The history of Water

in urban heritage, research avenues for water management in the future city.

Paris' case study

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La cooperazione bilaterale italo-francese nelle scienze per il patrimonio: il patrimonio culturale nella transizione verde
Coopération bilatérale franco-italienne en sciences du patrimoine : le patrimoine culturel dans la transition verte
Consiglio Nazionale delle Ricerche, Piazzale Aldo Moro 7, Roma
giovedì, 15 settembre 2022 / *jeudi, 15 septembre 2022*

Historical water supply systems in Paris

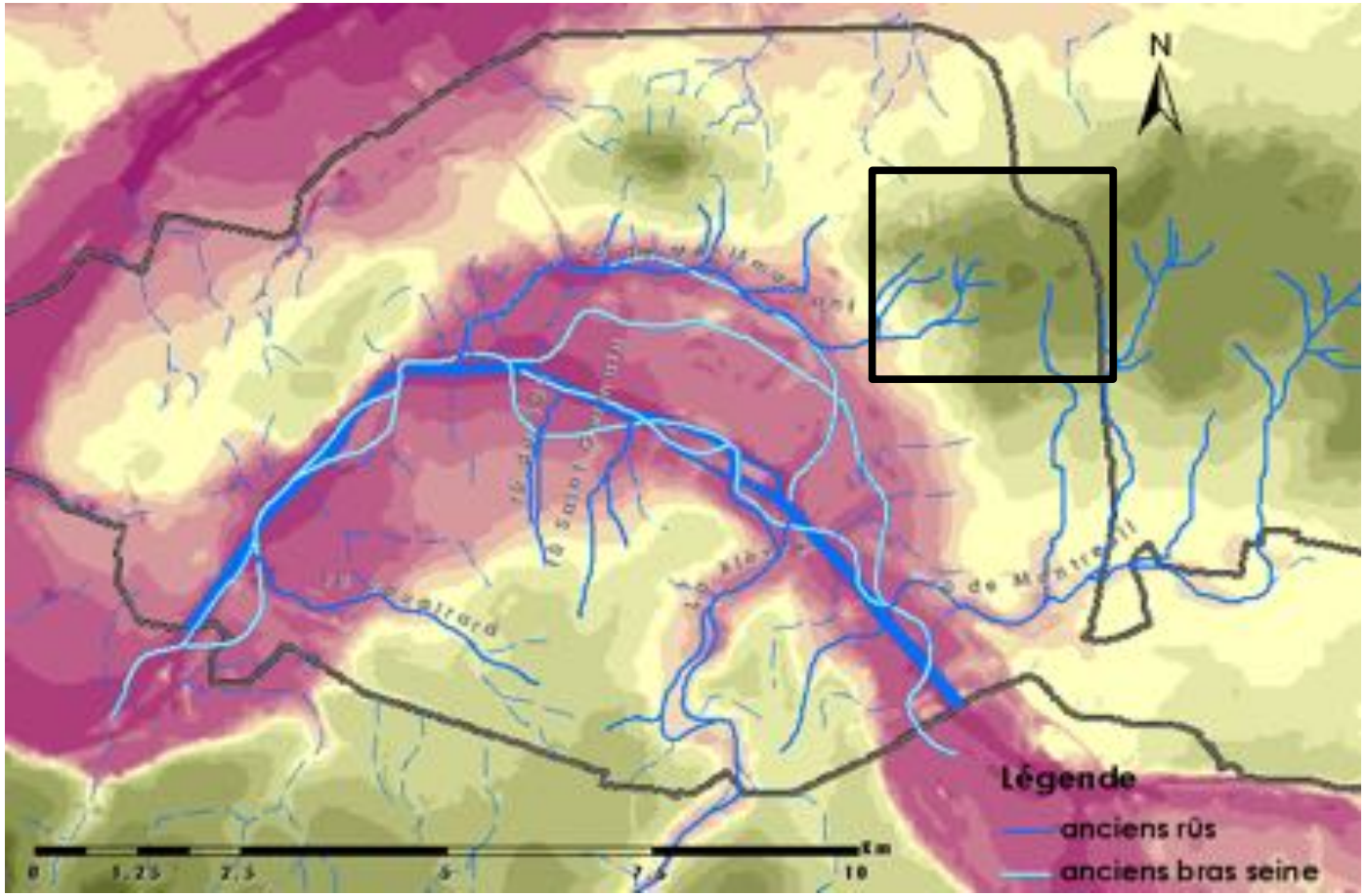
A case study

The Belleville Aqueduct, in Northern Paris.

