



# Indigenous communities, archaeology and, volcanism in Puracé, Cauca, Colombia

Diógenes Patiño C.<sup>a,\*</sup>, María Luisa Monsalve<sup>b</sup>

<sup>a</sup> Department of Anthropology, University of Cauca, Popayán, Colombia

<sup>b</sup> Servicio Geológico Colombiano, SGC, Colombia

## ARTICLE INFO

### Keywords:

Archaeology  
Kokonuko  
Indigenous  
Puracé  
Volcanism  
Colombia

## ABSTRACT

This article deals with archaeology and volcanism in the lands of indigenous communities who live in the mountains of the high Andean region of Puracé, Colombia. The study was carried out in four Indian reservations: Poblazón, Puracé, Kokonuko and Paletará. The effects of the Puracé volcano on community settlements are recorded over the period from 2500 to 500 years before the present. Archaeological sites and cultural materials indicate that these societies were politically homogeneous with an economy based on agriculture; they were linked to one another through the exchange and barter of different products. In the cosmogonies of these communities, volcanoes are related to the ancestral past. Thus, for each community nature and the volcanoes' power are represented as mythical beings. The results of the study contribute to the knowledge of recent volcanic activity in the area and will help to mitigate the risks from future eruptions; at the same time, they record the oral history and historical beliefs in the memory of these indigenous peoples with regard to their territory and the neighbouring volcanoes.

## 1. Introduction

This work deals with archaeological investigation in the region of the Puracé volcano, home to indigenous communities for several thousand years. This research was conducted in the ancestral lands of the Indian reservations of Poblazón, Puracé, Kokonuko<sup>1</sup> and Paletará, where the people have based their economy on agriculture and cattle in these fertile areas of the Andes (Cerón, 1996). Historically they have undergone various processes of acculturation and colonization, particularly European, followed by the regimes of New Granada and the Republic. Today these populations enjoy greater autonomy and continue to struggle for their land (Pacha Mama),<sup>2</sup> traditions and communal lifestyle. Their sacred ancestral sites are located in areas where archaeological sites have yielded cultural material dating from 2500 B.P. to the contact period. These sites reflect a homogeneous society based on agriculture and the exchange of food products from different climatic zones. Similarly, these peoples' cosmogony is intimately linked to natural features, especially in the area of the Puracé and Sotar

volcanoes, which are seen as representations of mythical and symbolic power relationships.

The area has been a zone of volcanic activity since the beginning of the Holocene, with a long history of activity during pre-Hispanic and more recent historic times.<sup>3</sup> Our fieldwork in the region was focused on investigating human occupation in the lower and upper zones of Puracé, in an attempt to understand the chronology of the archaeological sites; to study the possible vulnerability of these societies with respect to volcanic threat in this chain of the Andes; and at the same time to analyze cultural materials, chronologies and population dynamics with regard to the social, economic and political aspects of the communities settled in the Puracé region.

Archaeological remains have been found in these areas from pre- and post-Hispanic cultures and it is likely that these cultures witnessed and confronted volcanic events at different times in the regions of Popayán, Puracé and Sotar. During research it was noted that human settlements within the area of volcanic influence had experienced falls of volcanic ash in the past. This can be seen in several settlement

\* Corresponding author.

E-mail addresses: [diopatin@unicauca.edu.co](mailto:diopatin@unicauca.edu.co) (D. Patiño C.), [mmonsalve@sgc.gov.co](mailto:mmonsalve@sgc.gov.co) (M.L. Monsalve).

<sup>1</sup> The word *Kokonuko* refers to the indigenous people of this name and also to the Kokonuko linguistic group (Cabildo Indígena Kokonuko). The word *Coconuco* will be used to refer to the administrative area (*corregimiento*) and geographical region located in the mountainous centre of Puracé (IGAC, 2009, 2013).

<sup>2</sup> Pacha Mama, the mythical Andean deity identified with Mother Earth, has been adopted by the indigenous Andean communities of South America to defend their territory, the natural world and their ancestral traditions (Longhena and Alva, 2005).

<sup>3</sup> The term 'pre-Hispanic' refers to periods of human occupation in the region before European colonization in the sixteenth century. The 'historic' era refers to later periods associated with the imposition of new economic and political systems (Colonial, New Granada, Republic).

complexes located between 2500 and 3200 m above sea level close to the volcanic cone of Puracé. It seemed fundamental to both anthropology and archaeology to continue archaeological studies in the upper Cauca and volcanic zones where little work of this nature has been done.

## 2. The indigenous councils (*Cabildos*) and community

This study was agreed with the Consejo Regional Indígena del Cauca (CRIC), with Señor Miller Valencia (Legal Representative) and the Committee of Councillors from ten *cabildos*. Proposals for the archaeological project were presented verbally to the meeting, stressing the importance of continuous study and monitoring of the area influenced by the Puracé volcano. Emphasis was also placed on the need to begin with archaeology, to register and analyze sites occupied in the pre-Hispanic and historic past and understand the chronologies of these cultural phases, particularly in relation to the risks and vulnerability they must have confronted as a result of the volcanic activity. After hearing the presentation, the councillors agreed on the importance of archaeology in the community, especially since much of their land was and still is, in areas at risk. In addition, they appreciated the need for a better understanding of archaeological sites with the information these can provide about their ancestors – the *antepasados* as they call them – given that there are still very few systematic archaeological studies in the region of Puracé. The councillors stressed the need for further interaction at the end of the project, for the results of the study to be presented to the communities in the form of reports, lectures, magnetic and other media. Finally, the councillors of CRIC agreed that they welcomed the project and resolved to publicize it through public meetings in each of the communities in which the study would take place.

Once the goodwill of CRIC had been established, public meetings were arranged with the *cabildos* of Poblazón, Puracé, Kokonuko and Paletará. These meetings took place in each reservation in the presence of their *cabildos* and with the communities assembled. Discussion was open to the community in general, with participation from members of the *cabildo*, teachers and students of the Manuel María Mosquera School (Fig. 1). The proposals of the study were outlined from the point of view of volcanic threat and also with regard to the relevance of archaeology in collaboration with the community.

The interaction between indigenous and *campesino* communities of the Puracé region was a successful activity. Results are helping these people understand the effects of past eruptions and the response of ancestral populations to such volcanic events. Equally they are contributing to the knowledge of the history and oral traditions of pre-Hispanic forebears of the Kokonuko people, organized today into



Fig. 1. Meeting with the *Cabildo* of Puracé, Cauca.

several Indian reservations.

