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REPORT

New Data on the External Canal at the Tetzcotzinco Site, Mexico

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Abstract
This report presents new documentation of the external canal in the Late Postclassic site of Tetzcotzinco in the municipality of Texcoco, Mexico. This structure was previously considered a waterwork separate from the monumental water-management system discovered in the central part of the site. However, reanalysis of the course of this canal allowed us to reassess its function and revise the existing Tetzcotzinco maps. We propose that this structure formed part of the main water-management system of the site.

Resumen
Este informe presenta una nueva documentación del canal externo en el sitio del Postclásico Tardío de Tetzcotzinco, municipalidad de Texcoco, México. Anteriormente, esta estructura se consideraba una obra hidráulica separada del sistema hidráulico monumental descubierto en la parte central del sitio. Sin embargo, el reanálisis del curso de este canal provee una base para la reflexión sobre su función y la revisión de los mapas existentes de Tetzcotzinco. Con base en la documentación, proponemos que esta estructura formaba parte del sistema central de gestión de agua del sitio.

Keywords: Tetzcotzinco; water-management systems; canals; GIS; archaeological survey

Palabras clave: Tetzcotzinco; sistema hidráulico; canales; SIG; prospección arqueológica

This report provides new documentation of the external canal at Tetzcotzinco in the municipality of Texcoco, Mexico, that revises previously published data. The canal was first identified by Jeffrey Parsons (1971:149), who described it as a "functioning canal" possibly related to earlier prehispanic structures. Parsons's description caught our attention because the canal was one of the least-known elements of Tetzcotzinco. This feature was believed to be separate from the local water-management system (WMS), and subsequent archaeological reports of the site did not mention it. In 2019, we conducted an archaeological survey in the area where this canal was located to document it precisely using the latest techniques. This report corrects Parsons's maps and describes this canal in detail, including its previously undocumented section that may directly connect it to the rest of Tetzcotzinco's WMS.

Tetzcotzinco

Tetzcotzinco is located on two andesite hills (Tetzcotzinco and Metecatl) in San Nicolás Tlaminca, approximately 7 km east of Texcoco (Figure 1). The site is renowned for its Late Postclassic (AD 1400–1521) monumental buildings—temples and one residential structure—and a complex WMS comprising canals and reservoirs. Tetzcotzinco appears in colonial sources as an important ceremonial center (Anales de Cuauhtitlan 1975:40–41), an essential point for distributing freshwater (Medina Lima 2012:1–2), and a monumental palace-garden complex of the rulers of Texcoco (Ixtlilxochitl 1975:114–116; see also Lesbre 2001:323–325).

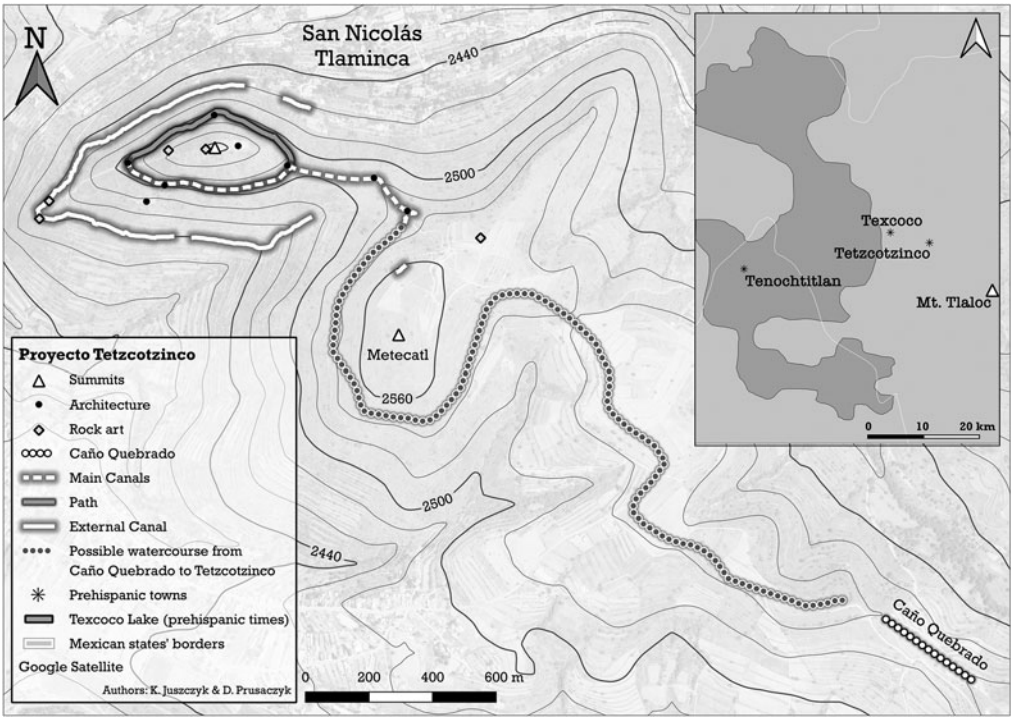

Figure 1. Tetzcotzinco archaeological site.

