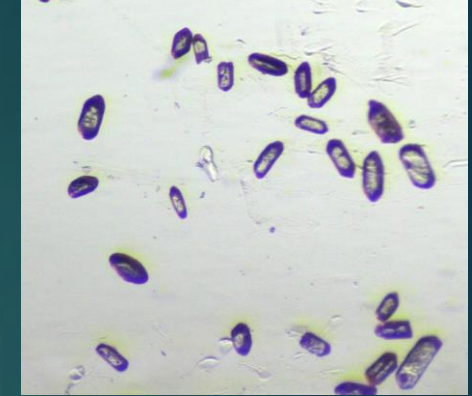


Provenance analysis of the Early Cretaceous fluvial succession of the Agadir-Essaouira Basin : research strategy and early results.



Emmanuel **Roquette**, 1st year PhD student

Dr. Stefan **Schroeder** (University of Manchester),
Prof. Jonathan **Redfern** (University of Manchester),
Dr. Shane **Tyrrell** (NUI Galway),
Prof. Giovanni **Bertotti** (TuDelft)

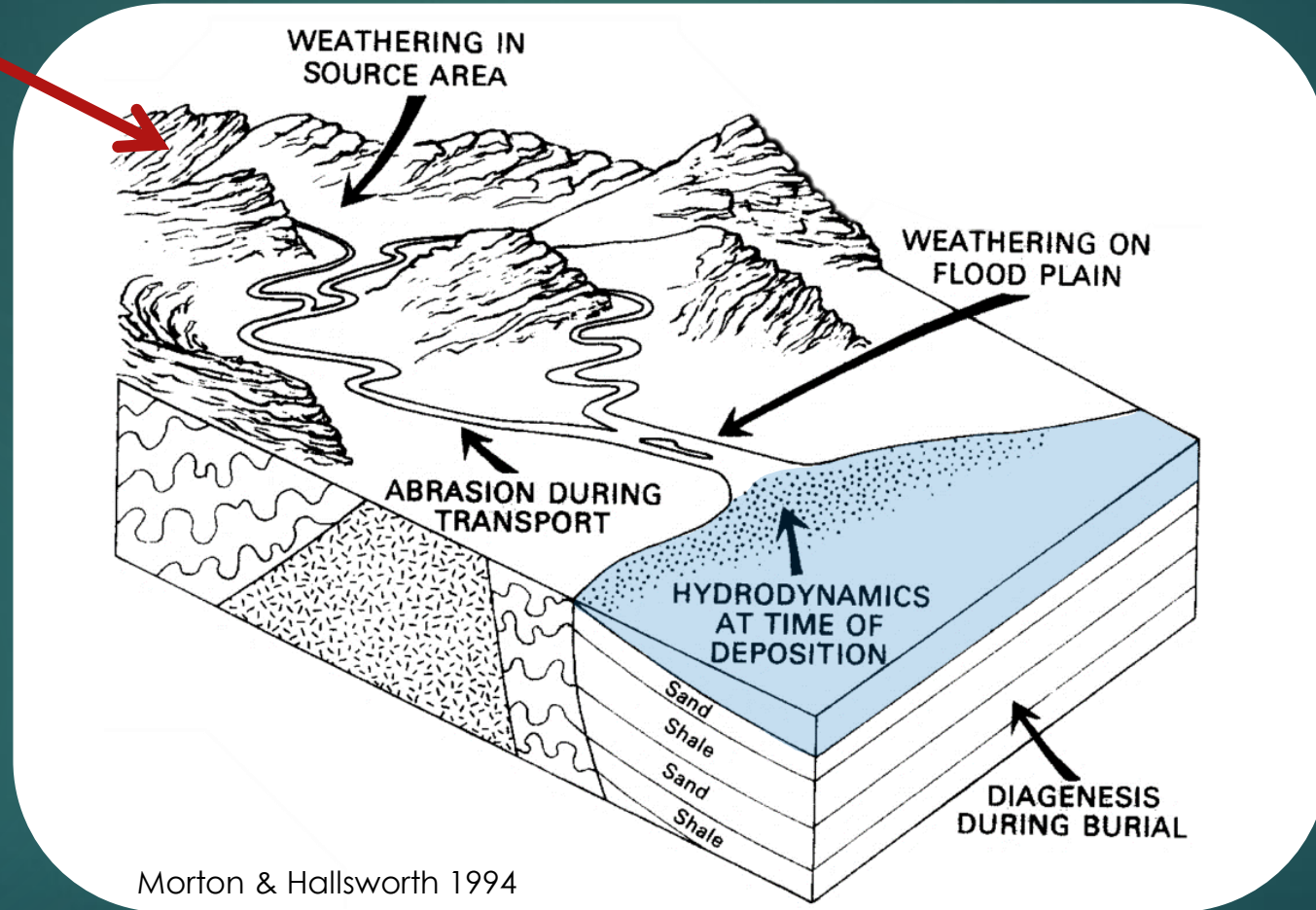


Provenance Model



SOURCES

Quantity,
timing and
nature of the
sediments



Morton & Hallsworth 1994

Provenance Model



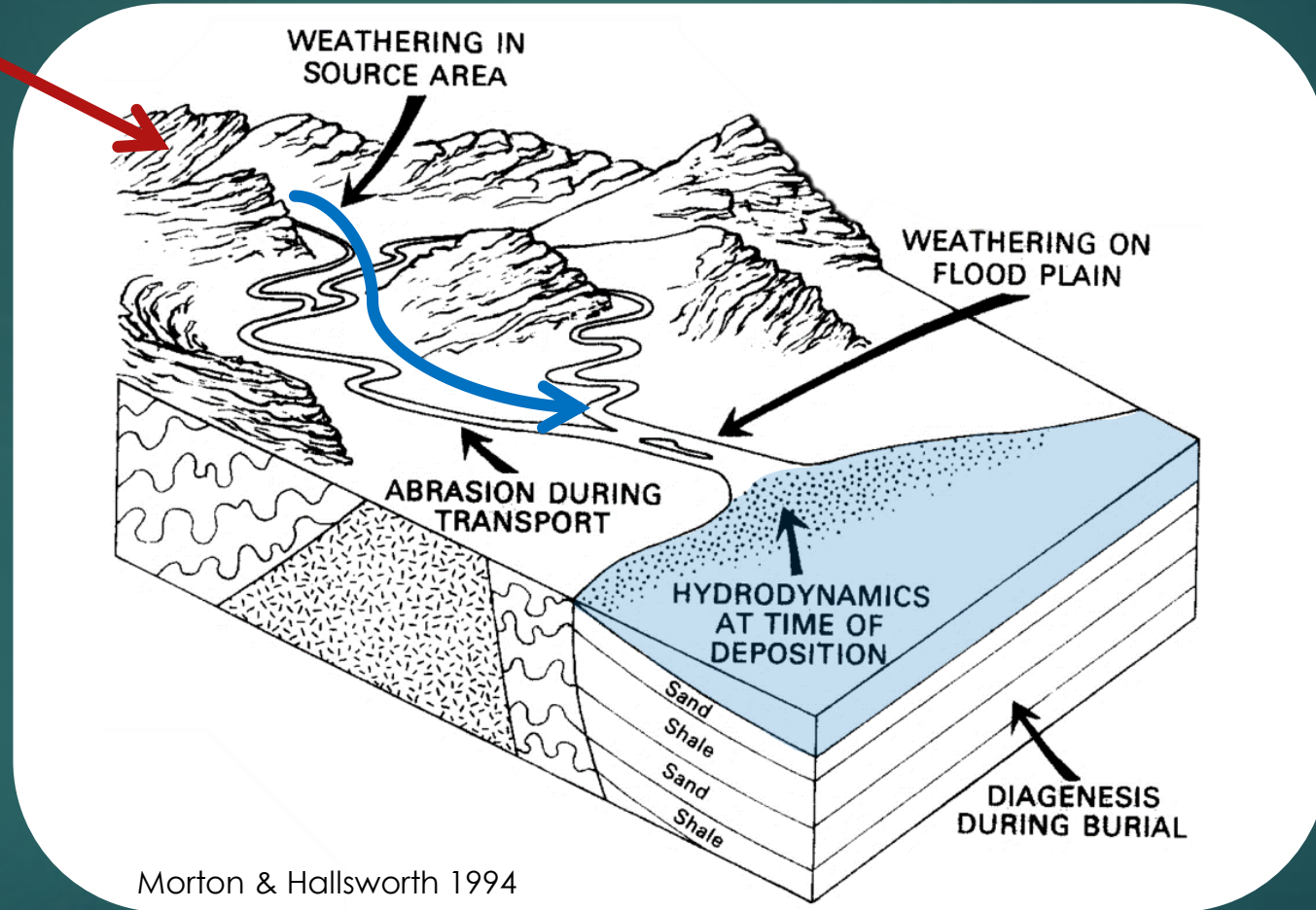
SOURCES

Quantity,
timing and
nature of the
sediments



TRANSPORT

Textural
maturation,
storage, mixing



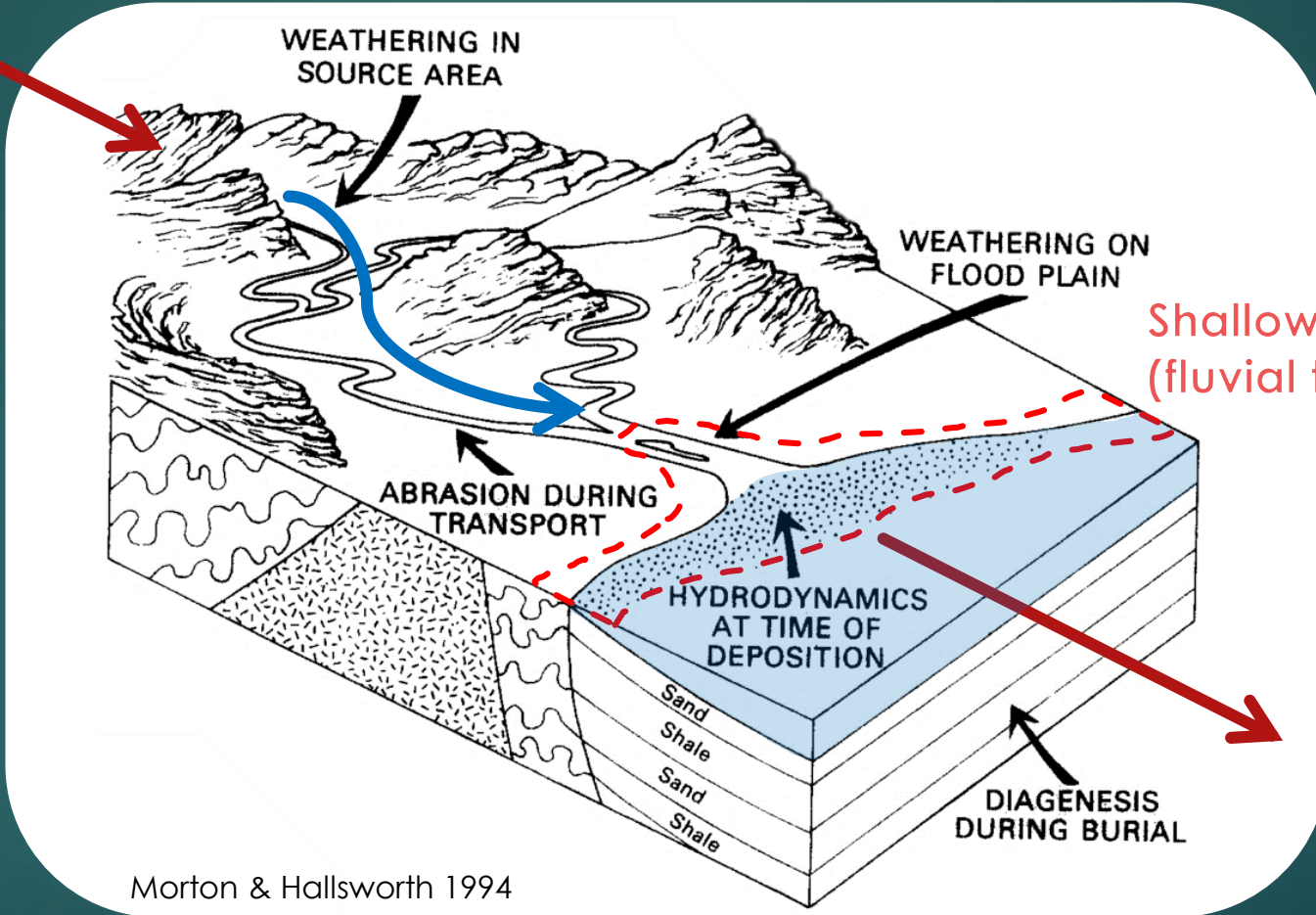
Morton & Hallsworth 1994

Provenance Model



SOURCES

Quantity, timing and nature of the sediments



Shallow sink (fluvial to shoreface)

