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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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52

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 m² and 1050 m². 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 m², in five cases
235 between 8 and 11 m², and in the remaining two cases 13.5 m² and 16.8 m². 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 m², and 63% between 1 and 2 m². 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 m² and the other (MoU02) 1010 m², 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 m², these crop fields range from 300 m²
268 to 2450 m². 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 m². 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 m² to 14 m², with only one case exceeding 20 m².
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 m² 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 m² and 700 m². 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 ^{houses} about 80
358 corrals, most of which are rectangular or quadrangular in perimeter and vary in size from 50 m²
359 to 300 m². 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 m²,
364 with only 3 corrals larger than 300 m².

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 m² to 2000 m². 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 m² in Morohuasi, 1668 m² in Coctaca, 1729 m² in Alfarcito, 1731
417 m² in Capla, and 1683 m² 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 *colqas*. 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 m², 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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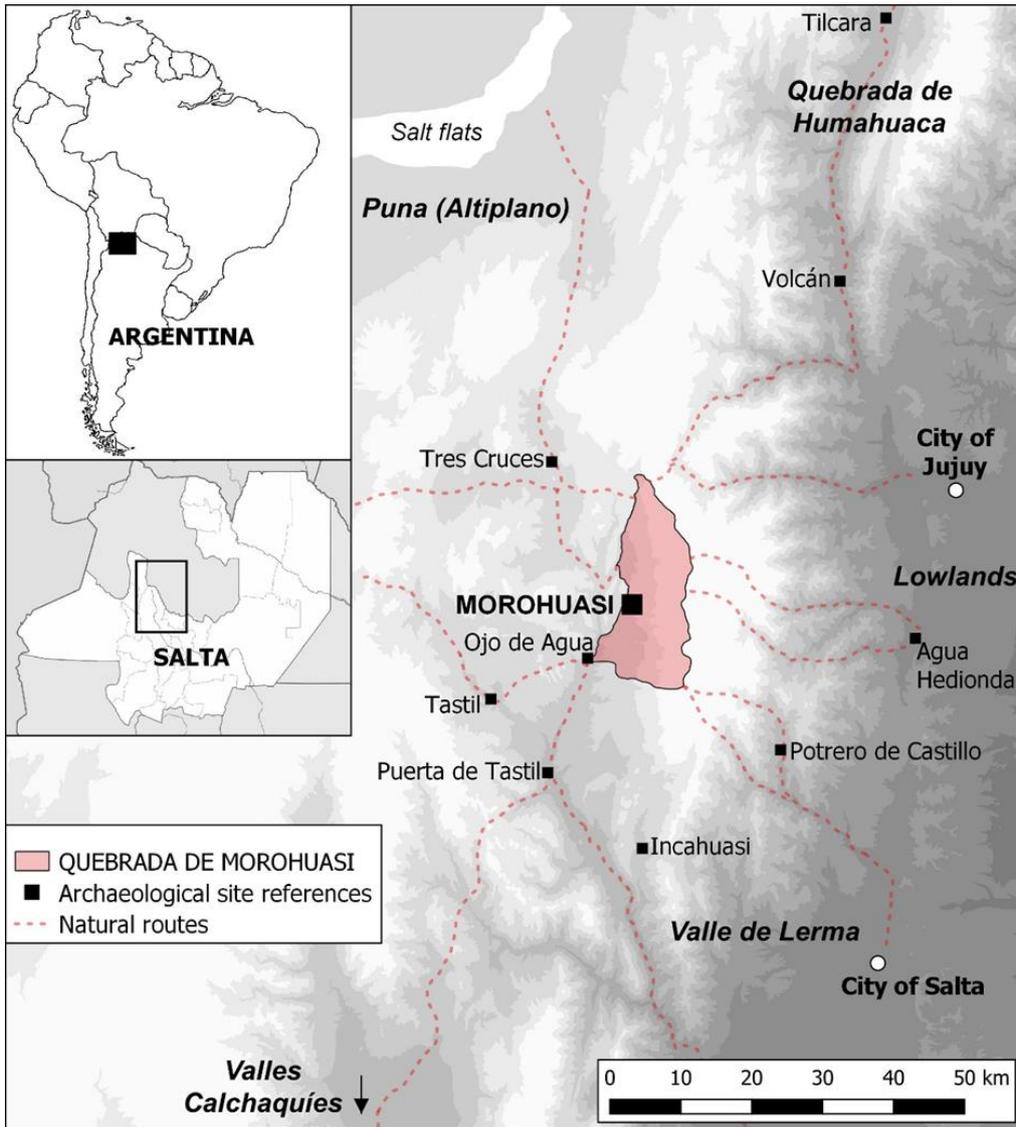
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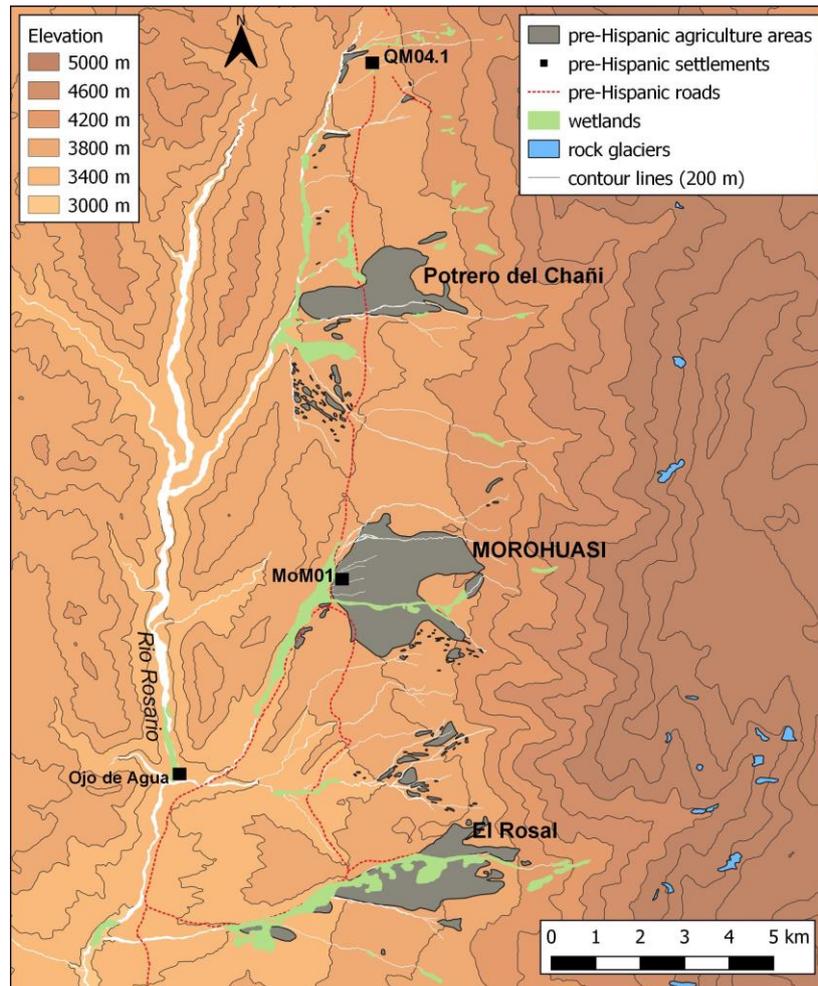
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746 Figure 1. Map showing the location of Quebrada de Morohuasi and localities cited.