Academic interest in Tetzcotzinco began toward the end of the nineteenth century when the first site's drawings were made, together with archaeological surveys and mapping (e.g., Mayer 1852; Reyes 1888; Tylor 1861). Subsequent decades saw the discovery of new structures and a better understanding of Tetzcotzinco's ceremonial significance (Lorente Fernández 2012; Parsons 1971:122–125; Townsend 1982). The most significant research was conducted by Mexican investigators, including Patricia Hernández (1993), Miguel Medina (1997), María García García (2007:136–204), and Martín Domínguez (2007), who discovered and reconstructed the central part of the site and prepared archaeological maps that are still being used today.

Water Management at Tetzcotzinco

During the Late Postclassic period, various Aztec WMSs were built in central Mexico, whether in the form of city-supplying aqueducts, including at Chapultepec (Doolittle 2004:142) and Acuecuexcatl (Rojas 2009:38), or as irrigation canal systems, known from Tepetlaoztoc (Rojas 2009:100), Coatlichan (Rojas 1988:152), and Cuautitlan (Doolittle 2004:135), among others. Among them, the most extensive and best preserved is the system from Tetzcotzinco, which has been a main topic of numerous studies (e.g., Doolittle 2004:145–154; Palerm and Wolf 1955; Parsons 1971:145–151; Peña Santana and Levi 1989:20–25; Rojas 2009:70–76). The system primarily comprised canals that surrounded the Tetzcotzinco hill in its central part, accompanying the main path and feeding water to three large water reservoirs (Alcántara Onofre 2002:52–53). The main canal was supplied by an aqueduct erected on an artificial embankment that connected this hill with Metecatl (García García 2007:150). Moreover, at Metecatl, archaeologists found structures that may have played essential roles in controlling water distribution in the system (García García 2007:215–216). Scholars (García García 2007:211; Parsons 1971:149) also suggested that a natural spring in the San Pablo Ixayoc area could be a source of water for Tetzcotzinco's WMS.

These studies determined that its WMS played a vital role in Tetzcotzinco, serving important ceremonial functions (Avilés 2006; Townsend 1982), especially related to the rain cult (Townsend

2009:143–148), political propaganda and expressing the power of Texcoco's rulers (Granziera 2001:208), and aesthetic roles as decoration and a water source for the entire garden complex (Lesbre 2001:324). However, the importance of Tetzcotzinco's canals within a broader geographical perspective and their potential economic significance for the local community still remain understudied. Written sources (Medina Lima 2012) and colonial maps (see Rojas 2019) suggest that Tetzcotzinco's WMS was part of a larger system that distributed water throughout the region. This idea, however, has not been fully supported by archaeological evidence, and the WMS maps appearing in the literature suggest that it was limited only to the areas of Tetzcotzinco and Metecatl.

Thus, studies conducted outside the site's central part may be relevant for a better understanding of Tetzcotzinco's WMS. So far, such external canal systems have been preliminarily documented by Jeffrey Parsons (1971:147–149, 2002; see Figure 2) between San Pablo Ixayoc and Cerro Purificación. We were particularly interested in one of the southern canals that surrounds the Tetzcotzinco hill and that was described as "functioning" by Parsons (1971:146). Despite its proximity to the main WMS on the site, Parsons could not locate the connection between the two. This structure was overlooked by later archaeologists who focused on the site's central part, and Parsons's plans were not commonly included in Tetzcotzinco's archaeological maps. As a result, little is known about the structure's historical and archaeological context, despite its potential to revise our understanding of the local WMS.

