

The ITRAX Core Scanner : a non-destructive tool for the chemostratigraphic analysis of drill cuttings and split cores by X-ray fluorescence (XRF)

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During exploration, when log has failed to provide any stratigraphic framework diagnostic, continuous XRF can be used to determine where you are within the stratigraphy. Split cores or drill cuttings could be useful for non-destructive and fast acquisition of data. Indeed, element profiles along the cores could help in understanding the geochemical element content and distribution.

The ITRAX Core Scanner



In few hours the scanner allows to acquire:

- A high resolution optical image (1)
- A micro-radiography record (2),
- Very high resolution elemental analysis
- The magnetic susceptibility

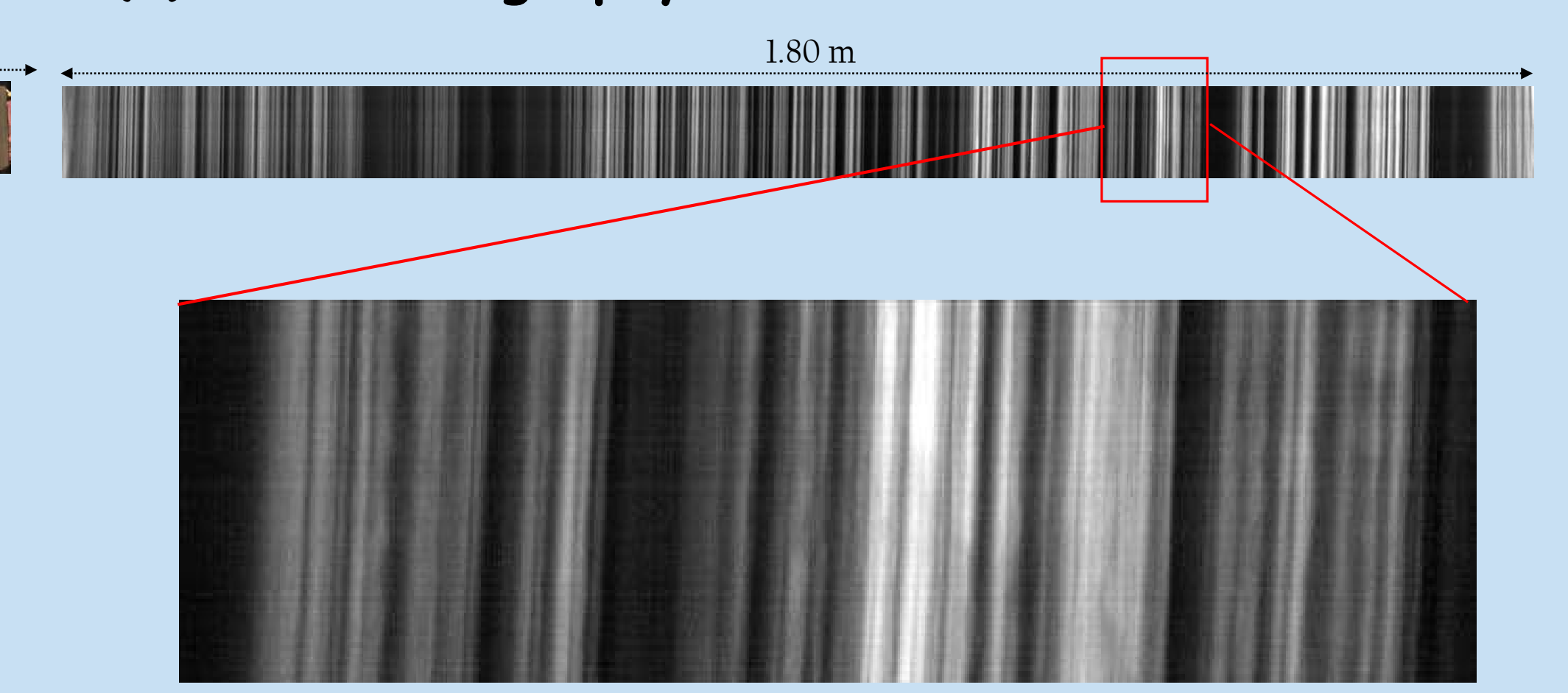
Providing respectively:

- Colour informations,
- Micro-density and structural variations,
- Records of down-core geochemical changes.