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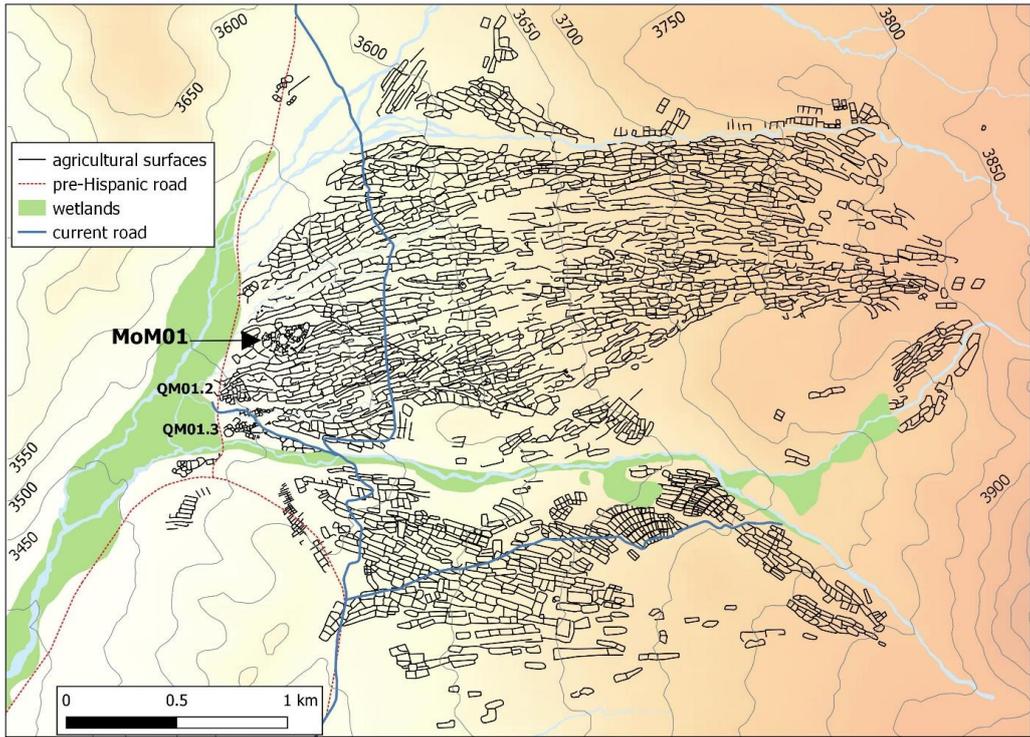