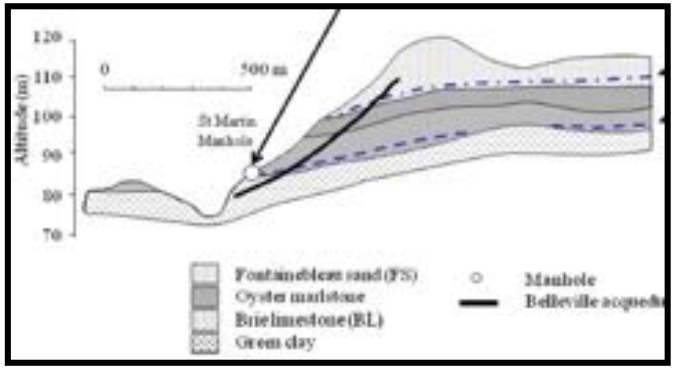
Perched aquifer (rain waters that infiltrate soil and shallow aquifer) drained since the middle age (exact age not known, at least since the 1500's), to provide water for religious communities.

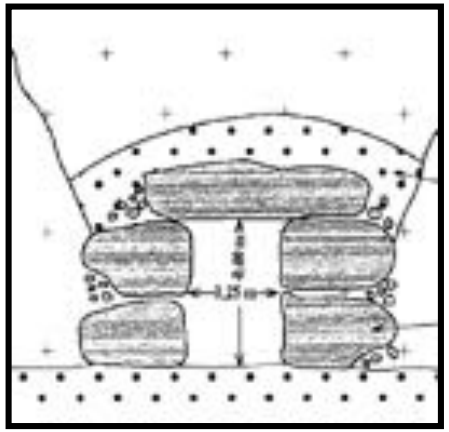
Historical patrimony

ASNEP: for its study, protection and preservation.



Map W Borst, Cerema





Water from Belleville's aqueduct :

-Is still flowing but not used.

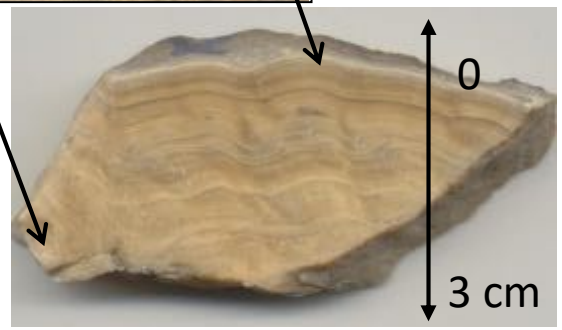
-Is it suitable for alternative resource (public garden cleaning of the street…) in the context of pressure due to climate change ?

- What is the "natural" state of waters in town or anthropized zone?

European Water directive 2000/60/EC, 23 October 2000 to protect European water bodies and restore them to good ecological status to ensure long-term, sustainable water use.

Credit photo: cerema

Galleries and fountains: heritage to preserve (Patrimony) AND record of past water



Historical Water Quality ?

-Reported as “unsuitable for human consumption” since the year 1848 Boutron-Charlard and Henry (1848).