These communities have very strong relationships with the natural world, through which they explain their cosmogony and traditional and cultural values. According to F. Faust (1989–90), (1991), (2004) among the Kokonuko the Puracé volcano represents ‘the force of nature’: it protects the waters (the lake of San Rafael) which tend to be ‘fierce’; it can give or take away life; it can generate explosions, conflagrations or earthquakes. The mythical *Jucas* is the ancestral power that is equally related to water, the paramos and the balance of nature, which can give life or also illness and death if it is altered. The Pan de Azúcar, another volcano, is the older brother who protects the water (the lake of El Buey); and the Sotará volcano represents Mother Water, who is converses permanently by means of ‘lights’ (eruptions) with Puracé. In the representation of mythical landscapes there is a constant fluid relationship between the world of the spirits above and those of the underworld, represented by the armadillo and animals who live beneath the earth, where the dead are also found (Fig. 2). Thus, the volcanoes become tutelary peak mountains or sacred places linking natural phenomena with shamanic rites and ancestral customs (Ceruti, 2010); (Sheets, 2002); (Yepes, 2017) (Alvarado and Soto, 2008).

Both within the communities and in their contacts with visitors and tourists, there is a harmonious relationship based on a consciousness of the importance of nature, its attributes, the maintenance of an equilibrium and the recognition of all that nature can offer us. This harmonious relationship includes the “asking permission of the spirits” for all human actions which imply an intervention of natural space. Nature may become “furious” and “punish” humans when they cause damage by cutting down the forest, contaminating the water, or exploiting natural resources without permission. There is an ontological relationship between the wise men (the *Té’walas*, shamans or traditional healers) and the body of knowledge belonging to the community. This permits the affirmation or reaffirmation of the powers of nature and the beings that guard it. The indigenous cosmogonies are intimately related to the ancestral past, stretching back for thousands of years, and to nature and the environment as well as to mythical forces (culture) (Faust, 1989–90); (Portela, 2000). In the landscape, the indigenous burial grounds can be distinguished high up in the mountains, where the graves are associated with large stones and with pottery vessels. The emblems on the shields of every indigenous/Indian reserve in the Puracé region include the volcano, represented with its cap of snow or ice. They also include the staffs of office, mythical beings and representations of farm land (*chacras*), elements characteristic of these societies and of the lands of their ancestors.

## 3. The Puracé region

The region in question is located to the east of Popayán on the west flank of the Puracé-Coconuco volcanic chain; fieldwork was concentrated in the areas of Poblazón (2200 m above sea level), Puracé (2650 m), Coconuco (between 2450 and 3100 m) and Paletará (3100 m). The terrain is defined by a landscape of mountain chains and peaks of Tertiary and Quaternary origin, with volcanic formations which have created various geographical spaces: mountain ranges, longitudinal or transverse valleys, tablelands and cold high plateaux (*paramos*). The soils are also varied and generally contain thick layers of humus with pyroclastic materials (IGAC, 1993); (IGAC, 1975). In several archaeological sites cultural remains were identified associated with volcanic materials such as fallen ash (*lapilli*), indicating the existence of indigenous populations of farmer-potters in this volcanic region hundreds of years ago.

Puracé, at the north-western extreme of the Coconucos Volcanic Chain (Fig. 3) is one of the few volcanoes in Colombia with a well-documented eruptive history (Espinosa, 2011). There were no archaeological reports relating to volcanoes in the area; however, our study found evidence of early human groups from the beginning of the Holocene (10,000 B.P.), and of permanently settled communities from



Fig. 2. Volcanoes in the indigenous cosmology of the Kokonuko (Puracé and Paletará *Cabildos*) (Faust, 2004).



Fig. 3. The coconucos volcanic chain and caldera Chagartón, from Paletará.

2500 B.P., occupying lands adjacent to zones at risk from volcanic phenomena. Areas located between the Coconucos and Nevado del Huila were home to major archaeological cultures with successful social, economic and political development such as San Agustín, Tierradentro and Moscapán.

The Coconucos Volcanic Chain, snow-capped in the last century, dominates the Puracé region. It is formed of 15 eruptive centres, of which the Puracé volcano (4646 m) is the northernmost and Pan de Azúcar the most southerly at 4500 m (Monsalve and Pulgarin, 1999). This volcanism is associated with an ‘active continental margin’ and has been interpreted as the resurgent volcanism of a large caldera 35 km in diameter (Paletará) from which the ignimbrites of much of Cauca and Huila originated (Pulgarin et al., 1996); (Torres et al., 1999). Puracé is the most active volcano in the chain and its evolutionary history is also linked to the Chagartón caldera and the pre-Puracé volcano. Formation of the present Puracé volcano began around 10,000 years B.P. and its eruptive activity has been registered in various deposits including lava; ash flows with blocks; ash and scoria; and fallen pyroclasts. Deposits left by the most recent eruptions correlate with reports of activity in historic times (Figs. 4 and 5) (Monsalve M. L., Pulgarin, Narvaez, Aguirre and Laverde, 2012).

Palaeoenvironmental data obtained in the Puracé National Natural Park (PNN) indicate that around 9500–7500 B.P. temperatures and precipitation increased, allowing the establishment of sub-Andean/Andean forest; our study indicates the presence of hunter-gatherers at this time. Between 7500 and 5000 B.P., as conditions changed slightly with a decrease in precipitation, the forest expanded and the páramo was reduced: favorable conditions for human groups hunting and foraging.<sup>4</sup> In the period from 5000 to 3500 B.P. temperature and precipitation fell, and the Andean forest extended into sub-Andean areas; in the lowlands it is possible that some human groups became semi-sedentary or formed small hamlets of horticulturalists or incipient agriculturalists in the Puracé region. Finally, from 3000 B.P. to the present, the temperature increased with dry periods and less precipitation; more complex pre-Hispanic societies became established in the area, cultivating maize and occupying zones transformed by volcanic eruptions (Herrera et al., 1989); (Van der Hammen, 1974); (Hall