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749 Figure 2. Map of the Morohuasi valley showing the location of agricultural areas and pre-
 750 Hispanic sites.

751

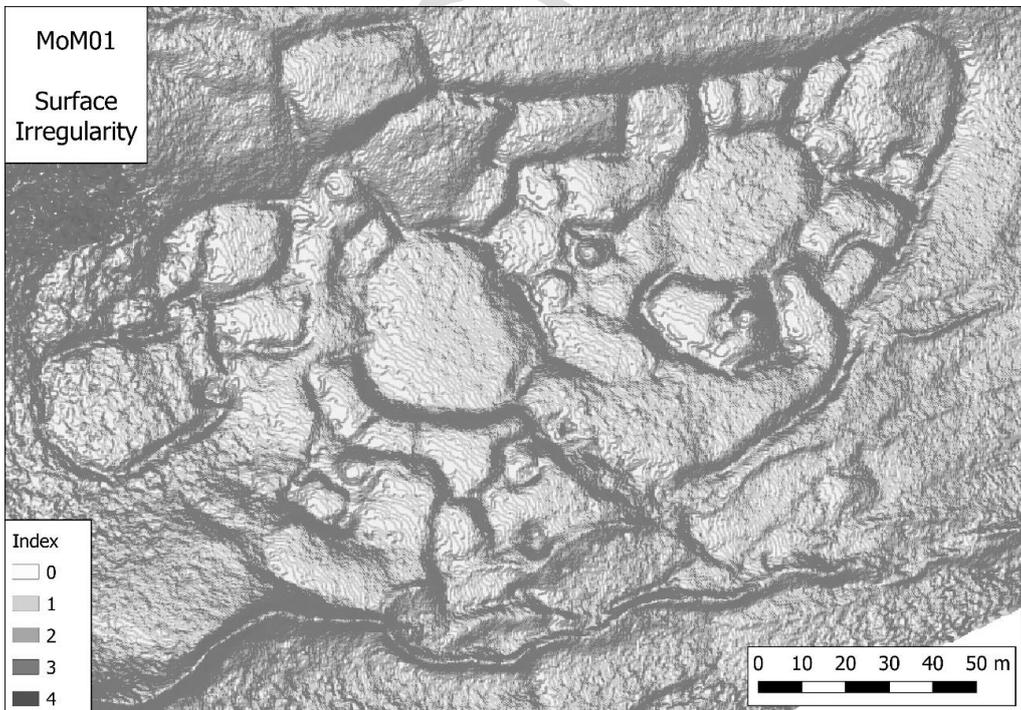
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753 Figure 3. Map of the agricultural area of Morohuasi.