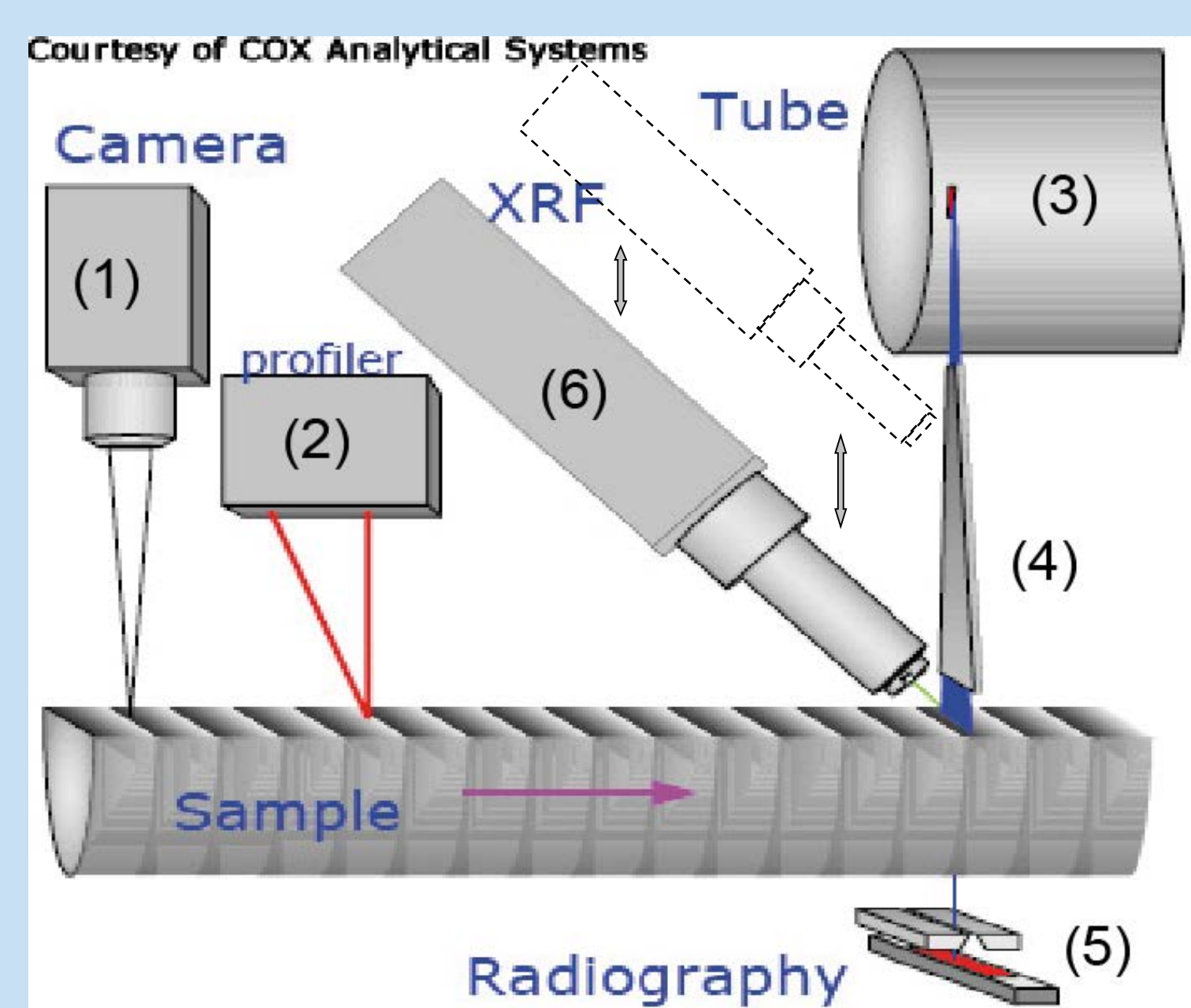
(1) Optical image:



(2) Microradiography:



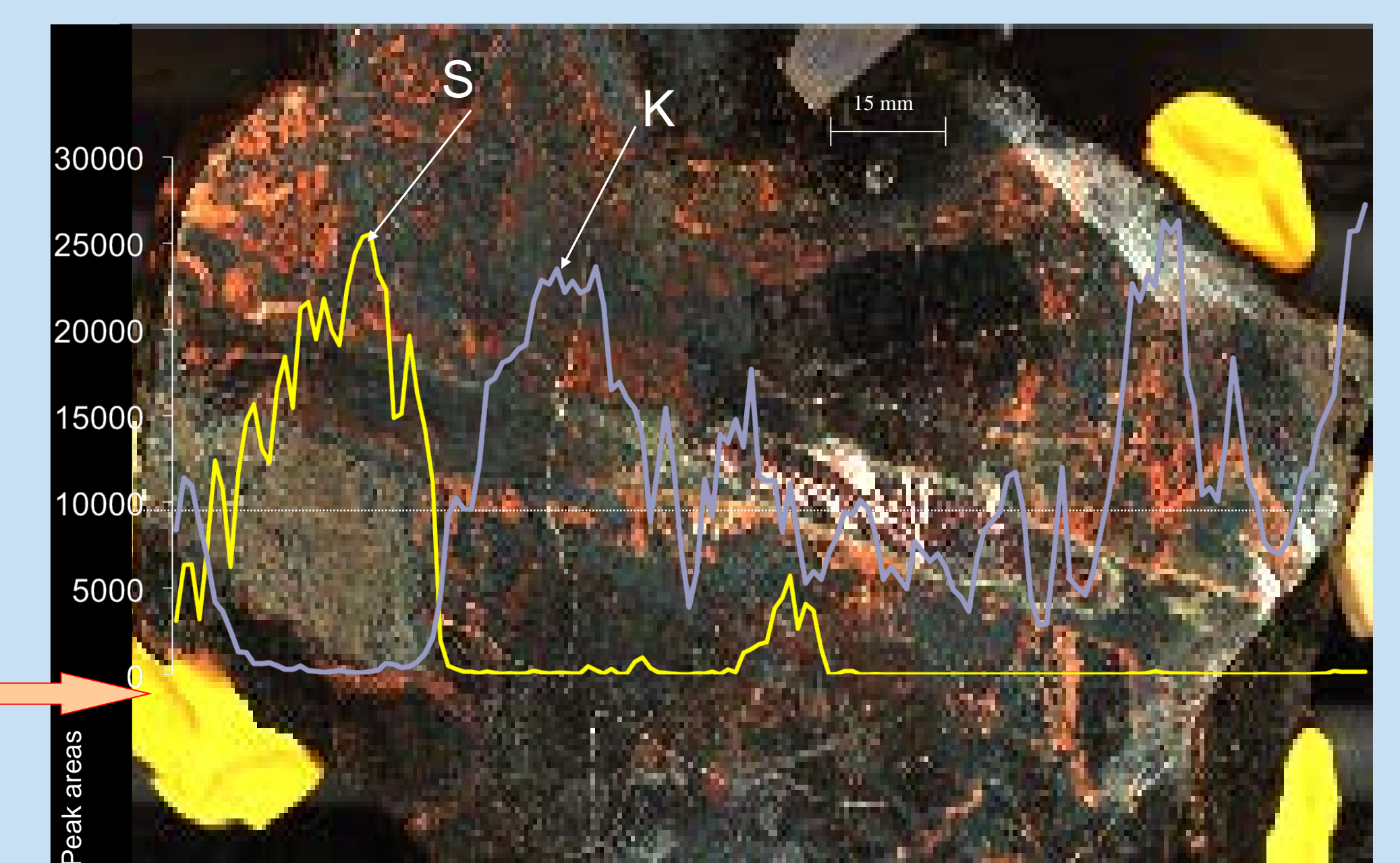
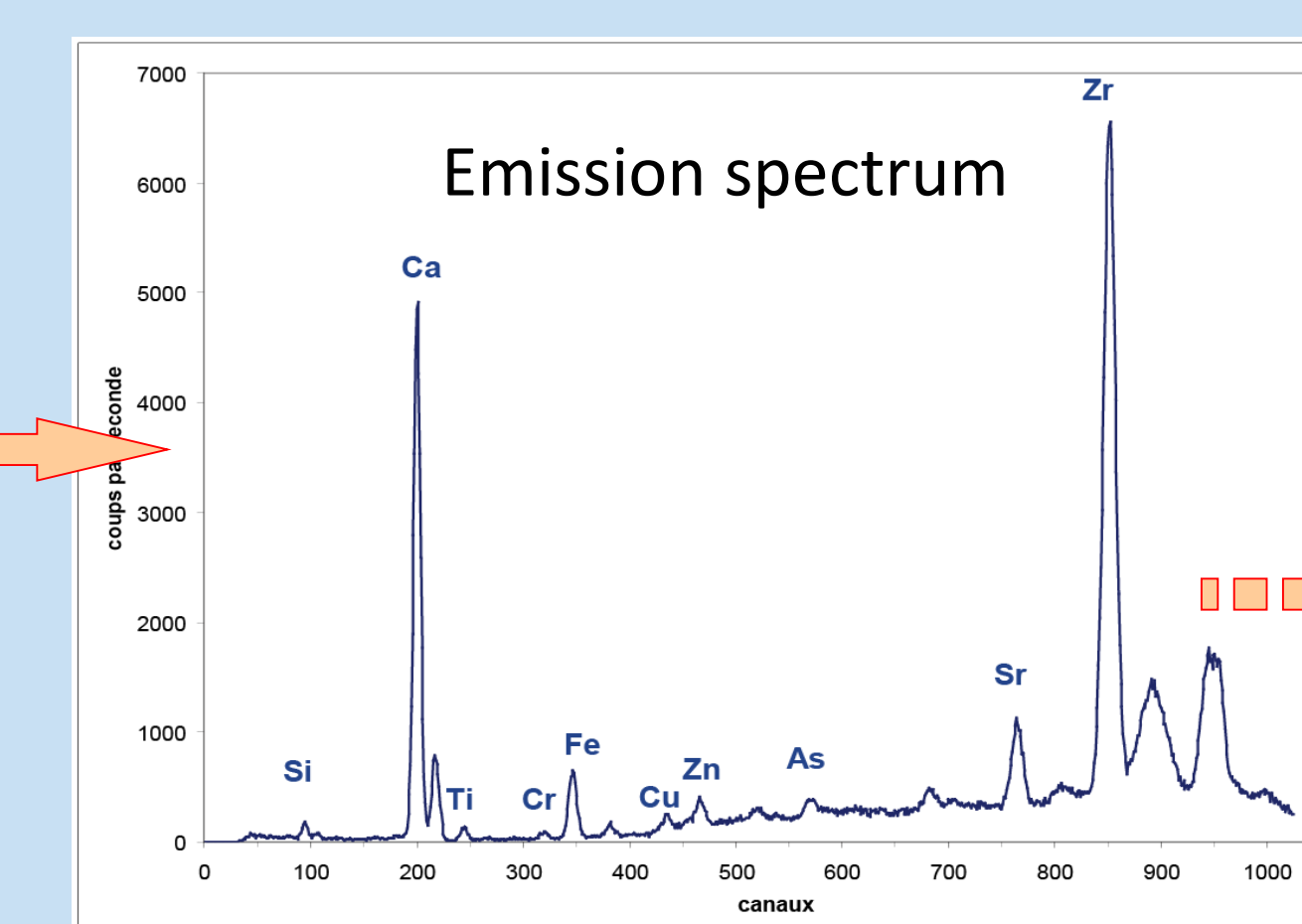
