



Pre-Columbian raised fields in Panama: First evidence



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ABSTRACT

This paper reports on the first documented evidence for Pre-Hispanic ridged fields in Panama (Chinina, Eastern Panama Province, Pacific), identified in online aerial photographs, and the results of the field work carried on in 2011.

Aerial photography has been known as an extremely useful tool of archeological prospection for nearly one century. In recent years however it gained increasing importance by two reasons: First the availability of high quality aerial photographs via internet made it quite easy to start archeological surveys even in remote areas. Second archeological perspectives on past human societies changed in recent decades. Modern ecological problems caused an increasing interest in landscape archeology.

In Panama, archaeobotanical and paleoecological studies were carried out by Dolores Piperno and her team, already since the 1980s. The results of this research contributed to understanding American agricultural development especially related to the manipulation and domestication of plants and human/environmental interactions. However, despite this important role of the Panamanian evidence for the overall discussion of the development of agriculture in tropical environments, there has been little data generated on agricultural practice and land use pattern until this project.

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In the Americas, raised fields have been documented in several regions, for example, Mexico (Siemens, 1983), Colombia (Broadbent, 1968; Parsons, 1966; Plazas and Falchetti, 1981; Plazas et al., 1993), Ecuador (Bouchard and Usselman, 2006; Gondard, 2006; Marcos, 1987; Parsons, 1969), Peru (Pozorski et al., 1983), Bolivia (Denevan, 1963, 2001; Erickson, 1995, 1996; Smith et al., 1968), Venezuela (Gassón and Rey, 2006; Zucchi and Denevan, 1979) and the Guianas (Iriarte et al., 2010; 2012; Mckey et al., 2010). Although were present from the Caribbean coast to the Andes (Denevan, 2001; Rostain, 2008), they all manage agrarian land in floodplains. Several drivers have been proposed for the construction of these kinds of fields: mitigating high water levels in floodplains, controlling drainage, enriching the soil with fresh nutrients, and influencing microclimate particularly humidity (Denevan, 2001; Erickson, 2008). Prior to this study, the most extensive hydraulic system nearest Panama was located in the San Jorge river floodplain in the Caribbean lowlands of Colombia. This complex system of seasonal swamps, lakes and sloughs covered

approximately 500,000 ha (Parsons, 1966; Plazas and Falchetti, 1981; Plazas et al., 1993). Extensive archeological research has assigned the beginnings of landscape transformation and the first dense human occupation there between 2000 and 1000 uncalibrated years BP (Groot, 2009; Plazas and Falchetti, 1981).

In Panama the first evidence of raised fields has been identified in Chinina, Eastern Panama (Fig. 1). This region, known as Gran Darien, has an archeological sequence that starts with Palaeoindian materials found in Lake Alajuela and the Pacific entrance to the Canal (Bird and Cooke, 1977; Ranere and Cooke, 2003), as well as data obtained in paleoecological studies in the regions, such as those in the river Chagres (Bartlett and Barghoorn, 1973; Piperno, 1985), Monte Oscuro (Piperno and Jones, 2003) and the area of Cana on the border with Colombia (Bush and Colinvaux, 1994; Piperno, 1994) (Fig. 1).

In the Gatun Basin for instance, 100 km northwest of Chinina, evidence of maize was found dating to around 4600 BP (Piperno, 1985). In core samples taken at Monte Oscuro, 100 km west of Chinina, significant burning of the vegetation (charcoal) and increases of weedy plants occurs at ca 7500 to 7000 radiocarbon years BP, indicating disturbance, most probably attributed to human occupation of the forest and the development of slash-and-burn methods of cultivation (Piperno and Jones, 2003:79). Maize phytoliths were found alongside a decrease in

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Fig. 1. Geographical location of studied area.

evidence for arboreal taxa and an increase in early successional taxa such as *Heliconia*, and those from the Poaceae family (Piperno and Jones, 2003:84).