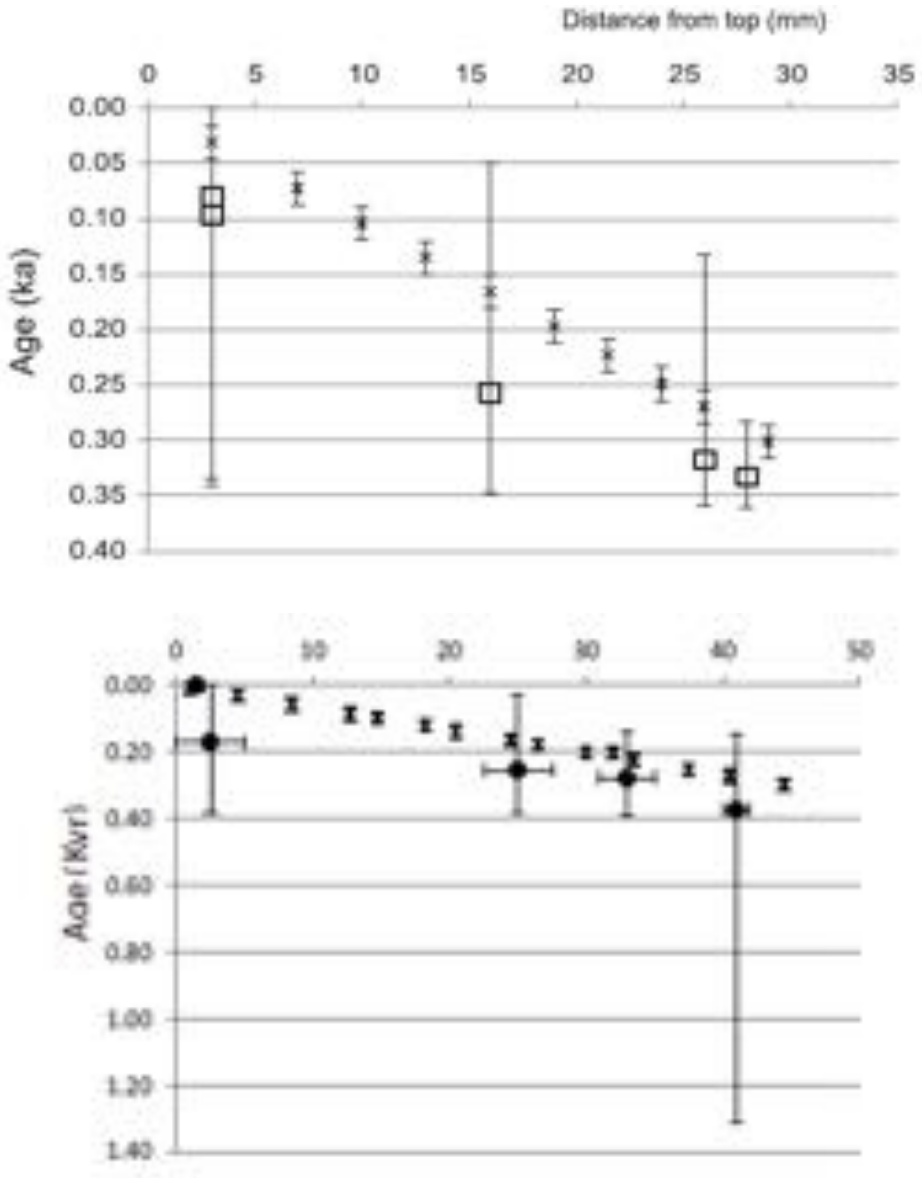
-Nowadays contaminated with sulfates (up to 1200 mg/L, unpublished data from CEREMA)…

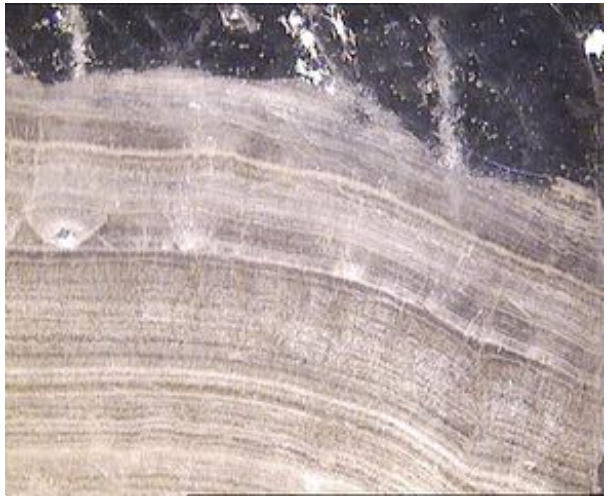
-Origin and timing of contamination (sulfates and other) ?
Historical record is lacking

- How this resource is modified by centuries of anthropic modification (aqueducts, construction on the watershed…).

- Can we reconstruct his history to constrain pollution sources ?