TRANSPORT

Textural maturation, storage, mixing

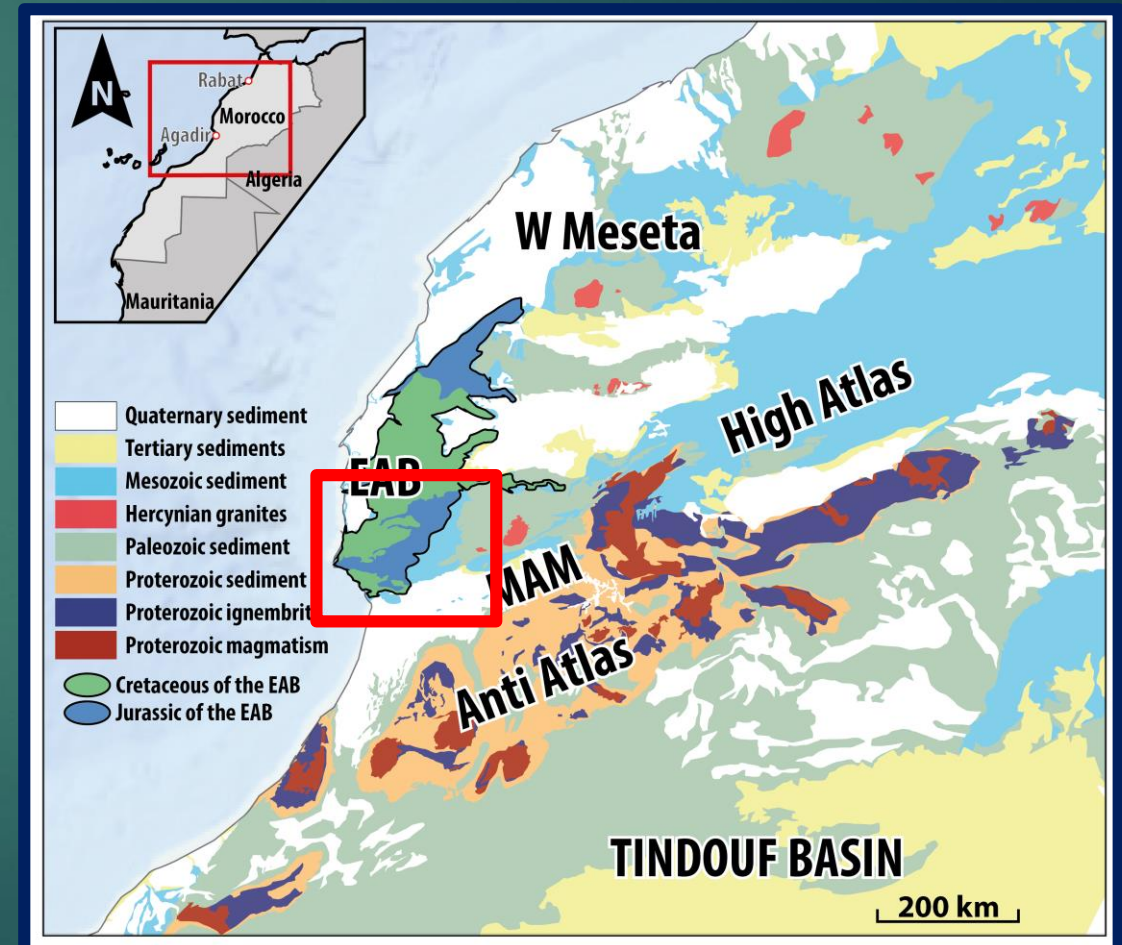
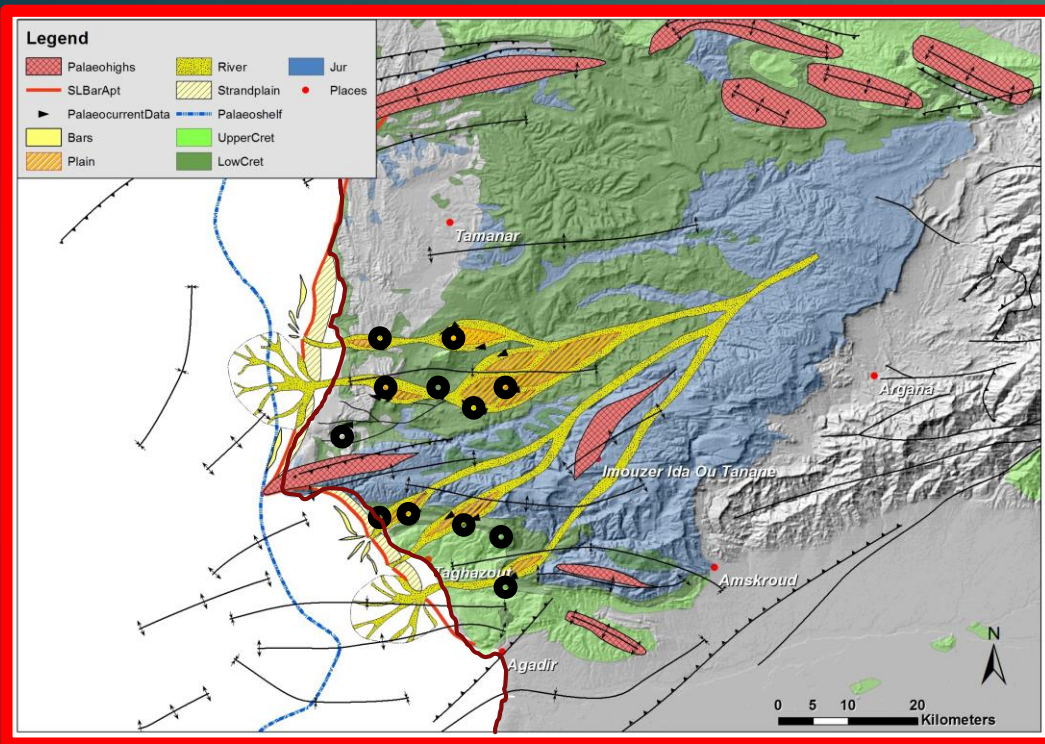
BASIN

Deposition processes, compaction, diagenesis

Provenance Model



- Early Cretaceous regressive interval of the Essaouira-Agadir Basin (EAB)

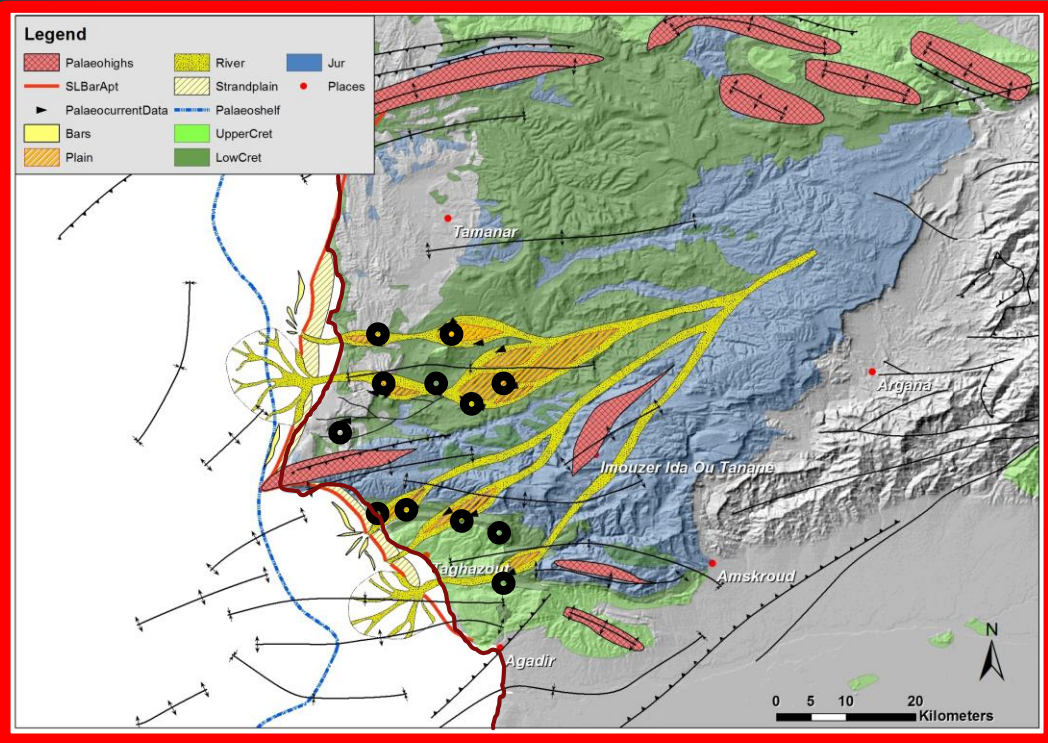


Provenance Model

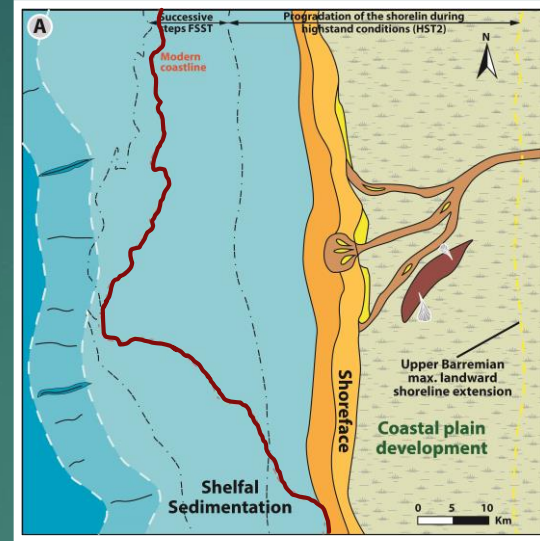


Barremian to lowermost Aptian evolution

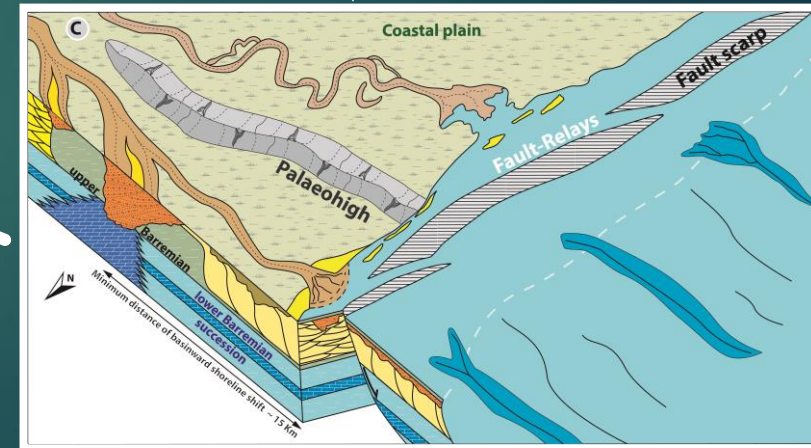
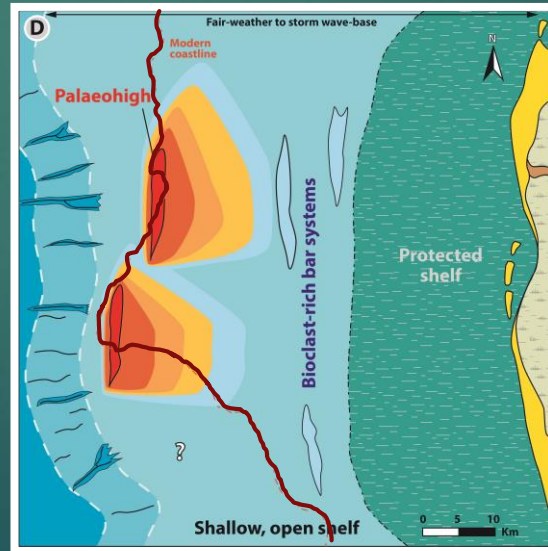
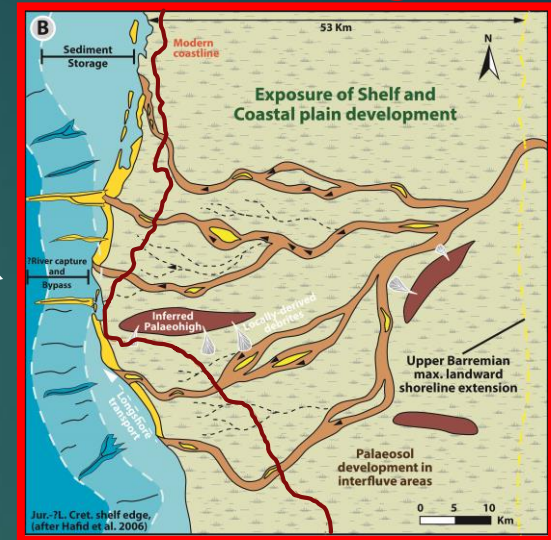
Pre-regression