At Cana Swamp in Darien, which lies about 200 km southwest of Chinina, more evidence of human disturbance of the rainforest was also found with charcoal deposits, together with the continuous presence of maize pollen in all levels dating from around 4000 BP until the Spanish conquest (Piperno, 1994). Thus these studies reveal that in the East of Panama, human groups developed productive agriculture by 5000 to 4000 years ago. However it must be said that no palynological studies have been carried out in the 300 km between Monte Oscuro and Cana, which is situated adjacent or within the Bayano river watershed, a densely populated area that was home to several important chiefdoms according to 16th century accounts (Cooke, 1984).

The archeological cultures of the Gran Darien are characterized by the preeminence of plastic decoration and the almost total absence of paint in most of the ceramics reported in the region (e.g. Biese, 1964; Linné, 1929; Lothrop, 1954, 1959, 1960; Torres De Araúz, 1992; Cooke, 1976; Drolet, 1980; McGimsey, 1964; Martín, 2002a, 2002b, 2006, 2007; Mendizabal, 2004; Stirling and Stirling, 1964) and in the area to the east of Panama City and Bayano river (Cooke, 1973; Torres De Araúz, 1971a, 1971b, 1975; Martín and Etayo, 2006). Linné (1929) had observed this ceramic homogeneity, and he included the Pearl archipelago within the region, as did Bray much later on (1984), establishing a maritime connection between the Panamanian and Colombian Pacific coasts, a link that has been confirmed through more recent research in the Pearl islands (Cooke et al., 2010; Martín and Sánchez 2007).

1. The Chinina site

Aerial photographs provided by Google show raised field structures near Chinina, approx. 55 km east of Panama City near the estuary of the Bayano river, a hundred meters or so from the Pacific coast (Fig. 2). The site is located in the Pacific coastal plain of Panama, within the Holocene alluvial fan of the River Bayano river which is crisscrossed by smaller water bodies, many of these of a seasonal nature (Fig. 3).

The landscape today consists of pastures with small forested remnants, for the last 20 years used primarily for cattle grazing. Aerial photographs from the 1970s show that the area was covered with continuous tropical seasonal forest at that time. Given the steady wet season (May–December) precipitation of 1650 mm/year, the proximity to the sea and groundwater conditions, the area is flooded seven months of the year. Thus, agricultural usage required a complex transformation of the landscape.

2. The raised fields

The raised fields consist of at least 22 blocks of parallel banks and ditches. These are about 50 m in length, 2.5 m in width and 0.6 m in height. Between the ridges associated parallel ditches provided the function of retaining enough water for the dry season. The whole system is associated with a stream that flows down from northeastern hills, and seems to be artificially channeled towards the flat plain (Fig. 4).

The most visible ridges cover ~30 ha, just 1500 m E-SE of the described area, other less clear structures are visible in the aerial photographs (Fig. 3).

3. The survey in Chinina

In order to check the accuracy of the aerial photographs the site was visited for the first time in March 2011, for ground-truthing the structures discovered in aerial photographs. They were clearly visible on the ground.

In June 2011, twelve days of survey were carried out. The survey technique used was field walking on 10 Ha and target sampling in areas with archeological potential (Fish and Kowalewski, 1990). Finds were registered by handheld GPS device providing an accuracy of approximately 5 m.

The survey area includes three slightly different terrains: 1) the flat coastal strip with the vestiges of the fossil fields, 2) terraces slightly more elevated than the rest of the plain, and 3) low hills in the northeast.

