Preliminary Study on The Sacred, Hidden, Water Source inside the Basilica Ulpia in Roman Forum

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Aim of the research

*The work here presented is inserted in wider research program aiming to characterise and compare waters outcropping in the area of the Roman Forum; results reported in the following deal with water gushing inside the Basilica Ulpia (see **figure 1**).*

Introduction

The Basilica Ulpia is located inside the "Foro di Traiano", i.e. the last constructed by Romans and completed in 112-113 A.C.. Today only the central stump is visible, with the western apse hidden beneath the Imperial Forum and the eastern under the Magnanapoli staircase and the adjacent buildings.
The Basilica's area was excavated in the early nineteenth century, during the Napoleonic occupation of Rome. The western end of the nave up to the attack of the apse was dug in the thirties while an eastern apse area has been brought to light from excavations conducted by the Superintendence of Cultural Heritage of Rome in recent years under the palazzo Roccagiovine. The gushing point of water is placed outside the ancient Basilica, on the left side beyond the wall of the apse and, with respect to the street level, is located between the Bibula's tomb and "Fori Imperiali" street. "In situ" and in lab measurements were performed in three different seasonal periods (all on 2015) as well as a continuous monitoring of some parameters on September 2015.

Results

***Fig 2** evidences a microclimate typical of hipogean environment (**fig. 2a and c**), Temperature and Relative Humidity range in narrowed intervals with respect to macroclimate (**fig. 2b and d**). The continuous monitoring has revealed that the water Temperature always is higher than the microclimate Temperature (**fig. 3 and 4**). **Figure 3** also evidences that water Temperature follows the one of microclimate that, in turn, follows the one of macroclimate even if the cyrcadian cycles are heavily smoothed. We can say nothing about the influence of the rainfall on the water Temperature because the monitoring period was marked by drought or rain very scarce (**figure 5**)*
*The content of soluble salts in the water resulted higher in September; in such month the content of anions was about the same while in March and May nitrate and chloride were the most abundant respectively. As it regards the cations, as expected Calcium was the main component (**figure 6**).*
***Tabs 1 and 2** report the main data, obtained over soluble salts and the content of Volatile Organic Compounds (VOC); in **tab 2** a comparison with other sources and two standpipes, all present in the area of Roman Forum, is done. **Figure 7** groups all the obtained data in form of a label similar to those of commercial mineral waters but surely more rich.*

The water gushing inside the Basilica Ulpia has a very low content of VOC , the lower between all the other analysed samples and below the law's limits while the Total Organic Carbon is about the same as in the standpipes. Calcium, Magnesium and sulphate also resulted similar to those of the standpipes while Sodium, Magnesium, nitrate and chloride were higher. Conductivity is about double with respect to the potable water, Temperature and pH also resulted higher; the last is congruent with the higher content of carbonate and bicarbonate.

The scatterplot in figure 8 shows that the only found correlation between the monitored parameters are the ones between Water Temperature – pH and Water Temperature-Air Temperature, I.e the same already appreciable from the run plot in Figure 3.

***Figure 1** – Water sources survived in the area of Roman Forum*

1: Juturnae
2: Romulus Temple,
3: Lapis Niger
4: Mamertino Jail (Tullianum)
5: Basilica Ulpia,
6: Valentini Palace (Small Baths)
7: Valentini Palace (the well)
8-9: standpipes
10: Meta Sudans
11-12: Ancient sources

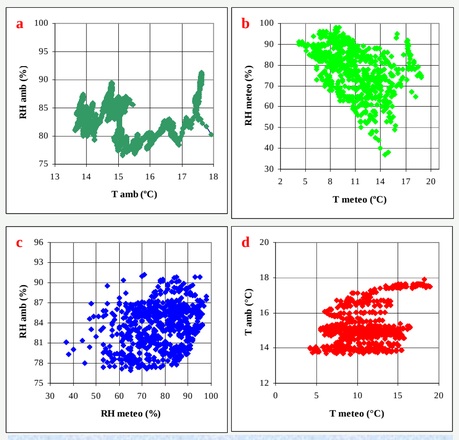


***Figura 2**– Correlation Diagrams between Relative Humidity (RH%) and Temperature (T): **(a)** microclimate; **(b)** macroclimate; (c) RH% microclimate versus macroclimate; (c) T microclimate versus macroclimate*

