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1 **PRE-HISPANIC AGRICULTURAL DYNAMICS IN THE QUEBRADA**  
2 **OF MOROHUASI (SALTA, ARGENTINA)**

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5 **DINÁMICAS AGRÍCOLAS PREHISPÁNICAS EN LA QUEBRADA**  
6 **DE MOROHUASI (SALTA, ARGENTINA)**

7  
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20 **Abstract**

21 The Quebrada de Morohuasi (Salta Province, Argentina), located in a semi-arid high-altitude  
22 environment, is known to host vast pre-Hispanic cultivation areas. Recent archaeological  
23 studies carried out in the agricultural area of Morohuasi allow for a better definition and  
24 understanding of the social and productive dynamics that took place there. Field records and  
25 AMS dating indicate two main productive phases that were discontinuous in time. These show  
26 an initial phase during the Formative Period, between the 1st and 4th centuries CE, during  
27 which the agricultural substratum was formed, and a final phase during the first decades of the  
28 15th century CE that was related to the establishment of an agricultural colony under the control  
29 of the Inkas. Although the same cultivation plots were utilized during both phases, the mode  
30 and relations of production were substantially different, particularly in the second phase with  
31 the participation of contingents of *mitmaqunas* brought from other regions.

32  
33 Keywords: pre-Hispanic agriculture, southern Andes, Formative Period, Inka, *mitmaquna*.

34

35

36 **Resumen**

37 *Ubicada en un ambiente semiárido de altura, la Quebrada de Morohuasi (Provincia de Salta,*  
38 *Argentina) es conocida por albergar vastas áreas de cultivo prehispánicas. Los recientes*  
39 *estudios arqueológicos realizados en el área agrícola de Morohuasi permiten una mejor*  
40 *definición y comprensión de las dinámicas sociales y productivas que allí se dieron. Los*  
41 *registros de campo y las dataciones AMS realizadas indican dos fases productivas principales*  
42 *discontinuas en el tiempo. Una fase inicial durante el Período Formativo, entre los siglos I y*  
43 *IV CE., en la cual se conforma el sustrato agrícola, y una fase final durante las primeras*  
44 *décadas del siglo XV CE, relacionada con el establecimiento de una colonia agrícola bajo*  
45 *control de los inkas. Si durante ambas fases se cultivaron las mismas parcelas, el modo y las*  
46 *relaciones de producción fueron sustancialmente distintas, destacándose particularmente en la*  
47 *segunda la participación de contingentes de mitmaqunas llevados desde otras regiones.*

48

49 *Palabras claves: agricultura prehispánica, espacio surandino, Periodo Formativo, Inka,*  
50 *mitmaquna.*

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53

## 54 **Introduction**

55 Despite the harsh climatic conditions of aridity and cold, the high Andean valleys located in the  
56 provinces of Salta and Jujuy, in northwestern Argentina, were the scene of important  
57 agricultural developments in the pre-Hispanic era. The numerous areas covered by old  
58 croplands are omnipresent elements of the rugged landscape of these high-altitude valleys.  
59 Since the early twentieth century, these areas have attracted the attention of archaeologists, who  
60 have emphasized the importance of these agricultural developments in the pre-Hispanic social  
61 processes of this part of the Andes. However, relatively few studies have dealt in detail with  
62 these ancient production systems compared to other regional topics, which mainly concern  
63 those areas located on the high slopes of the Quebrada de Humahuaca (Olivera y Palma 1986;  
64 Nielsen 1997; Leoni 2010; González 2011; Albeck 2019).

65 Three aspects of these agricultural areas are remarkable. First, their extensions vary but can  
66 reach several thousand hectares, as in Coctaca (Humahuaca, Jujuy) where it exceeds 3000 ha  
67 (Albeck 2019; Cruz et al. 2021). Second, contrary to what is generally assumed, in all areas  
68 most of the spaces of cultivation are rainfed, with only a very small number of irrigated areas  
69 that are mainly located on the slopes. Lastly, these are agrarian landscapes that are no longer  
70 functional and in which we can clearly observe the transformations and productive and social  
71 discontinuities linked to agricultural practice over a long period of time (Cruz et al. 2021).

72 The chronology of these agricultural developments in the Quebrada of Humahuaca, obtained  
73 by radiocarbon dating of habitational contexts associated with cultivated surfaces in the  
74 localities of Estancia Grande, Alfarcito, and Atumpa dates to between 900 BCE and 700 CE, a  
75 range associated with the Formative Period (Palma and Olivera 1992, Tarragó and Albeck 1997,  
76 Leoni et al. 2013). Based on similarities observed in the pre-Hispanic cultivation surfaces of  
77 different localities located on the high slopes of the Quebrada de Humahuaca, such as Rodero,  
78 Coctaca, Capla, and Alfarcito, we recently proposed the formation, during the Formative

79 Period, of a regional-scale agricultural substrate, which remained in force without major  
80 transformations until the Regional Development Period (LRDP, 13th-15th centuries CE) (Cruz  
81 et al. 2021: 4-7). Significant changes in the agrarian landscape of these areas occurred after the  
82 southern expansion of the Inkas and their territorial dominance in the region. In this context,  
83 Nielsen (1995, 1997) and Albeck (2016, 2019) have noted that the agricultural areas of Coctaca  
84 and Rodero were integrated into the colonial system established by the Inkas in the region,  
85 which is reflected in the significant labor investment they made in the readjustment and  
86 improvement of the former cultivation areas (Cruz et al 2021). Nielsen's excavations at the Inka  
87 sites of Putuquito and Juire, both located in Rodero and directly associated with the cultivation  
88 areas, led him to conclude that they were occupied by local populations who rendered service  
89 to the Inka, as tribute, in agricultural work (Nielsen 1997:51). For her part, Albeck (2019:25)  
90 suggests that it is likely that these workers involved in cultivation were *mitmaqkunas*, that is,  
91 populations forcibly displaced from other regions, a common practice among the Inkas.  
92 However, the most significant transformations would occur later, after the Spanish settled in  
93 the region in the mid-sixteenth century and introduced new crops and, especially, new domestic  
94 animals. The concentration of the indigenous populations in reductions by the colonial system  
95 and the predominance of cattle ranching led to the definitive abandonment of most of the former  
96 cultivated areas.

97 Continuing this line of research, in 2019 we began the study of the pre-Hispanic agricultural  
98 areas located in the Quebrada de Morohuasi (Salta, Argentina), which, although known in the  
99 archaeological literature, had not been specifically addressed until the early 1970s (Raffino  
100 1972, 1973). Three main objectives guided this study: 1) the identification of the different  
101 agricultural and pastoral sectors of the Quebrada de Morohuasi, 2) the precise mapping and  
102 chronology of the Morohuasi site and the associated agricultural area, and 3) the evaluation of  
103 the Inka presence on settlement and agricultural land use dynamics. Beyond the case study, the

104 results obtained allow us to better understand the productive and social dynamics that took place  
105 around agriculture in this part of the southern Andean space during the pre-Hispanic period.

106

### 107 **Study area and archaeological background**

108 The Quebrada de Morohuasi is located in the Salta province in northwestern Argentina (Figure  
109 1). It is a narrow, north-south longitudinal valley of high altitude, about 3 to 4 km wide and 25  
110 km long, flanked to the north and east by the Chañi mountain range, whose peaks are Chañi  
111 (5896 m), Portezuelo (5417 m) and Negro (5028 m). Vast slopes and alluvial fans with light  
112 and moderate slopes whose elevations vary from 3800 m in the northern part to 3350 m in the  
113 southern part, occupy most of the Quebrada. The climate is typical of high altitude Andean  
114 valleys, cold and dry with less than 200 mm of annual precipitation, concentrated in the rainy  
115 months (December - March), an average monthly temperature that varies between 3.4° and  
116 13.6° and five months of frost (Fick and Hijmans 2017). From a phytogeographical point of  
117 view, the Quebrada de Morohuasi is located in a transition zone between the pre-puna and puna  
118 provinces (Cabrera 1976), alternating xerophytic steppes, highland grasslands and wetlands.

119 The first references to the pre-Hispanic occupation of the Quebrada de Morohuasi were made  
120 by Boman (1908) and Von Rosen (1957 [1914]), who focused their work on the site of Ojo de  
121 Agua, a settlement from the Regional Development Period, located near the village of El Rosal.  
122 Boman (1908) also pointed out the existence, near this site, of a footpath that communicated  
123 with the Inka state settlement of Incahuasi to the south. It was not until the 1970s that  
124 archaeological work resumed (Cigliano et al. 1972; Raffino 1972) with studies on the economy  
125 and agricultural production systems of the area called Pie del Paño and later Morohuasi (Raffino  
126 1973, 1977). The area analyzed by Raffino (1973, 1977), however, corresponds to a very small  
127 area (0.3%) located at the lower limit of the Morohuasi agricultural zone. Moreover, this area  
128 presents cultivation spaces that are distinctly different from the vast majority of the parcels in

129 this site. It is very intriguing that Raffino overlooked the habitation site (MoM01) located only  
130 200 meters north of his study area. The researcher's lack of knowledge of this area led him to  
131 incorrectly associate it with the site of Ojo de Agua, located 6 km to the south, thus attributing  
132 its chronology to the period of regional development. Nearly a century after Boman's passage,  
133 Vitry (2005, 2017) highlighted the integration of Quebrada de Morohuasi into the orbit of  
134 Tawantinsuyu through a detailed survey of the road network that connected it to Incahuasi in  
135 the south, and from there to the Lerma Valley (Vitry 2005, 2017).