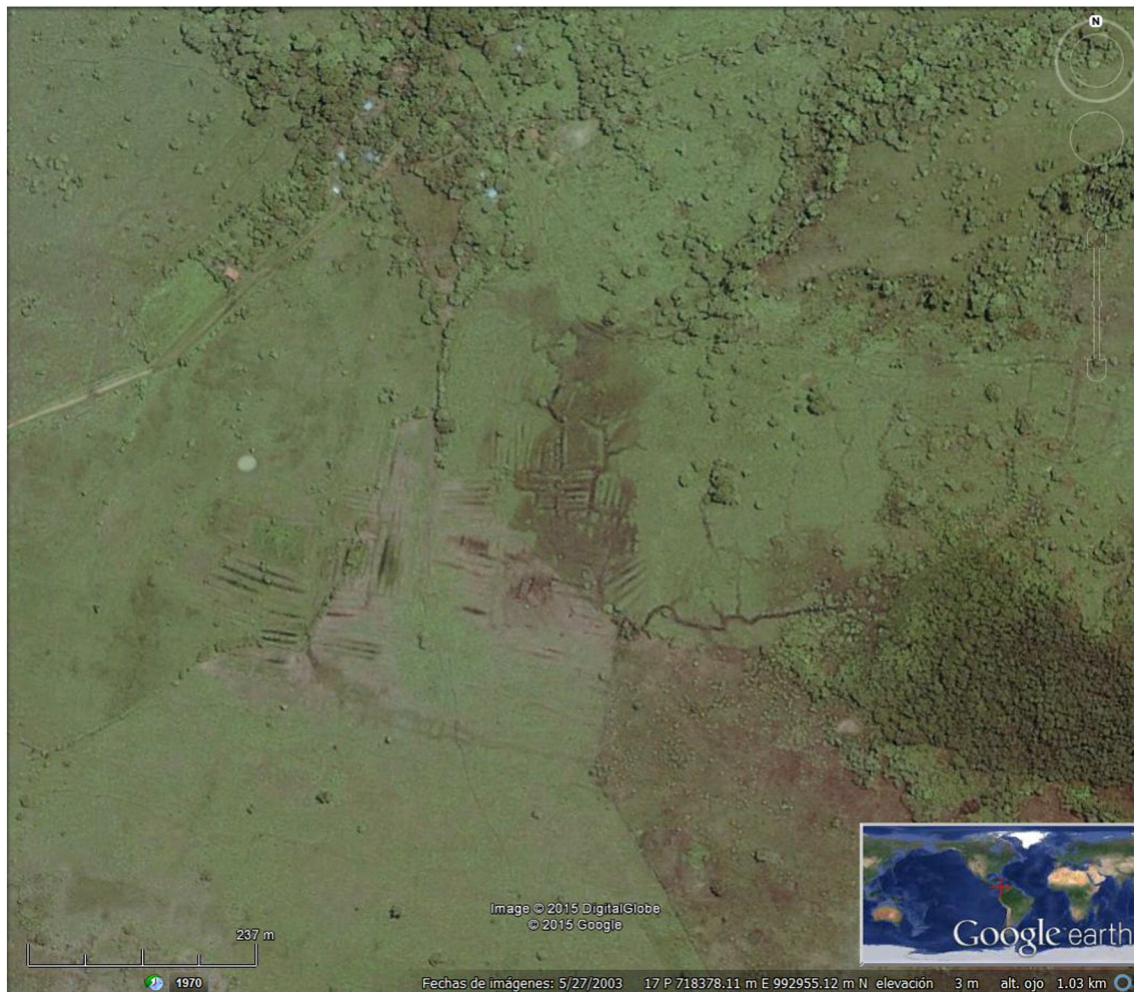


Fig. 2. Aerial photograph of the site. Google Earth 2014.

As the terraces provide rather dry locations suitable for settlements, the surveys tried to identify settlement areas associated with the raised fields. Transect surveys were conducted in these areas, near the ridges or banks, in order to detect archeological occurrences or other evidences of ancient human activity.

The low hills in the northeast, running parallel to the coastline, lacked evidence of past human activity despite their privileged position and panoramic views. Field walking as well as some shovel test pits produced negative results.

In all terrains surface visibility is good because the area is currently open to cattle grazing. This has led to vegetation loss and soil degradation when heavy rains wash soil away during the 7–8 months of the wet season.

4. Small scale excavation at the Chinina 1 field complex

Within the field system, an 11×1 m trench was excavated perpendicular to the orientation of the ridges and ditches, in order to identify landscape transformation by reconstructing a detailed stratigraphic profile of these human modifications. This permitted observation of a cross-section of a ridge and associated ditches (Fig. 5).