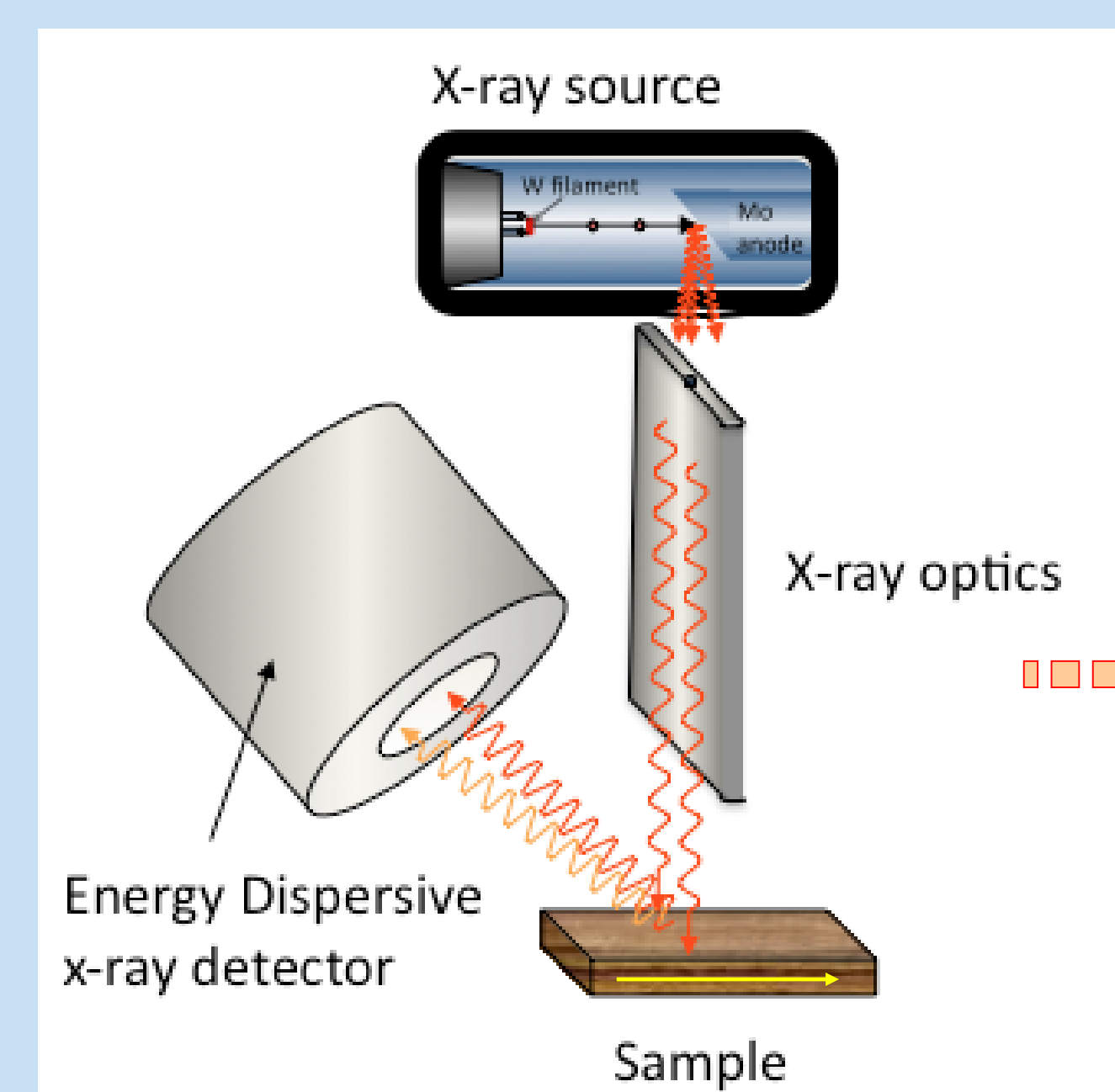
The principle setup