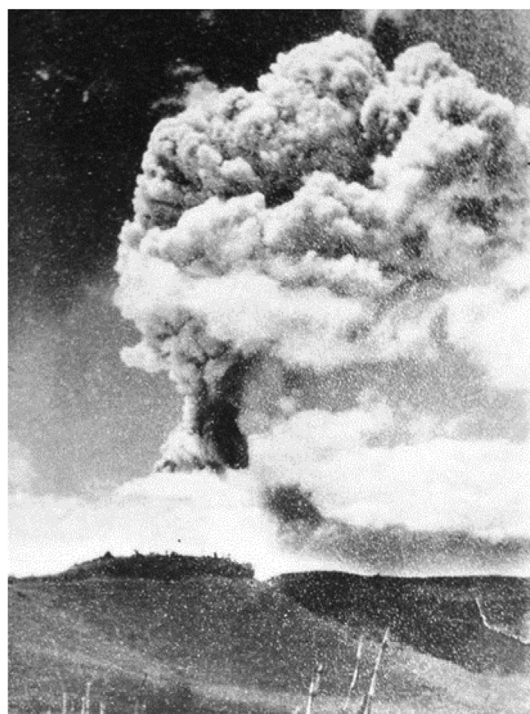


Fig. 4. Puracé volcano eruption in 1936 (Foto Vargas) (Espinosa, 2011).

and Mothes, 2008) (Salomons, 1996); (Sheets, 2001). In Colombia new data with evidence of human activities from the Late Pleistocene to the Middle Holocene is provided from the western slope of the Central Cordillera, especially around the volcano Machín and the Palestina area of Caldas region (See the chapters of H. Salgado/M. Varón and L. Herrera, on this especial issue).

In anthropological terms, the Sierra de los Coconucos is fundamentally connected to the ethnological vision and past of the ancestral indigenous communities, as well as to their present life and the lands reserved for them. Through myth, ritual and festival it can be seen how these ethnic groups express the flow of vital force between opposite poles where the spirits of nature endow human beings with creation and social life. Thus, in each local Indigenous reservation the nature, and especially the power, of its volcanoes is represented. Puracé, Pan de Azúcar and Sotará: they too are mythical beings with considerable power within these cultures.

Geological studies of deposits resulting from historic eruptions indicate that these occur principally in the high parts of the volcano: pyroclastic flows may be at distances of less than 5 km from the crater; mud flow deposits are found at greater distances in the Paletará sector. In the case of pyroclastic fall, while there are reports of ash falls leaving accumulations from a few centimetres to a few millimetres thick at distances up to 50 km from the volcano, these deposits are only conserved in the highest parts (up to about 4 km from the crater at the

<sup>4</sup> According to M. Cardale, the páramos are – or were – more favorable regions for hunting than the mountain forests; they were the habitat of herds of white-tailed deer as well as of wild guinea pig, spotted paca, bear, tapir and other animals (pers. comm.). In Cundinamarca there are numerous Pre-ceramic sites with abundant faunal remains in páramo zones (Correal and Van der Hammen, 1977).





Fig. 5. Puracé volcano in 1955 (Foto Vargas) (Espinosa, 2011).

present time). At slightly greater distances only small remnants of material are visible, on top of or partially buried in the present soil, a situation comparable to that found in archaeological excavations in the region.

#### 4. Regional archaeological theory and human occupation

Archaeological reconstructions of the Popayán and the surrounding area indicates that this territory was inhabited by various pre-Hispanic societies whose cultural development enables us to group them in three categories.

(a) *Hunter-gatherers*. These bands of hunter-gatherers occur in a time-scale of between 10,000 and 4000 years before present (B.P.)<sup>5</sup>; their tools comprise projectile points, rasps, scrapers and other objects of worked stone including obsidian, basalt and chert among other lithic materials.<sup>6</sup> These implements were used in hunting and collecting food; tools made from bone, horn and wood were probably also used, but their presence at sites is unlikely given that these perishable materials are only preserved under very special conditions. The most representative sites for this period are San Isidro (Morales) (1660 m above sea level), La Elvira, Parque Industrial (Popayán) (1780 m) and Las Guacas (1880 m) (Gnecco, 2000); (Patiño, 2009). At least one site of this period was reported during archaeological work in the region of Santa Elena near Poblazón at 2550 m above sea level. Taking this discovery into account, we can be sure that there were groups of hunter-gatherers close to the Puracé-Coconuco region in the early stages of human occupation. Certain archaeological sites in similar geographic zones have been

reported to the east of Quito and in the middle Cauca Valley (Gnecco, 2000); (Patiño, 1990); (Dickau et al., 2015).

(b) *Centralized Populations of Farmer-Potters*. A second period is defined by cultures who settled permanently in the area, living in nuclear villages and scattered dwellings, developing agricultural and ceramic techniques. Some appear to have developed important political structures with hierarchies showing varying degrees of power. These communities are known in the anthropological literature as ‘ranked societies’, controlling large geographical regions in northern South America and of course in south-western Colombia. In Cauca archaeological remains of these societies are found spread over many sites: around Popayán (the most studied) and towards the Central Cordillera in the regions of Polindara, Totoró, Guambía, Poblazón, Santa Bárbara, Coconuco, Paletará, Puracé and Moscapán, areas of interest to the present study (Lehmann, 1953); (Patiño and Hernández, 2014); (Urdaneta, 1988); (Urdaneta, 1991). The chronology of this second period can be estimated as between 2000 and 500 B.P., although earlier dates should not be discounted. Archaeological remains in the majority of these sites comprise living areas, either artificial terraces or platforms cut into the hillside (*tambos*); cultivation areas with scattered ceramic material; the occasional presence of statuary; and sacred sites with cemeteries comprising few or many tombs with shafts and lateral chambers. Ceramic vessels are for domestic use in cooking and serving food, though some become offerings when buried with the dead; in some cases, pots have been deposited with objects of gold and stone as sumptuary items. Anthropologists and ethnohistorians (Faust F., 2004) distinguish the Pubenense, Kokonuko and Totoró groups as the traditional occupants of the volcanic zones of the upper Cauca. Most of the archaeological sites studied in the Puracé region correspond to ranked societies of this group.

(c) *Colonial and Republican Occupation*. Studies of the colonial occupation of Europeans who settled in American territory (500 B.P. to the present) are also important to history and archaeology: they too left indelible cultural marks on society, as well as on urban and rural archaeological landscapes. The most studied sites are colonial Popayán and the Calibío, Antón Moreno and Coconuco haciendas. Other sites and monuments of later periods – New Granada and the Republic – are of interest to historical archaeology, not only in order to study the culture of these societies and their developments in every sense, but also regarding the influence of the forces of nature, particularly volcanoes and earthquakes, in the past (Patiño, 2012). Of special interest in this area is the Hacienda Coconuco, where General Tomás C. Mosquera lived in the eighteenth and nineteenth centuries (Helguera, 1970).