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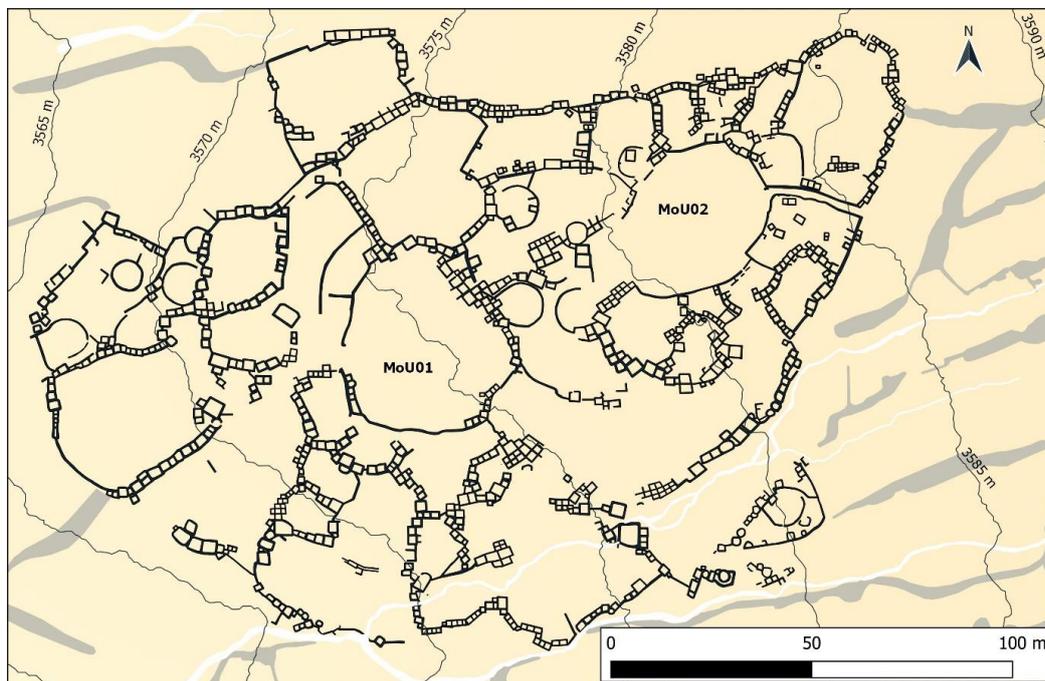
756 Figure 4. Image of site MoM01 showing the monolithic formations. Modeling of surface

757 irregularities made from a DEM.

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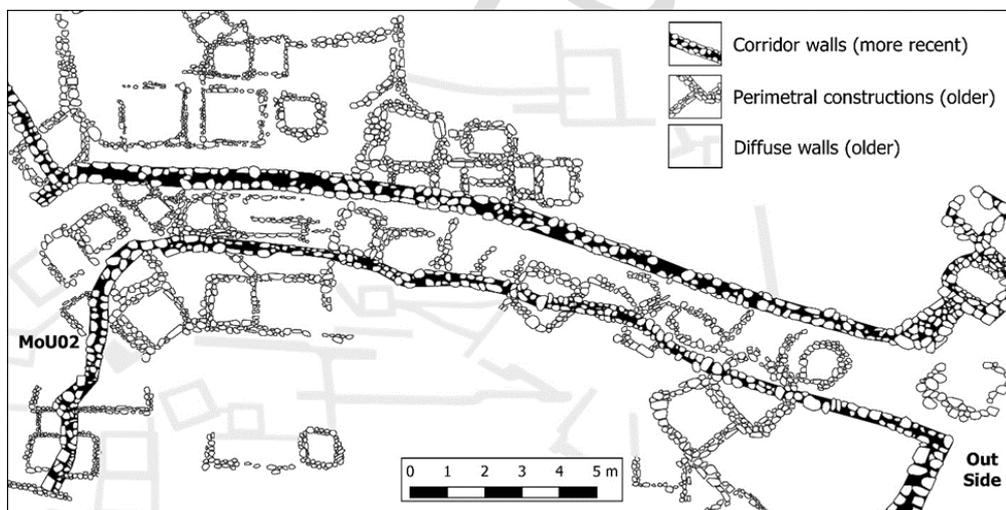
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762 Figure 5. Plan of site MoM01.