Our Investigation

We present the findings here of our work conducted under the auspices of Proyecto Tetzcotzinco, covering two one-month seasons of fieldwork in 2018–2019 (INAH permit no. 2018-614). The project's aims were to supplement existing documentation with data from unrecognized sectors of Tetzcotzinco, thereby embedding the WMS in a regional context. We used 3D photogrammetry, laser scanning (with stationary FARO FOCUS 3D), and GPS RTK (real-time kinematic) that enabled us to document,

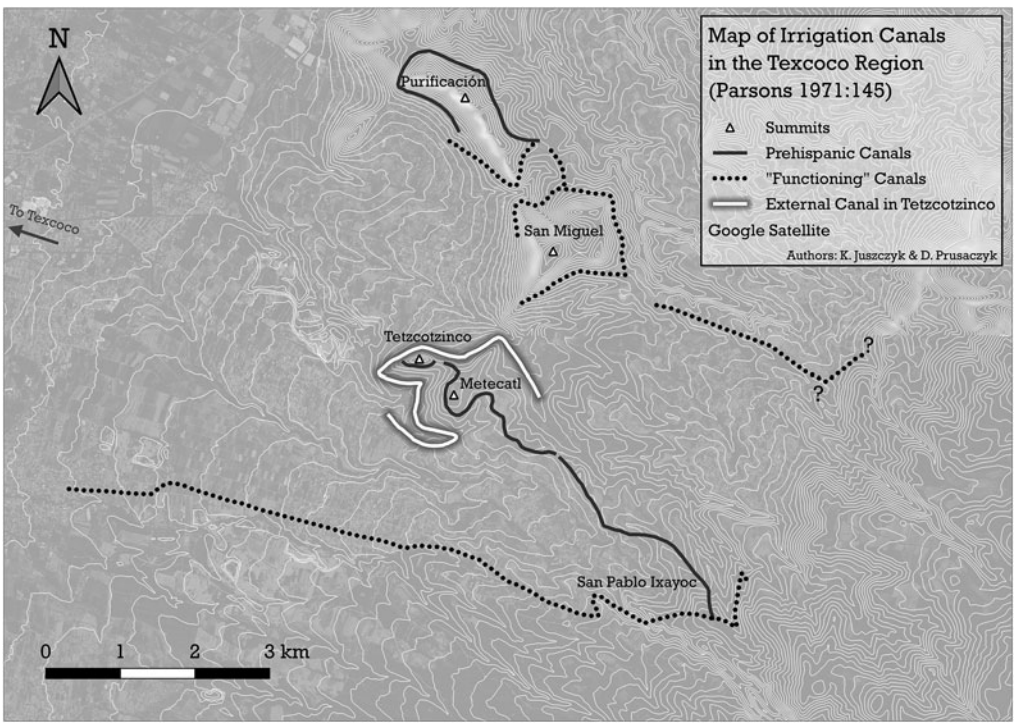

Figure 2. Map of prehispanic and functioning canals according to Parsons (based on Parsons 1971:Figure 31).

measure and georeference all known remains of the architectural structures, WMS, and rock art at Tetzcotzinco and place them within the GIS database.

Moreover, we conducted an additional survey on less-explored site sectors to register unidentified archaeological remains. During this stage of our work, we located the external canal mentioned by Parsons, documented its construction, and recorded its course over a distance of more than 1,300 m (Figure 3). Our study relies on surface findings because our project was noninvasive, but excavations in the future could provide more detailed data.

Survey of Less-Explored Sections of the Canal

Section A. The first surface remains we associated with Parsons's canal were found on Tetzcotzinco's northeastern slope, at an elevation from 2,467 to 2,469 m asl, about 140 m north of the main aqueduct's western end. The structure is preserved for about 65 m, heading west with a slight northward deflection. We were unable to document any further canal remains to the east due to legal issues (those areas are private property).

Section B. The survey's next stage was directed toward the west, where we located the second section of the canal 110 m from Section A. No other surface remains were found between the two parts of the structure. In this section, the canal heads west to south, curving along the natural slope of the Tetzcotzinco hill and stretching uninterruptedly for 440 m, at an elevation between 2,460 and 2,453 m asl.

Section C. In the next section, the canal heads south, crossing the site's main entrance. It runs along a steep slope at an elevation from 2,454 to 2,452 m asl and stretches continuously for 180 m.

Section D. The next part of the canal turns around the hill and then heads east for 390 m with an elevation between 2,454 and 2,445 m asl. The entire Section D is located on one of the levels of the abandoned terraces in the southern part of the site, running parallel to the terraces' walls.