136

### 137 **Materials and Methods**

138 We conducted three fieldwork campaigns in 2018 and 2020, during which we completed  
139 systematic prospections, surveys of archaeological sectors and sites and different  
140 archaeological excavations, mainly in the agricultural area of Morohuasi. Due to its relevance,  
141 our attention was particularly focused on site MoM01, where we carried out a complete  
142 sampling of the surface material and a record of the different constructive components, which  
143 provided a first chronological contextualization of the site. Subsequently, we finished a series  
144 of exploratory surveys in the habitational contexts of site MoM01 and others connected with  
145 the cultivation fields, in order to obtain material for dating. Since it is evident that site MoM01  
146 and the agricultural surfaces of Morohuasi were occupied at different times, we proceeded,  
147 when possible, to date charcoal and samples of bone material taken from the same context. Four  
148 contexts were thus doubly dated, the results being concordant in all cases. All dates were  
149 calibrated and updated using OxCal 4.3.2 with ShCal13 atmospheric curve (Hogg et al, 2016;  
150 Bronk Ramsey & Lee 2013). We also created a general base map of the Quebrada de Morohuasi  
151 using QGIS editing tools and based on (i) the land surface topography extracted from the Shuttle  
152 Radar Topography Mission (SRTM) v2 that allowed the creation of a Digital Elevation Model  
153 (DEM) with 1-arc sec resolution (~30 m), and (ii) high-resolution satellite imagery available



154 on Google Maps [source: GeoEye, DigitalGlobe, CNES (Centre National d'Études Spatiales)/  
155 Astrium, and CNES/Airbus]. Likewise, we comprehensively covered the agricultural area of  
156 Morohuasi (600 ha), including the MoM01 site, taking high resolution aerial photographs (15  
157 mm/pixel - 15 cm/pixel) obtained by UAV and kite system. The aerial photographs were later  
158 processed to obtain orthorectified mosaics, and then cartographies and an initial typology of  
159 crop surfaces, as well as different spatial and distributional analyses. Finally, we calculated Gini  
160 coefficient of the internal surfaces of housing units using bootstrap resampling techniques with  
161 a number of resamples equal to 1000 (Peterson et al, 2018; Dixon et al., 1987).

162

## 163 **Results**

164 The three main pre-Hispanic field areas in Quebrada de Morohuasi cover 1527 ha (El Rosal,  
165 Morohuasi, and Potrero del Chañi) (Figure 2). They are located in catchments that, within the  
166 Quebrada de Morohuasi, are the only ones close to rock glaciers that provide additional water  
167 supply (Fig. 2). These areas are located mainly in alluvial fans and adjacent plains, within  
168 relatively homogeneous reliefs and with slopes ranging from 6% to 13.5%. We focused our  
169 field studies on the Morohuasi area because of its large extension and better conservation status  
170 (Figure 3).

171

### 172 ***The Site MoM01***

173 The site identified as MoM01 is located in the lowest part of the agricultural area of Morohuasi  
174 (3530 m), 300 m from the main river and on the border of the crop fields. Covering an area of  
175 2.3 ha, the site is visually delimited by the presence of a complex network of mounds (Figure  
176 4). These are constructive conglomerates composed of ancient dwellings, storage structures,  
177 corrals, enclosure walls and other collapsed constructions (Figure 5). The site is also  
178 characterized by abundant ceramic fragments, lithic material and faunal remains on its surface.

179 The appearance and state of preservation of the buildings suggest different periods of  
180 occupation, with much superimposition and reconditioning of structures. This is consistent with  
181 the ceramic styles and surface lithic material, which indicate at least two main phases of  
182 occupation.

183 Fragments of San Francisco style ceramics assign this occupation to the Formative Period (500  
184 BCE - 500 CE). The formative San Francisco style ceramics are found in their incised brown,  
185 wavy orange, unglazed, and two-tone and incised gray variants (Ortiz 2003), and to a lesser  
186 extent, incised or engraved gray ceramics related to Phase III of the Candelaria tradition  
187 (Raffino 1977; De Feo and Bazzano 2015). The numerous obsidian projectile points found on  
188 the surface and in excavation contexts correspond to the A I V and A2 subgroups characteristic  
189 of this region (Escola 1991: 181) and align with the chronology of this initial occupation. This  
190 chronology is confirmed by six AMS dates, made from charcoal and bone material samples  
191 recovered from within two circular structures (MoM-S1 and MoM-S6) and from a slag heap  
192 (MoM-S5) located at the northern edge of the site. As can be seen in Tables 1 and 2, these dates  
193 indicate that this initial occupation phase occurred between 50 BCE and 300 CE. Although the  
194 density of superimposed structures on site MoM01 makes it impossible to define with certainty  
195 the building elements attributed to this first occupation, we identified at least 10 circular  
196 constructions with diameters varying between 4.5 m and 11 m, typical of settlements from this  
197 period in the region.

198 After this initial phase of occupation, the site appears to have been permanently abandoned until  
199 at least the mid-13th century CE. However, this observation hinges on the validity of one AMS  
200 date obtained from a charcoal sample taken from inside a housing unit (MoM-S2), which gave  
201 1270 - 1389 CE (95.4%). It is likely that this date is skewed by the old wood effect, as no other  
202 evidence found at MoM01 indicates that the site was occupied during the Regional  
203 Development Period (RDP). On the contrary, the constructive and taphonomic characteristics

204 of the enclosure from which the sample was taken are consistent with a Late Period occupation  
205 of the site. It is important to keep in mind here that during the LRDP, a nucleated settlement  
206 pattern in villages predominated throughout the region, and these were frequently located on  
207 high reliefs. This is the case of the Ojo de Agua site mentioned at the beginning, a settlement  
208 of about 6 ha in extent that housed between 110 and 300 residential units (Boman 1908: 332;  
209 Raffino 1977: 306), located only 6 km south of MoM01.

210 The second and last significant occupation of MoM01 took place during the first decades of the  
211 15th century, i.e. in the early Late Period (1400-1535 CE). This is confirmed by three other  
212 AMS dates from samples taken within two housing units (MoM-S3 and MoM-S4) located in  
213 the southern part of the site. The two dates from MoM-S3 yielded 535 +/- 30 BP and 515 +/-  
214 30, 450 +/- 30 BP, being calibrated at 1404 - 1451 CE and 1409 - 1456 CE respectively (95.4%).  
215 The remaining date, obtained at MoM-S4, gave 450 +/- 30 BP, calibrated at 1435 - 1620 CE  
216 (95.4%), but with a more consistent curve between 1447-1496 CE (68.3%). This second and  
217 final phase of occupation of MoM01 is directly related to the expansion and territorial  
218 dominance of the Inka in the region, with the site being the head of an established agricultural  
219 colony at Morohuasi under state control at this time. Therefore, with the exception of a platform  
220 that may have been an *ushnu* (Inka ceremonial platform), no features, buildings, or architectural  
221 elements characteristic of state settlements in the region have been identified at MoM01, nor  
222 have fragments of Inka or regional style ceramics associated with the Inkas.

223 During this last phase of occupation, the site was organized into at least 42 well-defined spatial  
224 units, distributed around two large central spaces. The total surface area of each unit varies  
225 significantly between 128 m<sup>2</sup> and 1050 m<sup>2</sup>. While, in general, all the units are composed of a  
226 variable number of perimeter constructions, living quarters and storage structures arranged  
227 around an open space, they present two different configurations. First, 26 units, including the  
228 largest, have large interior spaces without buildings and with homogeneous and clean stone

229 floors, very similar to what is observed in cultivation plots. The abundant amount of lithic  
230 shovel remains, made of schist and basaltic andesite, found on the surface of the site indicates  
231 that these are indeed cultivation spaces. In contrast, the remaining 16 units have significantly  
232 smaller internal spaces, such as courtyards, and show a greater density of buildings as well.

233 A total of 48 residential complexes were identified, 47 of which were rectangular in shape, and  
234 only one circular. In 41 cases, the units have an internal area between 5 and 8 m<sup>2</sup>, in five cases  
235 between 8 and 11 m<sup>2</sup>, and in the remaining two cases 13.5 m<sup>2</sup> and 16.8 m<sup>2</sup>. Similarly, we  
236 identified a minimum number of 264 probable storage structures, and 90% of these have an  
237 internal area between 1 and 3 m<sup>2</sup>, and 63% between 1 and 2 m<sup>2</sup>. The majority of these structures  
238 are clustered, located in a row next to the habitational structures on the perimeter of each unit.

239 The two large central spaces in MoM01 have a sub-circular outline, one (MoU01) occupying  
240 an area of 1225 m<sup>2</sup> and the other (MoU02) 1010 m<sup>2</sup>, and it is likely that they were also used as  
241 cultivation areas. The first (MoU01) is visually distinctive because its southern part is elevated  
242 above the level of the outer surface, and its boundaries are marked by a retaining wall about 30  
243 m long. In contrast, the other central space (MoU02) is connected to the exterior of the site by  
244 a corridor about 25 m long and 2 m wide, which was bounded laterally by thick double-sided  
245 stonewalls. As can be seen in Figure 6, this site entrance shows the superposition of structures  
246 corresponding to the two main phases of occupation of MoM01.

