

Original, rapid and in situ colorimetric method for Acid Volatile Sulfide determination in sediment using a smartphone camera

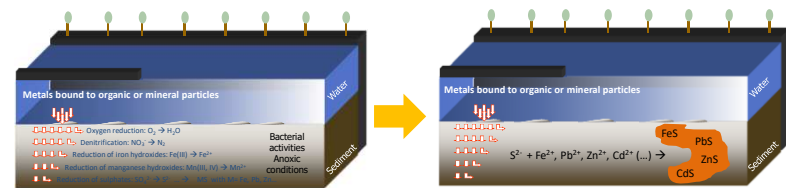
Context

During dredging operations, the quantification of metallic trace elements (TM) is essential in order to classify the various sediments collected for future deposits on agricultural soils, urban.... In a sediment, during the diagenetic degradation processes of organic matter, a large part of the TM can precipitate with the sulfides (freshly formed) in the form of metallic sulfides (AVS: Acid Volatils Sulfides). Metals can be then trapped over a longer or shorter period and be therefore less available (and less toxic for overlying benthic organisms or/and future soil organisms, among others).



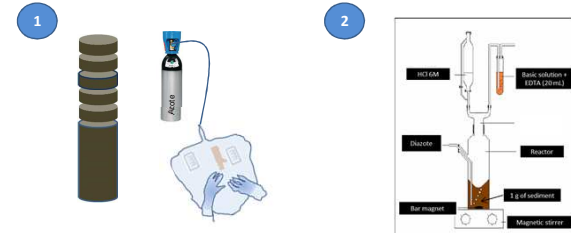
This is in this context that it was proposed to optimize the "classic" method of extraction of AVS to adapt it to a rapid and on-site method

How are form AVS in sediment?



- Early diagenesis: organic matter degradation by bacterial activity
- Reduced species will be formed (Fe^{2+} , Mn^{2+} , S^{2-} ...) in porewater sediment
- AVS (Acid Volatil Sulfide) = mainly FeS but also PbS, ZnS, CdS...
- Sulfides will trap dissolved and available trace metals by forming AVS in anoxic media.
- In contrast, in dredged sediments spread over oxic deposits, these AVS will play a key role in the potential mobility of the associated metals

Classical technique for measuring AVS in lab?



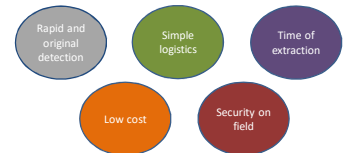
1 Sampling of sediment on field
Under inert atmosphere using a glove box

2 AVS extraction from sediment
With HCl 6M for 1 hour

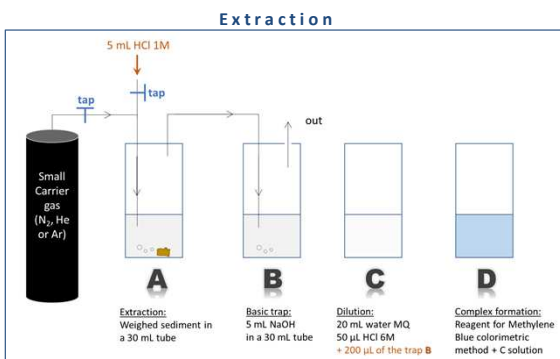
3 AVS detection from basic solution
Titration of sulfide with cadmium by potentiometry

Challenge ?

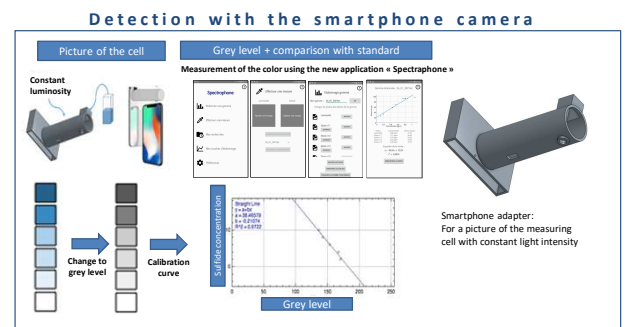
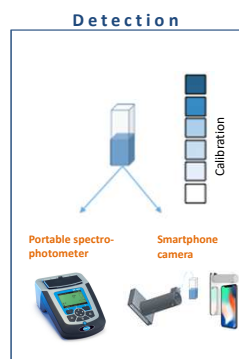
→ Transferring a traditional, time-consuming and cumbersome method of measuring AVS in the laboratory... to an original, fast and miniaturized method on site!



Toward a novel, rapid and in situ colorimetric method for AVS detection...



Conceptual scheme with the different steps for the determination of AVS in sediment



- Easy to use
- All the material fits in a small bag !



Conclusion and Perspectives

- This new and innovative method allows AVS measurements to be carried out quickly and directly on site. Compared to the classical method, the extraction time and the acid content used have been optimized (**20 minutes, 1M HCl**).
- The bulky glass bottles was replaced by a **smaller plastic bottles** that fits in a small case. The carrier gas (nitrogen), which is initially very bulky, can be transported in a **small 2 kg bottle of N₂**.
- Finally, the colorimetric detection is carried out using a **smartphone coupled with a newly developed application (Spectraphone, in French for the moment)**.
- The comparison between the classical laboratory method and the fast, in situ method provides the **same order of magnitude (10-15% error)**.
- This new method is perfectly adapted to the **screening and rapid assessment of AVS in complicated terrain** (at sea, very far from the laboratory, ...)