Section E. We recorded the next part of the canal 55 m east of Section D. We documented this fragment as having a length of 115 m with an elevation between 2,456 and 2,460 m asl; it then continues its

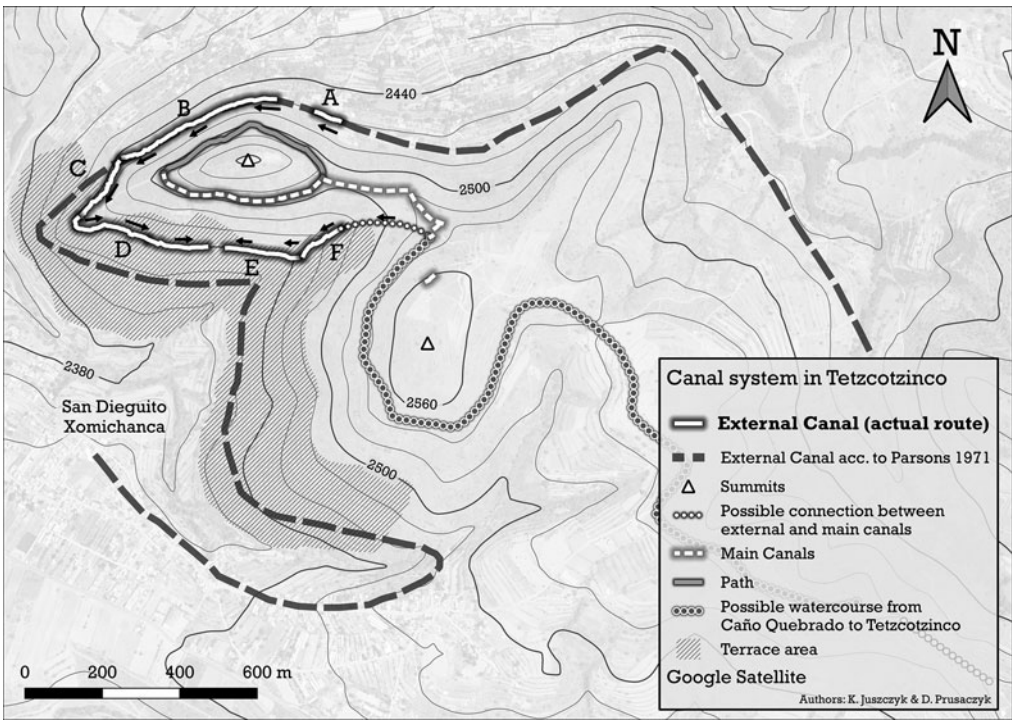

Figure 3. Tetzcotzinco's canal system. The actual course of the external canal is compared with Parsons's plans.

course at the level of cultivated terraces. In this part, the canal descends from east to west, running in the opposite direction of Section D.

Section F. The last part turned out to be the most surprising. According to Parsons's plans, this canal should divert and head south, on the slope of Metecatl, toward the village of San Dieguito Xomichanca. We did not register such a watercourse, nor did we find any surface archaeological remains running south. In contrast, this part of the canal runs to the northeast on a steep slope, between 2,457 and 2,478 m asl. We registered only 135 m of the structure's length in this area. Due to environmental reasons—the steep elevation of the slope and the dense vegetation—we were unable to document the rest of the canal. However, the part we discovered suggests that it may have been directed toward the previously known water-control buildings in the pass between Tetzcotzinco and Metecatl.

Construction of the External Canal

Along almost its entire documented course, the canal presents forms typical of other hydraulic structures known in Tetzcotzinco. It is an open channel with an internal width ranging between 20 and 30 cm and a depth ranging from 15 to 25 cm. Based on the forms on different canal sections, we can distinguish two construction types: (1) masonry—a bottom of flat stone slabs and side walls made of a relatively regular, volcanic gravel reinforced with earth mortar; this type has a rectangular cross section (Figure 4a); and (2) monolithic—rock-cut smoothed canal, carved in the natural rock; this type has a U-shaped cross section (Figure 4b). The first type of canal dominates most of the course, particularly in Sections A, B, and D–F; the monolithic structure appears mainly in Section C. We also discovered small parts in Sections B and C, up to 1 m long, where the canal took the unusual form of a closed circular pipe. Based on preliminary observations, we presume that these fragments are the remains of colonial or contemporary repairs and additions.

Discussion and Conclusions

The survey within the area of the external canal allowed us to trace its course in detail and to correct and complete Parsons's maps. It should be remembered that Parsons used all the methods available to him at the time, which were much less precise than contemporary documentation techniques. Therefore, we corrected previous inaccuracies in the structure's maps that put some places (particularly in Sections C–E) almost 100 m from their actual locations.