247 Finally, two aspects of the lithic shovels found on the surface of the site are relevant. On the  
248 one hand, these tools are very rare in the cultivation plots of Morohuasi. This observation has  
249 already been made in various Late Period agricultural enclaves in the Puna of Jujuy, in places  
250 like Moreta, Casavindo, and San Juan Mayo (Albeck 2011:31, Angiorama et al. 2019:37,  
251 Franco Salvi et al. 2019:67). On the other hand, in addition to the shovels, abundant flakes,  
252 preforms, and failed products were also found on the surface of MoM01, indicating that these  
253 tools were made and maintained, at this same site. The existence of these agricultural tools in

254 the late occupations of Quebrada de Humahuaca has been considered a direct indicator of the  
255 presence of the Inka state, being also related to the presence of an extra-local labor force  
256 (Nielsen 1997, Albeck 2019). Nielsen (1997:50) points out that this type of tools is also  
257 common in Inka State settlements in other more remote areas, such as Titiconta in the eastern  
258 slopes of the Argentinian Andes, Turi in northern Chile, and Lacaya in the southern Bolivian  
259 highlands.

260

### 261 *Morohuasi crop field areas*

262 In the Morohuasi sector, a minimum of 2250 units constitute a vast and dense network of  
263 archaeological crop fields (Figure 3). Of this total, 1946 units (87%) correspond to crop fields  
264 cultivated under rainfed conditions. These fields are generally lenticular or subrectangular in  
265 shape and are arranged longitudinally in the direction of the slope. Their contours are irregular  
266 and are delimited by stone clearing heaps (Albeck 2019), boundary lines and perimeter  
267 constructions (Figure 4). With a mean value of 1627 m<sup>2</sup>, these crop fields range from 300 m<sup>2</sup>  
268 to 2450 m<sup>2</sup>. Depending on the relief, 15% of these large surfaces have alignments of stones  
269 perpendicular to the slope, without forming terraced levels. Two groups of unequal importance  
270 could be distinguished according to their boundaries characteristics. In the first group  
271 representing 71% of the units, the units are delimited by complex programmed and ordered  
272 constructions, which we call here structured stone clearings (Figure 7, types A-C). In the second  
273 group (29%), the boundary wall is simple, between 0.6 and 1.0 m thick, and consists of stones  
274 resulting from the clearing of the cultivation area (Figure 7, types D and E).

275 The structured stone clearing heaps are well-defined constructions combining two components,  
276 external walls formed of large stones (between 30 and 80 cm) and an infill generally consisting  
277 of stones of much smaller size (Figure 7, types A-C). Their width is comprised between 2 and  
278 3 m with extreme values from 1.5 to 4 m (types A-B, fig. 4). Their internal organization reveals

279 compartmentalized volumes by means of transverse walls delimiting rectangles or squares with  
280 a surface area of between 1 and 3 m<sup>2</sup>. These volumes are filled with the small stones resulting  
281 from the cleaning of the cultivation surfaces. Less frequently, these internal volumes are not  
282 filled and form receptacles. Internal partitions are not only present in a longitudinal direction,  
283 they can also form additional volumes in the transverse direction (Figure 7, type B). In general,  
284 the crop fields delimited by elaborate structured boundaries have a higher level of completion  
285 and a significantly better state of preservation than the rest of the parcels (Figures 8 y 9). The  
286 internal surfaces of these crop fields are cleaner and more homogeneous. In contrast, crop fields  
287 with less elaborate and less preserved perimeter boundaries have more stony internal surfaces,  
288 which are also more affected by water erosion. These differences in soils are evident in aerial  
289 photographs and satellite images, where the better-preserved units are darker in color. This  
290 differentiation, imperceptible on the ground, is related to the homogeneity of the soils, the  
291 greater or lesser vegetation cover and the capacity to conserve moisture, aspects that are  
292 particularly visible on the Sentinel-2 L2A spots. As noted at the MoM01 site, these distinctions  
293 are related to the development of different productive periods in the Morohuasi agricultural  
294 area, with two chronologically discontinuous phases: an initial phase during which the  
295 agricultural substrate was formed, and a final phase during which the soils of the former crop  
296 fields were reconditioned and improved for cultivation again. The initial phase corresponds to  
297 the first occupation of the MoM01 site during the formative period, and the final phase to the  
298 reoccupation of the site during the late period. As seen below, the chronology of the latter phase  
299 has been confirmed by two other AMS dates.

300 A distinctive feature of the later productive phase is the numerous stone housing units  
301 associated with the crop fields. Scattered throughout the agricultural area, a minimum of 417  
302 housing units were identified, 93.2% are attached to the perimeter of the fields, with the  
303 remaining 6.8% located a few meters outside (Figure 10). The majority (90.2%) of the housing

304 units have a rectangular or quadrangular contour, with 9.8% having a circular contour (Figure  
305 11). Their internal surface area ranges from 6 m<sup>2</sup> to 14 m<sup>2</sup>, with only one case exceeding 20 m<sup>2</sup>.  
306 Excavations carried out in two of these units (Moc20 and Moc21) revealed occupied floors with  
307 rustic ceramic remains, as well as hearth-type combustion structures. The small amount of  
308 material remains and the precariousness of the constructions suggest that these units were most  
309 likely occupied on a temporary basis. This coincides with the observations of Raffino  
310 (1972:166), who some fifty years ago conducted a series of test pits in five housing units and a  
311 dump associated with them, located in the aforementioned area. In these test pits, Raffino  
312 identified various regional ceramic styles attributed to the LRDP and Late Period, such as  
313 fragments of coarse, polished black-red ceramics similar to those found at the Tastil site,  
314 fragments of black-on-red Tilcara style, and even a fragment of Santamaría (Raffino 1972:162-  
315 165). These data are consistent with the two AMS dates we performed on charcoal samples  
316 from housing units Moc20 and Moc21, which yielded 560 +/- 35 BP, calibrated to 1307 - 1431  
317 CE (95.4%) and 465 +/- 30 BP, calibrated to 1410 - 1464 CE (95.4%) respectively. These dates  
318 assign these housing units, and associated crop fields, to the same chronological context as the  
319 second occupation of MoM01, i.e., they were also part of the agricultural settlement established  
320 at Morohuasi during this period under Inka control. In marked contrast to what was observed  
321 at MoM01, the footprint of the Inka state is clearly reflected in the quantity, distribution, and  
322 high degree of uniformity of these units. We quantified the degree of inequality in these units  
323 through GINI coefficient analysis based on measurements taken from aerial photographs.  
324 Based on the internal surfaces of 344 housing units, this resulted in a GINI of 0.098 (10% 0.089  
325 and 90% 0.098; SD 0.003). These values show a surprisingly low level of inequality, which  
326 suggests that the housing units are the result of centralized planning following strict  
327 construction guidelines.

328 Another 51 crop plots, much smaller (233 m<sup>2</sup> in average) and with irregular contours, very  
329 similar to those identified in MoM01 (QM01.2 and QM01.3), are located at the southern edge  
330 in the lowest sector of the area (Figure 12). Grouped in two clusters, they cover a total area of  
331 about 1.3 ha, and correspond to the area studied by Raffino (1972, 1973, 1977) to which we  
332 refer above. On the slopes of the hills are groups of terraced *canchones* associated with canals,  
333 which cover a total area of about 6.3 ha. Finally, near the river, there is a 30 ha area of wetlands  
334 and pastures interspersed with a network of canals. This is the only area still cultivated today  
335 by the local population.

336

### 337 *Pastoral sites and rock art*

338 The three principal areas of pre-Hispanic agricultural surfaces of the Quebrada de Morohuasi  
339 are associated with wetlands within which, or in their immediate vicinity, we have identified a  
340 large number of abandoned (598) and functioning (331) corrals. The significance of pastoral  
341 activities is also evidenced by the existence of eight habitation sites associated with numerous  
342 corrals. Due to their size and number of corrals, three sites stand out, located in the northern  
343 part of the Quebrada, above 3700 m near wetlands. Site QM04.1, located 10.5 km north of the  
344 Morohuasi area and 5.2 km from Potrero del Chañi, covers approximately 5 ha (Figure 13). The  
345 number of corrals identified in QM04.1 exceeds 48 units, most of which are orthogonal in  
346 shape, with irregular contours to a lesser extent, and in a few cases circular, with surface areas  
347 varying between 50 m<sup>2</sup> and 700 m<sup>2</sup>. As observed at MoM01, the constructions and ceramic  
348 fragments found on the surface of QM04.1 indicate a multicomponent site with two main phases  
349 of occupation. The initial phase corresponds to the formative period, as evidenced by the  
350 abundance of San Francisco style incised ceramics, circular constructions and rock engravings  
351 with iconography typical of the Formative Period. The second phase corresponds to the Late  
352 Period, mainly attested by Tastil-style ceramics (Cigliano y Calandra 1972) and, to a lesser



353 extent, by fragments of polished and red-lipped ceramics of possible Inka affiliation. Site QM06  
354 is located in Abra de Reyes, a natural pass that connects the Jujuy Valley, at an altitude of 3875  
355 m. Covering an area of 2.2 ha, this site has a conglomerate of 40 corrals, plus another 19 corrals  
356 located in the periphery. Site QM07 is located on the slopes of Cerro Chañi, at an altitude of  
357 more than 3940 m, within a large wetland. The site occupies about 4.2 ha, and <sup>houses</sup> about 80  
358 corrals, most of which are rectangular or quadrangular in perimeter and vary in size from 50 m<sup>2</sup>  
359 to 300 m<sup>2</sup>. Unlike QM04.1, no chronological indicators are yet available for these three sites.  
360 In addition to the 8 sites with a high number of corrals, 34 small occupations were recorded in  
361 Quebrada de Morohuasi, which fit the definition of pastoral posts in that they are scattered and  
362 have a very limited number of corrals. There are 14 sites with only 1 corral, 13 with 2 corrals,  
363 5 with 3 corrals and 2 with 5 corrals. Most of the corrals have an area between 60 and 200 m<sup>2</sup>,  
364 with only 3 corrals larger than 300 m<sup>2</sup>.