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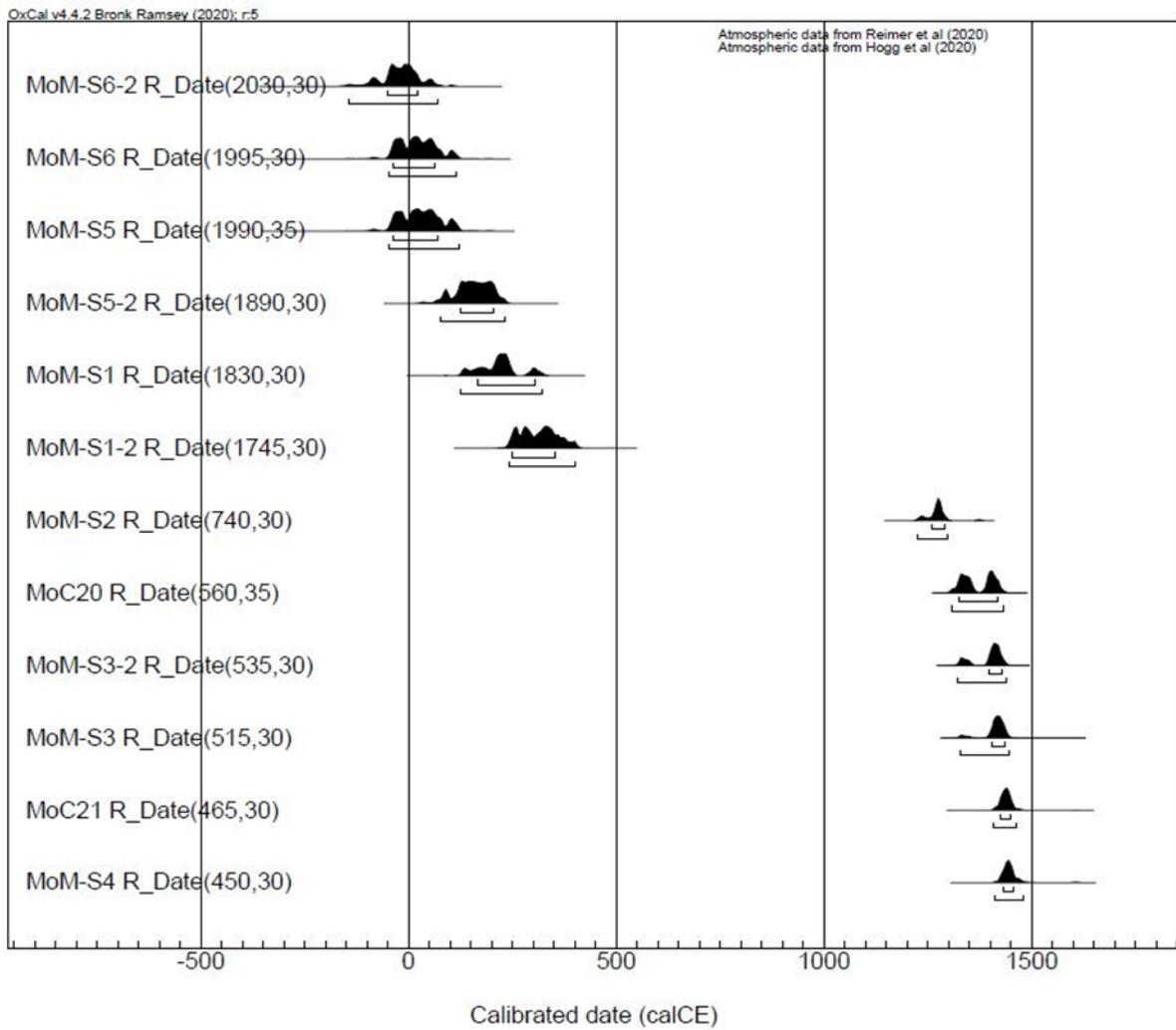
765 Figure 6. Detail of the eastern sector of site MoM01 where the corridor that communicates with
766 the exterior is located, superimposed on previous constructions and structures.