- (1) New high resolution RGB colour camera (Pixel size : 0.05mm, Image width: 80 mm)
- (2) Profiler,
- (3) X-ray tube anode (Rh, Mo or Cr),
- (4) A flat-beam capillary x-ray optic,
- (5) Radiograph detector:
 - ☞ Resolution: 0.1 mm
 - ☞ 65000 grey levels,
- (6) Energy dispersive X-ray spectrometer (EDS):
 - ☞ Scan resolution : 100µm,
 - ☞ Effective spotsize: 0.1 x 4 mm,

How does fluorescence work ?

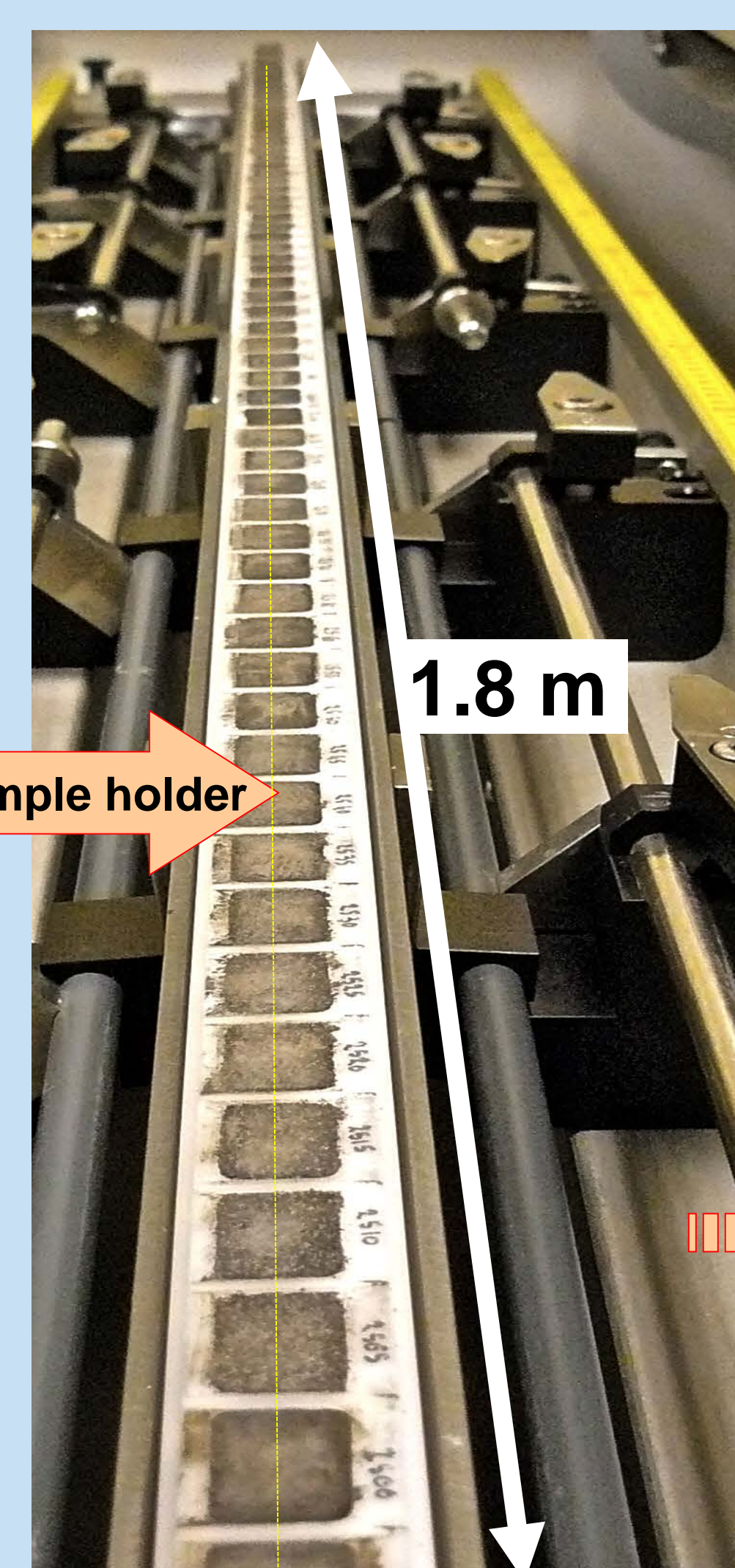
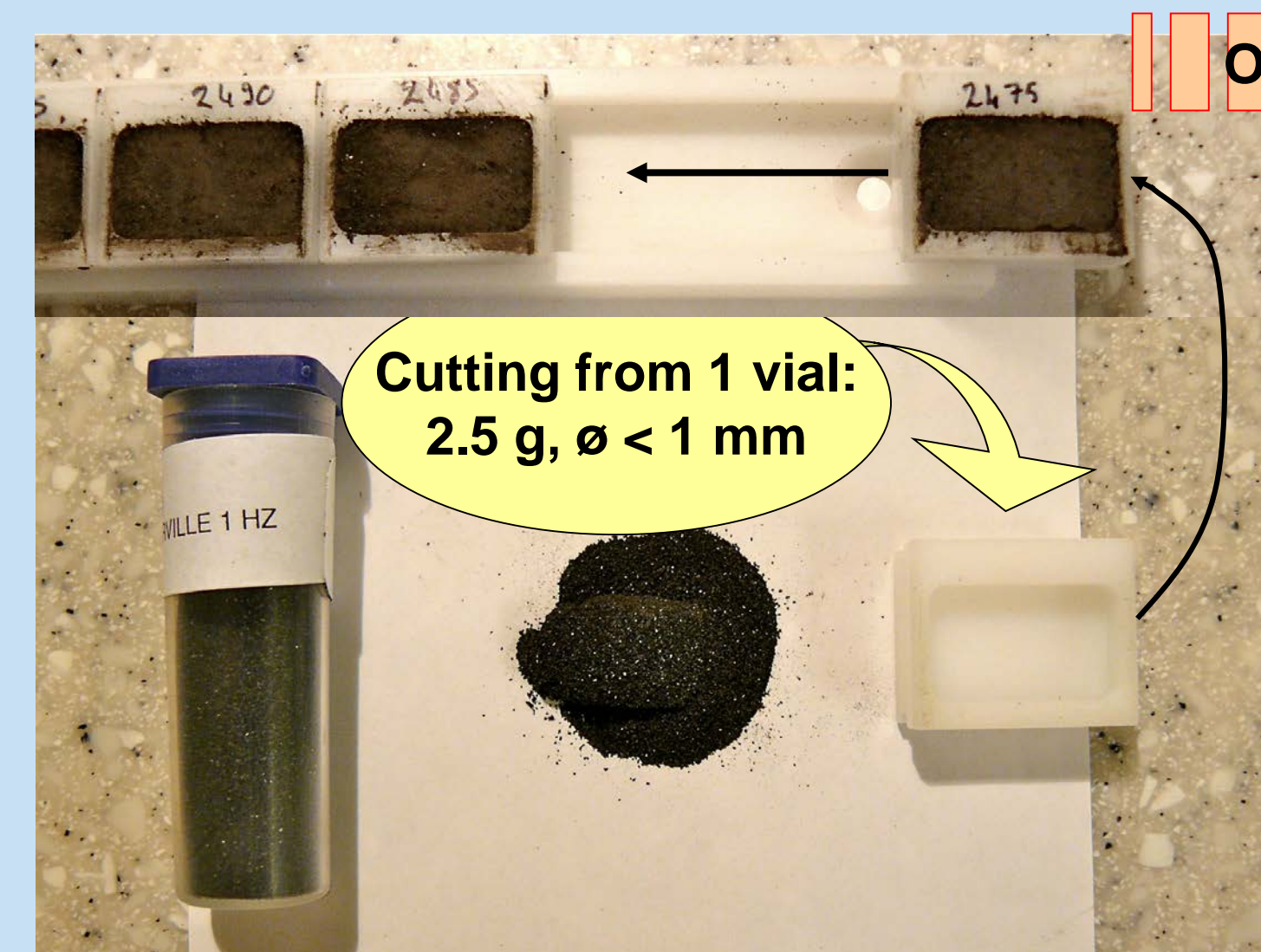
- ☞ Data from Al to U are recorded,
- ☞ Detection limit of most elements: 20 ppm.