365 Finally, from our surveys, we registered two sectors with rock engravings, both located near  
366 sites with corrals (Figure 14). One group comprised of at least 12 engraved rocks, is distributed  
367 along a slope leading to site QM04.1, and another of 10 engraved rocks is located on a small  
368 hill about 300 m east of site QM03.3. In addition, there are the two engraved rocks identified  
369 by Boman (1908: 348-352) in the vicinity of El Rosal. Most of the engravings show abstract  
370 drawings and representations of camelids, feline beings, and anthropomorphs in a style similar  
371 to those observed in other areas of the region that have been attributed to the Formative Period  
372 (Aschero et al. 1991, Aschero 1996-98; De Feo 2018). We also identifies, in smaller numbers,  
373 stylized representations of llamas and ancoriform pectoral motifs, typical of the Late Formative  
374 Period, a situation that has also been noted in nearby Quebradas (De Feo 2018).

375

376 **Discussion**

377 *The formation of an agricultural substrate in the Formative Period*

378 Our data indicate that the agricultural systems of Morohuasi, and most probably also those  
379 located in El Rosal and Potrero del Chañi, date from the first occupation of the Quebrada (0-  
380 300 CE). A main characteristic of the agricultural area of Morohuasi is the very large network  
381 of crop fields. Structured stone clearing heaps delimitate the vast majority of these fields whose  
382 surface range from 500 m<sup>2</sup> to 2000 m<sup>2</sup>. These two characteristics suggest that we are dealing  
383 with independent individual or family-scale cultivation units, with each individual or family  
384 farming more than one unit. This same agricultural substrate is present in the areas of El Rosal  
385 and Potrero del Chañi, being identified in the first two occupations with constructive features  
386 similar to MoM01. This occupation during the Formative Period correlates with the results of  
387 several studies carried out in neighboring areas, reflecting an important regional dynamic. A  
388 series of sites ascribed to this period can be found in a nearby Quebrada to the northwest of  
389 Morohuasi, all located on the margins of wetlands found there and extending over more than  
390 250 ha. These are the Potrero Grande and Cerro el Dique sites, respectively dated at 1710 +/-  
391 50 BP and 1690 +/- 50 BP (Cigliano et al. 1976: 123), the Tres Cruces site, with dates between  
392 1640 +/- 70 BP and 1230 +/- 70 BP (Raffino 1977: 68; De Feo 2010: 101), and the La Ollada  
393 and Salamina sites (De Feo 2010: 97-98). The small amount of ancient cultivated areas  
394 associated with these sites and the large extent of the wetlands suggests that they were more  
395 closely associated with farming and herding practices. Approximately 15 km west of these sites  
396 is located the Cerro La Aguada site, dated 1270 +/- 50 (Cigliano et al. 1976: 123), around which  
397 are distributed at least 26 ha of rainfed cultivated surfaces delimited by large clearings. Other  
398 Formative Period occupations were identified on the low slopes of the Acay hill, 25-35 km west  
399 of Morohuasi. These are the sites located in Las Cuevas locality, dated between 2485 +/- 60 BP  
400 and 1695 +/- 30 BP (Cigliano et al 1976: 122-123), and those registered in the Quebrada de

401 Incahuasi, this last one presenting approximately 60 ha with large areas of rainfed crops,  
402 morphologically very similar to those identified in Morohuasi.

403 Although all these Formative Period occupations are associated with ancient cultivation  
404 surfaces, these are not comparable in extension and diversity, with the agricultural areas of the  
405 Quebrada de Morohuasi which total more than 1500 ha. In this sense, the identification of a  
406 vast agricultural landscape ascribed to the Formative Period in Quebrada de Morohuasi,  
407 previously interpreted as originating during the Late Regional Development Period (Raffino  
408 1973, 1977), provides a new perspective for the development of the Formative societies of the  
409 region. Indeed, an agricultural landscape with characteristics similar to those of Morohuasi are  
410 found in different localities of the eastern slopes of the Quebrada de Humahuaca, such as  
411 Alfarcito, Capla, Cotacta-Valiazo-Pukara, and Rodero (Cruz et al. 2021). These areas occupy  
412 more than 4000 ha, located mainly in the ejection cones and on low slopes, between 3200 and  
413 3400 m above sea level. As in Morohuasi, this landscape constitutes a dense network of crop  
414 fields delimited by stone clearing heaps. Similarly, the outlines of these areas tend to be  
415 rectangular, arranged longitudinally in the direction of the slope, and the average size of the  
416 fields is very similar: 1627 m<sup>2</sup> in Morohuasi, 1668 m<sup>2</sup> in Coctaca, 1729 m<sup>2</sup> in Alfarcito, 1731  
417 m<sup>2</sup> in Capla, and 1683 m<sup>2</sup> in Rodero (our data). In other words, these similarities in the  
418 agricultural organization suggest that they are the product of very comparable societies. The  
419 formal similarities observed and the available dating suggest that the formation of the  
420 agricultural landscape on the slopes of the Quebrada de Humahuaca took place during the same  
421 Formative context as in Morohuasi, which makes sense considering the geographic proximity  
422 of both areas (100 - 150 km), the similarities of the environment, and the climatic conditions  
423 noted above.

424

425 *Morohuasi under the domination of the Inkas*

426 The second significant occupation of MoM01 took place during the first half of the 15th  
427 century, a period in which strong social changes took place in the region due to the expansion  
428 and domination of the Inkas. Among the most significant impacts was the depopulation and  
429 disarticulation of local settlements, such as Ojo de Agua, and even urban centers such as Tastil,  
430 as a result of Inka political and territorial reconfiguration (Vitry 2003). In this context, the Inka  
431 established an agricultural settlement in Morohuasi, giving rise to a new phase of production in  
432 which a large part of the crop fields of the formative agricultural substrate were reconditioned  
433 and reused. State control is reflected in the number and high degree of uniformity of the housing  
434 units installed next to the cultivation plots, which were temporarily occupied by workers from  
435 elsewhere (*mitmaqunas*). The absence of Inka state buildings at Morohuasi, as well as the very  
436 limited presence of Inka-style ceramics at the site, suggests indirect Inka control of this  
437 agricultural settlement. Both the architecture and the remains of late-style pottery found on the  
438 surface of sites QM03 and QM04 suggest that this dynamic of reoccupation and reuse of former  
439 productive spaces also involved sites related to ranching and pastoral activities located in the  
440 northern part of the Quebrada de Morohuasi. It is significant that some rocks with engravings  
441 from the Formative Period located near these sites, incorporated new figures of stylized llamas  
442 and ancoriform pectorals, designs that were linked in this part of the Andes to the southern  
443 expansion of the Inka (Berenguer et al. 2007). This same situation has been observed in the  
444 rock art of localities near Morohuasi, such as La Damiana (De Feo 2018), indicating that this  
445 was a widespread practice of symbolic appropriation of territory.

446 Two aspects of the agricultural colony established by the Inkas in Morohuasi should be  
447 highlighted. Indeed, a similar dynamic of reuse of the formative agricultural substrate under  
448 state control occurred on the upper slopes of the Quebrada de Humahuaca, in the Coctaca,  
449 Rodero, and Alfarcito areas (Cruz et al. 2021). However, the investment made by the Inkas in

450 the readjustment and improvement of the former crop areas of Morohuasi did not have the same  
451 intensity as in these other areas, especially in comparison to Coctaca, where the stone quarries  
452 and cultivation enclosures of Coctaca reached monumental levels (Albeck 2019). On the other  
453 hand, the agricultural settlement established at Morohuasi was fully integrated into a geography  
454 of state power articulated by the *Inka Ñan*, the network of Inka roads and paths that connected  
455 the areas of greatest agricultural, pastoral, and mining production in the region to various  
456 administrative centers and enclaves (Vitry 2019). In this sense, the agricultural settlement of  
457 Morohuasi is directly related to the site of Agua Hedionda, located in the lower part of the  
458 eastern foothills, 40 km east of the Quebrada. Agua Hedionda was a medium-sized regional  
459 administrative center with a sector with a *kallanka*, *aucaypata*, and *ushnu*, several housing  
460 sectors, and a storage sector (Cremonte et al. 2003, 2005). In this last sector, the circular  
461 foundations of some 91 *colqas* or storage depots have been identified, which could be more if  
462 we take into account that part of this sector has collapsed. Agua Hedionda is located at the foot  
463 of a narrow ravine that flows directly into one of the passes leading to the agricultural area of  
464 Morohuasi and the MoM01 site, with two pre-Hispanic occupations that may have served as  
465 posts. Similarly, Morohuasi is connected to the south, through the Quebrada del Toro, to the  
466 state settlement of Incahuasi (Boman 1908; Vitry 2019), and from there to the Lerma Valley,  
467 where the main regional collection center was located: Campo del Pucará, 70 km from  
468 Morohuasi, a center that had a storage area of 1,700 *qolqas*. In addition to these state centers,  
469 Morohuasi's agricultural production also had to supply the pastoral enclaves north of the  
470 Quebrada, the mining enclaves of Cerro Chañi, as well as a *tambo* in the locality of El Moreno  
471 (Vitry and Soria 2007: 43). According to the colonial chronicler Juan de Matienzo (1910  
472 [1567]: 183), this *tambo* was one of the posts that segmented the successive stages of the  
473 Qhapaq Ñan or main Inka route in this part of the Andes.