767

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

Sample	Lab N°	Material	C Age 1 σ (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.



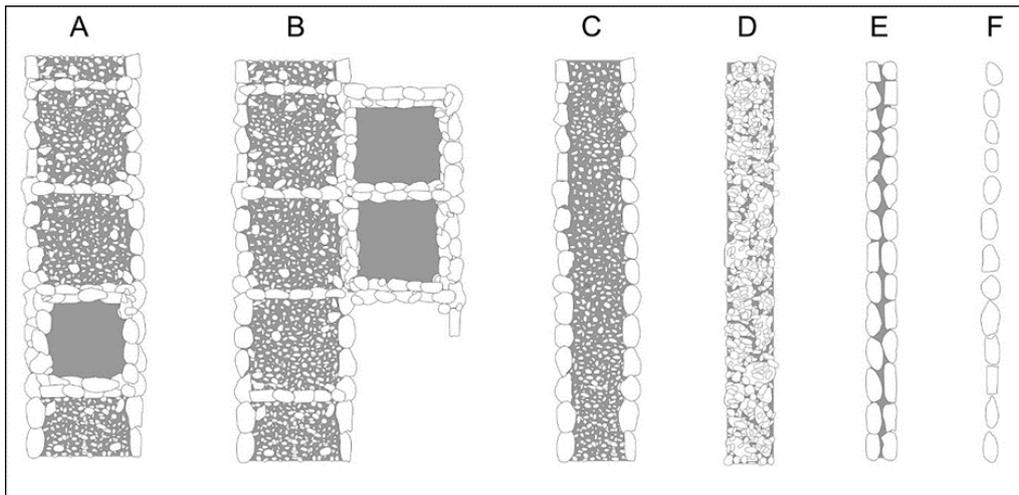
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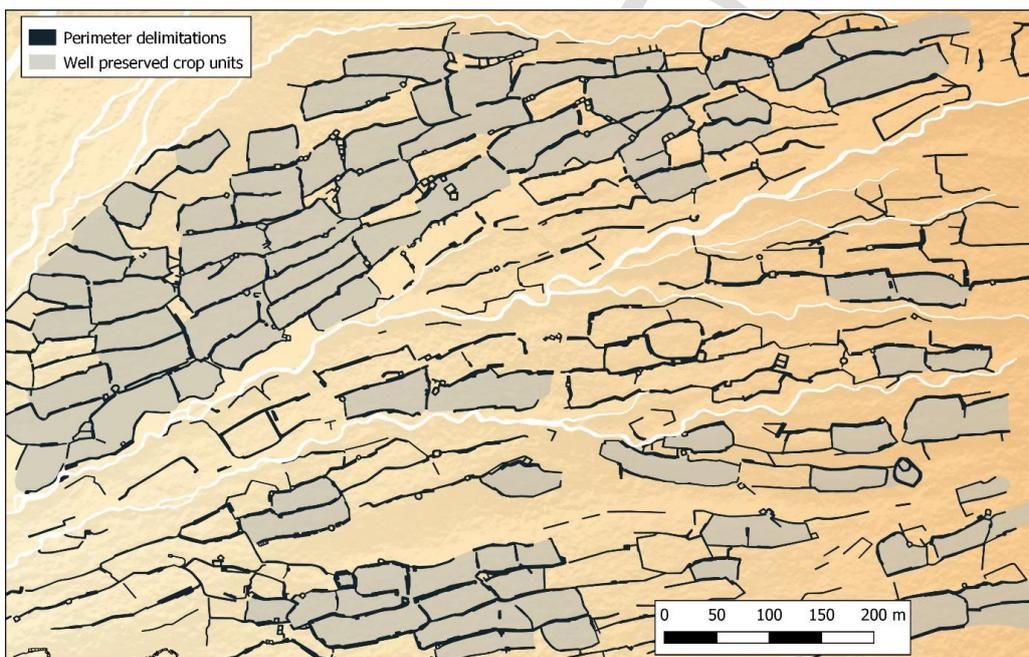
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778 Figure 7. Types of delimitations of cultivation units. A-C: structured clearings. D: lines of
 779 boundaries. E: perimeter walls. I: stone alignments.