Maximum transgression



Maximum regression

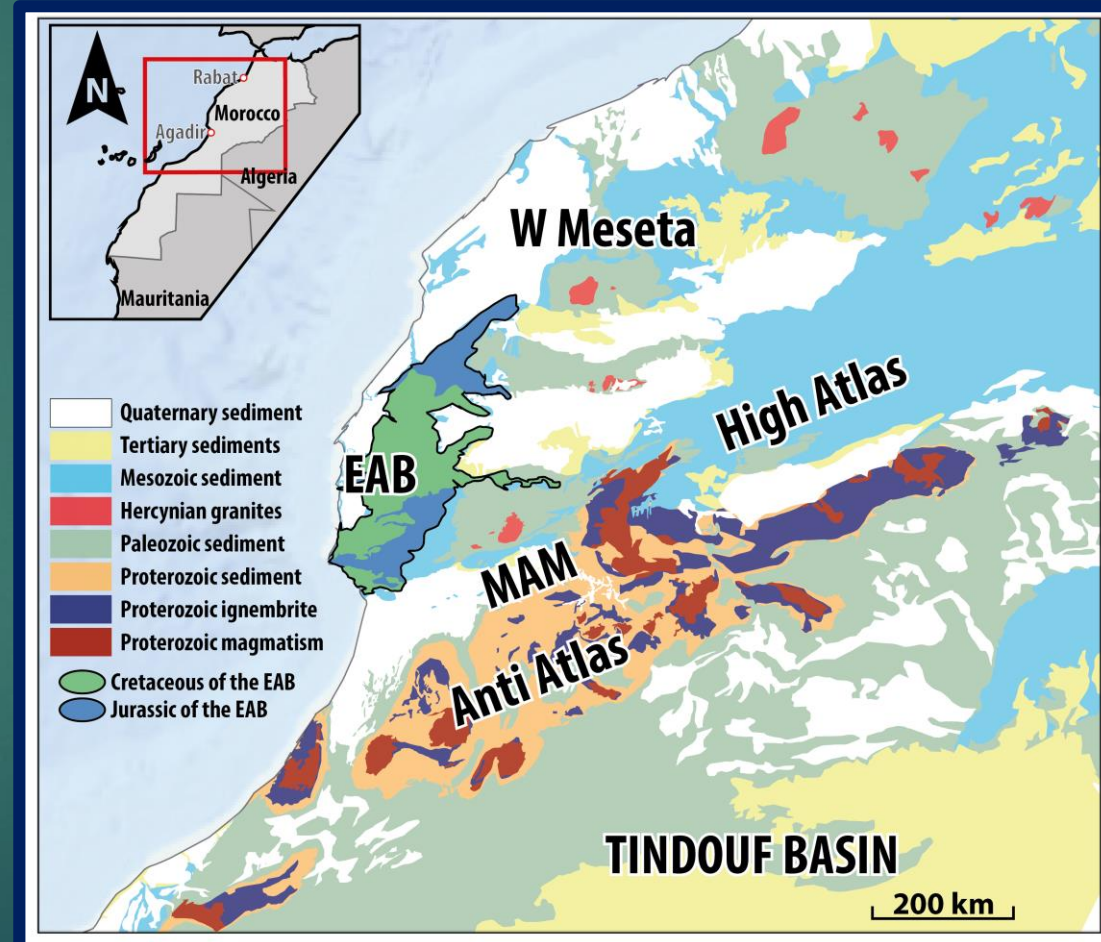
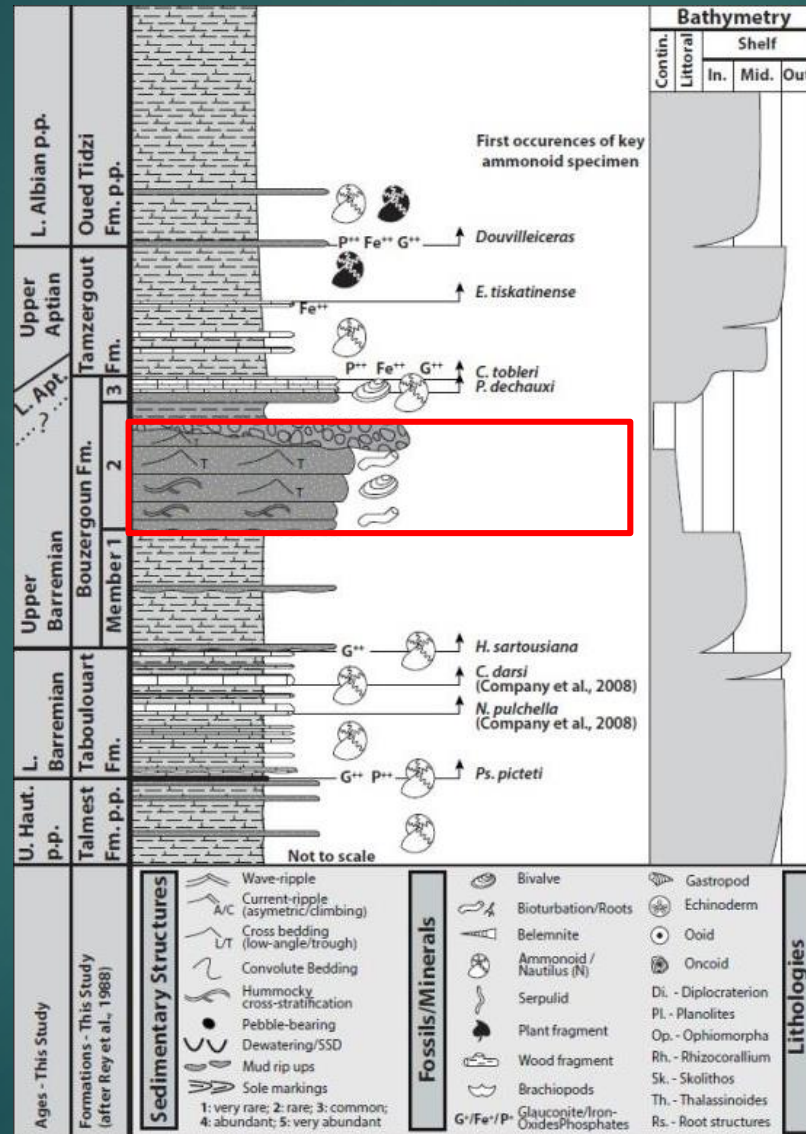


Transgression Onset

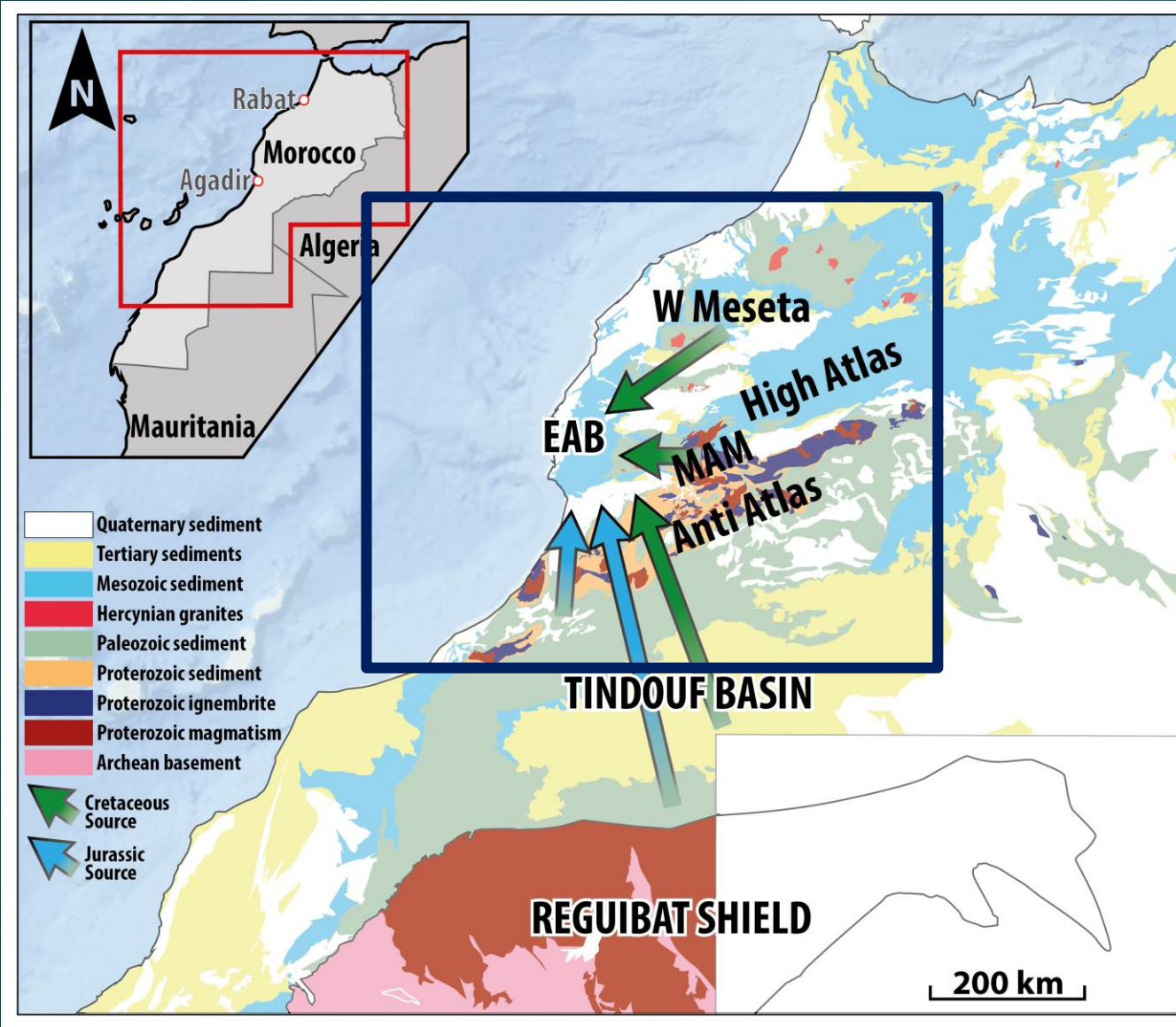
Provenance Model



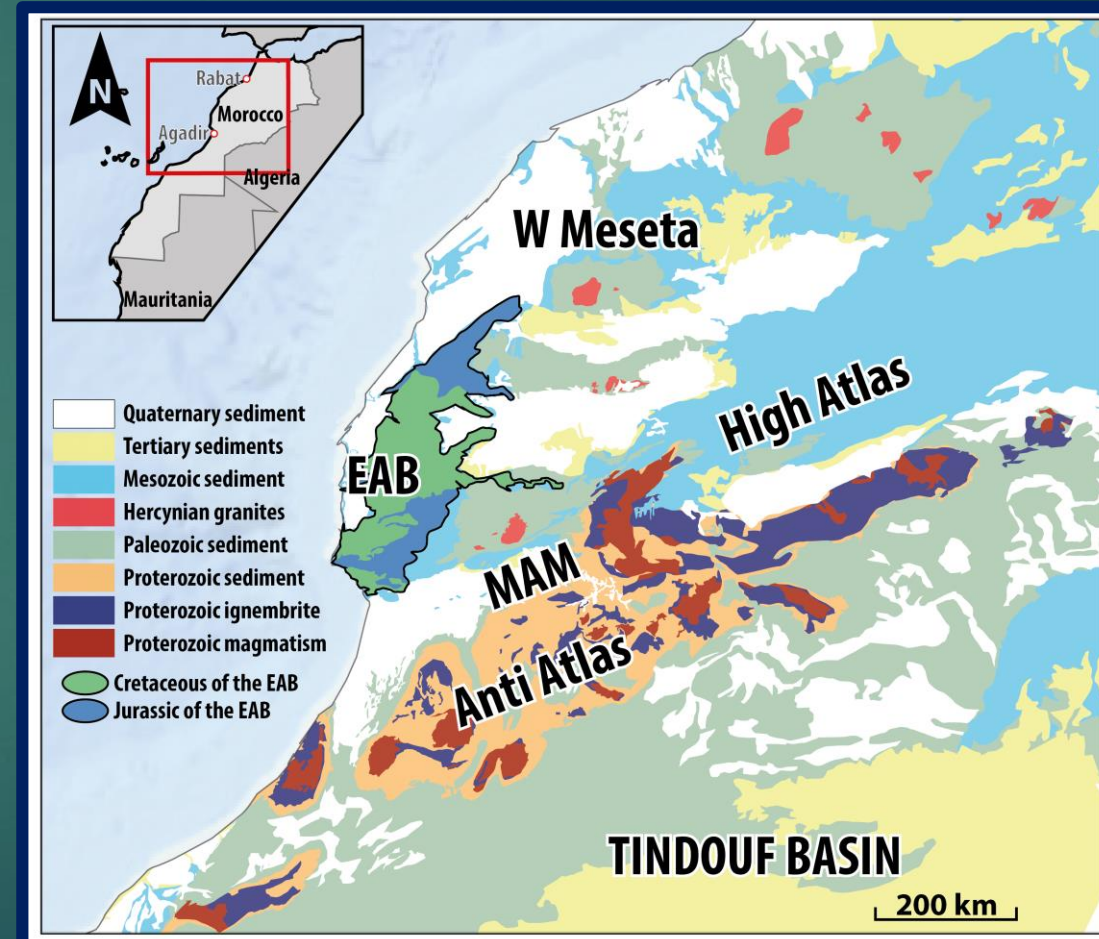
TARGET :
Coarse clastic interval of the Barremian to Lowermost Aptian regression