474

475 *Evidence of mitmaqkuna in Morohuasi*

476 The mode of agricultural production developed by the Inka in the various regions that they  
477 colonized was based on the use of *mitmaqkuna*. This term designated populations transferred  
478 by the Inkas, either for military purposes, or employed as workers in the agricultural colonies,  
479 and possibly also in mines. The information provided by the colonial documentary sources  
480 allows us to distinguish two types or categories of *mitmaqkuna*. On the one hand, the  
481 *mitmaqkuna* or *mitimas* themselves, i.e., contingents of people, usually from remote areas, who  
482 were permanently displaced or for extended periods of time, in many cases dissociating  
483 themselves permanently from their places of origin (Pease 2015:65). Settled in agricultural  
484 settlements, the *mitimas* are noted for being responsible for controlling the granaries (Wachtel  
485 1980:311). On the other hand, there were the *mittanis* or *mittayocs*, usually settlers from closer  
486 areas who participated in the *mit'a* service, a labor service that was performed at certain times  
487 of the year. Unlike the *mitimas*, the *mittani* were temporarily transferred to the agricultural  
488 settlements to work on farmland preparation, planting, and harvesting (Wachtel 1980:308;  
489 Pease 2015:48-66). This work was done individually, with each *mittani*, or each *mittani* family,  
490 engaged in work on a given portion of land. The two categories of *mitmaqkuna* were not  
491 mutually exclusive, appearing together in Inka agricultural settlements, such as those in the  
492 Cochabamba Valley (UMSS 1977[1556]), with the *mittani* playing specific roles in productive  
493 tasks, and the *mitimas* as guardians of production.

494 In accordance with the information provided by the colonial sources, the new archaeological  
495 data converge to indicate the presence in Morohuasi of *mitmaqkuna* populations in their two  
496 variants: *mittanis* and *mitimas*. The number and construction characteristics of the housing units  
497 associated with the cultivation plots, the fact that they were temporarily occupied, and the  
498 records of ceramics with styles from neighboring regions, indicate association with *mittani*  
499 contingents. In this regard, the high degree of uniformity of these pieces, consistent with the

500 standardization that characterizes Inka architecture, ceramics, textiles, and other material  
501 production (Gasparini and Margolies 1977, Hyslop 1990, Moore 1996), highlights the control  
502 exercised by the Inka state. At the same time, the small living area of these housing units  
503 indicates that they were temporarily occupied by a very limited number of people, probably  
504 only one person. This is consistent with the size of the associated cultivation units, the vast  
505 majority of which (97%) are no larger than 0.3 ha. Significantly, the 12 cropping units larger  
506 than 0.3 ha identified in Morohuasi are the only ones associated with two or three housing units.  
507 The MoM01 site, consisting of at least 30 residential complexes composed of a variable number  
508 of residential buildings and storage structures is fundamentally different. These habitation  
509 structures, the abundant material remains found on the surface, and the existence of cultivation  
510 spaces next to the dwellings indicate a more prolonged and stable population. The amount of  
511 lithic shovels found on the surface of MoM01, which were produced at the same site, is relevant  
512 at this point, being these agricultural tools very infrequent in the cultivation plots. This is a  
513 significant difference insofar as it corresponds to two distinct modes of cultivation practices  
514 probably linked to the presence of populations of different origins. Furthermore, the 264 storage  
515 structures identified at MoM01, with internal areas totaling approximately 470 m<sup>2</sup>, far exceed  
516 the domestic scale of residential assemblages, and the breakdown of these structures into  
517 sectoral groups is also relevant. These data, coupled with the fact that these structures are rarely  
518 associated with cultivation plots, indicate that the established population at MoM01 had under  
519 its control, the storage of at least a considerable portion of the produce harvested at Morohuasi,  
520 which is fully consistent with what the colonial documentary sources indicate about the  
521 functions performed by the *mitimas*.

522 Finally, we should consider another fundamental aspect of the logistics developed by the Inkas  
523 in their agricultural colonies. Indeed, the colonial documentation indicates that in these  
524 agricultural colonies, there was a clear distinction between the "*chácaras*" (crop plots) of the

525 Inka, which occupied the biggest expanses of land and whose products were not consumed  
526 locally, and the other zones of cultivation, the minority, which were destined to the subsistence  
527 of the *mitimas* and the *mittanis*. For example, in the agricultural settlement that the Inka  
528 established in the Cochabamba Valley, Bolivia, crops for *mitmaqkuna* subsistence were located  
529 at the lower and upper ends of the lands intended for the Inka (Wachtel 1980:310). This  
530 historical information is also consistent with our observations at Morohuasi. We have seen that  
531 the probable *mitimas* established at MoM01 had at least some of their crops next to their housing  
532 units. But, 200 m south of the site, at the edge of the lowest area of the zone, 51 other small  
533 crop plots are grouped into two clusters (QM01.2 and QM01.3), very similar in size and shape  
534 to the cultivation spaces identified within MoM01 (Figure 12). Significantly, they are  
535 associated with at least 15 habitation units similar to those identified throughout the area, so it  
536 is reasonable to hypothesize that these habitation sites were intended for the contingent of  
537 *mittanis* temporarily relocated to work in the Inka fields. Although numerous archaeological  
538 studies have highlighted the probable presence of *mitmaqkuna* populations in Inka contexts,  
539 this is the first time that this has been clearly demonstrated in their most immediate context:  
540 agricultural production. Beyond the particularities that this case may present, it is a relevant  
541 result for archaeological and historical studies centered on the Inkas and the Tawantinsuyu.

542

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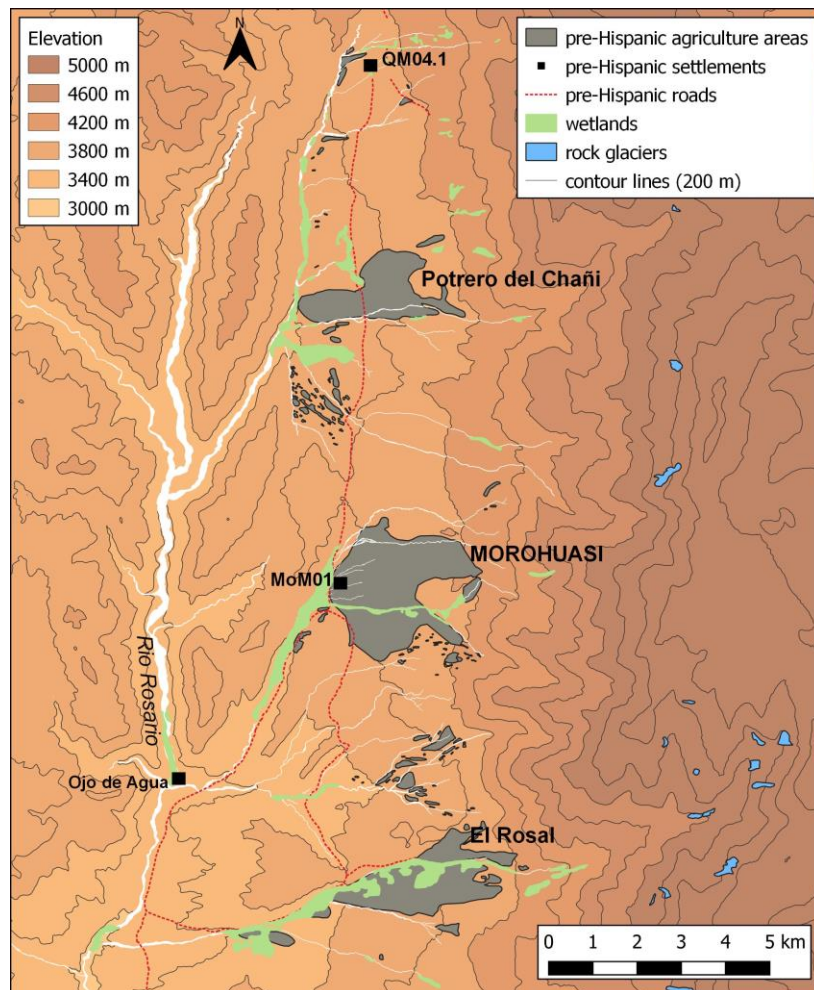




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746 Figure 1. Map showing the location of Quebrada de Morohuasi and localities cited.