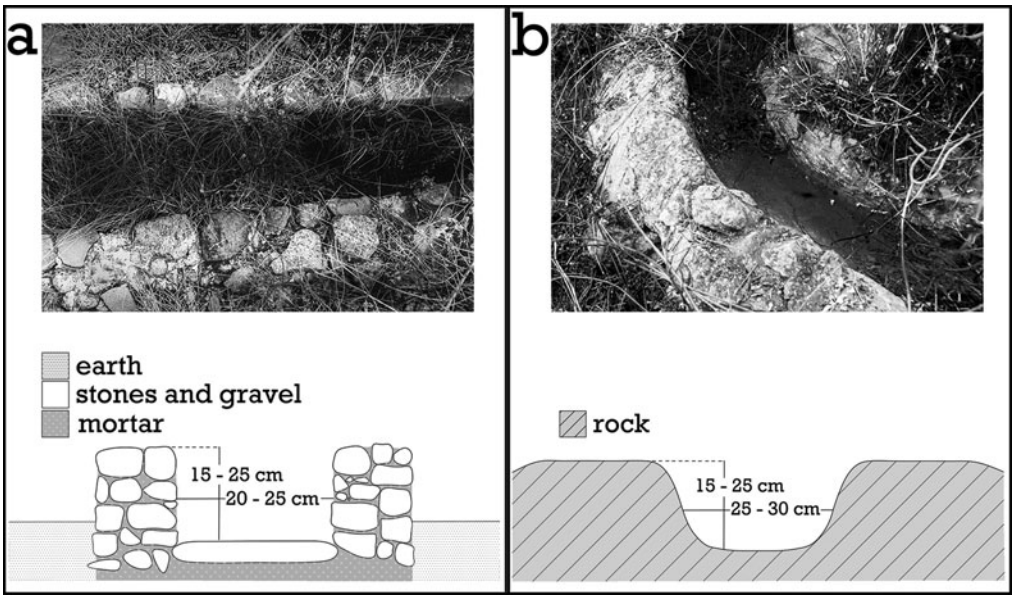

Figure 4. Construction of the external canal: (a) canal made with masonry; (b) monolithic canal.

Moreover, the construction types used in the canal are similar to other parallel prehispanic watercourses (e.g., Doolittle 2004:142,159; Parsons 1971:148; Peña Santana and Levi 1989:5–9). These similarities allow us to speculate that the structure's route has largely remained unchanged since precolonial times, despite its potential use in the twentieth century. However, due to the continuity of such building traditions in the region (Parsons 1971:149), we cannot determine whether the surface canal's fragments are the original prehispanic constructions or a later superstructure on the former waterworks. At the same time, small fragments in the form of a closed pipe allow us to presume that this structure was used for a long time and repaired in colonial or modern times.

The most important discovery was the course of Section F, which differs from the route proposed by Parsons. Earlier plans of this structure suggested it was part of a separate system parallel to Tetzcotzinco's WMS, but our documentation instead suggests the two were connected. At this point, the canal comes from Metecatl, which may suggest that it was connected to the main WMS of the site. Therefore, based on our documentation, we can more accurately embed the external canal in a geographic and archaeological context. Historical sources (Dávila Padilla 1625; Medina Lima 2012) suggest the existence of a long-distance canal complex throughout the Texcoco region. Tetzcotzinco's external canal heads northeast toward settlements, which may indicate that it was a part of such a long-distance WMS. Its connection to the site's central part thus allows the reconsideration of Tetzcotzinco as part of a larger regional canal network. It also appears that the external canal subsequently headed south, as Parsons noted. However, southern sections of the structure are not preserved, presumably because of agricultural activities on the terraces. Consequently, the further course of the southern extension can only be reconstructed through hydrological modeling and topographical analysis, which we will explore in a separate article.

Moreover, our measurements indicate two directions of water flow in the canal. The first (Sections A–D) leads from the north to the southeast, whereas from Section F, the canal descends in the opposite western direction. This may hint at a potential reservoir or drain between Sections D and E, which would direct water to the lower parts of the site. Therefore, the existence of canals carrying water from the north (estimated flow velocity: 1.53 m/s; volumetric flow rate: 0.109 m^3/s) and the central Tetzcotzinco's WMS (estimated flow velocity: 2.51 m/s; volumetric flow rate: 0.294 m^3/s) to lower sectors and (potentially) other settlements suggests that the site may have served not only ceremonial or political purposes but also economic ones, as proposed by several earlier researchers based on studies of the system's central part (e.g., Alcántara Onofre 2002; Palerm and Wolf 1955). The external canal's location in the terraces area (Sections C–E and the possible southern extension documented by Parsons) and its direction in the northern part may provide the basis for considering Tetzcotzinco as a place of water distribution for agricultural purposes. This hypothesis also allows a reassessment of the site's importance for the prehispanic communities of the region: it not only could have been a center of worship and a symbol of power but also the most important source of freshwater for those communities.

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Data Availability Statement. The authors confirm that the data resulting from this research are available within the article. Raw data that support the results of this study are available from the corresponding author on reasonable request.

Competing Interests. The authors declare none.

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