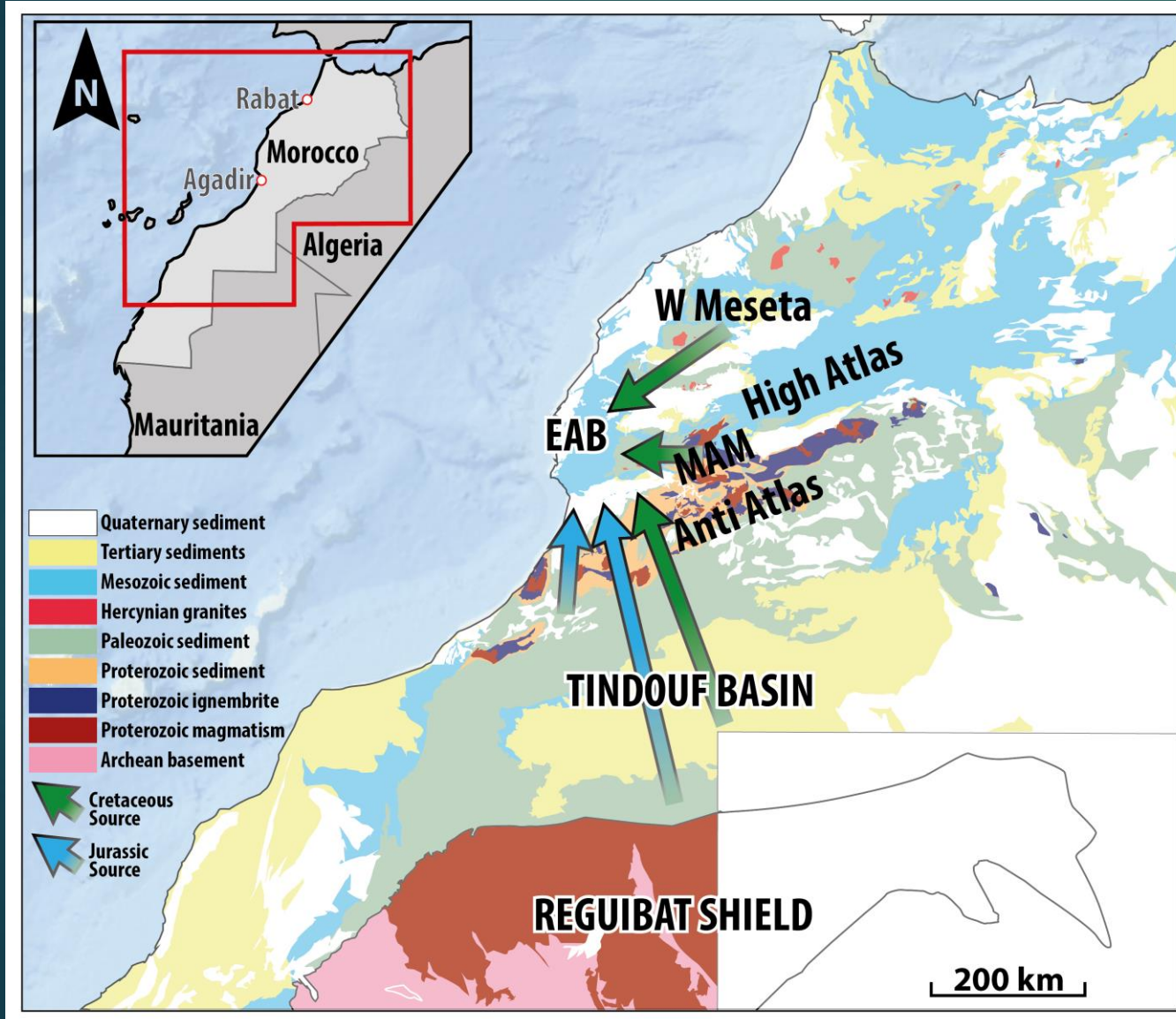
Provenance Model



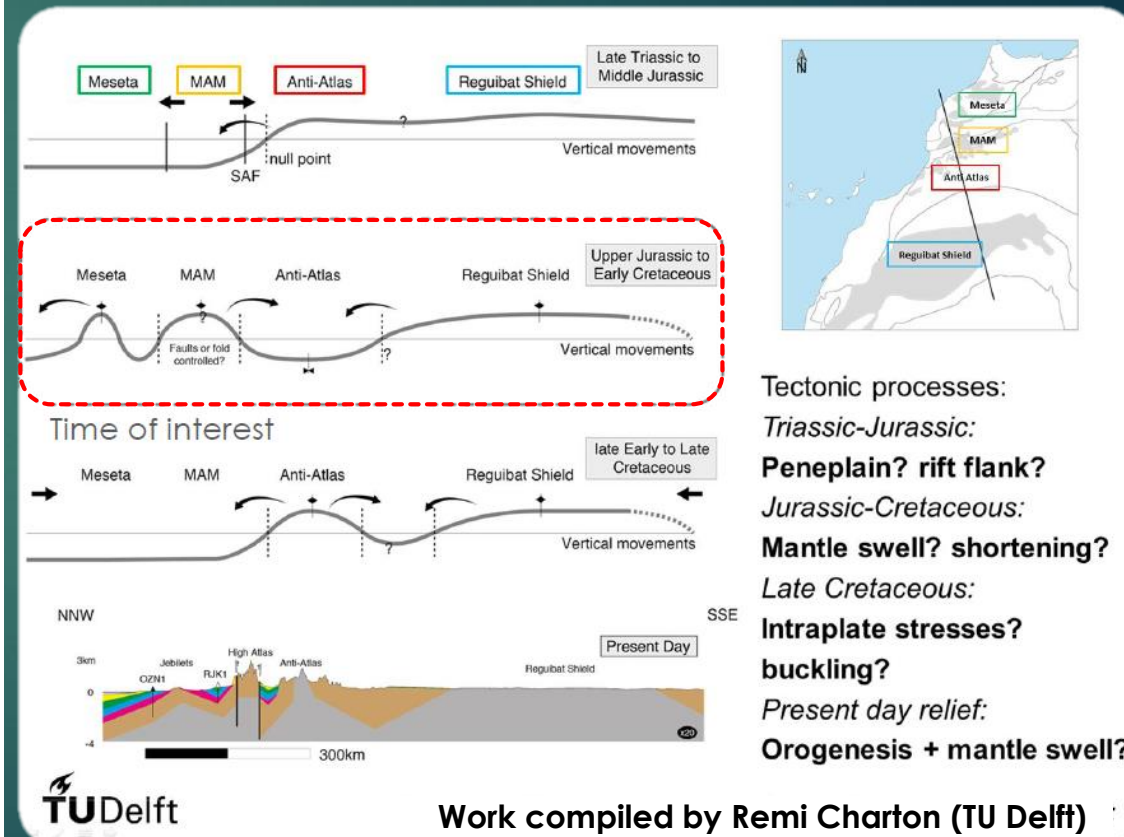
Meseta, MAM, Anti-Atlas or south ?



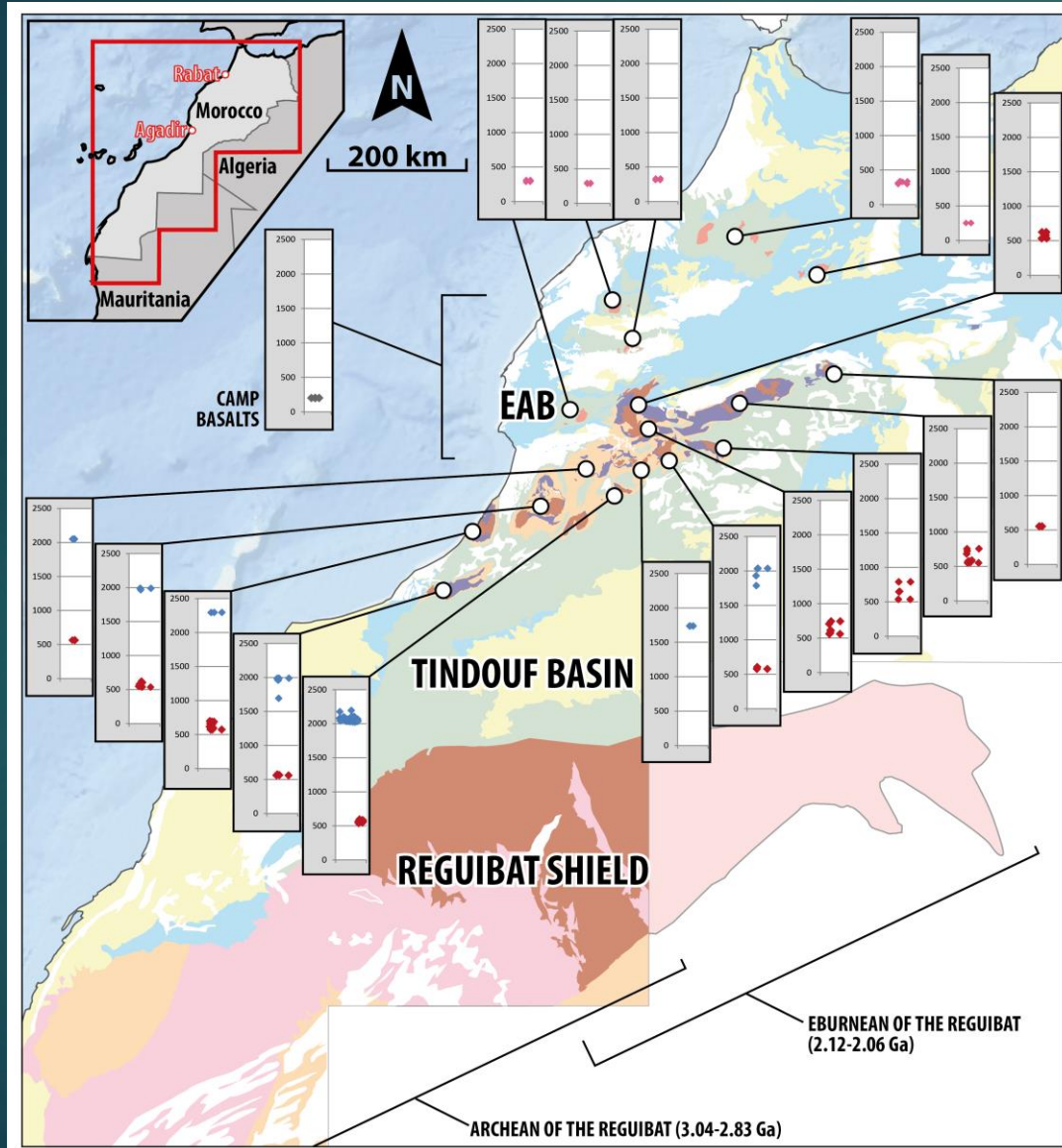
Provenance Model



Meseta, MAM, Anti-Atlas or south ?

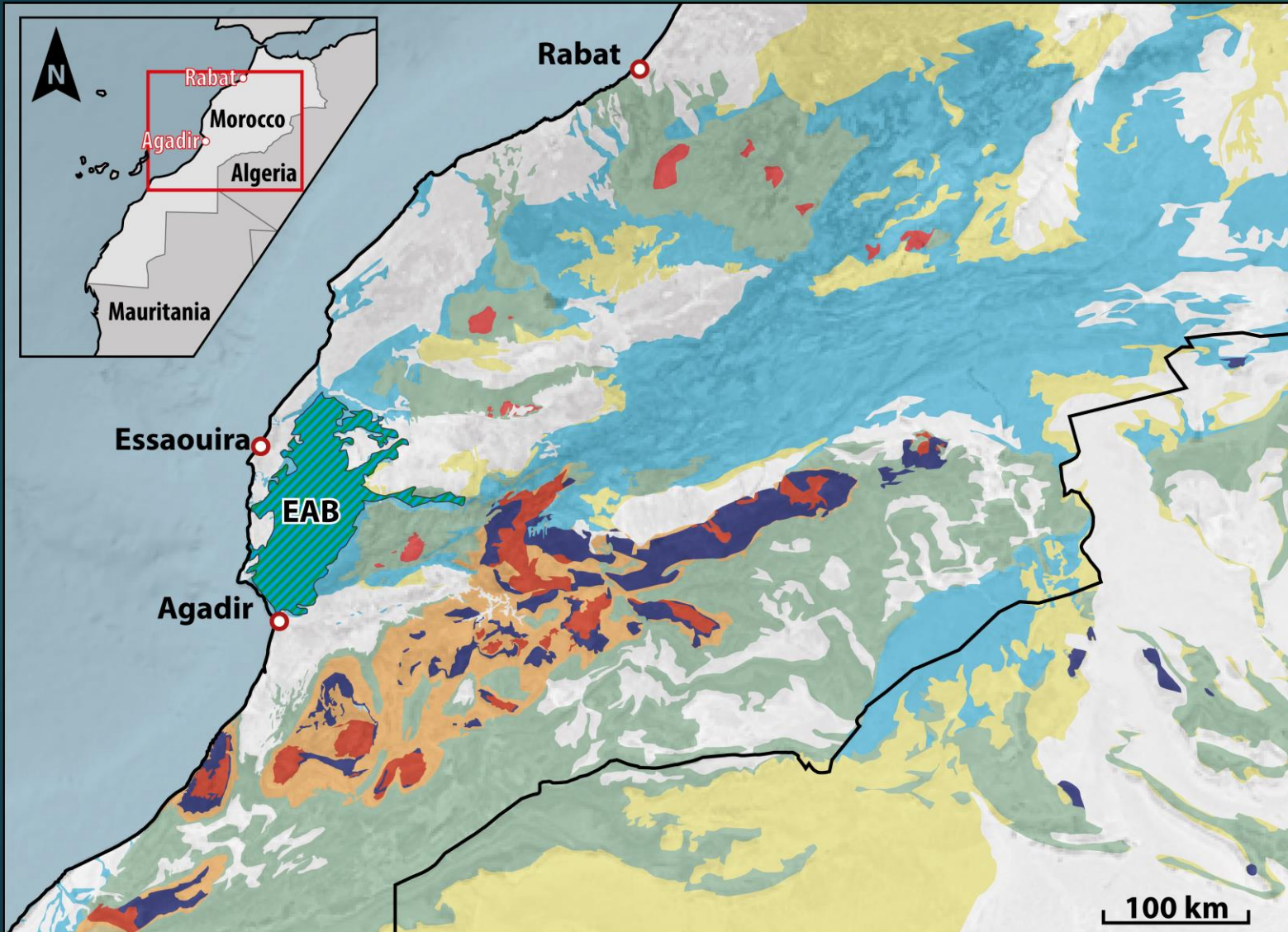


Potential Source Terrains of the EAB



- Central Meseta :**
 Hercynian magmatism,
 Cambrian and Carboniferous
 Metamorphic units
 Paleozoic magm. Paleozoic sed.
- Jebilet**
 Hercynian magmatism,
 Cambrian and Carboniferous
 Metamorphic units
 Paleozoic magm. Paleozoic sed.
- Massif Ancien de Marrakech**
 Hercynian and Panafrican
 magmatism, CAMP basalt,
 Cambrian/Ordovician fm.
 Paleozoic magm. Paleozoic sed.
 Precambrian Ignebrite Precambrian granite
- Eastern Anti-Atlas**
 Paleoprot. granite and
 Panafrican magmatism
 Paleozoic sed. Precambrian sed.
 Precambrian Ignebrite Precambrian granite

Potential Source Terrains of the EAB



- **Central Meseta :**

Hercynian magmatism,
Cambrian and Carboniferous
Metamorphic units

Paleozoic magm.

Paleozoic sed.

- **Jebilet**

Hercynian magmatism,
Cambrian and Carboniferous
Metamorphic units

Paleozoic magm.

Paleozoic sed.

- **Massif Ancien de Marrakech**

Hercynian and Panafrican
magmatism, CAMP basalt,
Cambrian/Ordovician fm.

Paleozoic magm.

Paleozoic sed.

Precambrian Ignebrite

Precambrian granite

- **Eastern Anti-Atlas**

Paleoprot. granite and
Panafrican magmatism

Paleozoic sed.

Precambrian sed.