Use of Calcareous deposits for past water





300 years (2 samples).

Stop of Aqueduct cleaning

Calcareous deposits as archive ?

They can be precisely dated

Use as temporal archive of the waters that deposited them.

Diachronic study of key potential pollutants

Link with town evolution / land use / soil occupation ?

Pons-Branchu E. Douville E. et al., 2014 Quat Geochro. 24

Source of S in water ?

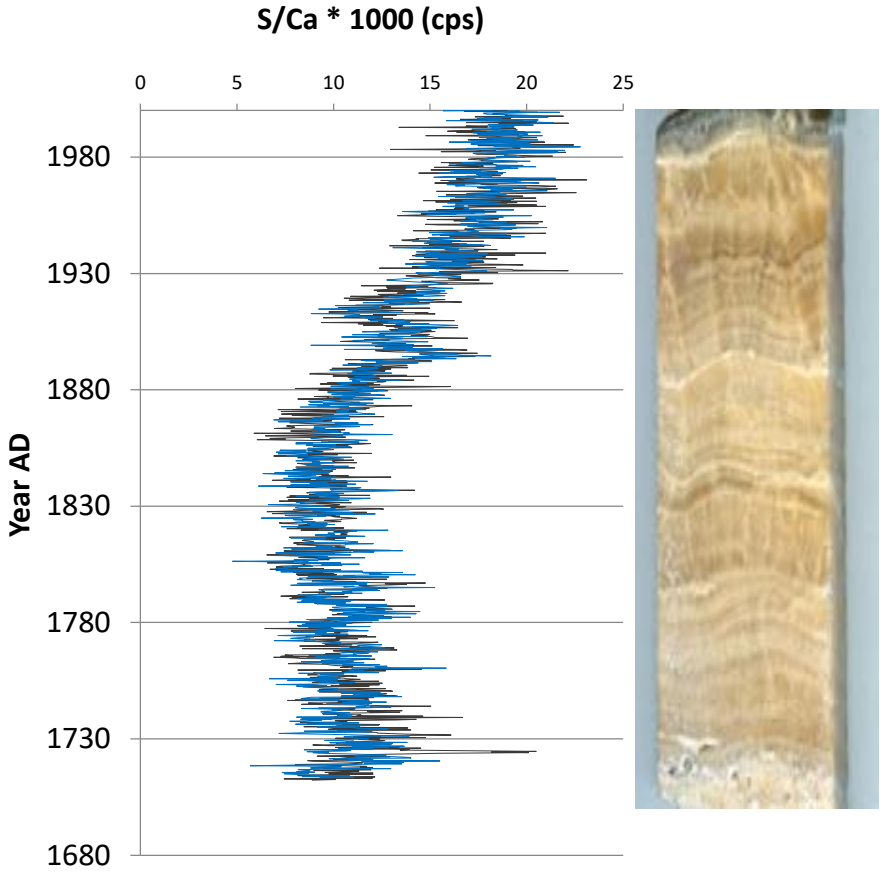
S: Increase (*3) during the 1850's:

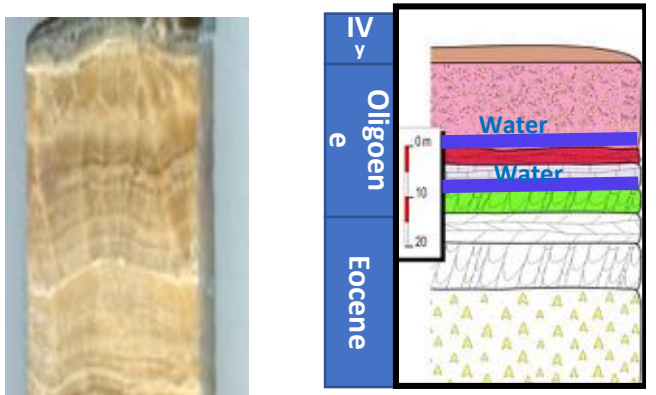
Construction of the district.