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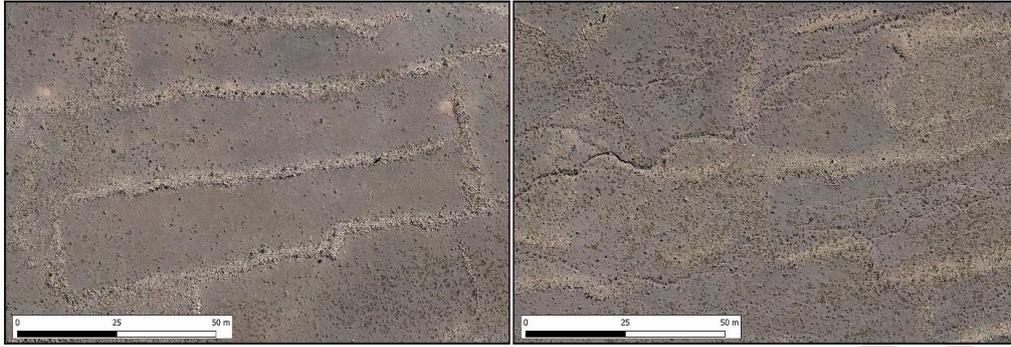


781

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

783

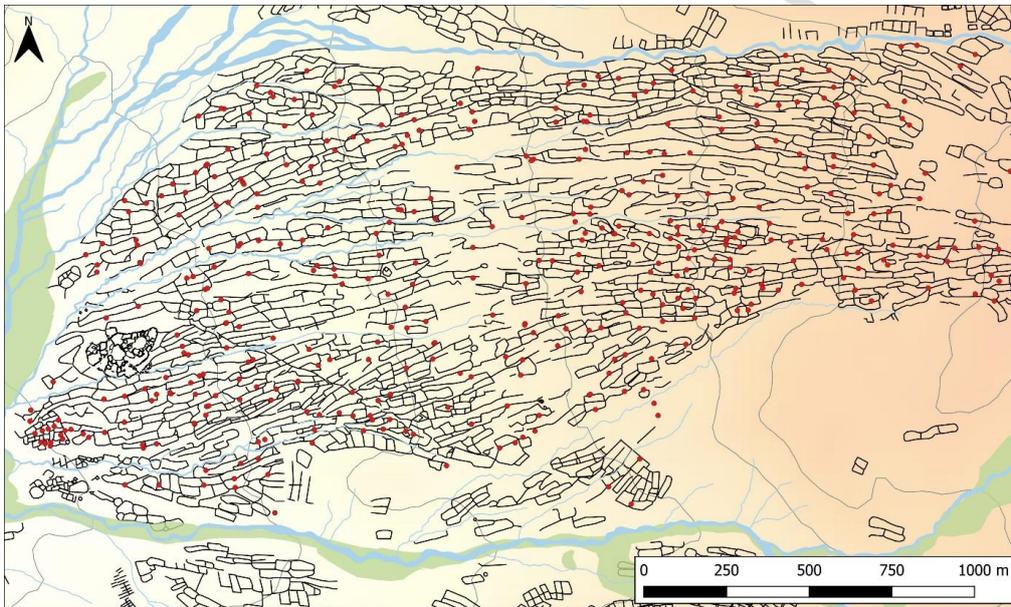
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785