Precambrian Ignebrite

Precambrian granite



- Petrography and mineral distribution
- Zircon U/Pb ages (ultimate Source)
- Pb in K-Feldspar (1st origin)
- Heavy mineral analysis

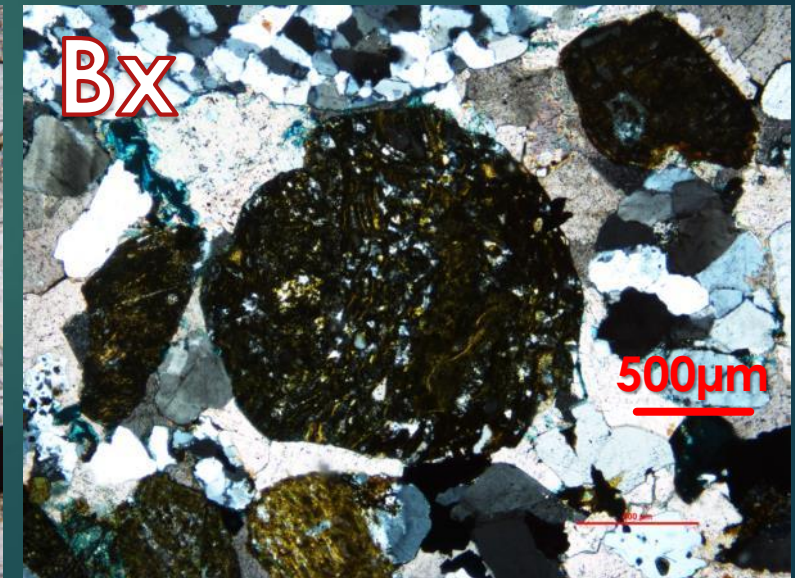
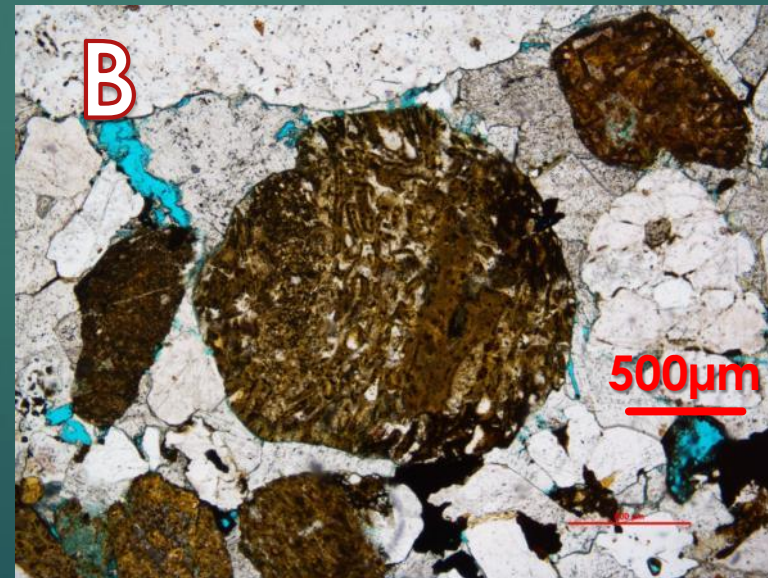
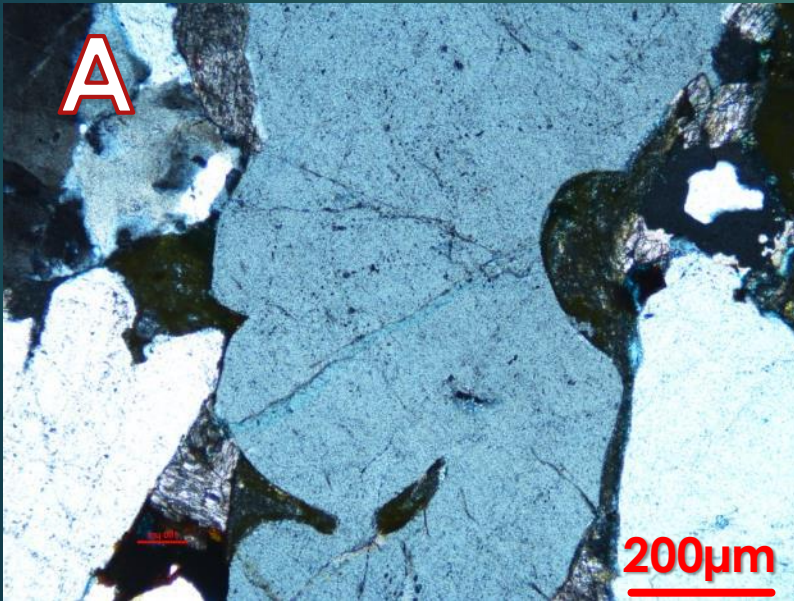
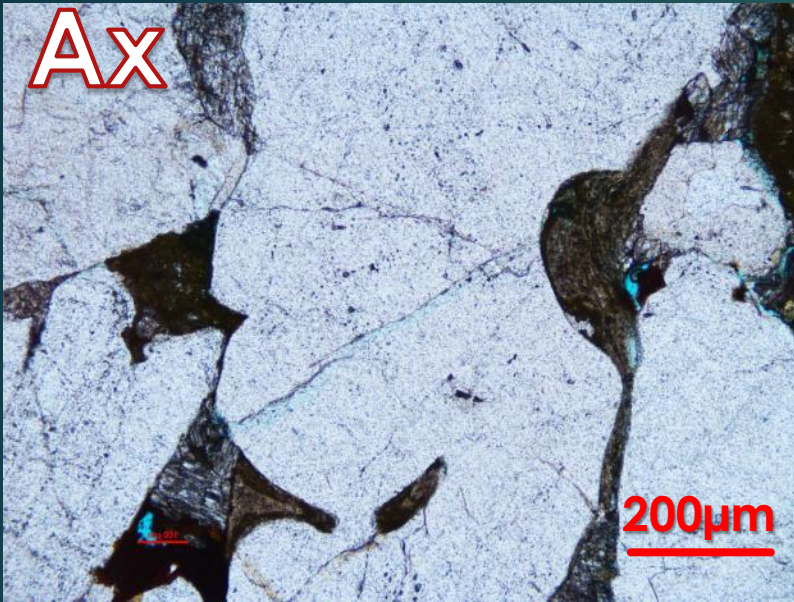
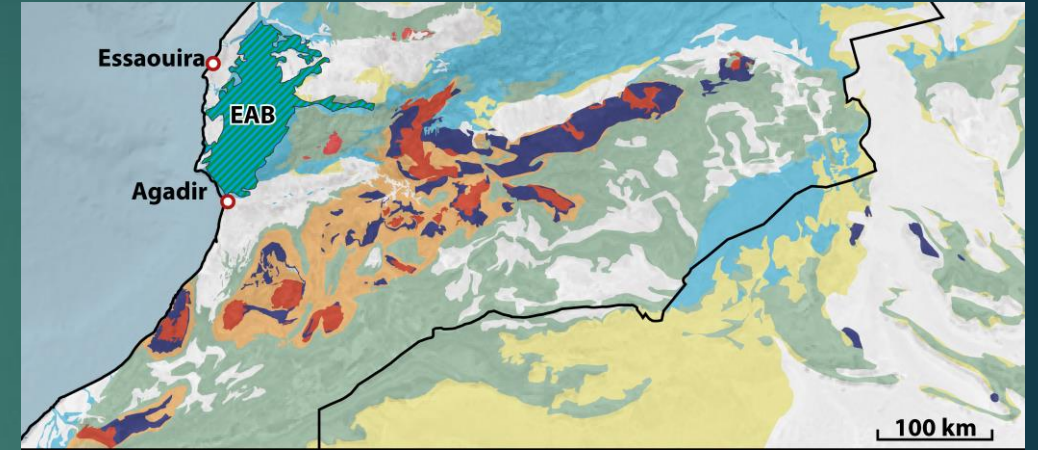


Petrography: Volcanoclastics

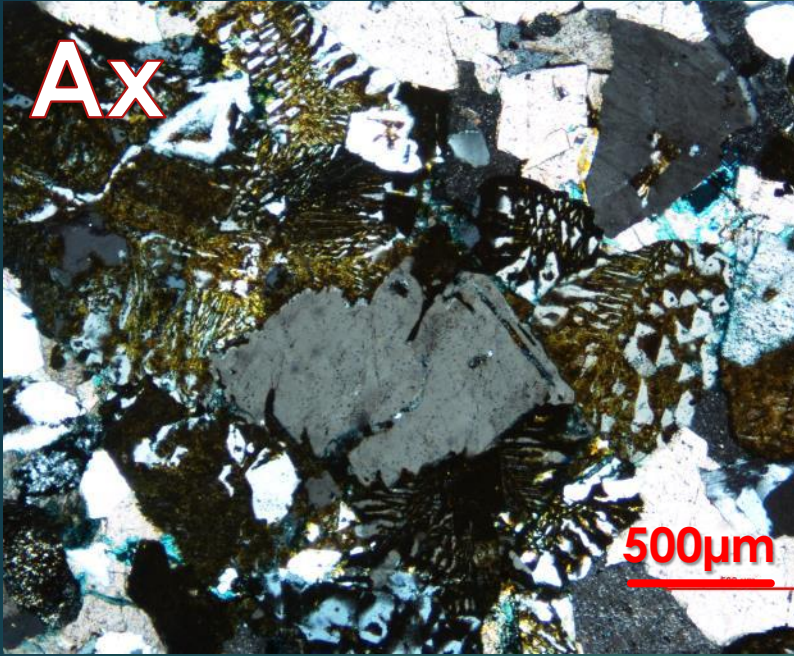
Volcanoclastics :

← Embayed Quartz
(pyroclasts ?)

Pumice ?