#### 5. Methodology, mapping and georeferencing

Methodology for research in Puracé was based on intensive field-work, an archaeological prospection was carrying out travelling along rural tracks and paths and through farmland in each of the Indian reservations (Poblazón, Puracé, Coconuco and Paletará). The archaeological landscape was recorded in areas of past human settlement including ceremonial burial sites. Surface collections reported ceramics, lithics and other materials.

Excavations were also carried out to recover material traces of the daily life of these societies. Charcoal samples were obtained for C-14 dating (Beta Analytic Inc., Miami, Florida, USA) both pre-Hispanic and early Colonial dates. Soil samples were sent to the palynological laboratory of the Institute of Natural Sciences at the National University of Colombia for identification by Gaspar Morcote and Alejandra Betancourt. These samples proved to contain pollen and phytoliths providing data on cultivated plants, as well as other elements indicative of the climatic conditions pertaining during periods of human settlement in the region of Puracé and Poblazón.

During the process of recording the archaeological sites of Puracé

<sup>5</sup> The abbreviation ‘B.P.’ will be used throughout to indicate years before present; calculations relate to the year 1950 which was when this method of chronological dating was discovered. Similarly, Carbon-14 (C-14) dates used throughout the text are conventional: the reader may check their respective calibrations (2 Sigma) in Table 1.

<sup>6</sup> The term ‘lithic’ as used in this study relates to archaeological tools made of stone. It is also used in a geological context to refer to materials of pyroclastic origin.



their geolocation was registered using geographical information technology. For this purpose, Garmin global positioning (GPS) equipment was used: A Dakota 20 and an eTrex Vista HCX. Measurements were taken using decimal geographic coordinates with the datum WGS84. These measurements were then fed into an EXCEL database. By refining and analysing the georeferenced data it was possible to produce a general map of the areas studied in the four Indian reservations of Puracé.

## 6. Archaeological sites and C-14 dates in Puracé

This is the first time that human settlement sites have been dated in the region. All samples are associated with cultural remains and come from artificial platforms, *tambos*, rubbish deposits and stratigraphic profiles. The samples were mainly associated with ceramic and lithic material; these remains were deposited in humic soils derived from volcanic material, with fragments of charcoal also present. Cultural strata, separated by defined layers of volcanic deposits, were not encountered at any site. On the contrary, cultural remains are found scattered throughout a continuous humic soil which may be up to 1 m thick. Analysis of the ceramic remains suggests some differentiation among the occupation sites; however, none of the excavations produced sequences of occupation strata showing abandonment or reoccupation. On the contrary, the recorded sites indicate continuity of settlement.

Dated materials indicate ages of between 2400 B.P. and the present, during which this period there is evidence, in the form of pyroclastic materials such as fallen ash (lapilli) with lithics and occasionally pumice, of the region being affected by volcanic eruptions.

In accordance with the chronological data and following geological and archaeological analysis, a sequence of cultural periods for the Puracé region is proposed: (1) Palaeoindian or Pre-ceramic – 10,000 to 8000 B.P. – with hunter-gatherers and lithic technology; (2) Archaic – 8000 to 5000 B.P. – with semi-sedentary groups of hunters and foragers; (3) Regional Development – around 3000–1500 B.P. – with established societies occupying large areas in settlements with developed agriculture and pottery; (4) Late period – 1500 to 500 B.P. – integration of chiefdoms with significant demographic increase; construction of truncated pyramids, platforms, *tambos*, cemeteries and roads; economy based on agriculture, the principal product of which may be maize (*Zea mays*) among other crops such as potatoes; and (5) Historic period – 500 B.P. to the present – a time of European colonization, independence and formation of the present-day state (Barona, 1995); (Colmenares, 1979); (Marzal, 1978). As our understanding of the region and its different cultural stages improves, it is hoped that this sequence will be complemented by future interdisciplinary studies.

Table 1 lists one pre-ceramic site dated 8660 B.P. (Santa Elena, POB-106); the others, related to pottery and agriculture, are dated between 2400 and 280 B.P. and located between 2500 and 3000 m above sea level. These human settlement sites correspond to various pre-Hispanic villages, now abandoned. In the past these settlements occupied a cold to very cold climatic zone and were characterized by multiple living structures – terraces, *tambos* – and some cemeteries. Their soils derive from the biodegradation of volcanic ash, suggesting a close relationship between high soil fertility and the density of settlement sites in the area. It can also be deduced from the location of these sites very near the base of the Puracé volcano, close to the zones traditionally referred to by the natives as *pajonales* (scrublands) at 3500 m.

The past of these societies is represented by important archaeological traces on the slopes of the Coconucos Volcanic Chain. In our study the location of archaeological sites encountered in the Indian reservations of Poblazón, Puracé, Coconuco and Paletará has been interpolated with high risk zones (red), medium risk (brown) and low risk (green) on the initial version of the risk map for the Puracé volcano, Digital Elevation Model (DEM) (SIG coverage) (Fig. 6) (Monsalve and Pulgarin, 1993).

## 7. The archaeology of Puracé

The participation of the indigenous communities of the different reserves was essential as without their consent and collaboration this research would not have been possible. In the reserve territories of the Puracé volcano region, it is essential to understand that the pre-Hispanic and historic societies that settled here in the past were repeatedly confronting natural phenomena of a volcanic nature. The Coconucos Volcanic Chain, of which Puracé forms the north-western part, has a geological history of eruptions which have occurred throughout the Holocene era down to the present day.

Our studies have enabled us to observe continuity in pre-Hispanic occupation in the region. Few archaeological sites were found within volcanic deposits, or covered with volcanic ash, indicating partial burial or direct destruction by volcanic phenomena. However, the presence of volcanic material (crystals and volcanic lithics) in most of the soils where archaeological remains were found enable us to infer that the inhabitants witnessed the volcanic activity of Puracé and other neighbouring volcanoes. This must have had a powerful effect on these communities, provoking temporary abandonment of settlement sites in some cases, and also relocation in neighbouring sites less affected by specific eruptions, particularly evident in the Regional Development and Late periods.

It is important to take into account that the geological history of this volcano indicates that past eruptions, including those registered recently, have been mainly moderate. They may however have lasted several years and, although they did not cause destruction, they may have affected the health of the population and their crops as well as, during the Colonial and Republican periods, the pastures for domestic animals. In pre-Hispanic times, it seems that communities in the Puracé region opted for new sites with nucleated dwellings on hilltops between 2000 and 3100 m above sea level.