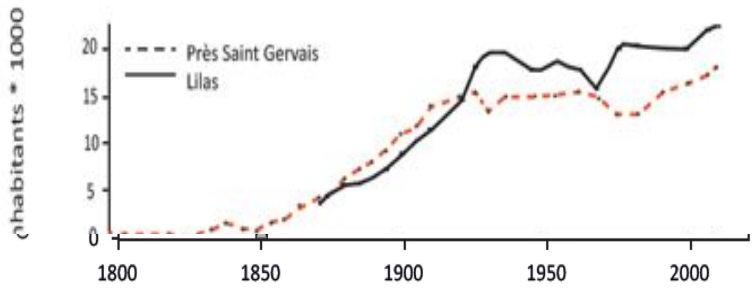
Use of remains of gypsum quarry for the embankments

Anthropic origin of S in the water

Beginning of the S pollution of the water identified

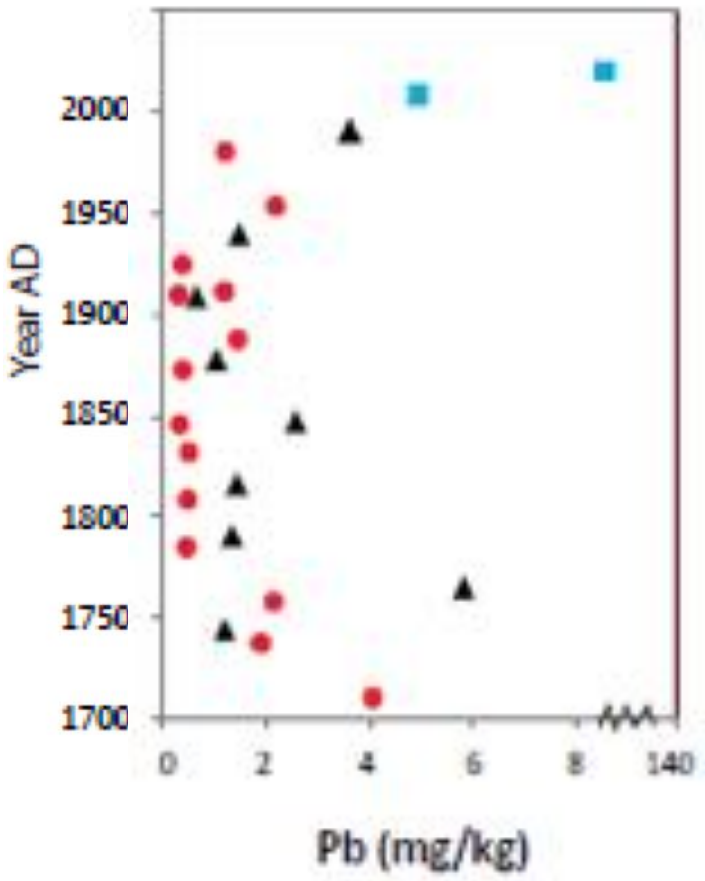


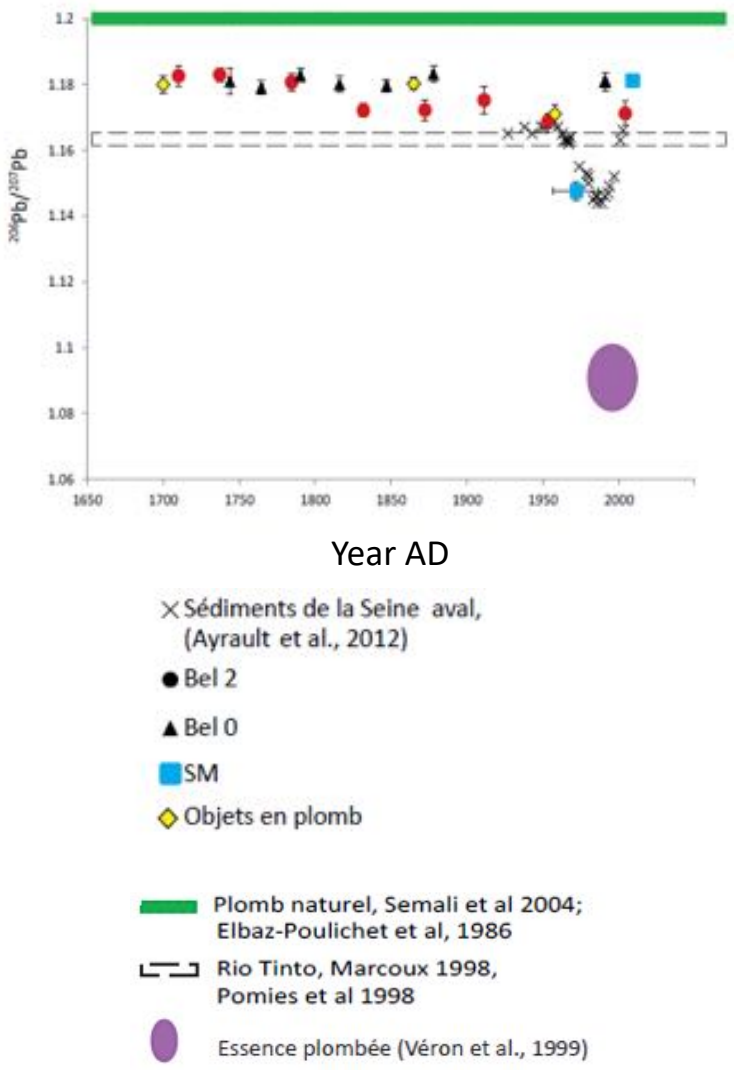




Pons-Branchu E, Roy-Barman M. et al., 2017 Sc. of the Total Env.579

Lead pollution





Pons-Branchu, Ayrault S. et al., 2015. Sc of the Total Env. 518

2 periods

-present day

-1700's

Anthropic lead during these two periods (isotopic signature different from natural lead in Paris)

Paris in 1728, Map from J De La Grive

Source gallica.bnf.fr / Bibliothèque nationale de France

SENTENCE
DE POLICE,

Qui condamne à l'amende les Habitans d'Aubervilliers, la Cour-neuve, la Villette, la Chapelle, Pantin, & autres Lieux, pour avoir négligé le Dégorgement des Voyries.

1771. ***« Ces pêches sont cueillies sur arbres décrépits… qui n'ont poussé qu'à force d'engrais de gadoues incapables de communiquer une bonne sève » « Une grande partie de ces fruits vient de terreins aquatiques, où ils ont belle apparence & nulle saveur…Ces pêches sont cueillies sur arbres décrépits, languissans, mal-sains & mal conduits, qui n'ont poussé qu'à force d'engrais de gadoues incapables de communiquer une bonne sève. Telle est la raison pour laquelle les vins***

Source of Lead pollution : use of wastes from the town as fertilizer during the 1700's