The idea was to cut the ridge and its respective parallel channels in order to see the trench allowed the observation of the stratigraphic formation, further confirming that the original height of the ridges must have ranged between 90 cm or one meter in height. The height of these features currently does not exceed 50 cm, a difference that surely

originates in the strong erosion processes they have suffered over the last centuries.

The intensity of erosion was evident. The dark soil from the top of the ridges was washed and deposited into the channels. We took two columns for paleoecological analysis, one in the center of the ridge and the other in the center of the channel.

5. A nearby settlement site – Chinina 1

Survey in the surrounding area resulted in the discovery of a settlement site named Chinina 1, which lies about 50 m north of the raised fields. It was here that we identified a terrace at a slightly higher elevation (the size of the settlement is 100×250 m), which was certainly adequate for human occupation. Its UTM coordinates are 17P 718469E 992,601 N (WGS84 datum). Today it forms part of a pasture used for cattle. In this area we conducted a subsurface survey (two transects) and collected pottery sherds and lithics (fragments of metate) (Table 1). The shovel tests (20 in total) showed a deep dark soil that contains high levels of organic matter with ceramics (for typical forms see Martín, 2007). It has a gritty texture, of 7.5 years 2.5/2 color, and an average thickness of 50 cm.

6. Dating

Charcoal encrusted on the surface of a ceramic sherd was AMS dated to 1410 ± 30 BP (Cal BP 1350 to 1290 $\delta^{13}C = -19.6\%$) (Beta Analytic

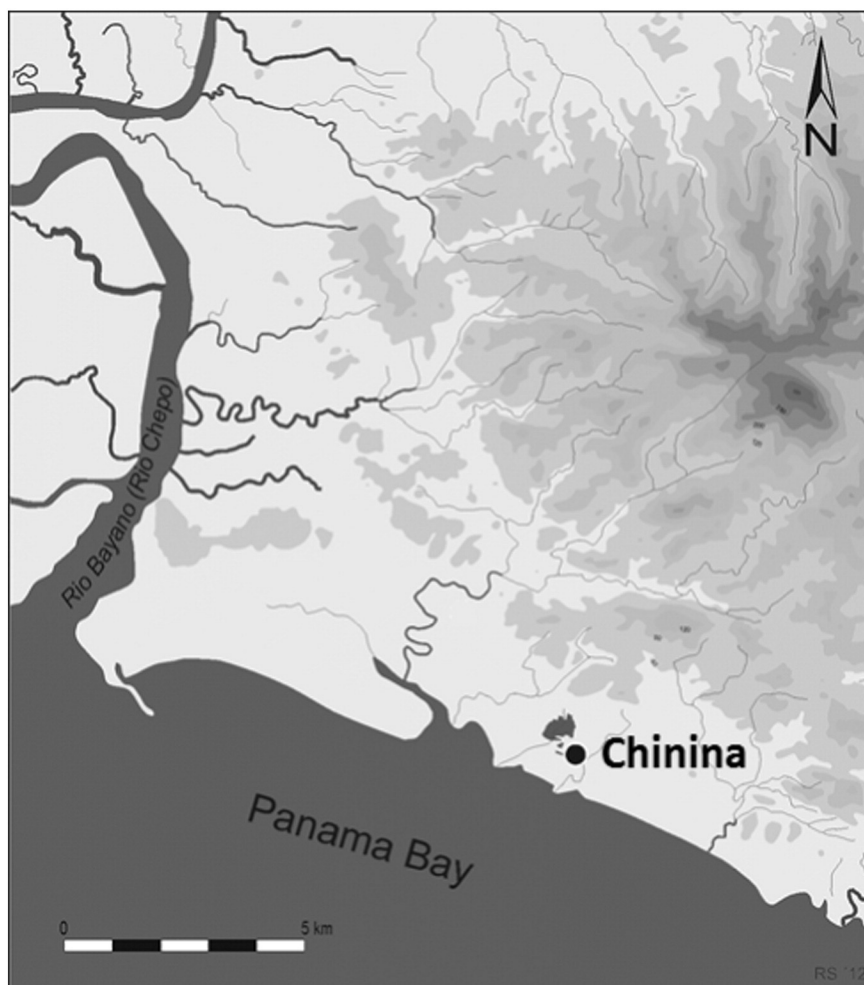


Fig. 3. Detailed location of Chinina.