### 7.1. Early occupation

Human occupation in the Andean massif, crowned by the Puracé volcano, began in Holocene times 10,000 years B.P. Remains have been recorded at Santa Elena (POB-106) in a mountainous area some 2550 m above sea level. The excavation produced carbonized material dated to 8660 B.P. (Beta 363904), clearly associated with pre-ceramic lithic artifacts such as a grooved projectile point, knives, scrapers and waste flakes in the local volcanic material, obsidian. This raw material was extracted in the same region of Poblazón, probably in the Río Negro area, where outcrops of ignimbrites are found with a high obsidian content, originating from the Paletará caldera. The finds at Santa Elena are related to other sites in the upper reaches of the river Cauca (eg., La Elvira, Las Guacas and San Isidro) (Gnecco, 2000); (Patiño, 2009).

Palaeoclimatic studies for this period indicate improved conditions in temperature and precipitation for Andean and sub-Andean forests, enabling this human groups to develop specialized hunting of animals and to collect roots and fruits of various plants. At this time the groups must have experienced explosive volcanic activity, as the site they occupied corresponds to a layer of yellow pumice, indicating that the region was affected by the activity of a nearby volcano. This may have been Sucubún, which is known for its high explosive potential and which, in contrast to Puracé, has generated deposits of this kind.

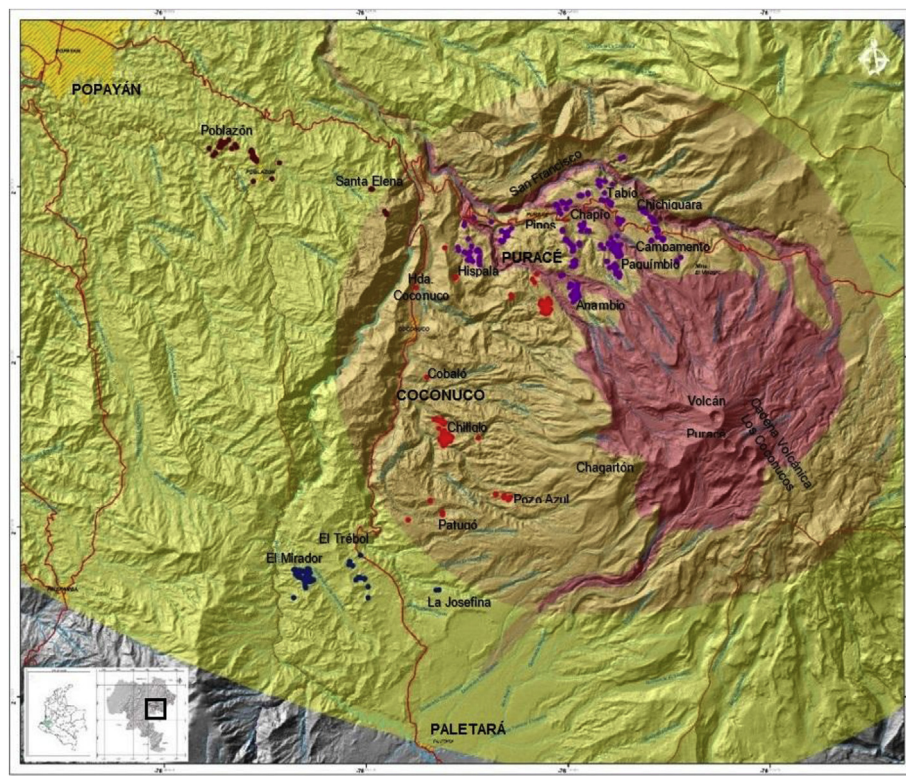
The area of study did not produce sites with evidence of activity during the Archaic period. In the surrounding areas however there are sites corresponding to this period, related to semi-sedentary groups of hunters and foragers. These groups probably experimented with seeds and tubers to develop a form of incipient horticulture. Their sites are recorded in the Cajibío area and the high plain of Popayán.

### 7.2. Regional Development and Late Periods

Most of the archaeological sites in Puracé belong to the Regional

**Table 1**  
C-14 dates for Puracé. Beta analytic, Inc.

| SITE CODE   | ALTITUDE m.a.s.l. | CONVENTION-AL DATE | CALIBRACIÓN 2 Sigma  |
|---|-------------------|--------------------|--|
| POB-106. SANTA ELENA Level: 35–40 cm Beta 363904                                    | 2550 m.           | 8660 ± 40 B.P.     | Cal BC 7750 to 7590 (Cal BP 9700 to 9540)  |
| PUR-135. ALTO LOS PINOS Level: 50–60 cm Beta 355340                                 | 2985 m.           | 2400 ± 30 B.P.     | Cal BC 730 to 690 (Cal BP 2680 to 2640), Cal BC 660 to 650 (Cal BP 2610 to 2600)                                 |
| COC-223. PATUGO Profile level: 90–100 cm Beta 363908                                | 3061 m.           | 2010 ± 30 B.P.     | Cal BC 90 to 80 (Cal BP, 2040 to 2030), Cal BC 50 to Cal AD 60 (Cal BP, 2000 to 1890)                            |
| POB-085. POBLAZON Level: 70–80 cm. Beta 359215                                      | 2222 m.           | 1490 ± 30 B.P.     | Cal AD 540–640 (Cal BP 1410 to 1310)   |
| PUR-101. CAMPAMENTO Cut level: 60–70 cm. Beta 359217                                | 3178 m.           | 1580 ± 30 B.P.     | Cal AD 410–550 (Cal BP 1540 to 1400)   |
| PUR-258. HISPALA Sample María Luisa Monsalve (S.G.C.) Profile at 67 cm. Beta 322720 | 2508 m.           | 1160 ± 30 B.P.     | Cal AD 780–900 (Cal BP 1170 to 1050) and Cal AD 910–970 (Cal BP 1040 to 980)                                     |
| COC-016. CRISTALES Profile in road Exactly 80 cm. Beta 359213                       | 3051 m.           | 960 ± 30 B.P.      | Cal AD 1020–1160 (Cal BP 930 to 790)   |
| PUR-060. PAGÜMBIO Rubbish deposit Level: 50–60 cm. Beta 359216                      | 3124 m.           | 780 ± 30 B.P.      | Cal AD 1220–1280 (Cal BP 730 to 670)   |
| PUR-281. ALTO ANAMBIO Level: 50–60 cm. Beta 359219                                  | 3160 m.           | 560 ± 30 B.P.      | Cal AD 1310–1360 (Cal BP 640 to 590) and Cal AD 1390–1430 (Cal BP 560 to 520)                                    |
| COC-235. CHILIGLO ALTO POZO AZUL Rubbish deposit Profile 70–80 cm. Beta 363909      | 3024 m.           | 400 ± 30 B.P.      | Cal AD 1440–1500 (Cal BP 510 to 450), Cal AD 1500–1510 (Cal BP 450 to 440), Cal AD 1600–1620 (Cal BP 350 to 330) |
| COC-114. CRISTALES POBLADO Level: 50–60 cm. Beta 359214                             | 3117 m.           | 280 ± 30 B.P.      | Cal AD 1520–1590 (Cal BP 430 to 360) and Cal AD 1620–1660 (Cal BP 330 to 290)                                    |



**Fig. 6.** Indian Reservations and Archaeological Sites in Poblazón, Puracé, Coconuco and Paletará. Puracé. Digital elevation Model (DEM). Volcanic Treat Map (Servicio Geológico Colombiano, SGC, 2014) ([www.sgc.gov.co](http://www.sgc.gov.co)).