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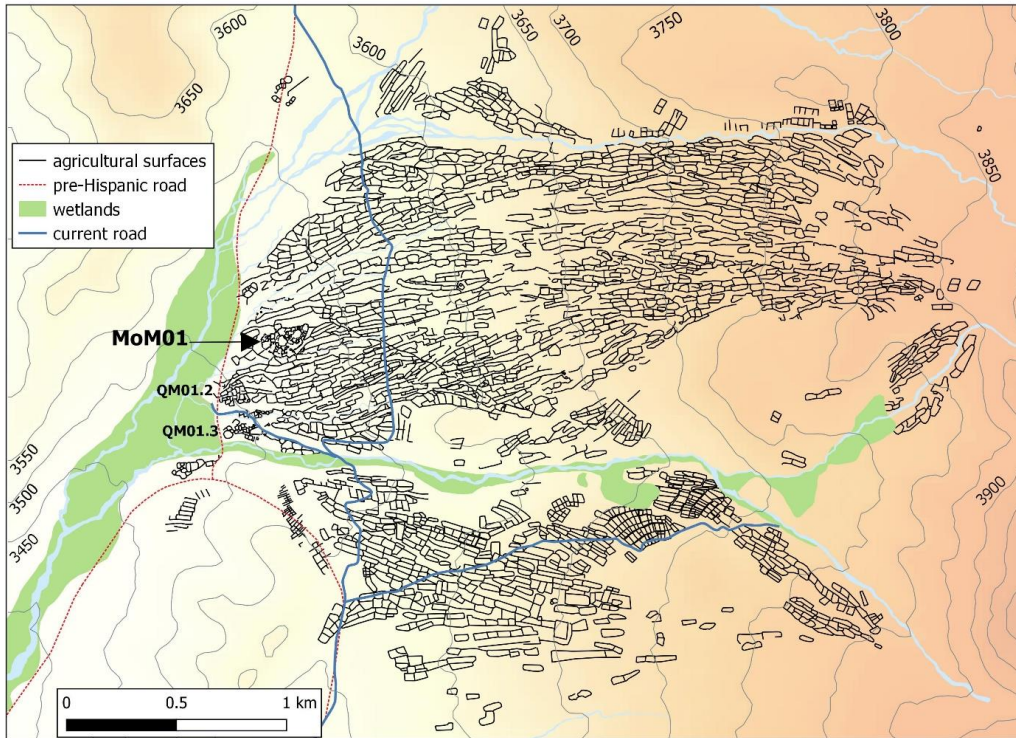
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749 Figure 2. Map of the Morohuasi valley showing the location of agricultural areas and pre-  
 750 Hispanic sites.

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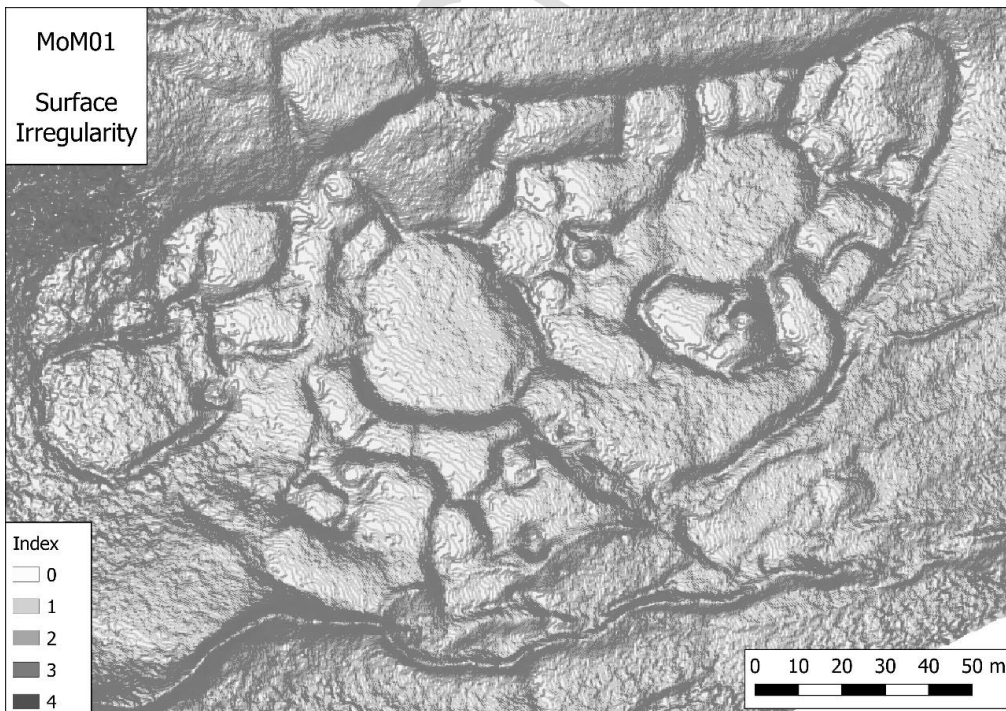




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753 Figure 3. Map of the agricultural area of Morohuasi.

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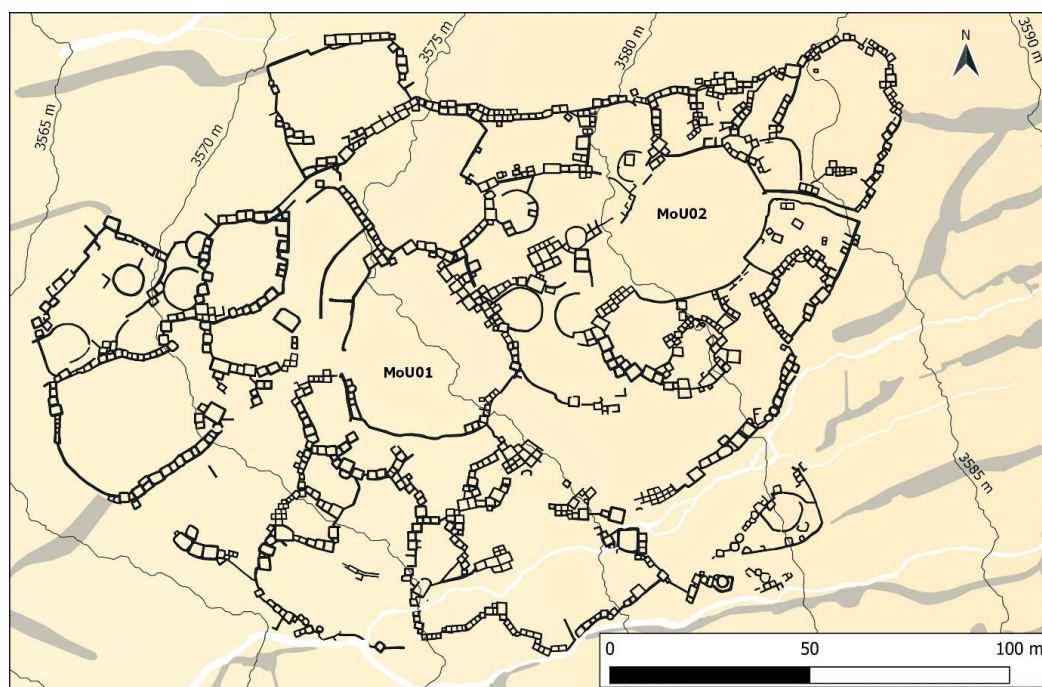
756 Figure 4. Image of site MoM01 showing the monolithic formations. Modeling of surface

757 irregularities made from a DEM.

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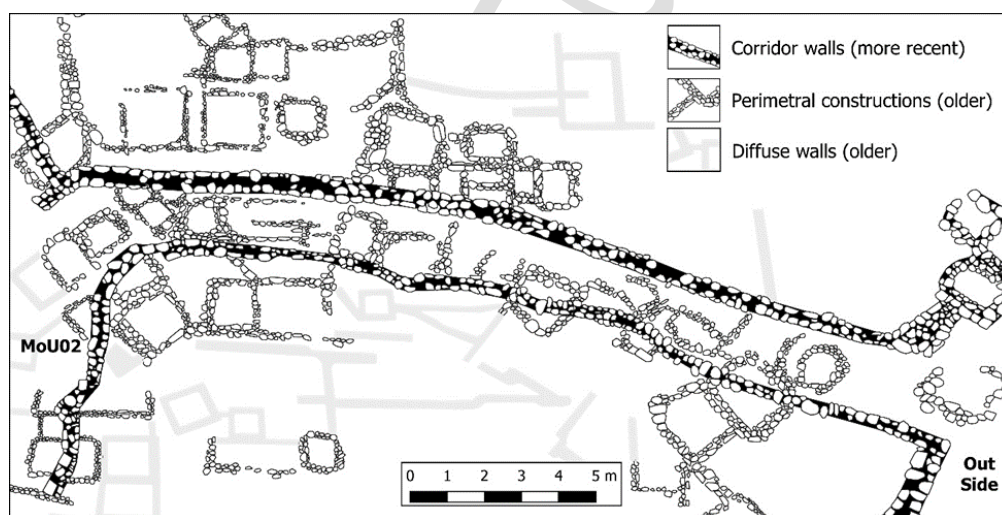
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762 Figure 5. Plan of site MoM01.