306,995). It was found at the bottom of the excavated ridge and probably acts as a *terminus post quem* for to the initial transformation of the landscape in these coastal lowlands. Obviously we require larger and more diagnostic samples to date the fields in the light of the discussion about possible population displacements into the area (Fig. 5).

The small and still unrepresentative samples of sherds are quite homogeneous in technology and style. It is assumed that this is a household ceramic assemblage locally manufactured with good firing control and surface finishes. Red slip and some plastic decoration match the cultural setting (or milieu) that characterizes Gran Darien pottery production at all times (BP 1200 – 800). (Martín, 2002a, 2002b, 2007; Mendizabal, 2004).

We recovered samples of ceramics and lithics in all excavation units studied in the settlement near the fields. One of these fragments was sent to Beta Analytic for dating of charcoal residues on the interior surface. Since it did not contain enough organic matter; the laboratory proceeded to analyze a fragment of organic matter included in the fabric obtaining a date of 570 ± 40 BP (Cal BP 650 to 520 $\delta^{13}C = -23.8\%$) (Beta 303,616). This date coincided in time with the latest phase Gran Darien pottery after the brief appearance and expansion of a different polychrome tradition from the west ca 1500–1150 BP.

7. Phytolith analysis

Preliminary studies of phytoliths from raised field contexts were undertaken by Piperno using standard techniques (Piperno, 2006). A total of 10 soil samples taken, 5 from the canal and 5 from the

ridge were analyzed. Phytolith content was fair to good in four of the five canal deposits and very poor in all the ridge samples. No further discussion is possible for the latter. The five canal samples came from depths of from 20 to 60 cm. Some interesting changes in phytolith frequencies were observed from the bottom to the top of the canal sequence. At 60 cm, the bottom-most sample, phytoliths are uncommon. Grass and arboreal phytoliths were observed, but in insufficient quantities to be statistically meaningful. No crop plant phytoliths were observed. Freshwater diatoms in the genus *Aulacoseira* (formerly *Melosira*) were present along with sponge spicules, indicating a moist soil environment with some standing water. Phytolith content continues to be fairly low at 50 cm. However, grasses begin to dominate the assemblages and *Aulacoseira* and sponge spicules become common.

At 40 cm, more than 90% of the phytolith assemblage is composed of grasses, many of which show signs of burning, and the early successional herbaceous plant *Heliconia*, also burned, is present. At this level, maize phytoliths were detected, most of them from the leaves of the plant and a few phytoliths from cobs were present. *Aulacoseira* and sponge spicules were abundant.

At 30 cm phytoliths from maize continue to be present. Grass frequencies decline to 61% although many still exhibit signs of burning and 35% of the assemblage is from arboreal species. These patterns indicate a lessening human influence on the field areas. The top-most sample analyzed from 20 cm has an assemblage indicating a little-disturbed tropical forest with >90% arboreal phytoliths, 3% palms, and 2% grasses. No crop plants including maize are present. Phytoliths exhibiting signs