The continuous analysis is performed without touching the sample and is completely non-destructive

Drill cuttings:

- ☞ 1 batch: 68 vials (340 meters depth covered),
- ☞ 10 individual measures per vial (yellow dots)
- ☞ Process time ≈10 hours



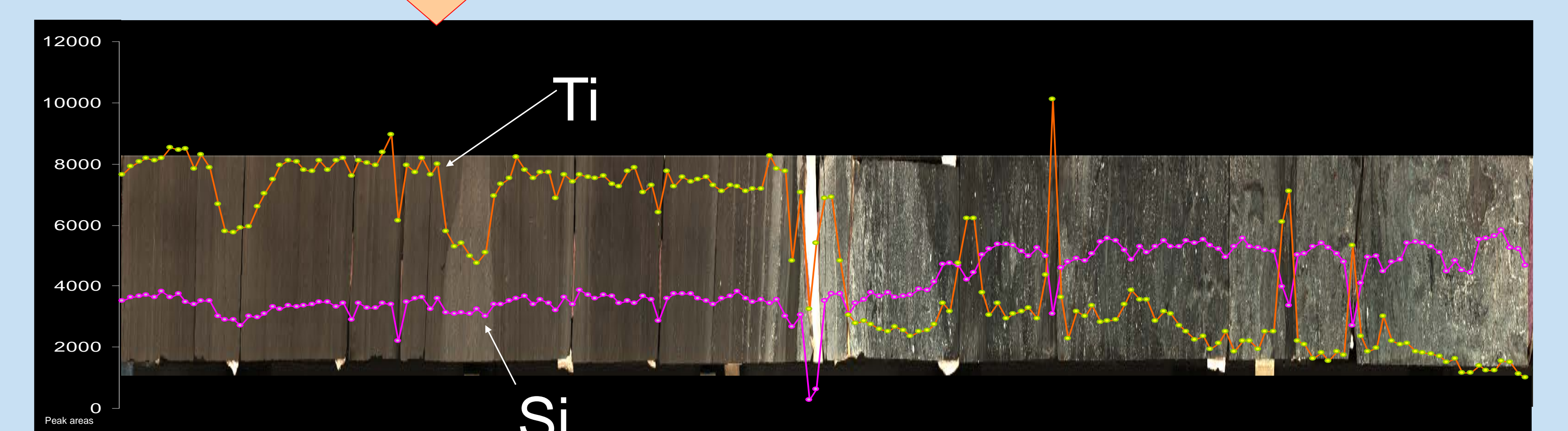
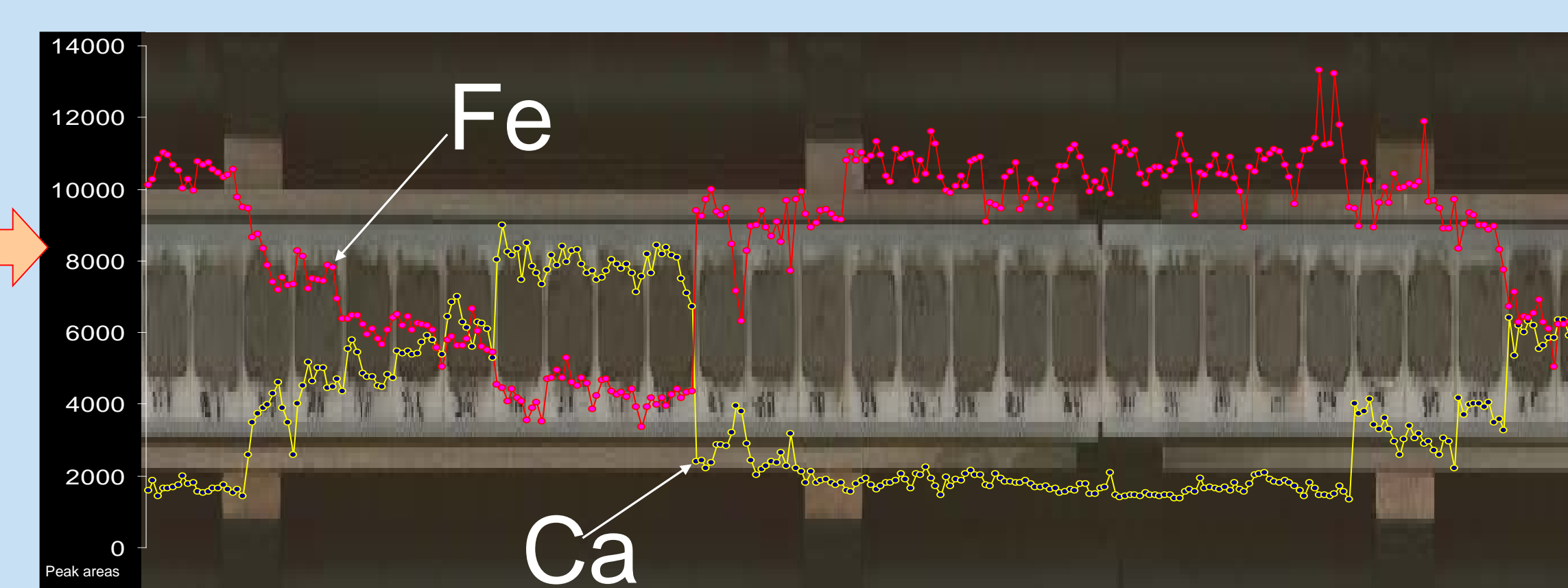
Input materials

