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Underground medieval water distribution network in a Spanish town

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ABSTRACT

The city of Alcudia de Crespins, in the centre of the Valencia province (east of Spain), has an exceptional water distribution system that in the past served fresh water to many houses in the town. This system is formed by more than one km of tunnels and underground cisterns, and dates probably in the late medieval times, while it has been in use and suffering modifications until 1955. This paper presents the structure and characteristics of such exceptional system, and explains the functioning parameters of the infrastructure.

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1. Introduction

The east of Spain is a Mediterranean climate region, with dry summers and winters and two rain seasons in spring and autumn, with a total rain amount of about 600 mm per year in the area of the city here studied. Thus, water has been always a priority in all human populations in the region, and the knowhow of water distribution, control and use has reached traditionally a remarkable level. Underground cisterns for rain water are frequent in the region, named after an Arab term as “aljibes” or “aljubs”, while there are present before the Arab period, as some of them are dated in the 4th century BC, or even before (Egea Vivancos, 2010; Llanos Ortíz de Landaluze, 2010).

In the Roman times (for this region approx. 150 BC to 450 AD), important water infrastructures were constructed, and relevant aqueducts can be found in Tarragona, Chelva, Albarracín and other places, frequently including not only the best known scenic image of arches crossing a valley, but also tunnels of hundreds of meters long.

In the Arab period (from 700 AD to 1250 AD) the use of water for agriculture reached high level not only in infrastructures (probably based on Roman schemes) but also in water management, as is proved by the existence of the “Water Court of the Plain of Valencia”, better known by its shortened name of “Water Court”, the oldest existing justice institution in Europe, dating from the

10th/11th century, and still active (Prytherch, 2009). The starting of water mining activities is probably related also with the Arab period, as they imported to the dry regions of Spain the construction of “qanats” or water mines, long underground galleries to capture water springs (Juncà Ubierna, 1998; Stiros, 2006; English, 1998).

With this background, the idea of underground water storage and conduction has been easily incorporated into daily life, and where geological characteristics and water availability allow, we can find interesting examples of water infrastructures. In this paper we present one of such cases.

Before starting with the study of our specific case, it can be convenient to put in context the water underground infrastructures. We will refer to qanats and aqueducts, as examples more related with our case.

Qanats are structures characterized by a double function of conveying water from underground springs or aquifers, and transport water to an area requiring its use, for irrigation or for human use. Qanats, with different names (Foggara in the North Africa, Karez in Afghanistan, and up to 27 different names in countries from Japan to Spain, including Iran and the Middle East, Hamidian et al., 2015) have played a relevant role in water capturing and transporting in dry climate areas, and in different parts of Spain, including the region of Valencia, there are some examples of these structures (Iranzo and Hermosilla, 2011; De Bustamante et al., 2015). While in Iran qanats achieve extraordinary sizes (up to 80 km, Hamidian et al., 2015) in the east of Spain lengths are not so important, and Iranzo and Hermosilla (2011) for an area 40 km east of Alcudia (our area of study) identify eight qanats with lengths under 500 m.

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¹ A. Fornes sadly passed away on February 2015, while working on this research. We all regret his loss. He will be deeply missed.