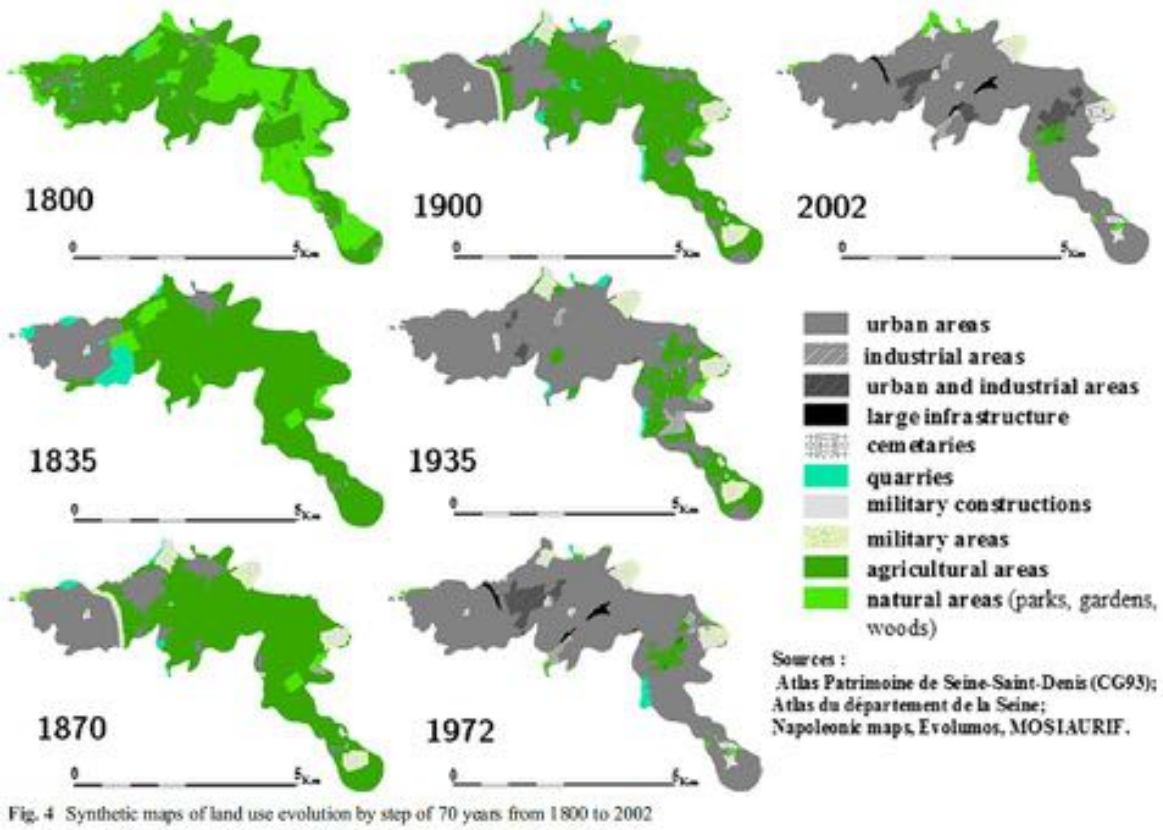


Fig. 4 Synthetic maps of land use evolution by step of 70 years from 1800 to 2002

Soil occupation, Belleville Plateau

Franck-Néel C., Borst W. et al., 2015, J of soils and Sed. (15)

Work in progress

Source of water ?

Decrease of the infiltration zones (Neel et al.,2015)

Flow is still high: input from leakckages (tap water and/or waste water) ?

Work in progress

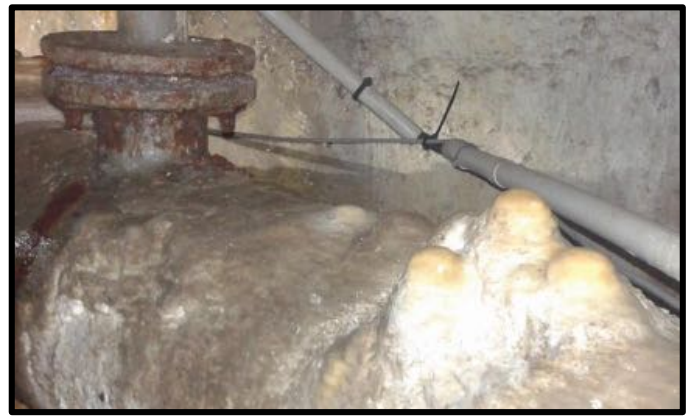
Fountains of the Versailles Castle.

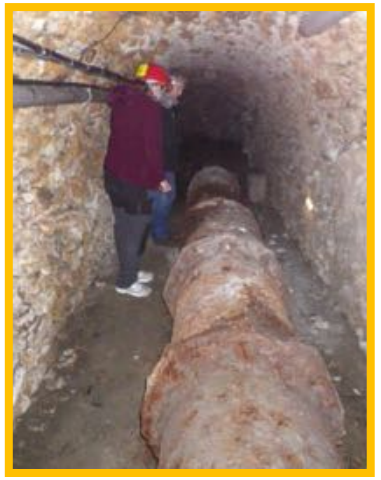
Collaboration with «Service des Fontaines» (D. Malnar).

Origine of the water throught the centuries.

Impact of works on water

Water quality (re use?)