Ax

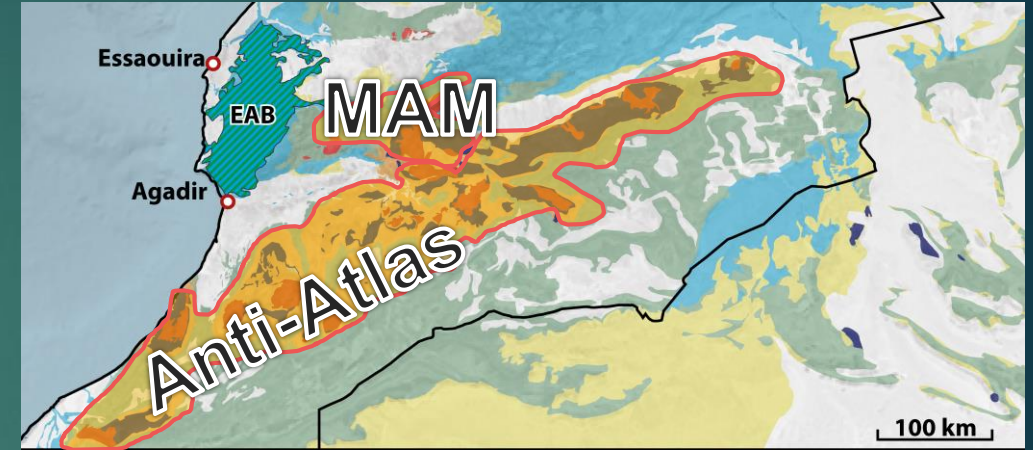


Petrography: Volcanoclastics

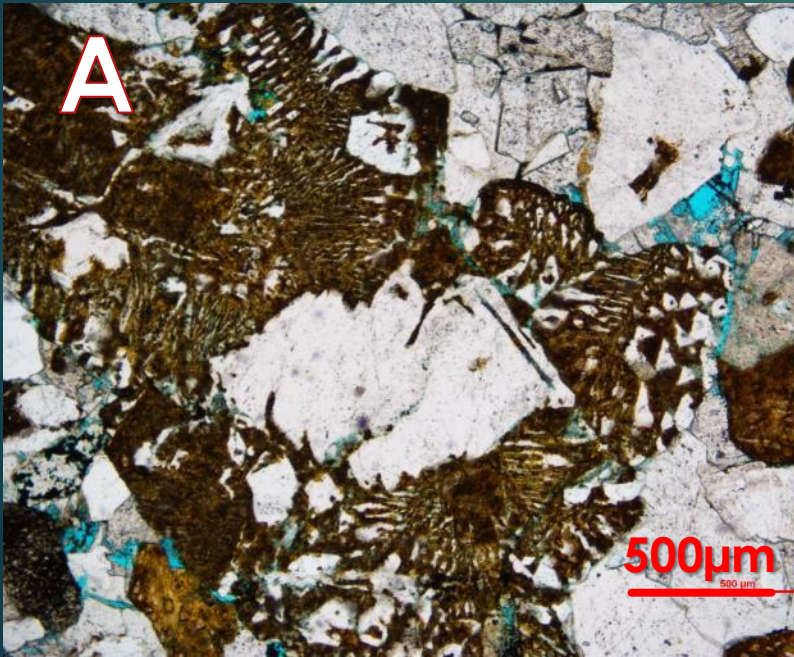


Granophyric texture

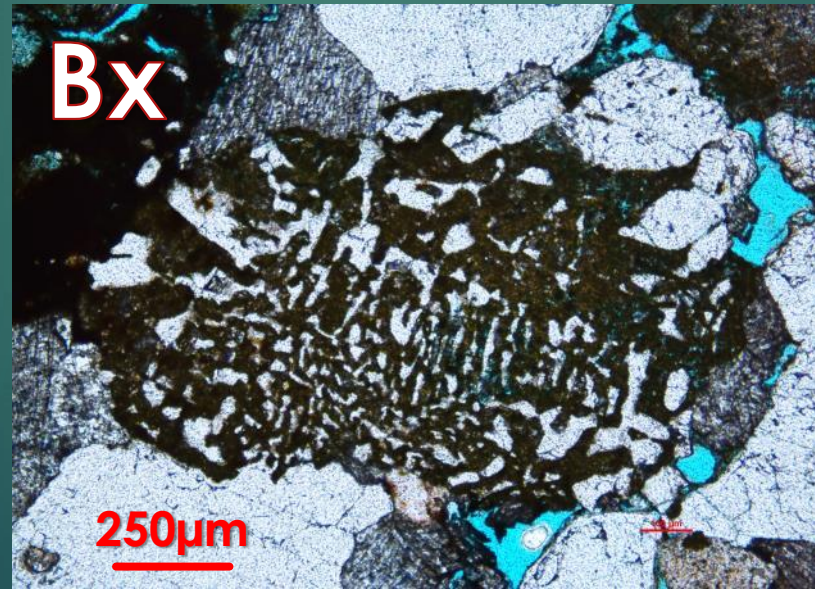
Presumed source:
Anti Atlas or MAM



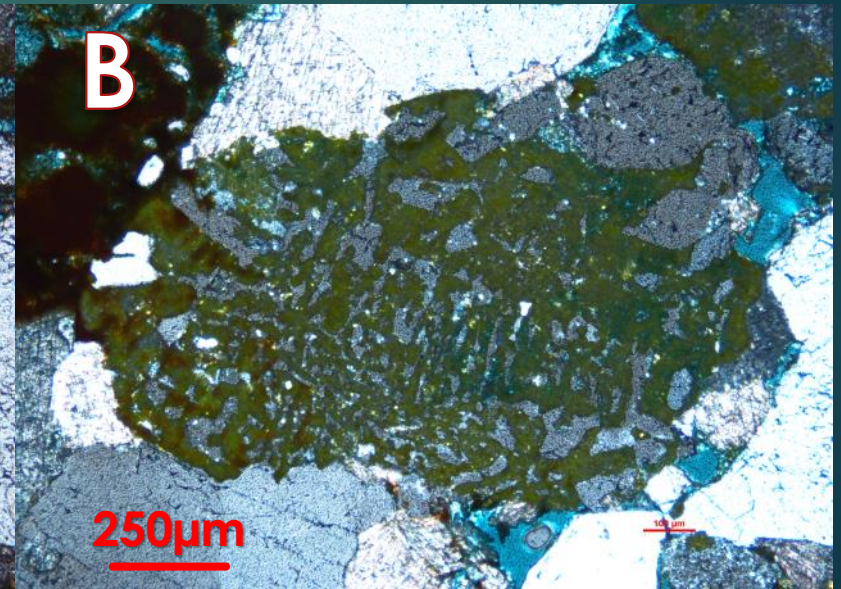
A



Bx



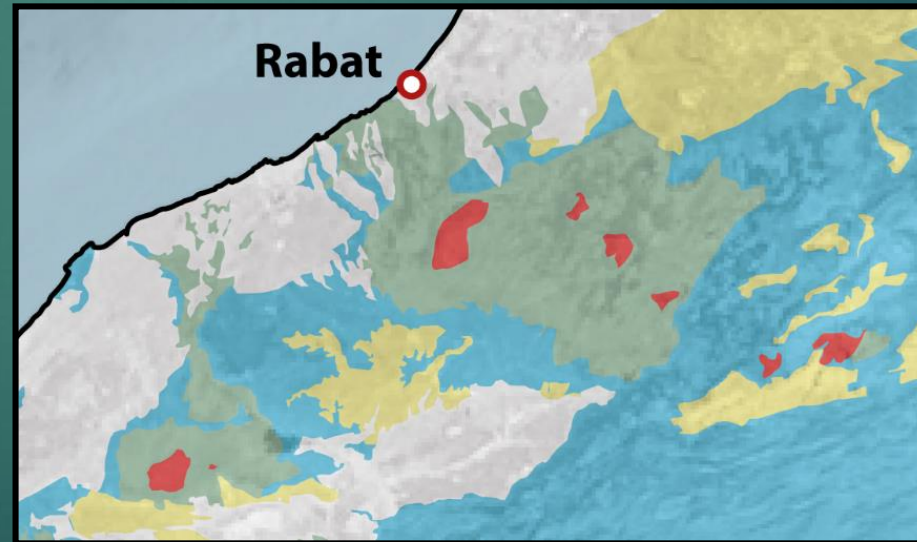
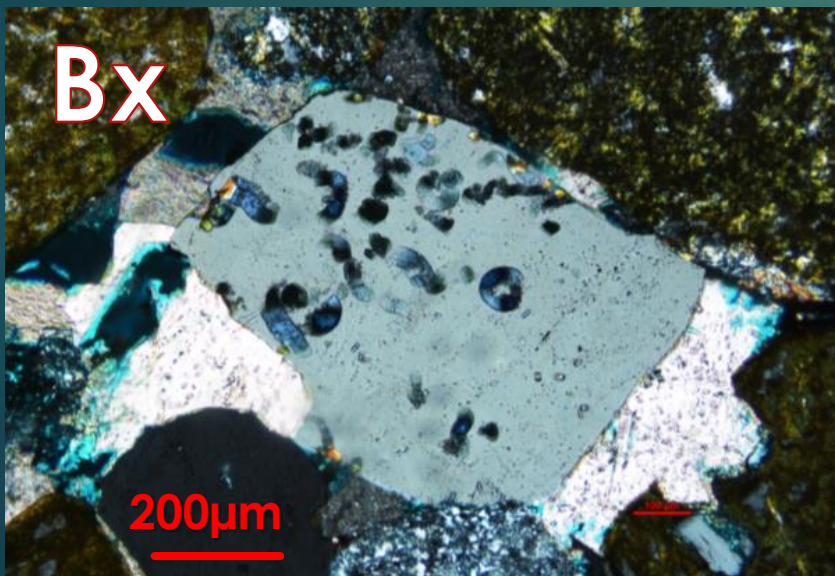
B





Petrography: Hydrothermal metamorphism

Presumed source:
Western Meseta



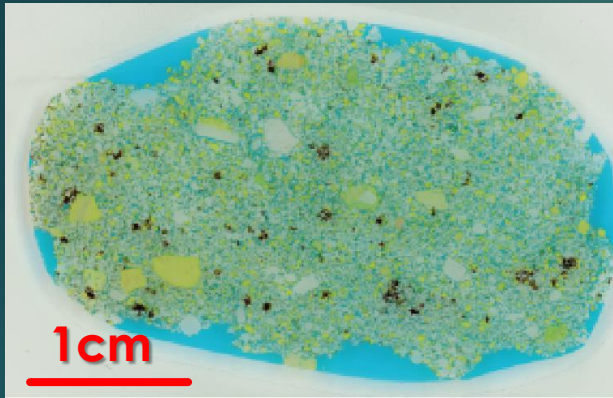
Assessing recycling



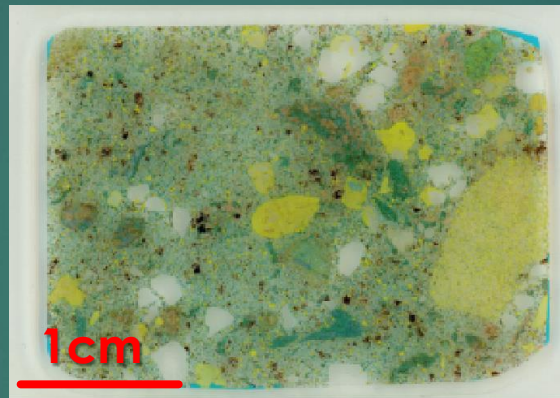
Feldspars contributions :

- 1st origin (unlikely to survive recycling)
- Provenance tool (Pb isotopes)

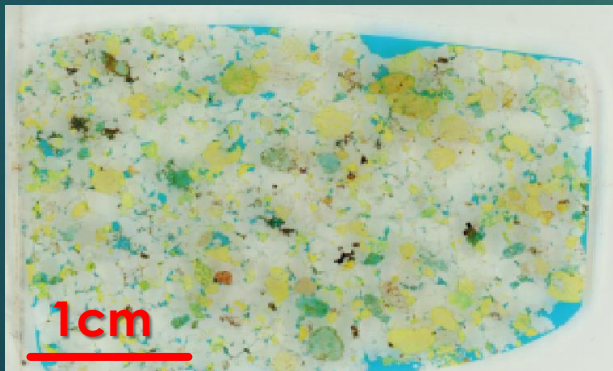
MTDAN 863



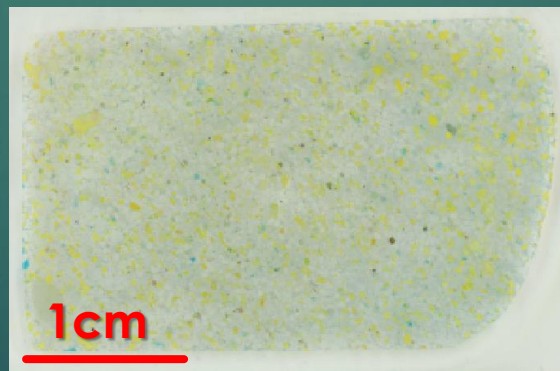
MTMH 722



MTBR 837



MTII 702



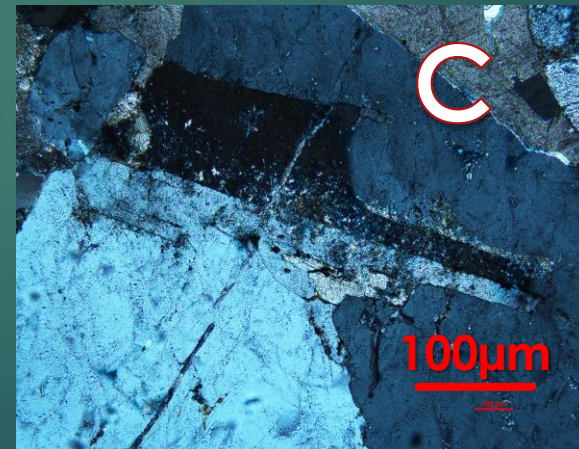
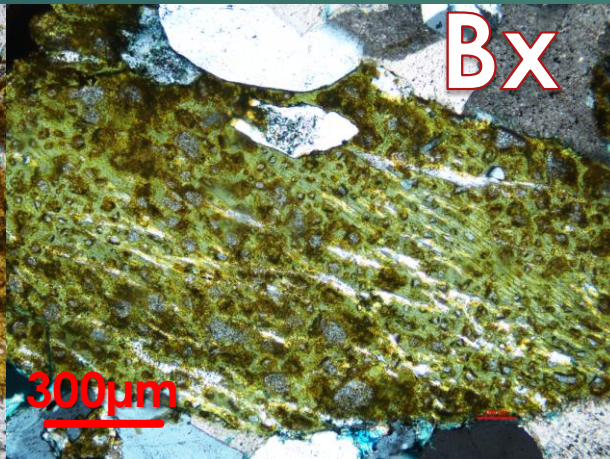
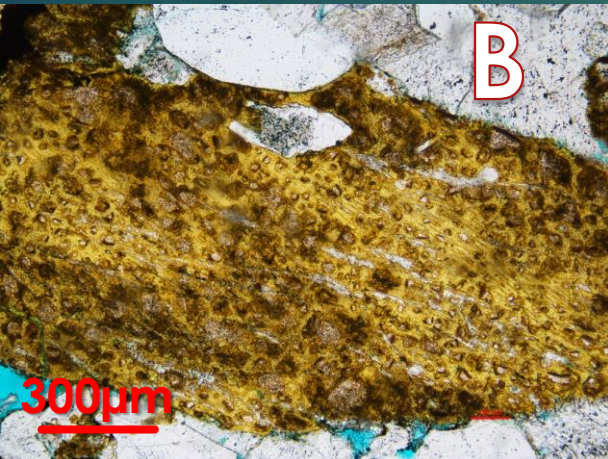
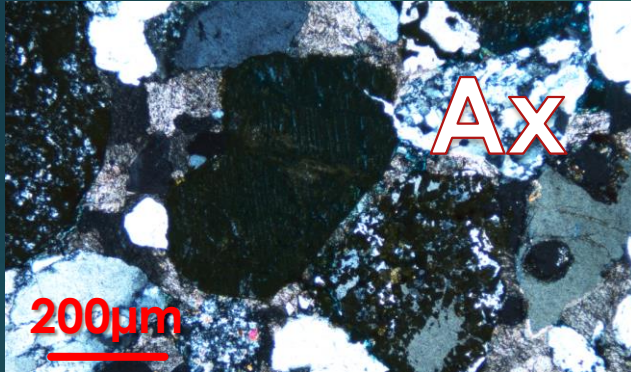
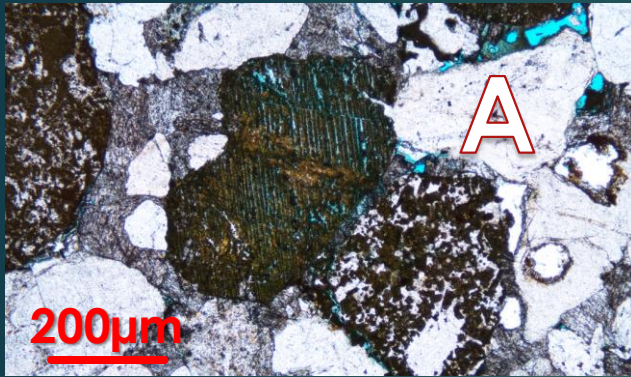
Staining with SCN of thin sections to quantify the amount and morphologies of the K-Feldspar populations



Recycling of the sediments : 1st or 2nd origin ?