Development and Late periods. The study has produced information on pre-Hispanic and historic societies who lived around the Puracé volcano and were exposed to continuous risk from natural phenomena, particularly those of volcanic origin.

### 7.2.1. The Poblazón area

The sites in this region are further away from the volcanoes but, even so, ash falls are reported. Excavations revealed layers of pyroclasts which may well correspond to the Puracé, Sotaró or Subucún volcanoes. Societies inhabiting the region were certainly subject to ash falls, not only in recent historical and colonial times but also in the pre-Hispanic past. A few elderly people in Poblazón still remember the effects of ash

on their fields and pastures, especially in 1949 and 1977 when explosions of the Puracé volcano were recorded.<sup>7</sup> Archaeological evidence is scattered over the surface and on the habitation platforms, some of which are enormous: those recorded on Guillermo Maca's land for example (POB-085) cover an area of 2900 square metres. It would be

<sup>7</sup> Señor Otiniano Maca (aged 64), a native of Poblazón, told us, 'Around 1979 or 1980 I saw thin, reddish-grey volcanic ash falling in the Poblazón region. On that occasion the crops weren't damaged, and the cattle didn't die; but in Puracé there was damage, the ash went on falling for about 10 min' In another account José Domingo Velasco (aged 72) said, 'In 1979 I saw the volcano spout smoke (ash) twice; it was white, blue and grey, little particles; the plants were covered with ash, but the rain took it away. There were only twenty houses in Poblazón.'

possible for many people to congregate in these areas for public meetings or markets for regional exchange. At this site a level at 60–80 cm deep in humic soil was dated to  $1490 \pm 30$  B.P. (Beta 359515); pollen collected at 45 cm indicates that maize (*Zea mays*) was cultivated in the area. In Poblazón there are signs of influence from the Popayán chiefdoms during the Late Period. Archaeological evidence of contact includes ceramics, platforms cut into hillsides and fields, as well as stepped terraces (an agricultural technique introduced from the south in later times). Also worthy of note are the pre-Hispanic roads passing through the area towards Popayán and the high Andean zones of the Colombian Massif.

### 7.2.2. Puracé Area

The same kind of society was also present in Puracé, although few sites or samples have been found. The most notable site is Los Pinos (PUR-135) dated  $2400 \pm 30$  B.P. (Beta 355340), with its complex of stepped living platforms located between 2940 and 2970 m above sea level. The positioning of these platforms is strategic, given their situation on a hill with a panoramic view of the landscape, as it were from a balcony or vantage point. These platforms yielded pottery and stone artifacts, including larger quantities of obsidian than in the rest of the Puracé Indian reservation. Knives, flakes and waste have been found made of this material. On the basis of this evidence the site is interpreted as an obsidian workshop, this lithic material being a product of exchange in many Andean regions. Analysis of the botanical remains provides new evidence that these farmer-potter societies depended on maize (*Zea mays*) as their basic product of cultivation.

In other areas of south-western Colombia, the Regional Development period has been well documented. Although no evidence has been found at these sites of archaeological occupation sealed by volcanic deposits, nor of massive destruction due to volcanism, there is no doubt that the inhabitants witnessed one of Puracé's most important eruptions around 2100 B.P. (Monsalve, 1993). The dates show that around this time there were falls of pyroclasts, pyroclastic surges and pyroclastic flows of scoria which coursed through most of the river valleys and streams that rise on the flanks of the volcano. Deposits of these materials can still be seen at distances of more than 10 km. Other discoveries in areas to the north-west of the volcano suggest that this eruptive activity may have led to temporary abandonment of the territory, with displacement possibly towards the Coconuco region, out of range of the pyroclastic flows. After this there appears to have been a strategic change in settlement pattern, with occupation of high hills, away from the river beds, in later periods. This could be seen as an early and partial strategy aimed at mitigating the risk of volcanic threat. The best examples observed in the study are in the area encompassed by the Vinagre, Anambío and Agua Blanca rivers, with various occupations above 3000 m above sea level on high hills and gentle slopes, corresponding to the Late period, estimated at between 1500 and 500 B.P.

Evidence of pre-Hispanic occupation in Puracé seems to be principally of the Late period, indicating that the population tended to become progressively denser in various nucleated pre-Hispanic sites such as Campamento (PUR-101), Chichiguará (PUR -125) (Fig. 7), Pagüimbio (PUR-060) and Alto Anambío (PUR-281). It is clear that these communities, mainly those settled on the flanks of the Puracé volcano above 3000 m, lived under conditions of permanent volcanic threat, especially from the fall of pyroclasts. This can be observed at the excavated sites, where remnants of this kind of volcanic material are generally found. Also, as mentioned above, the nucleated settlements in these areas are found away from valleys, rivers and streams, occupying instead the higher parts of gently-sloping hills. There, despite the volcanic risk, an increase in population density can be observed. This may be explained by the eruptions and their effects becoming less serious. This is borne out by the volcano's own history as well as the diminished quantity of volcanic material encountered, equivalent to only a few centimetres of material accumulated at the time of eruption. This situation is reflected, in varying degrees, at all the sites prospected, as

well as in excavations of platforms and rubbish deposits.

At the site of Pagüimbio (PUR-060) at 3100 m, the population settled in an area of 5 ha on the margins of the Pagüimbio stream and the river Vinagre. Although the site is located among steep and gently-sloping hills, excavation of a rubbish pit produced a small deposit of secondary mud flow. A sample from this excavation gave a date of  $780 \pm 30$  B.P. (Beta 359216). This was obtained in the humic stratum at a depth of 50–60 cm, indicating that the inhabitants of the settlement were affected by this natural phenomenon which obliged them to abandon the site temporarily. On their return, there is evidence that they removed the debris from platforms and fields, depositing it in rubbish pits at their margins or piling up rocks to clear the space (Fig. 8). At this period the ceramic density was low, but from 50 cm upwards the excavated profile showed a considerable increase in pottery production, suggesting prosperous human activity at the site despite the ongoing risk. As with other Andean archaeological sites, there was no evidence at this site of layers of volcanic ash separating occupation levels.

