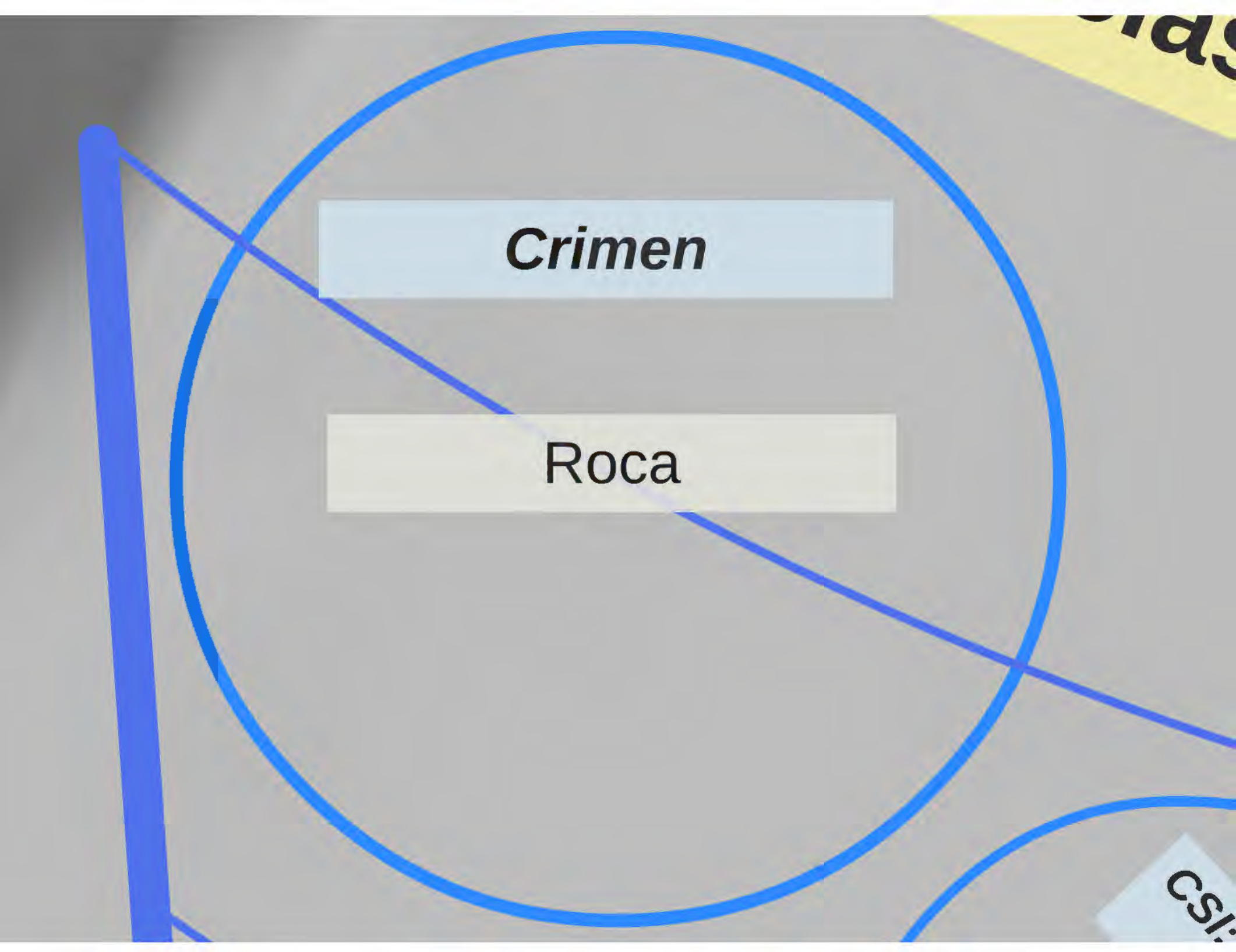


Investigación Aplicada en Ciencias de la Tierra



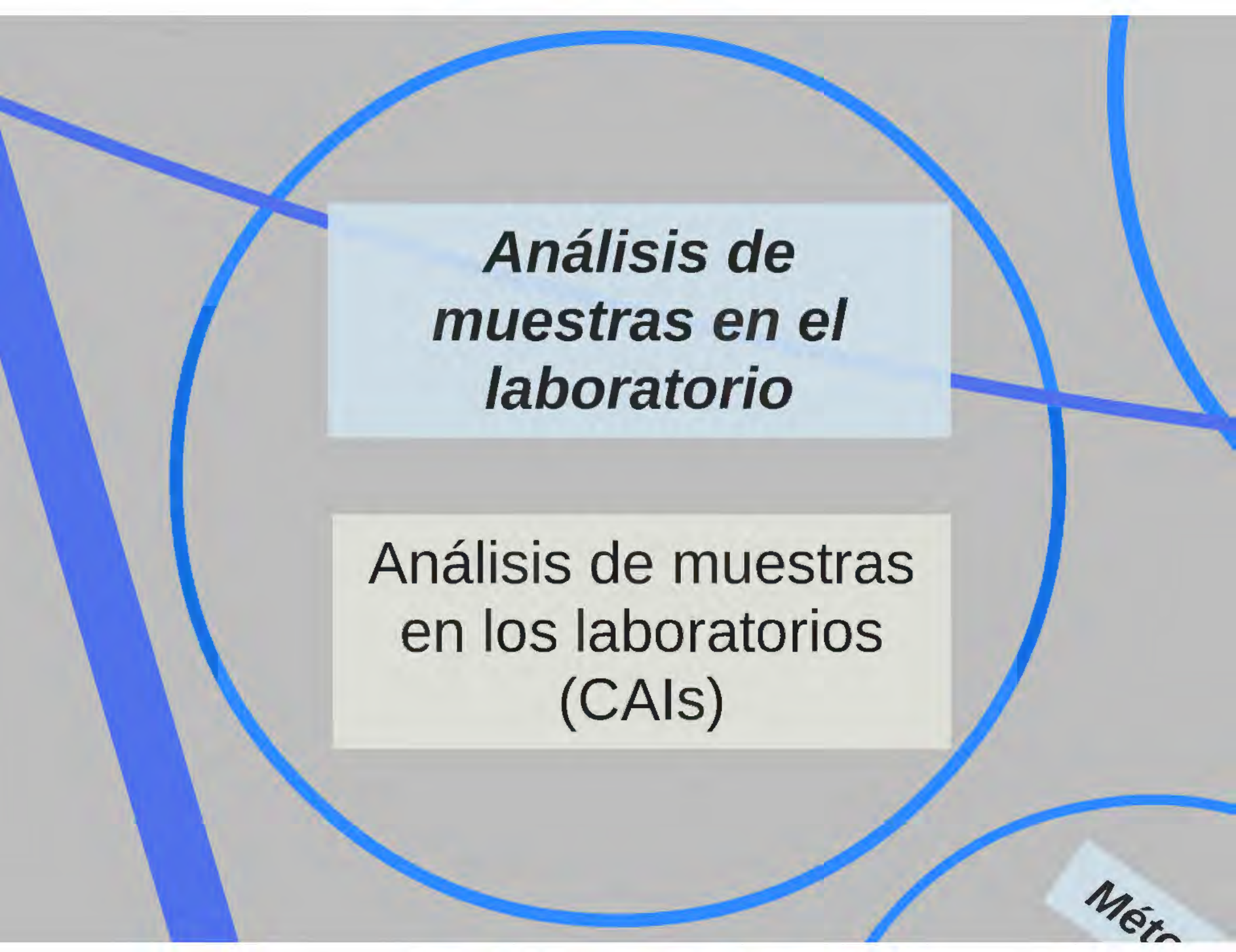
Investigación Aplicada en Ciencias de la Tierra




Crimen
Roca

CSI: toma de datos y de muestras

Geólogos en el campo: toma de datos y de muestras


Análisis de muestras en el laboratorio
Análisis de muestras en los laboratorios (CAIs)
Méto

Método científico

Método Científico

Reconstrucción de lo sucedido e identificación del culpable

Reconstrucción de lo sucedido y resolución del problema

Sentencia

Difusión: Informes, Presentaciones a Congresos y Publicaciones

GRACIAS