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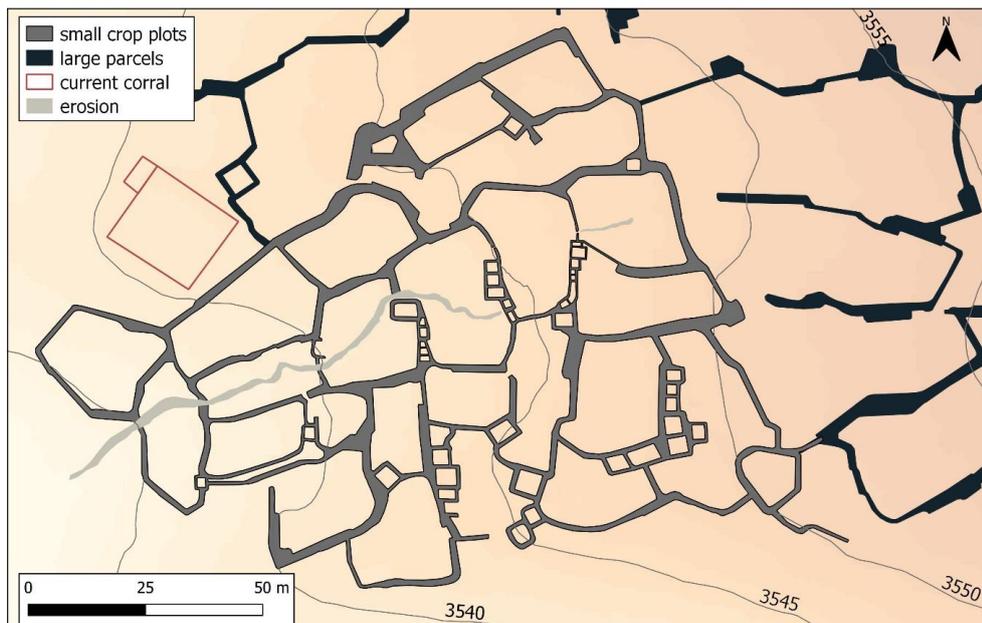
796 Figure 11. Orthophotos of three habitational enclosures associated with the cultivation parcels
 797 (MoC20, MoC21 and MoC52).

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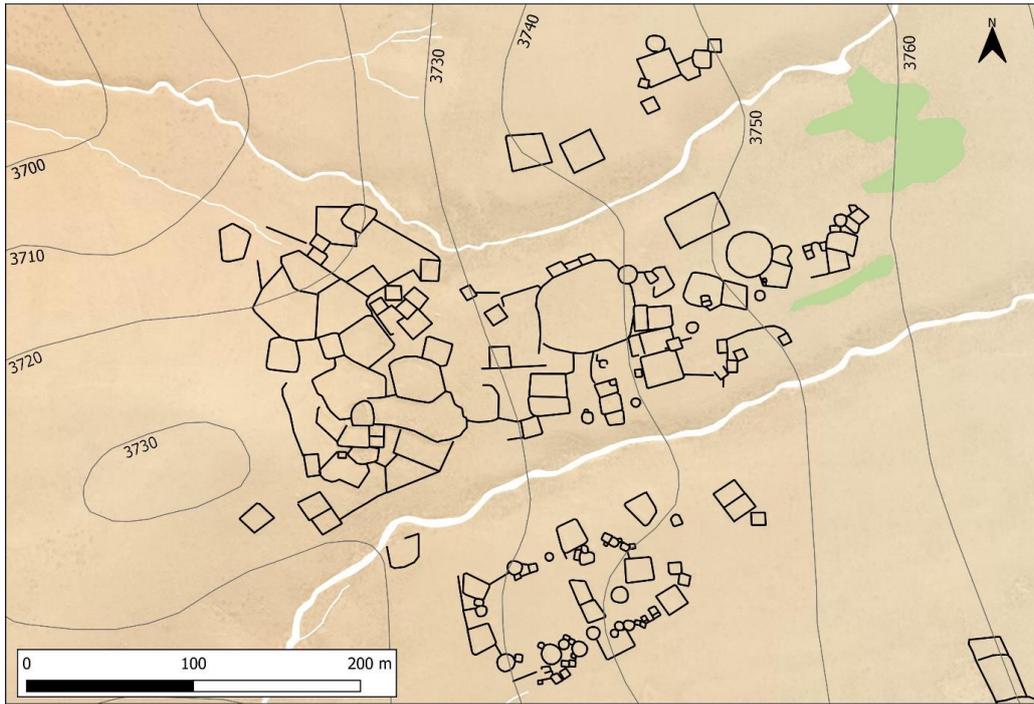
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803 Figure 12. Detail of sector QM01.2 where a group of small crop plots are located.

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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.