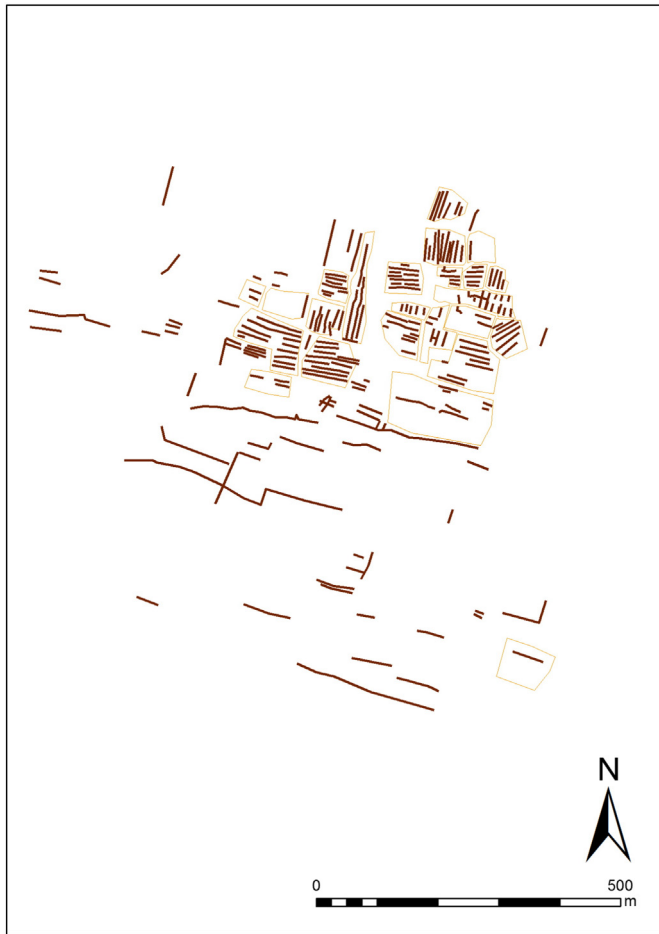


Fig. 4. Chinina's ridges. Microtopographic features visible on the ground and interpretations of field clusters.

of burning were not observed. This sample appears to reflect abandonment of the fields and vegetation regeneration at the site.

As in other pre-Columbian raised field systems recently investigated in the Neotropics (e.g., Iriarte et al., 2010; Whitney et al., 2014) maize appears to have been a primary crop grown. No other crop phytoliths were observed although additional phytolith work should be undertaken.

Table 1
Artifacts recovered during the survey in Chinina 1.

Shovel test	Coordinates	Ceramics	Lithics
Surface	17P 718472E 992,596 N		2
S01	17P 718444E 992,599 N	38	
S02	17P 718453E 992,599 N	59	
S03	17P 718461E 992,601 N	45	
S04	17P 718468E 992,601 N	26	
S05	17P 718478E 992,600 N	13	
S06	17P 718490E 992,601 N	109	
S07	17P 718499E 992,599 N	8	
S08	17P 718509E 992,600 N	26	
S09	17P 718515E 992,601 N	4	
S15	17P 718476E 992,621 N	8	
S16	17P 718479E 992,611 N	21	
S17	17P 718479E 992,600 N	32	
S18	17P 718479E 992,591 N	18	
S19	17P 718479E 992,580 N	27	
S20	17P 718479E 992,570 N	12	
Trench 1	17P 718469E 992,601 N	24	
Total		470	2

8. Discussion

Though novel, the evidence for ridged fields in seasonally flooded low-lying areas of eastern Panama is not surprising. Firstly, cultural interactions between this region and the Caribbean plains of Colombia are documented for the last ~2000 years of the Precolumbian Era. The earliest metalwork in radiocarbon-dated Panamanian mortuary features (Bray's Initial Style) vouches for northern Colombian antecedents (Bray, 1984; Cooke et al., 2000, 2003a, 2003b) although it is not possible in most cases to distinguish Colombian and Panamanian manufacture. At later funerary sites, such as Sitio Conte and El Caño in the central Pacific coastal plains, finds of emeralds, which are not present in Panama mineral deposits (S. Redwood, personal communication, 2014), confirm exchange in rare Colombian elite goods (Cooke and Sánchez 1997; Sánchez and Cooke 2000). Secondly, and more significantly to the ridged fields at Chinina is the fact that, after ca. 1000 BP, interactions between eastern Panama and adjacent areas of Colombia appear to have intensified with respect to earlier ceramic periods. One of these earlier periods (1500–1150 BP) is a burgeoning and sharp expansion eastwards towards coastal villages such as Playa Venado and Panama Viejo and the Pearl Islands of the well-known Central Panama Gran Coclé semiotic tradition in painted and modeled pottery, bone-work, shell work and metallurgy (Bray, 1984; Cooke and Sánchez, 2001; Falchetti, 1995; Martín, 2002b). This reorganization of production and