Feldspars contributions :

- 1st origin (unlikely to survive recycling)
- Provenance tool (Pb isotopes)

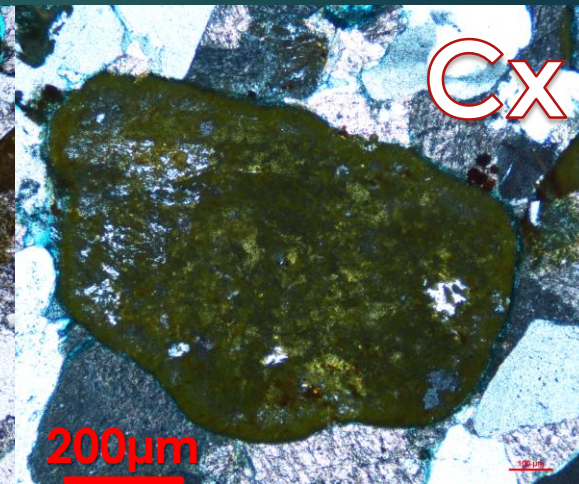
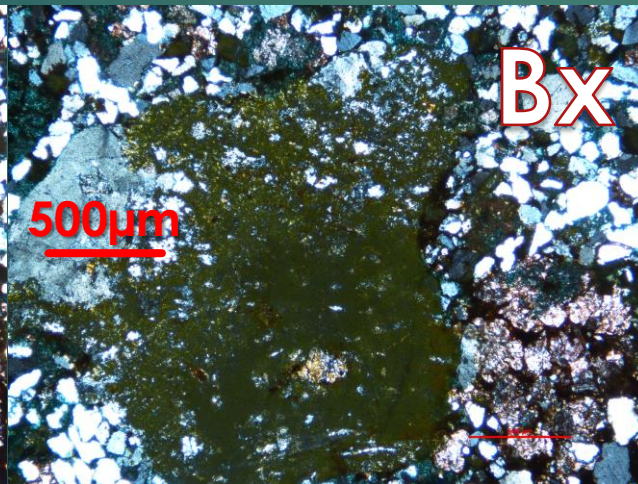
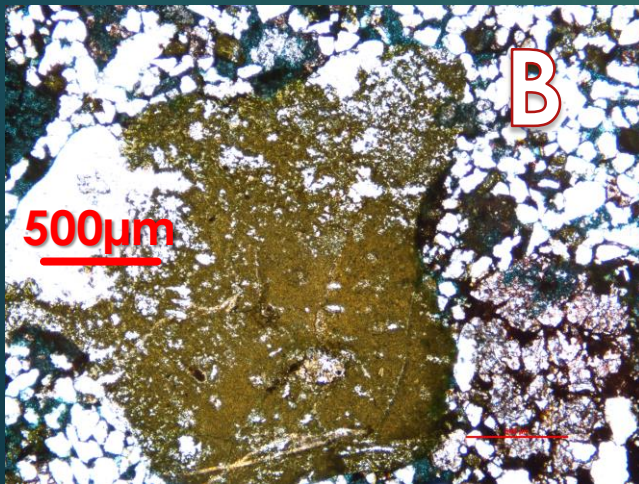
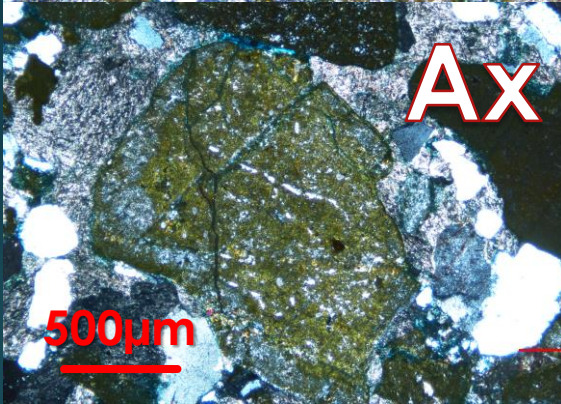
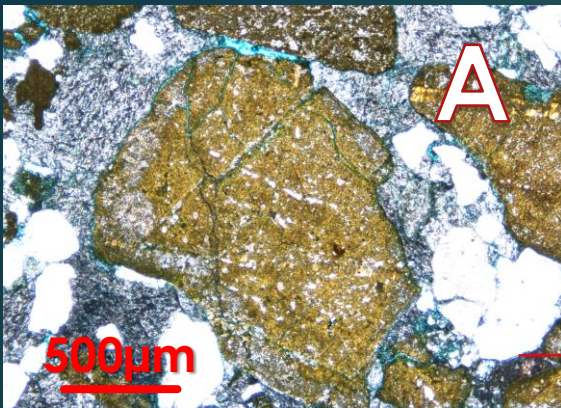




Recycling of the sediments : 1st or 2nd origin ?

Feldspars contributions :

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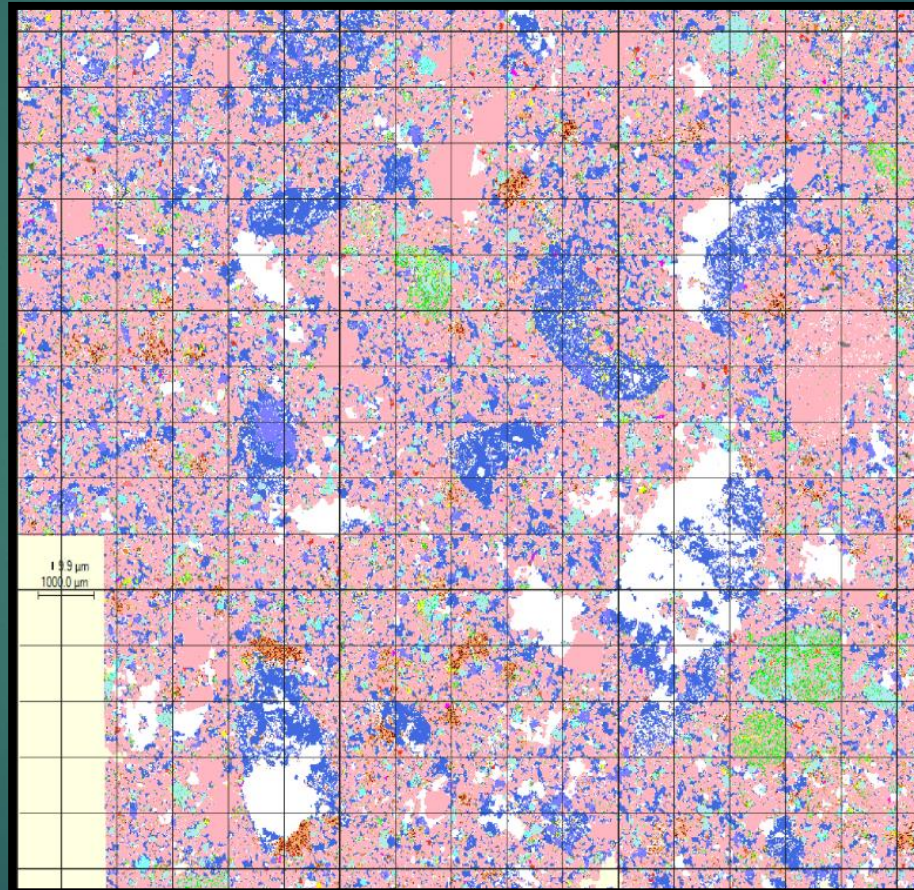


Recycling of the sediments : 1st or 2nd origin ?



QEMSCAN analysis :

- Texture information,
- Cement nature,
- Diagenetic features,
- porosity
- Feldspars state of weathering

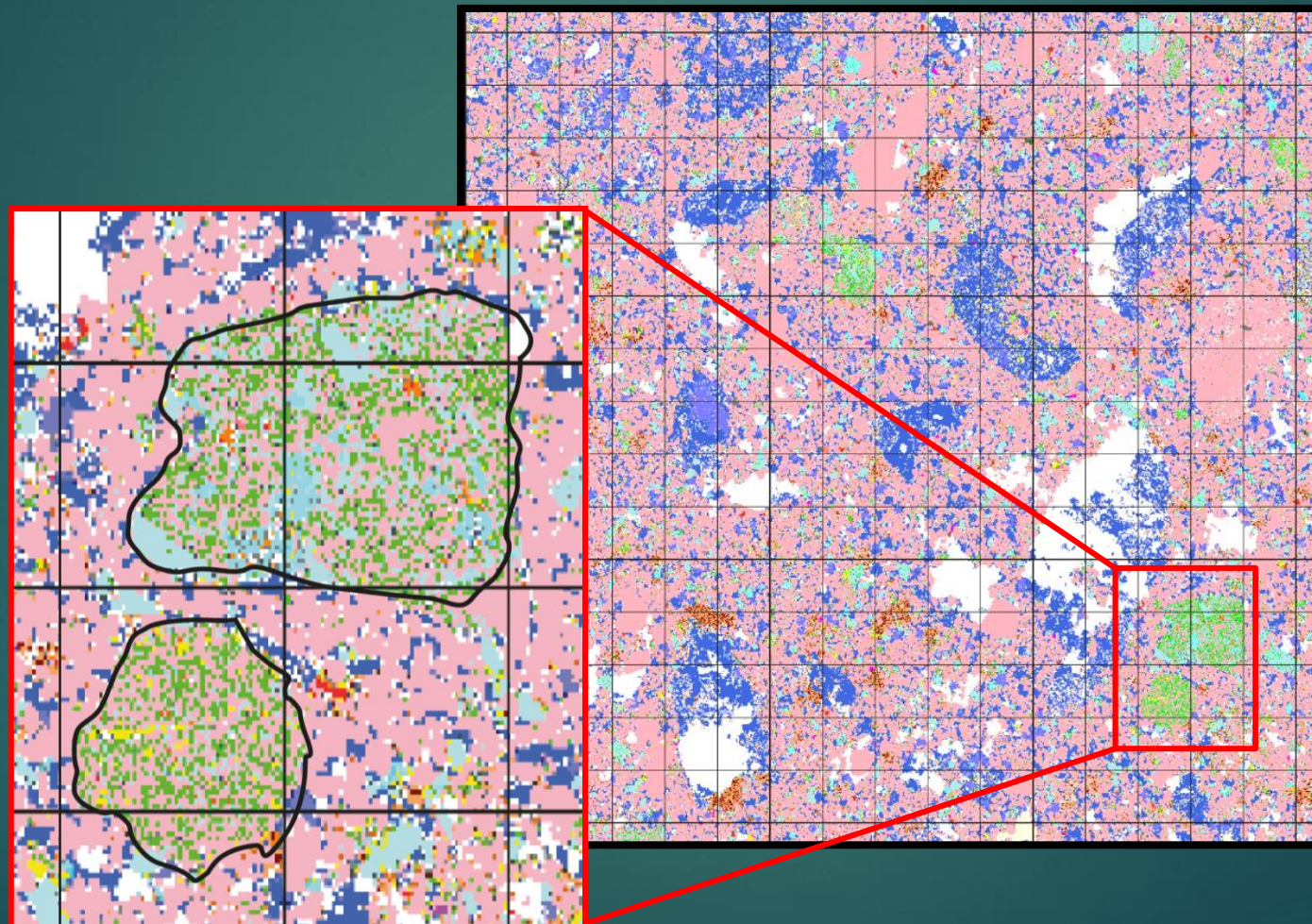


QEMSCAN
mineral map

Recycling of the sediments : 1st or 2nd origin ?



Pb-Pb on
K-Feldspar :
approach
challenged

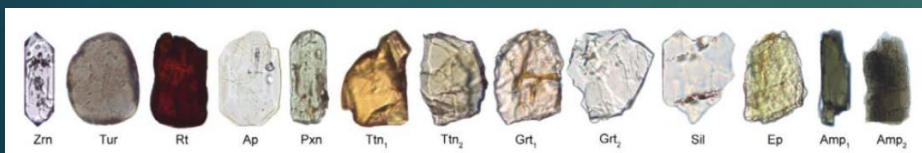
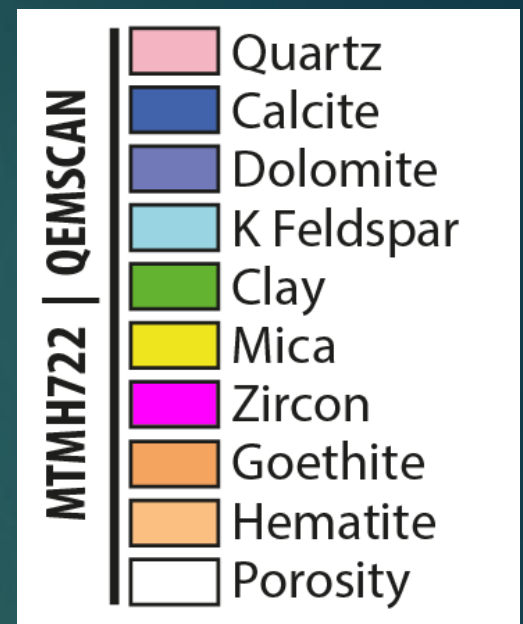
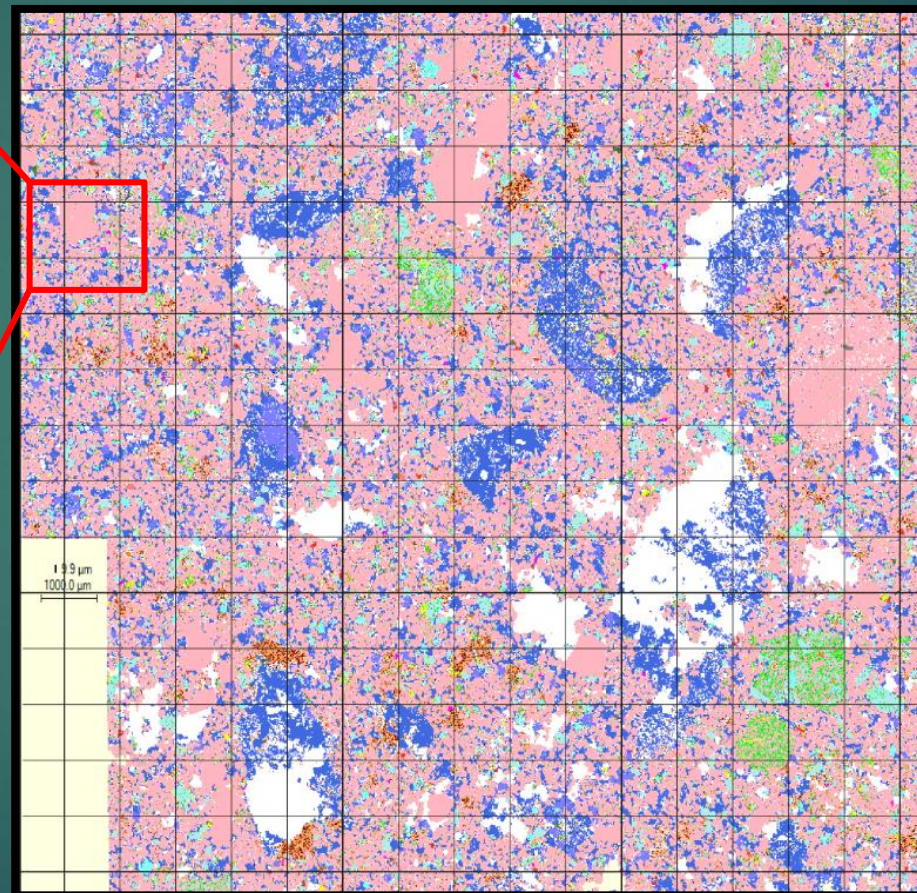
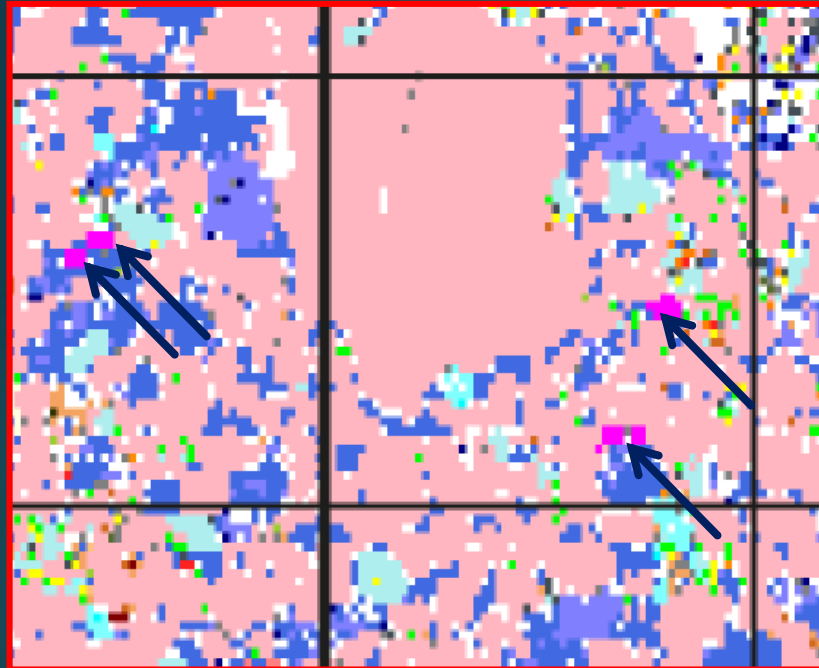