Split core:

- ☞ 1 batch: 1.8 m covered,
- ☞ Stepsize: 1 cm (see yellow dots),
- ☞ 178 data points,
- ☞ Process time ≈1.5 hours.



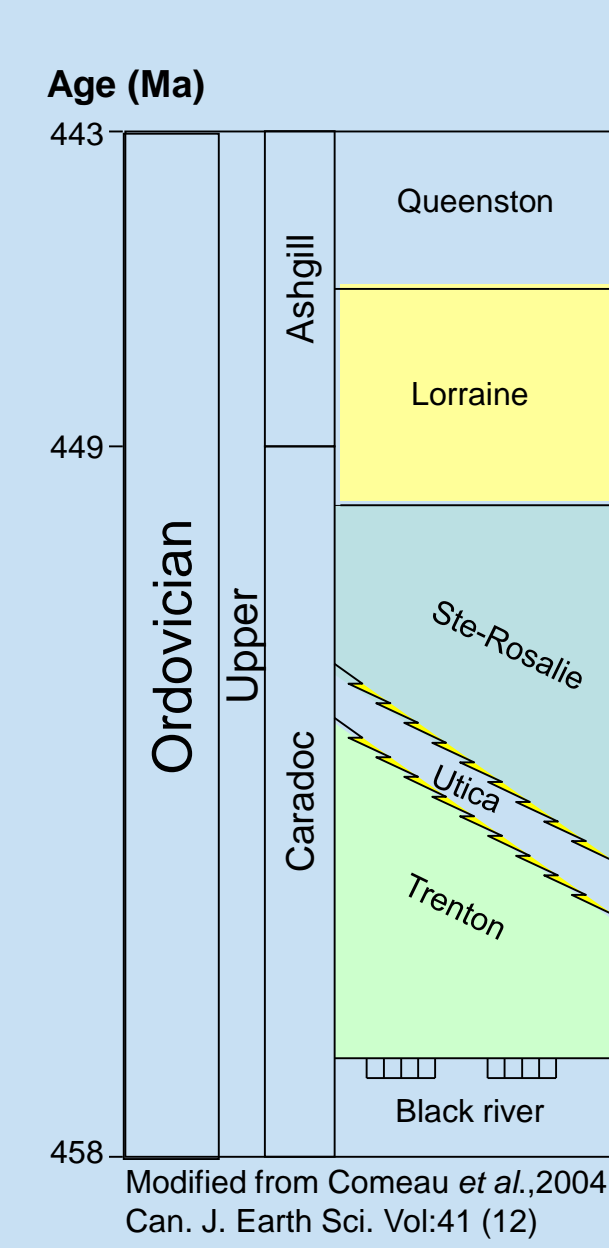
Output examples



XRF result analyses

Based on their distribution, the elements yield useful informations about geological history and origin through proxies:

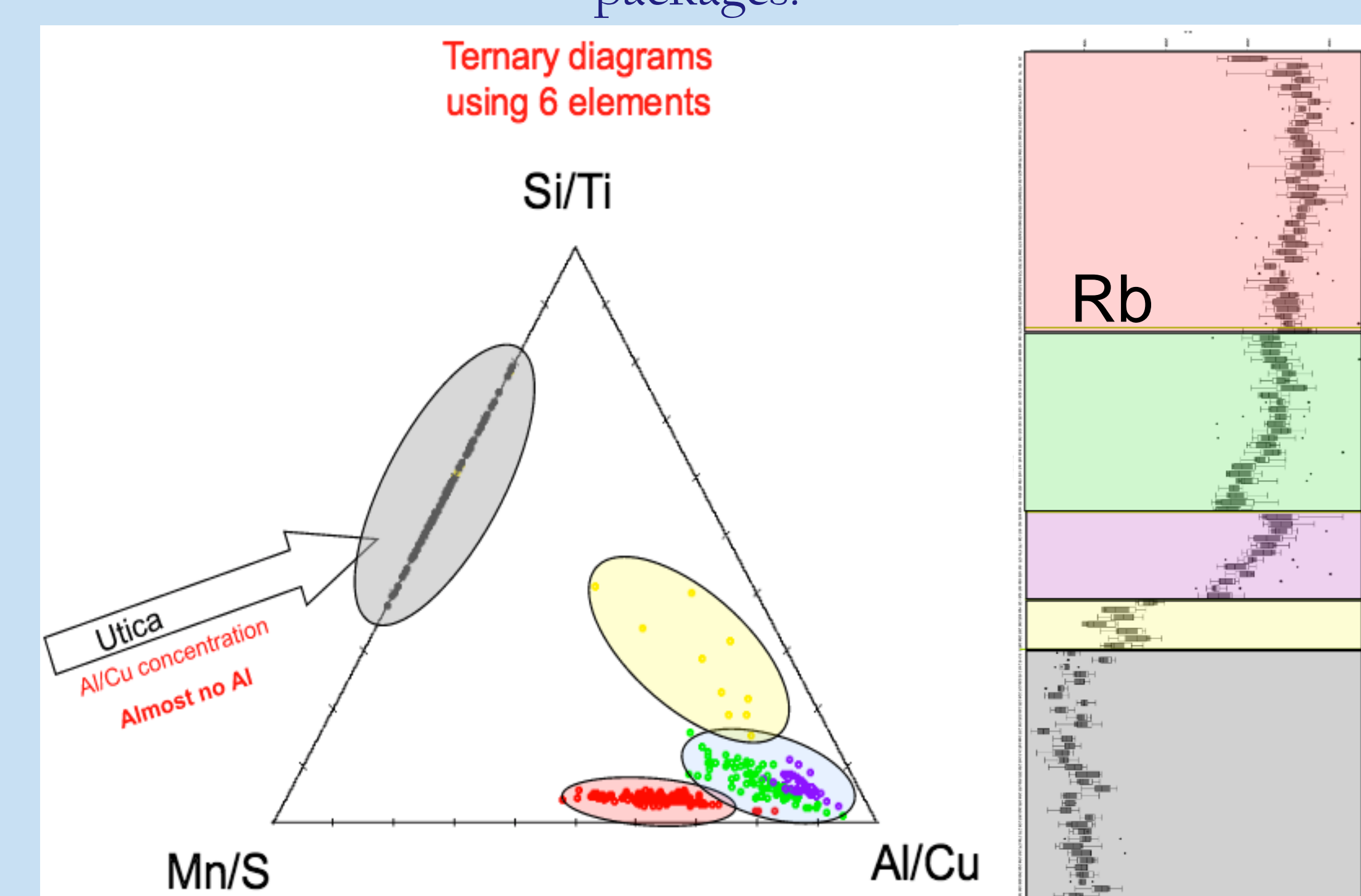
- Sedimentation rates,
- Oxidic/anoxic conditions
- Biogenic carbonate, silica
- Redox conditions
- Sediment grading
- Provenance studies
- Dynamic of particles



Chatellier et al. (2011) systematically analyzed all the elements recorded in three ways: individually, in combination with others, and in ratios.

- ☞ According to his study the best discriminating displays are ternary diagrams using ratios
- ☞ The best ratios for the Lorraine shale were Si/Ti, Mn/S and Al/Cu;
- ☞ The best diagnostic ratios for Utica shale were different (i-e: K/Ca, Rb/Sr and Ca/Ti).

Element ratios and box plots help identify chemostrat packages.



Courtesy of Jean-Yves Chatellier, from Chatellier et al., 2015. AAPG datapages - Search and Discovery Article 40656.

Conclusion

- Numerous other tests on shales have given good results to precisely pinpoint location in the stratigraphy.
- The XRF study gives a good overview of samples in a fast and efficient way with a minimum of sample preparation.
- According to Chatellier et al., (2015), XRF Core scanning is an economic complement to the sediment description and incredibly valuable when no log exists.