Chinina-Panama Trench 01

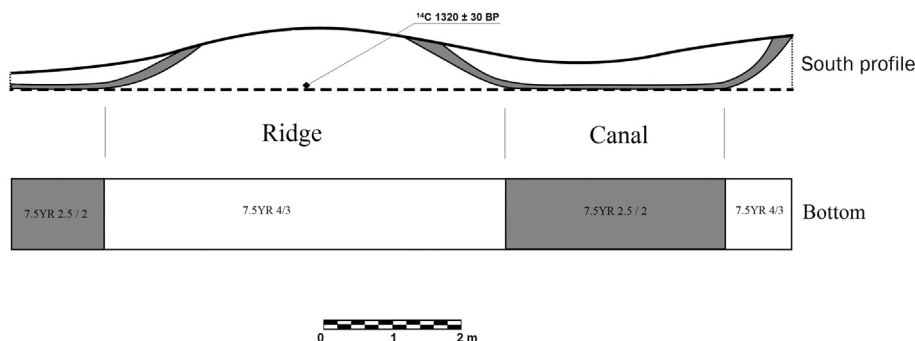


Fig. 5. Trench profile on Chinina 1.

exchange has been attributed to expanding and intensifying social contacts connecting major demographic foci with the production centers of marine shells used for personal ornaments (*Spondylus*, *Pintada*, *Conus* etc.) (Sánchez and Cooke, 2000). Starting about 1000 BP, however, pottery styles in eastern Panama developed a strikingly different trajectory (Cooke, 1998; Martín, 2002a, 2007; Mendizabal, 2004). Though still imperfectly documented, their spatial distribution corresponds *grosso modo* to that of the “Cueva language”, thought to be a trade language in a polyglot region that was used from the foot of the El Valle volcano to the Gulf of Uraba (Romoli, 1987; Cooke and Sánchez, 2004a; 2004b). In spite of the still imperfect data base, it is not unreasonable to suppose that agricultural system developed in the San Jorge river were adopted at this time in eastern Panama at field systems like Chinina's (Fig. 1).

This situation spurred the proposal of a Gran Darien culture area, the third such “cultural interaction sphere” or “semiotic tradition zone” in Panama after about 2500 years ago by which time decorated pottery was widespread. The others are Gran Chiriqui in the west and Gran Coclé in the center (Cooke 1976:122, 1984:263–265, 2005). Frontiers between these spheres were not static in time and space (Cooke, 2005; Martín and Sánchez, 2007) conceptualized to try to order, understand and explain the cultural diversity evident in the last 2000 years of the Panamanian Precolumbian archeological record. Although most of the recent archeological data suggests that the cultural differentiation could have taken place at least by about 2500 years ago between the Gran Coclé and Gran Chiriqui to the west, the historical inter-relationships with the eastern region, Gran Darien, remain to a great extent unknown, due to the lack of research in the area and thus the concomitant lack of local and regional ceramic chronological sequences.

There is no doubt that logging in this region and extensive cattle raising, have started generating serious environmental problems including loss of vegetation cover and consequent erosion processes that are accelerating the loss of young soils. There is no denying also that it was due to this deforestation and specialized remote sensing techniques, that it was possible to see the fields and to identify these human landscape transformations.

Similarly it was possible to identify a nearby area of 3 ha (Chinina 1), with dark soil, which, considering the frequency of archeological artifacts, could correspond to a large household area. This site was dated by ^{14}C to 570 ± 40 BP which, chronologically, corresponds to the late phase of the pre-Hispanic occupation of the so-called Gran Darien (Martín, 2002a, 2002b). There are probably more fields like this and other housing sites in the region, but this survey was limited to the sector whose visibility was high due to the pastures and open areas.

Although subsurface lithics were present in low frequencies metates were detected on the surface. Although it is assumed that their use was associated with maize production (*Zea mays*), the paleobotanical analyses provides more accurate data about the agricultural activities of these groups.

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