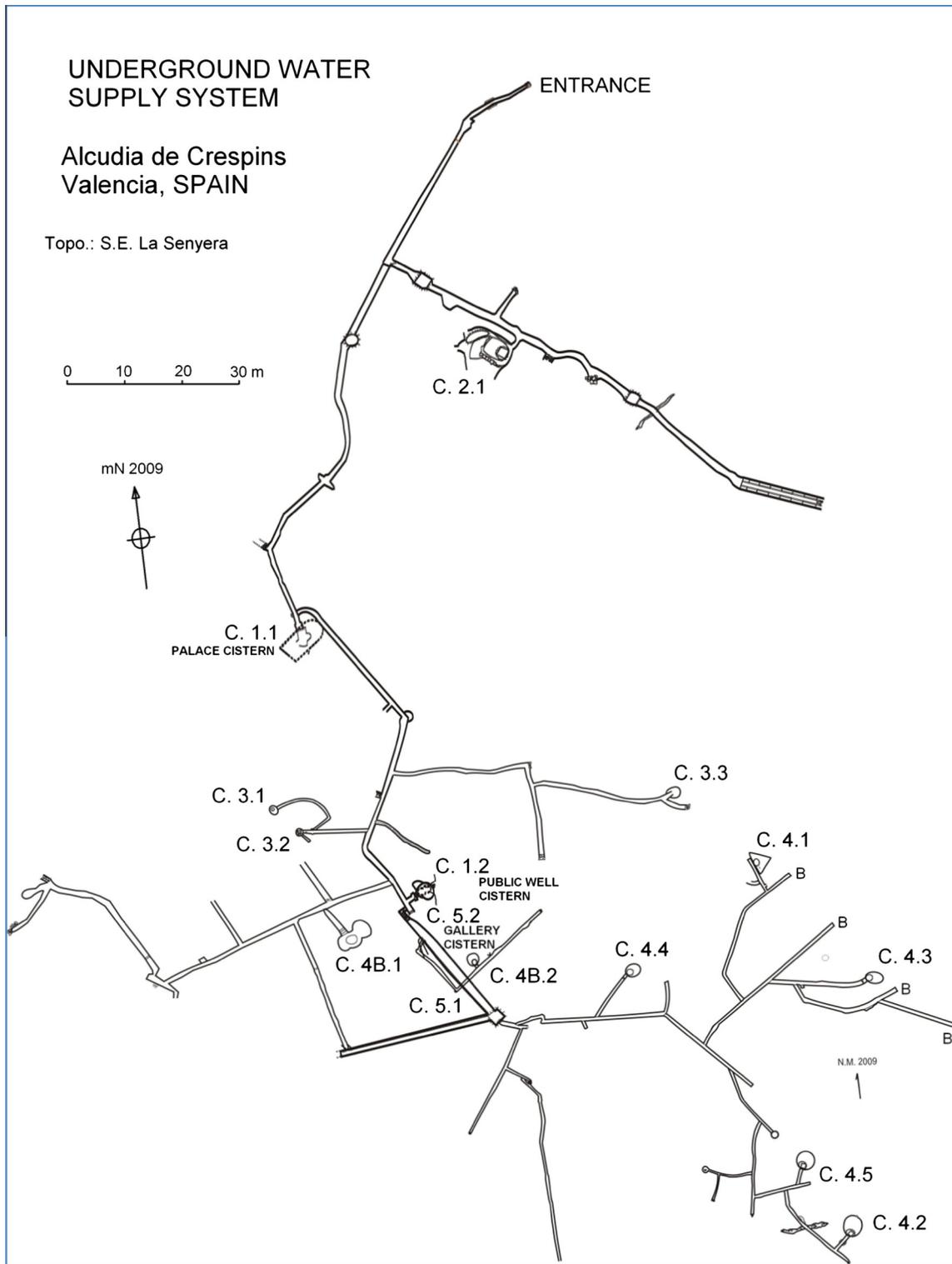


Fig. 1. General plan of the network with indication of the cisterns.

The other infrastructures we will briefly comment are aqueducts, specifically the tunnels related to them. To some point a *qanat* is also an aqueduct, or at least one of his sections plays this role. The world of aqueducts is extremely complex and is out of the focus of this paper, but at least we have to mention that in the Mediterranean countries they have played a very significant role for supplying water to cities and irrigation systems. In the east of

Europe, we find well studied examples like the Eupalinos tunnel, in Samos (Greece) to cite only one (Stiros, 2009). In France there are magnificent examples, as the Lyon Roman aqueducts, where more than 3.8 km of tunnels have been constructed (Burdy, 2002). In Spain, as in the entire in Roman world, we find various examples of aqueducts requiring tunnels. We will mention only two examples. In Chelva, 60 km north of Alcudia, we can find the

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