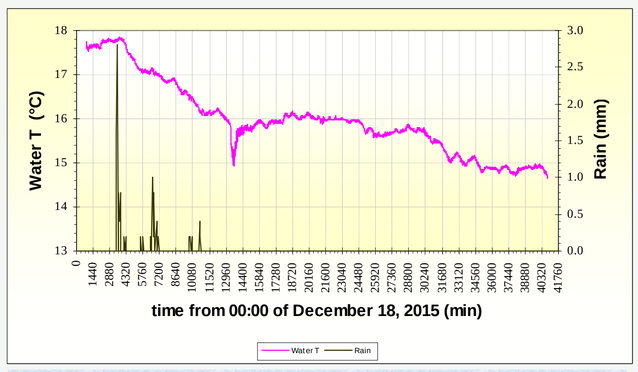


***Figure 5** – Comparison between Water Temperature and rainfall during the monitoring*

***Table 1** – Main data obtained in the analyses of the water outcropping inside the Basilica Ulpia*

	pH	Λ µS	ORP mV	$HCO_3^- + CO_3^{2-}$ ppm	TOC ppb
March	7.53±0.02	573±14	270± 13	--	
May	7.64±0.09	822±12	177± 12	162±3*	
September	8.00±0.01	951±9	-	652±12*, 642±12**	751

