Early construction at Nixtun-Ch'ich', Petén, Guatemala: An architectural-footing and -bonding sample

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ABSTRACT

The lowland Maya city of Nixtun-Ch'ich' (Petén, Guatemala) exhibits an atypical gridded layout featuring quadrilateral blocks of architectural construction, established in the Middle Preclassic period (~800–500 BCE). Early levels of some excavated structures revealed unusual dark-colored, sticky sediments used as architectural footings overlying limestone bedrock and as adhesives for binding construction stones. Physical, mineralogical, and soil nutrient (chemical) properties of two samples of this material were analyzed. The samples were found to be highly organic (high %LOI), and composed primarily of smectite clay. They are characterized by low green strength, marked swelling when mixed with water, and corresponding shrinkage on drying, suggesting low load-bearing capacity. Chemical analyses revealed a slightly elevated pH of 7.8 and high levels of six soil nutrients but low phosphorus, likely making the material unsatisfactory for agriculture. We conclude that these sticky organic clays, probably of lacustrine origin, functioned as bonding agents in early architectural construction.

1. Introduction

Recent archaeological fieldwork at the lowland Maya city of Nixtun-Ch'ich' in the lakes district of the Department of El Petén, northern Guatemala, has focused on its unusual early site plan. This long-lived site exhibits a regular grid of north-south and east-west corridors that demarcate quadrilateral blocks or sectors of architectural construction (Fig. 1). Fully gridded site layouts are extremely rare in the Mesoamerican culture area, which comprises Mexico, Guatemala, Belize, and northwestern Honduras.

Culturally, the eastern part of Mesoamerica—the Yucatán Peninsula, including northern Guatemala and Belize—is identified as the Maya lowlands. Geologically, the peninsula is a marine limestone shelf. Petén is an elevated (100–300 m asl) interior karst plateau composed of porous, interbedded limestone (CaCO₃) and dolomitic limestone (Ca-MgCO₃) interspersed with gypsum (CaSO₄), marl, occasional concentrations of silica (chert), and clays often containing magnetite nodules and ferric lumps. The central Petén lakes occupy an east-west fault line that roughly separates areas of exposed bedrock of Paleocene-Eocene age to the north and Late Cretaceous age in the south (Hodell et al., 2004). The proportion of major ions in the brackish waters of the lakes permits them to be characterized as bicarbonate (HCO₃⁻) and sulfate (SO₄²⁻) systems. Nixtun-Ch'ich' lies on the western shore of large and deep Lake Petén Itzá (area = 100 km², zmax = 165 m), a sulfate system with total dissolved solids of 311 mg L⁻¹ (Brenner, 2018).

Excavations at Nixtun-Ch'ich' yielded radiocarbon-dated samples indicating that the site grid was put into place during the Middle Preclassic period, 800–500 cal. BCE (Pugh and Rice, 2017; Rice and Pugh, 2017). Several areas of early construction revealed unusual black (Munsell 10YR 2/1), dark gray (10YR 3/1), or dark brown (10YR 3–4/2–3), sticky, clayey sediments. These appear in three primary contexts: as an architectural footing, sometimes as much as 40 cm thick, under-lying construction and overlying limestone bedrock; as a bonder or mortar-like material above, below, and between individual limestone construction stones; and as a “ballast” layer below plaster floors. Similar dark, sticky, clayey materials have been noted in structures at other Middle Preclassic and later sites in Petén.

Two samples of this unusual black material from Nixtun-Ch'ich' were submitted to the Ceramic Technology Laboratory (CTL) at the

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Florida Museum of Natural History (FLMNH), University of Florida (UF), Gainesville, to investigate its properties and explore why early builders might have incorporated it into their structures. This report presents the findings of physical, mineralogical, and soil nutrient (chemical) analyses and their implications. We conclude that these sediments served a mortar-like bonding function in early architectural construction.

2. Materials and methods

2.1. Materials

The two submitted samples were from 2014 excavations in Structure AA1/1 in the eastern part of the civic-ceremonial core of the site (Chan and Pugh, 2015). This structure is a low, west-facing, elongate north-south platform on the east side of a plaza, one of two primary buildings comprising the Sector AA “E-Group.” E-Groups are the earliest (Middle Preclassic period and later) civic-ceremonial architectural complexes in the Maya lowlands, and are believed to have functioned in horizon-based solar astronomy (see, most recently, Freidel et al., 2017; also Aimers and Rice, 2006; Aveni et al., 2003, among others). An early observer on the western pyramid could gaze across the plaza to the eastern platform and confirm equinoctial and solstitial sunrises over marked points (e.g., stones, wooden beams) on the eastern platform. In later times, the eastern platforms were remodeled and enlarged, three superstructures were built over the solar station points, and carved, dated stelae were often erected in front of the eastern face. Structure AA1/1, however, lacked such elaboration, suggesting an early date.

Structure AA1/1 was investigated by three excavations: a large, irregular unit over the front (west) center; a 1 × 2 m E-W test sounding (Unit 4003N/4238W), excavated ~2.5 m to bedrock, in the north-center of the platform; and another large unit (3991N/4248E) over the rear (east) façade. Of the two submitted samples, #64 (CTL sample 1; hereafter analysis sample #64-1) was extracted from the test unit near the center of Structure AA1/1 (Fig. 2). It came from Level 5, a ~70 cm-thick deposit of Middle Preclassic construction fill overlying 30–35 cm of fills atop bedrock, dated to the Middle Preclassic and Terminal Early Preclassic (Pre-Mamom; pre-900/800 BCE) periods. The second, smaller project sample, #15 (CTL sample 2; hereafter analysis sample #15-2), was from excavations into the eastern (back) façade. Here the material represented a 5–10 cm-thick bonder for dressed limestone blocks forming the lowest tier of the stairway access or a stepped back wall (see Figs. 2 and 3; Chan and Pugh, 2015: Figs. 48, 49. The sample was from smaller Unit 3991N/4245E, south of the E-W centerline). Similar material was noted in Level 9, bedrock leveling, in an adjacent unit (Chan and Pugh, 2015: 50, 52).

2.2. Methods

2.2.1. Physical properties

Characterization of the physical properties of the two samples followed CTL protocols (Cordell et al., 2017). The first step was particle-size analysis: wet-sieving through a set of USDA sieves. Analysis sample #64-1 was large enough that a range of properties of this material also could be explored. For example, a test bar (#64-1a) was made for measuring water of plasticity (%WP) and linear drying shrinkage (%LDS). After air-drying for a week, the bar was very hard and was placed...
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