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765 Figure 6. Detail of the eastern sector of site MoM01 where the corridor that communicates with  
766 the exterior is located, superimposed on previous constructions and structures.

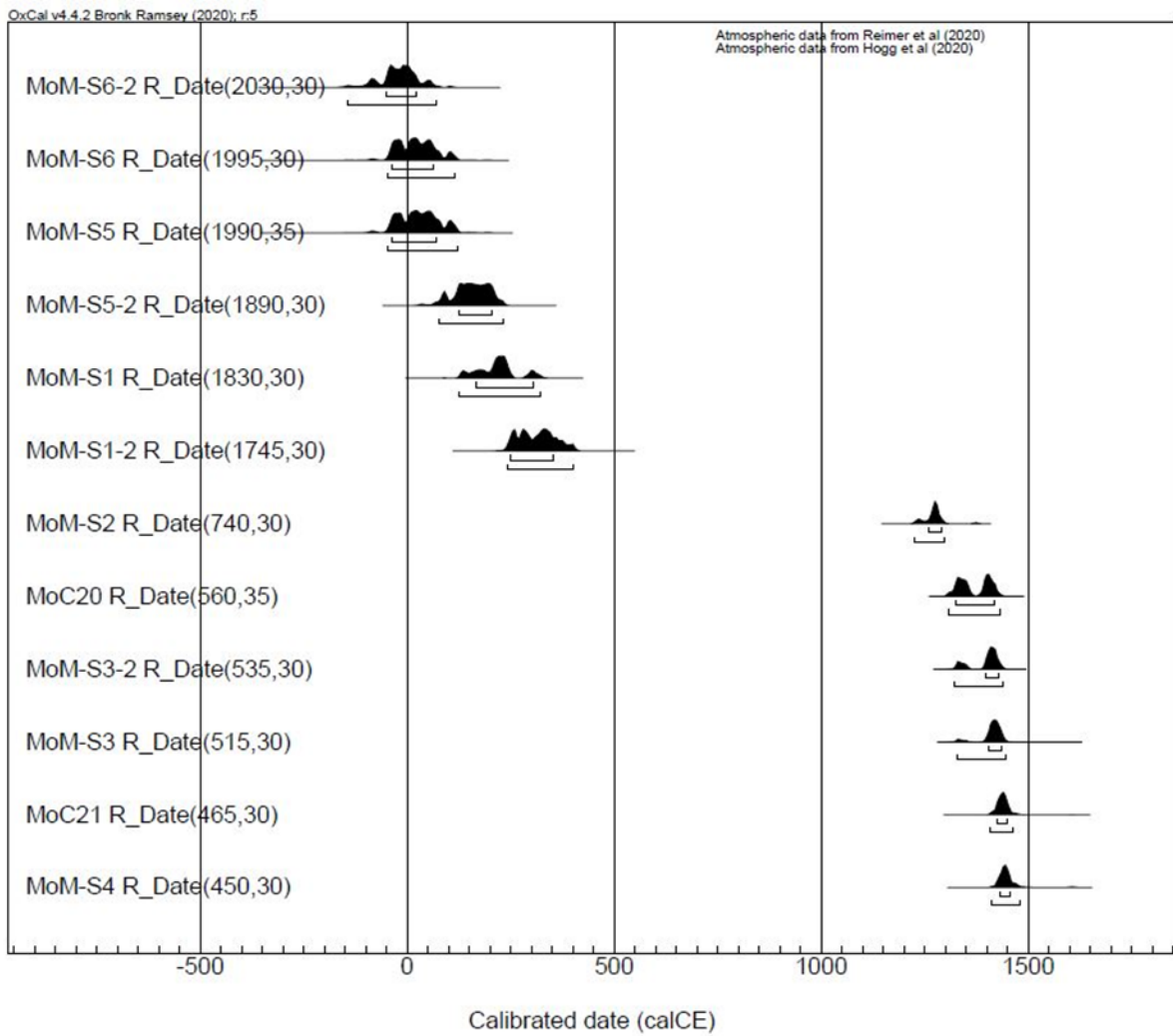
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769 Table 1. Radiocarbon dating (AMS) of Morohuasi.

Sample	Lab N°	Material	C Age 1 $\sigma$ (yr BP)	Calibration OxCal v. 4.3.2.SHCal13		Context
				68.3% (yr BCE/CE)	95.4% (yr BCE/CE)	
MoM-S1	Poz 119787	charcoal	1830 $\pm$ 30	165 – 188 CE (12.2%) 202 – 248 CE (53%) 299 – 305 CE (3.1%)	127 – 253 CE (84.7%) 290 – 320 CE (10.8%)	Habitational structure in residential unit
MoM-S1-2	Poz 119761	bone	1745 $\pm$ 30	249 – 266 CE (13.1%) 272 – 297 CE (19.8%) 309 – 353 CE (35.5%)	242 – 401 CE (95.4%)	Habitational structure in residential unit
MoM-S2	Poz 119791	charcoal	740 $\pm$ 30	1261 – 1291 CE (68.3%)	1225 – 1299 CE (95.4%)	Habitational structure in residential unit
MoM-S3	Poz 119789	charcoal	515 $\pm$ 30	1406 – 1435 CE (68.3%)	1328 – 1345 CE (4.8%) 1395 – 1447 CE (90.6%)	Habitational structure in residential unit
MoM-S3-2	Poz 119762	bone	535 $\pm$ 30	1397 – 1430 CE (68.3%)	1323 – 1355 CE (20.8%) 1392 – 1439 CE (74.7%)	Habitational structure in residential unit
MoM-S4	Poz 119792	charcoal	450 $\pm$ 30	1431 – 1456 CE (68.3%)	1413 – 1480 CE (95.4%)	Habitational structure associated with crops
MoM-S5	Poz 119790	charcoal	1990 $\pm$ 35	39 – 11 BCE (18.8%) 2 – 70 CE (49.5%)	49 BCE – 120 CE (95.4%)	Trash dump
MoM-S5-2	Poz 119763	bone	1890 $\pm$ 30	124 – 205 CE (68.3%)	76 – 231 CE (95.4%)	Trash dump
MoM-S6	Poz 119794	charcoal	1995 $\pm$ 30	38 – 13 BCE (20.7%) 3 – 62 CE (47.6%)	48 BCE – 84 CE (89.9%) 96 – 116 CE (5.6%)	Habitational structure in residential unit
MoM-S6-2	Poz 119764	bone	2030 $\pm$ 30	52 BCE – 23 CE (68.3%)	147 – 140 BCE (0.6%) 108 BCE -69 CE (94.8%)	Habitational structure in residential unit
MoC20	Poz 119795	charcoal	560 $\pm$ 35	1325 – 1353 CE (34.9%) 1394 – 1418 CE (33.3%)	1307 – 1364 CE (49.8%) 1385 – 1431 CE (45.7%)	Habitational structure associated with crops
MoC21	Poz 119793	charcoal	465 $\pm$ 30	1425 – 1450 CE (68.3%)	1410 – 1464 CE (95.4%)	Habitational structure associated with crops



772 Table 2. AMS dating with representation of the calibrated curves.



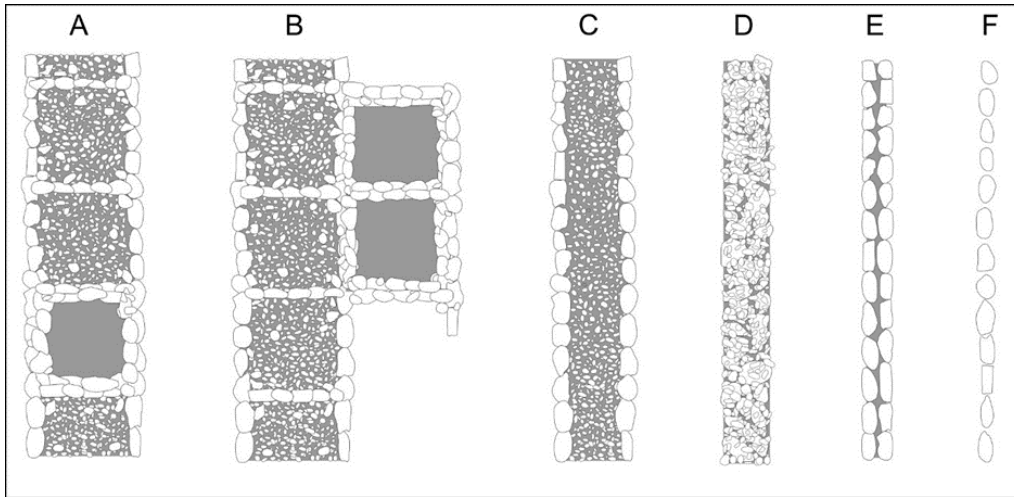
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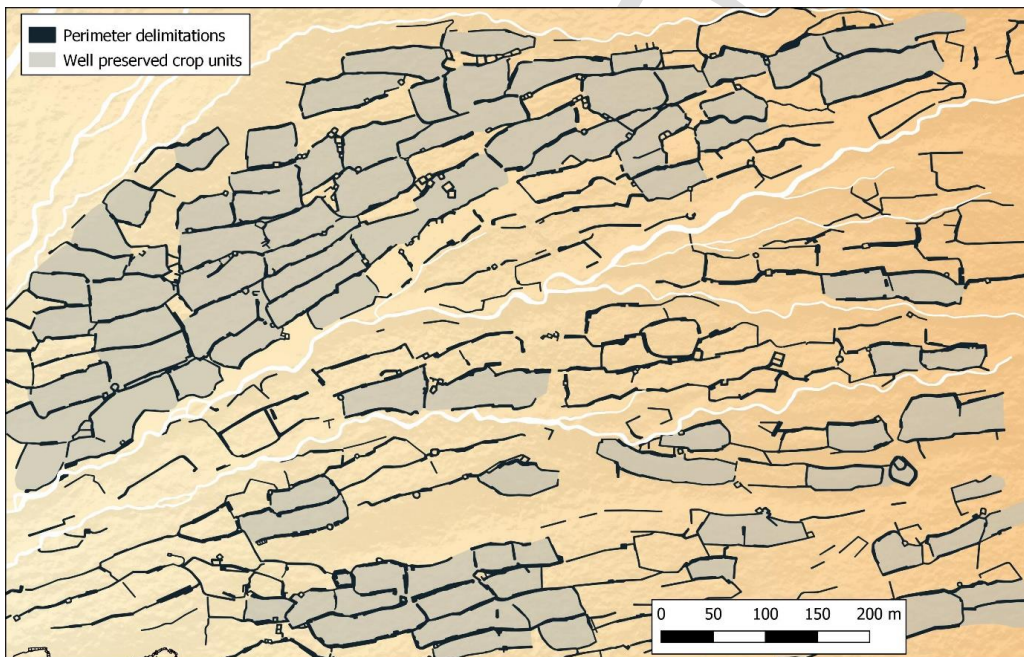
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778 Figure 7. Types of delimitations of cultivation units. A-C: structured clearings. D: lines of  
 779 boundaries. E: perimeter walls. I: stone alignments.