The same scenario is repeated in the other archaeological sites at high altitude, although they feature ash falls (lapilli) rather than layers of accumulated rock. This is the case with the settlements of Chichiguará on the margin of the river San Francisco; Alto Anambío, dated  $560 \pm 30$  B.P. (Beta 359219); and Cristales (COC-016) dated  $960 \pm 30$  B.P. (Beta 359213) and  $280 \pm 30$  B.P. (Beta 359214) (COC-114), the last two sites being located in the Kokonuko Indian reservation. The settlement of Chichiguará, although apparently late, has produced cultural material related to that at the site of Campamento, dated  $1580 \pm 30$  B.P. (Beta 359217). At all these sites changes in the density of ceramic and lithic material suggest an increase in the pre-Hispanic population, in consequence, a larger number of inhabited sites in the high Andean zones would be directly exposed to the volcanic effects of Puracé.

Archaeological sites also occur below 3000 m in the Puracé Indian reservation; these are less consistent in settlement pattern and there are no nucleated centres with platforms like those in the high Andean sites. Only at the site of Chapío (*Cabildo*) have ceramic materials been found on the ploughed surface: these belong to the Regional Development period and the sherds are parts of *alcarrazas* (double-spouted vessels with a bridge handle), bowls and medium-sized jars with everted edges, made of fine clay, polished and with red slip. Another site is Hispa.

Hispa (PUR-538), dated  $1160 \pm 30$  B.P. (Beta 322720), which, together apparently with Chapío (PUR-016) y Tabío (PUR-532), must have sustained falls of ash (lapilli), which is present in the humic strata excavated for the Late and Historic periods. This was despite the fact that they were located, as the map shows, in high areas away from the most important rivers in the region, through which flowed pyroclasts and mud from the most recent geological past.

Analysis of the archaeological materials indicates certain tendencies within the occupation of nucleated sites. It is notable that when settlement begins, the density of cultural materials is low; however, after a certain time, possibly around 800 B.P., there is an increase in material production in a number of these high Andean sites located above 3100 m above sea level. This aspect may in some way reflect changes in population density among the peoples who occupied these sites and who stayed until historic times, strongly influenced by European colonization of the territory. Towards the end of these occupations fewer cultural materials are recorded, suggesting that the sites were abandoned, probably due to the effects of acculturation and colonization. Some sites contain ceramics of European manufacture in conjunction with others of indigenous production or with elements of African origin.

We can conclude that in the Late period the societies settled on the flanks of the Puracé volcano experienced several of its eruptions, clear examples being the sites of Pagüimbio and Alto Anambío. At Pagüimbio site there is evidence of a possible mud flow containing archaeological material, the density of pottery suggesting that the site was reoccupied after the event. This phenomenon must have occurred around 780 B.P.





Fig. 7. Chichiguará site. Puracé Indian Reservation. (Photo R. Ruíz, 2013).

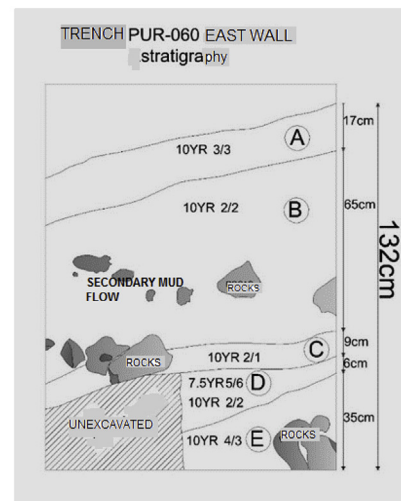


Fig. 8. Pagüimbio site, Chapío. Excavation trench PUR-060.

Alto Anambío on the other hand appears to have been affected by phenomena associated with the dome explosion which occurred around 600 BP. The sites were not seriously affected, but it is possible that they were temporarily abandoned and later reoccupied. The large settlements in these cold, damp zones must have been closely linked to agricultural practices in the fertile volcanic soils of the region.

### 7.2.3. Coconuco area

Here the archaeological sites, of ritual significance to indigenous communities of the region, are located on the south-western slopes of Puracé. One of the most ancient sites encountered in the region to date is Patugó (COC-223), dated  $2010 \pm 30$  B.P. (Beta 363908) and situated close to the extinct Chagartón volcano. The site contains several nucleated living platforms, with mound cemeteries located on the highest hills of the region. It is important to note that areas surrounding the Puracé volcano were affected around  $2.110 \pm 30$  B.P. by what has been considered to be its greatest eruption ( $2.110 \pm 60$  B.P.).

Archaeological sites of the Late period are found in greater quantities, the most notable being Pozo Azul in Chiliglo Alto (COC-235) (Figs. 9 and 10) and Cristales (COC-016 and 114), close to zones of cloud and páramo. In each site are areas devoted to the dead: it is common to find cemeteries of simple tombs close to a settlement or within it; there are also more formal cemeteries on the tops of hills, where funerary mounds were constructed with tombs dug out of yellow volcanic ash. These sites are sacred or ceremonial places with great spiritual symbolism for their people. In Kokonuko myths the dead are connected to the Puracé volcano, the ‘father’ and origin of living beings



Fig. 9. Stepped platforms at Chiliglo Alto.

(Faust, pers. comm., 2014).

Most of the archaeological sites belong to the Late period. Chiliglo Alto and Pozo Azul are regarded by the communities as the ancestral territory of their people (Figs. 11 and 12). These two sites are important in that they embody oral histories concerning the cultural and ethnic past of the Puracé region. At Pozo Azul, dated  $400 \pm 30$  B.P. (Beta 363909), the buildings of an actual town were found, transforming the landscape at 3100 m with platforms, *tambos*, roads and many mound cemeteries similar to those described above. The whole complex is circumscribed by the thermal springs of Pozo Azul, the muds of Pozo



Fig. 10. Thermal springs at sacred site of Pozo Azul.



Fig. 11. Chiliglo Alto. Sacred site and funerary mounds.



Fig. 12. Chiliglo Alto. Artificial platforms.