MTMH722 | QEMSCAN



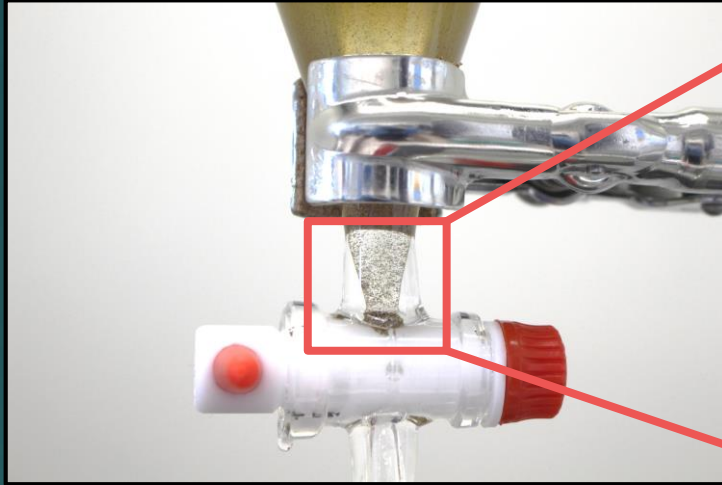
QEMSCAN
mineral map

Recycling of the sediments : 1st or 2nd origin ?



Good zircon, apatite and HM yield

Ongoing work : Heavy minerals



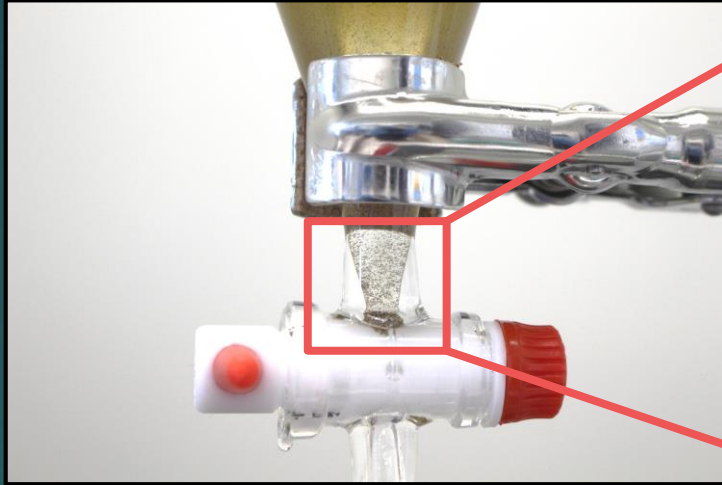
Heavy Minerals

Heavy mineral analysis:

- high yield of heavy minerals

Heavy liquid :
Lithium Heteropolytungstate
(2.85 g/ml)

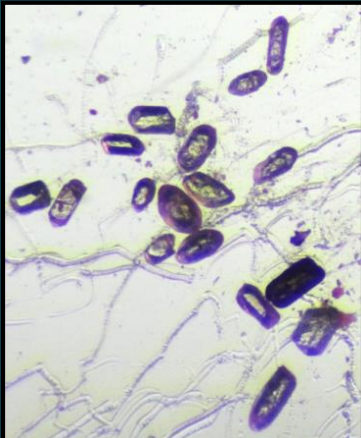
Ongoing work : Heavy minerals



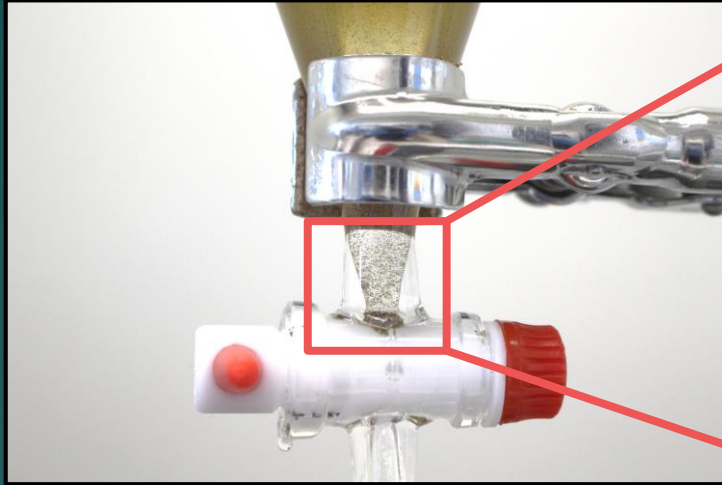
Heavy Minerals

Heavy mineral analysis:

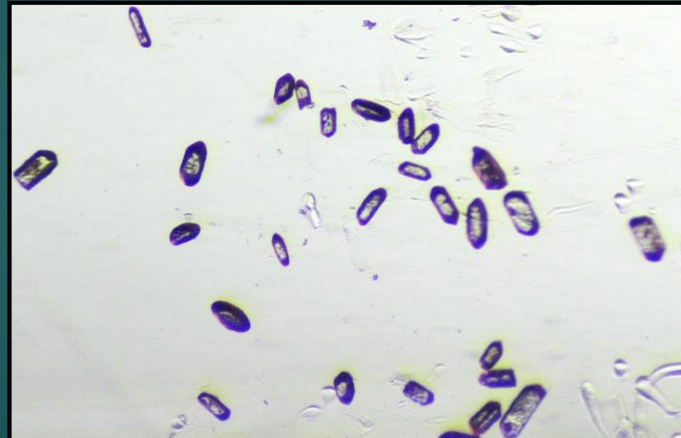
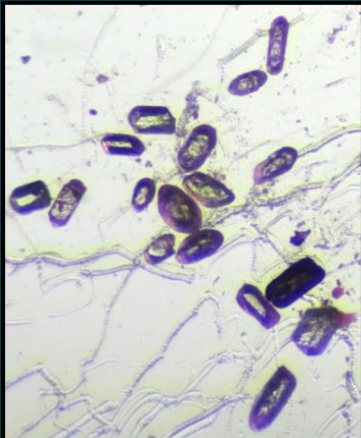
- high yield of heavy minerals
- **Numerous zircons**



Ongoing work : Heavy minerals



Heavy Minerals



Heavy mineral analysis:

- high yield of heavy minerals
- **Numerous zircons**

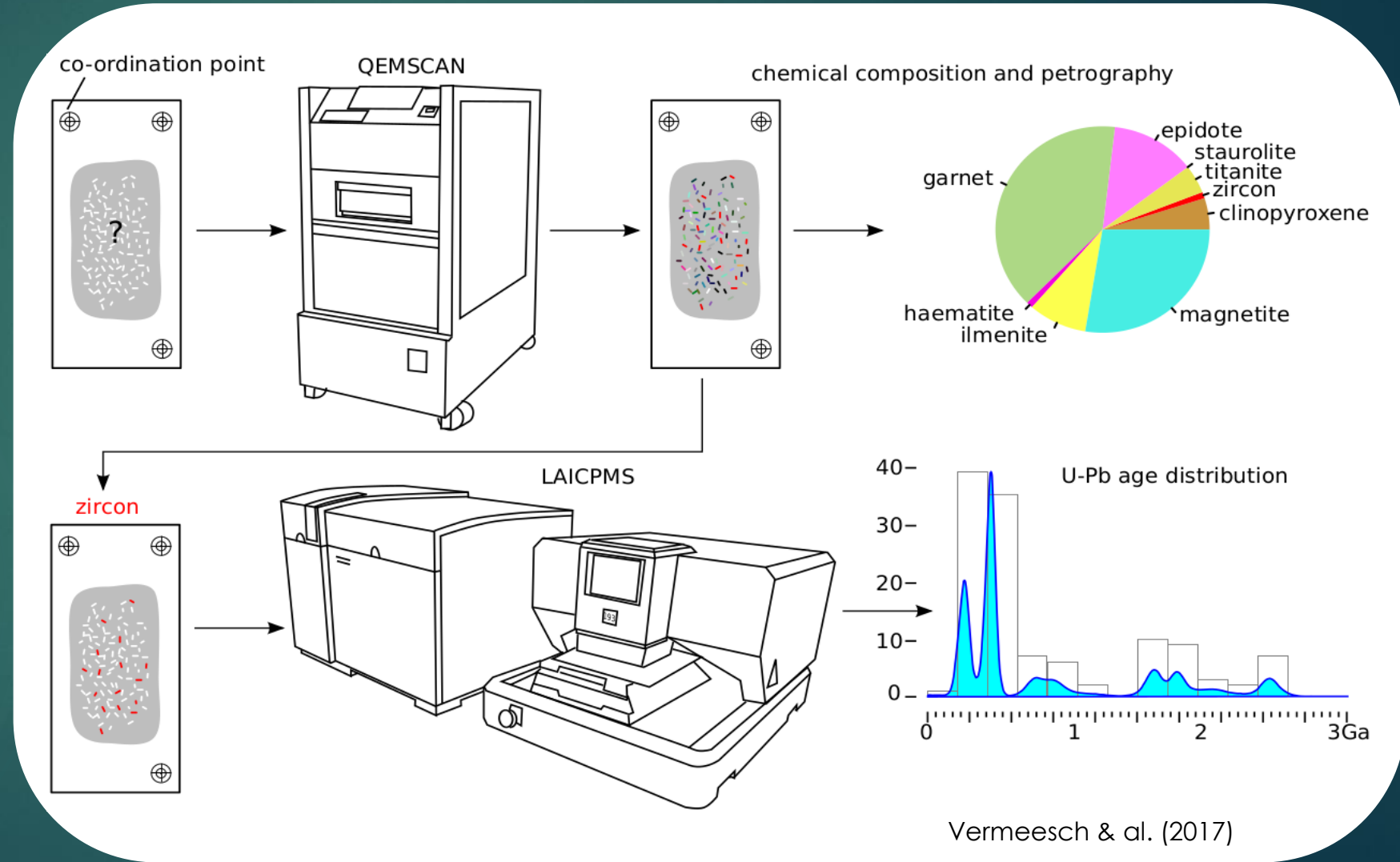
- **Good apatite yield**

Potential good replacement for feldspars as 1st cycle witness

Ongoing work : Heavy minerals



New methods being developed to **analyse and date heavy minerals** in the same sample

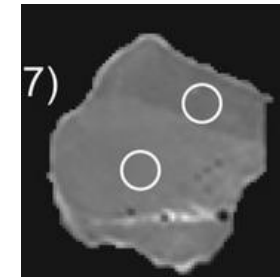
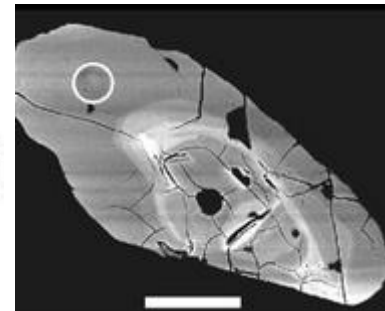
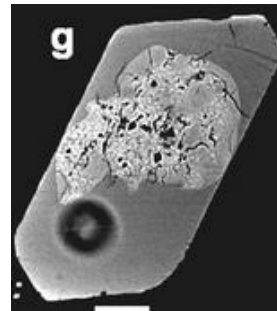
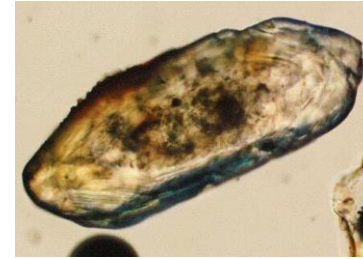
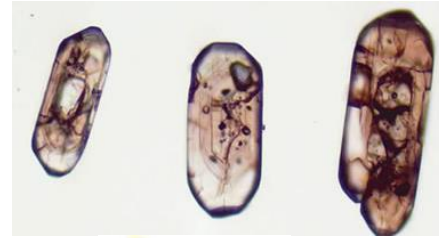


Ongoing work : Heavy minerals



New methods
being
developed to
analyse and
date heavy
minerals in the
same sample

Avoid biases
associated with
picking and
sample splitting !





Next steps :

Short Term

- **Quantification** of the **minerals distribution**
- Set up of a heavy mineral separation lab in Manchester
- Processing of the sst samples (crushing, sieving & heavy liquid separation) }
 - Crushing (Liverpool)
 - Sieving (Manchester)
 - HL Sep. (Galway/Manchester)

2018

- Feasibility study of the automated approach
- **U/Pb dating** of detrital zircons and apatites, Heavy mineral analysis
- Potential sampling of the sources



Thank you for your support



Special thanks to



Research partners :