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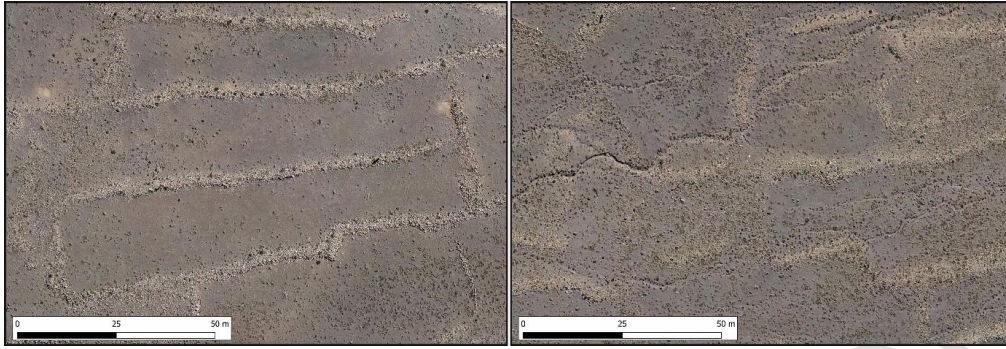


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782 Figure 8. Map of a sector of Morohuasi showing crop areas delimited by structured clearings.

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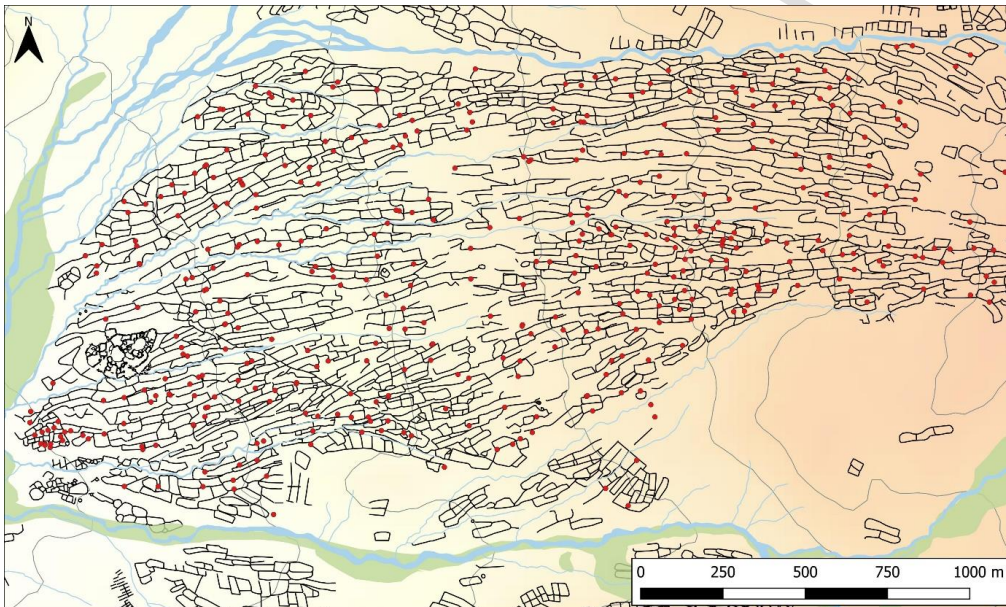
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786 Figure 9. Photographs showing the differences in the state of preservation between the plots  
787 delimited by structured boundaries (more recent) and the plots with simple boundaries (older  
788 ones).

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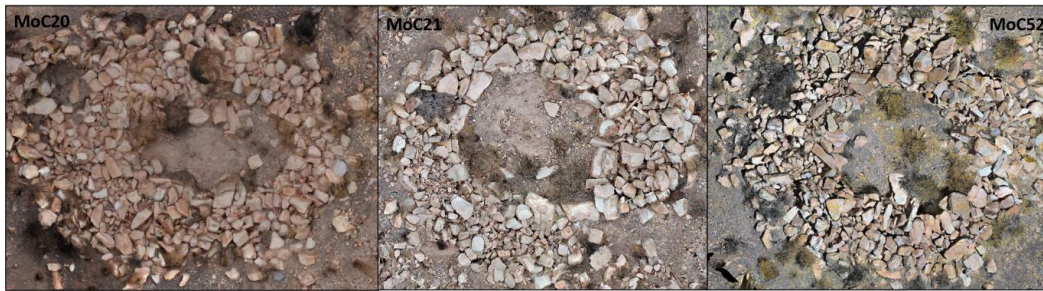
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791 Figure 10. Map of the Morohuasi area showing the distribution of housing units associated with  
792 cultivation parcels (in red).

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796 Figure 11. Orthophotos of three habitational enclosures associated with the cultivation parcels  
 797 (MoC20, MoC21 and MoC52).

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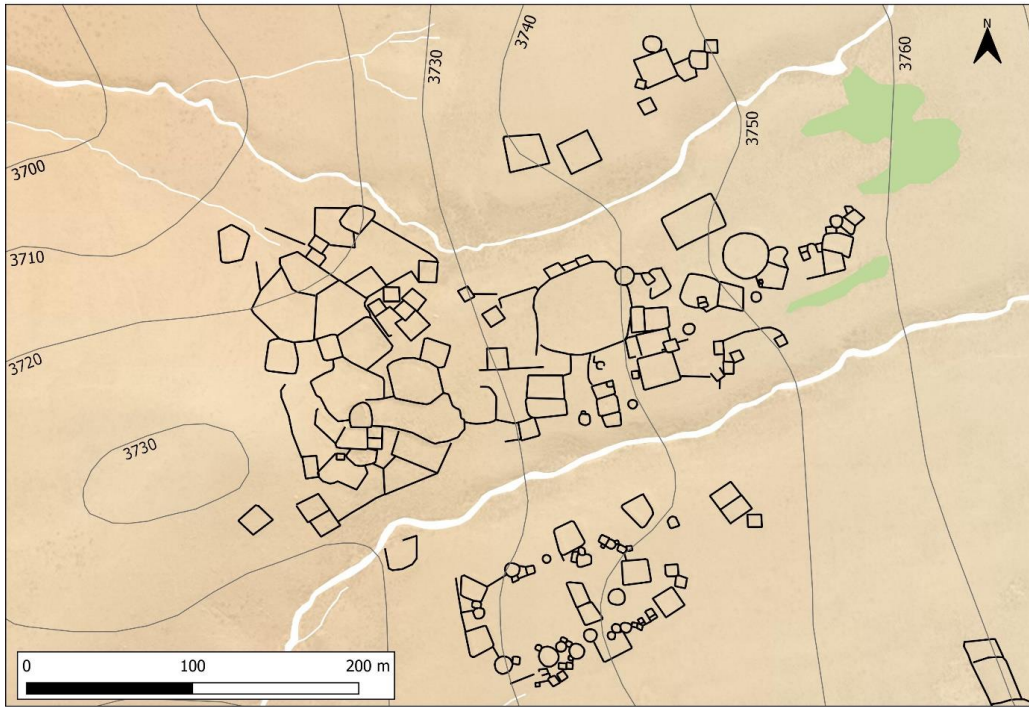
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803 Figure 12. Detail of sector QM01.2 where a group of small crop plots are located.

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808 Figure 13. Sketch of sites QM07 and QM 04 associated with camelid herding.

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812 Figure 14. Photographs of two engraved rocks near site QM 04.