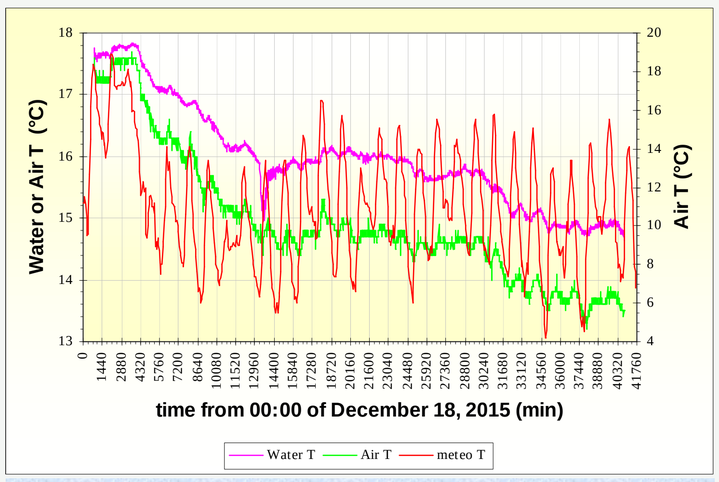


***Figure 3** – Comparison of water, air and meteo temperatures during the monitoring of the water source*

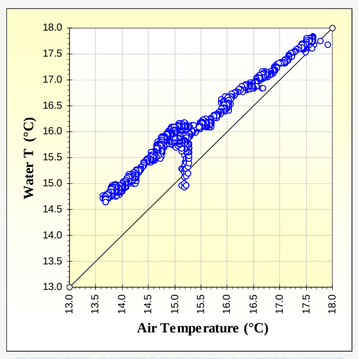


***Figure 4** – Correlation diagram between microclimate and water Temperatures*

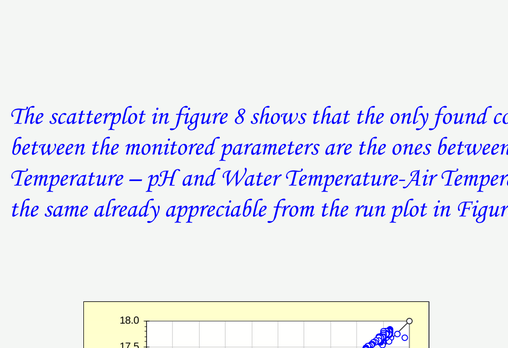


***Figure 6** – Soluble salts content (anions and cations) found in the water outcropping inside the Basilica Ulpia*

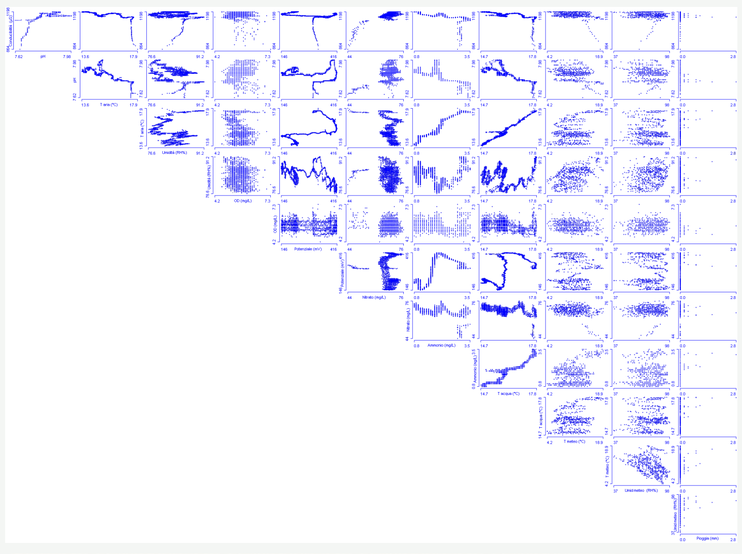


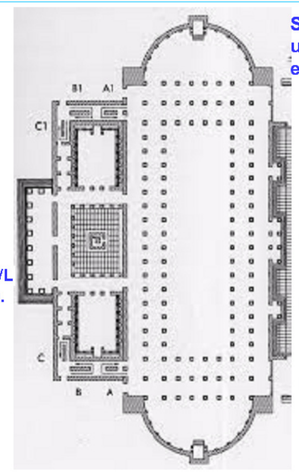
***Figure 8** – Scatterplot of all the parameters monitored in December for the water gushing inside the Basilica Ulpia*

Caratteristiche chimiche e chimico fisiche

T alla sorgente **15.9 °C**
pH alla sorgente **7.89 °C**
Conducibilità **1174 µS**
Potenziale redox **270 mV**
Durezza totale **62°F**
Solidi sospesi **290 mg/L**
Residuo fisso a 180°C **626 mg/L**
Ossigeno disciolto **5.5 mg/L**
Anidride carbonica disciolta **381mg/L**
Assorbimento a 254 nm **0.096 a.u.**

Sostanze organiche (ppb)

Total Organic Carbon **751**
Volatic Organic Carbon **0.034**



Sostanze disciolte in un litro d'acqua espresse in ioni (mg/L)

Na^+	40
K^+	23
Mg^{2+}	14
Ca^{2+}	136
Cl^-	40
F^-	0.42
NO_3^-	47
SO_4^{2-}	38
HCO_3^-	642
PO_4^{3-}	3.4

***Figure 7** – Full characterisation of the water outcropping inside the Basilica Ulpia*

***Table 2** –VOC content of the water outcropping inside the Basilica Ulpia and comparison with other sources and standpipes. the law limits for groundwater and potable waters are reported in round brackets; in the first and the last two columns respectively.*

		Ulpia	Source 6	Source 7	Source 4	Standpipe1	Standpipe2
1.1Dichloroetane (3.0)	ppb		0.001	0.001			
Chloroform (0.15)	ppb	0.031	0.048	0.018	0.096	0.101 (0.5)	0.156 (0.5)
Benzene(1.0)	ppb	0.002	0.000	0.019	0.002		
Trichloroetane (0.2)	ppb	0.000	0.012	0.001	0.001	0.016 (0.1)	0.016 (0.1)
1.2Dichloropropane (0.15)	ppb	0.000	0.014	0.001	0.019		
Bromodichloromethane (0.17)	ppb	0.000	0.001	0.001	0.008	0.506 (0.5)	0.346 (0.5)
Tetrachloroetilen (1.1)	ppb	0.001	0.052	0.018	0.013	0.115 (0.1)	0.112 (0.1)
Dibromochloromethane 0.13)	ppb				0.004	1.108 (0.5)	0.870 (0.5)
Bromoform (0.3)	ppb	0.000			0.003	0.974 (0.5)	0.798 (0.5)

Conclusions

The research work allowed to characterise the water gushing inside the Basilica Ulpia and will be inserted in a wider project aiming to compare all the up-today accessible water-sources emerging in the area of the Roman Forum.

Acknowledgment

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