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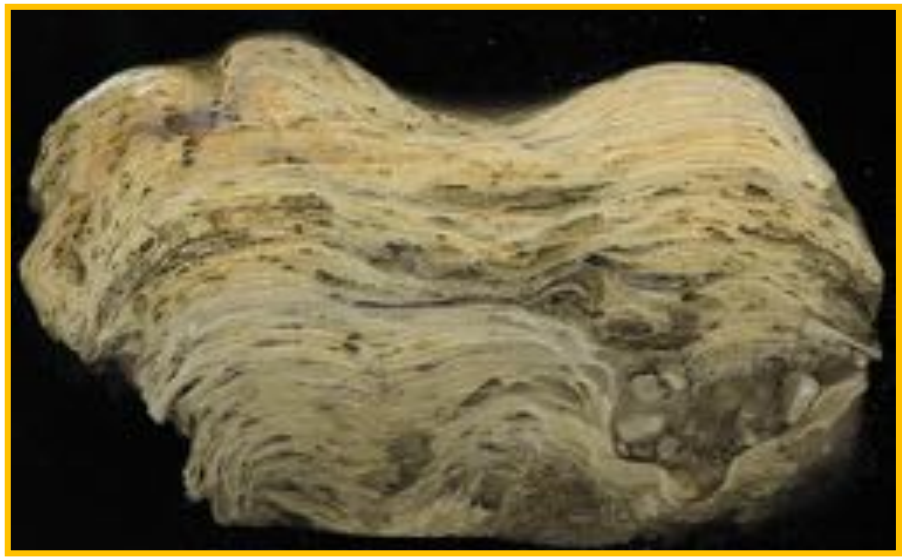

5 cm

0

2 cm

Perspectives

Comparison Paris / Versailles for chemistry

Traces of water adduction change (different isotopic signature ...) throught time (local ponds, artifical ponds and water supplied throught kms of rigoles and aqueducts...).

First application about past water of the fountains to be published soon.

Main collaborations / Partners

-Cerema : *P.* Branchu, E Dumont, D Ramier, W Borst and colleagues

-GEOPS / Paris Saclay **:** G Monvoisin, JL Michelot, A Noret

-Château de Versailles : Etablissement Public du château, du musée et du domaine national de Versailles : D Malnar G Bultez

-LSCE : S. Ayrault, L Bordier, A Dapoigny, E Douville, M Fernandez, J Garagnon, S Madikita, M Roy Barman, N Tisnérat Laborde and col.

-Inspection Générales des Carières (Mairie de Paris): J Querleux

-CRPG / U Lorraine: G Paris

-CNAM: A Guillerme / M Fernandez

-ASNEP : all the members

-Edytem : S Jaillet, Y Perrette and colleagues

-UMR Metis/Sorbonne University**:** L Lestel

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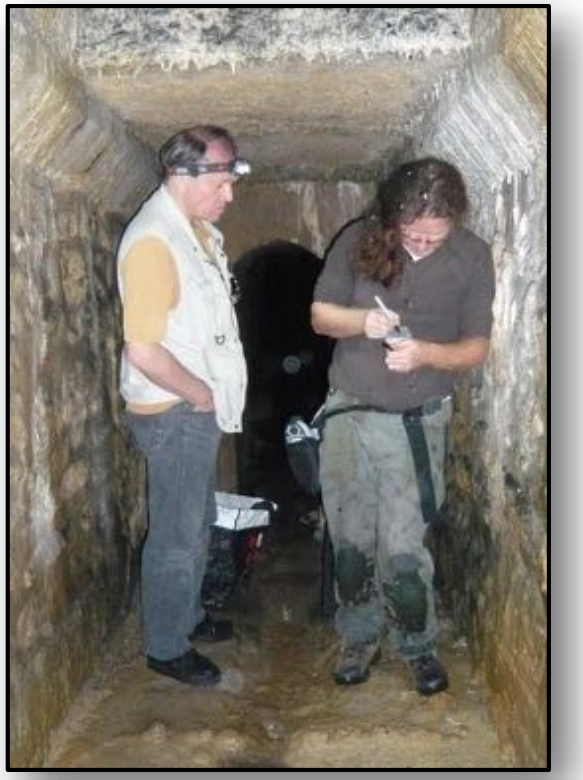

Conclusions – General perspectives

-Diachronic «Geochemical» map of Paris using Patrimony (former quarries, Catacombs, aqueducts) for a better knowledge of the waters and **discuss its possible reuse**.

-Export the methodology for question about patrimony (use of aqueducts, use of metals ...) and waters

-in Versailles Palace's gardens

-in other european (Italian) towns

Thanks for your attention!

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