Blanco and, above, the view of Chagartón. A short distance away are salt deposits and more thermal springs at Quebrada Azufrales in Chiliglo Bajo.

These adaptations to the environment suggest a degree of organization in the social, economic and political fields comparable to what is known about the Andean chiefdoms. In the case of Pozo Azul there is also a close relationship in mythical and cosmological terms between the present-day indigenous communities and the pre-Hispanic archaeological site, which remains present in some form in the memory of these cultures. The question we must ask is why this important ancestral site was abandoned: in the few stratigraphic records pyroclastic fall can be seen, but what this meant for the site requires further investigation. As regards ceramic material, this is found abundantly in living areas and rubbish deposits, together with agricultural grinding



Fig. 13. El Mirador Site with truncated pyramids.

implements and small cutting tools, some of obsidian. These characteristics are similar to those observed at other Late Period sites in the Puracé area.

Another important Late site in Coconuco is Cristales (COC-114), dated  $280 \pm 30$  B.P. (Beta 359214). This is a nucleated settlement with the same characteristics as sites like Pagümbio and Alto Anambío. These sites can be seen at a distance from one another at a level of 3100 m. A noteworthy structure at Cristales is a containing wall of earth along the San Andrés stream. The wall is 520 m long, 2–3 m wide and 1–1.5 m high, although it must once have been higher before the original structure was affected by erosion and cattle. It may also have had a palisade on top, if a high and invulnerable barrier was required. Such structures were common in the Regional Development and Late Periods, used as defences against enemies and warlike new-comers invading the area. Interestingly, the present-day communities recount stories and legends concerning the Pijaos, fierce Indians who are said to be buried with their belongings in certain areas of Puracé. The archaeological and ceramic evidence do not support this, no sites having been recorded in Puracé which are unconnected with the cultural homogeneity of the Late period.

#### 7.2.4. Paletará Area

Sites were recorded in Paletará in the areas of El Mirador (PAL 034, 084 and 085) and La Josefina (PAL-004); the first in particular contained the largest settlement observed in the course of this research. At the site of El Mirador (El Trebol) no evidence of destruction caused by volcanic eruptions was detected, although in excavated profiles and soundings pyroclastic material was observed which had become incorporated into the famously fertile humic soil of the Paletará valley. When recording sites towards the south-east of the volcanic chain we found that these were more complex and of greater size than those in the northern part of Puracé. At El Mirador, at 3100 m, truncated pyramidal structures were encountered within the settlement, their presence representing an exceptional feature in the region (Figs. 13 and 14). At least four structures of this kind were registered, built with sloping sides and access ramps to flat surfaces at the summit; they may have accommodated various special structures for chiefs and shamans. The site includes complexes of platforms and *tambos* of various sizes in terraces following the slopes and hills of the Los Ranchos stream and the river Cauca at the altitude of Piedra de León. The pre-Hispanic roads are broad and well-designed, their connections indicating that they lead to the Sotará volcano to the south of the Massif, and to the Popayán valley. They were re-used during the Colonial and Republican periods for communication between Cauca and Huila.

It is clear that El Mirador site, still undated, was a pre-Hispanic site with room for many people. It undoubtedly had a social structure with political and economic aspects leading to a substantial transformation of the landscape. Platforms, *tambos* and pyramids were constructed for





Fig. 14. El Mirador Site. Pyramids with artificial platforms.



Fig. 15. El Mirador. Funerary mounds.



Fig. 16. Pre-hispanic roads.

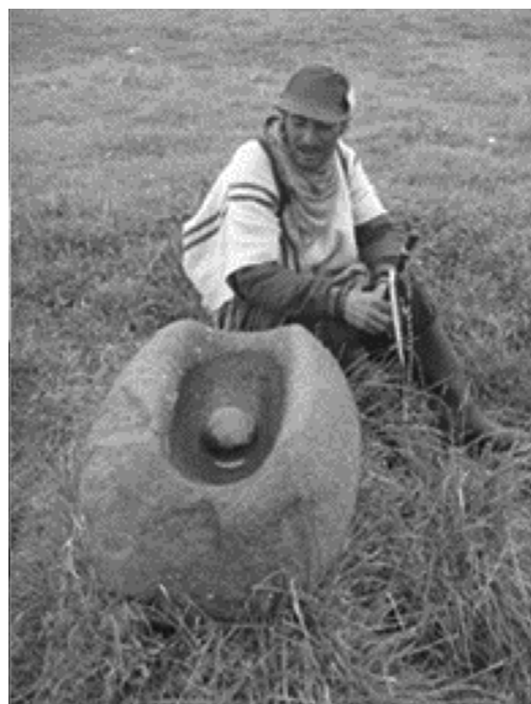


Fig. 17. Stone quern.

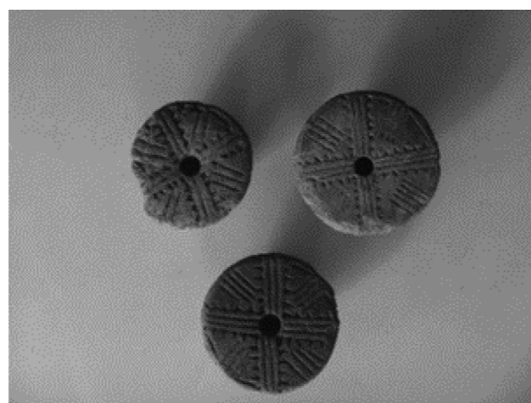


Fig. 18. Decorated wheel spindles from La Josefina (PAL-004), Paletará.



Fig. 19. Decorated Ceramic from La Josefina (PAL-004), Paletará.

dwelling and buildings for the *Caciques* (Figs. 15–17). Roads were maintained as axes of regional communication and for the exchange of products and ideas. In accordance with the archaeological evidence, such as pottery, querns, grindstones, (*manos y metates*), axes and obsidian, the economic basis was agriculture, working the fertile soils enriched with volcanic ash (Figs. 18–20). Graves are relatively common, some considerably disturbed by looters; The burial pattern is identical to that described for other settlements, that is to say on slopes and in mounds. One tomb excavated at El Mirador produced data on a young woman, 15–20 years old on the basis of pelvic bones without contusions. Archaeological studies in the area are of a preliminary nature and it is hoped that in future work will continue with further prospection and excavation in volcanic contexts.





Fig. 20. Vessel with anthropomorphic figure from La Josefina (PAL-004), Paletará.



Fig. 21. Colonial printed pottery. Hacienda Coconuco.

### 7.3. The historic period

Historic sites have also been recorded in the Puracé area, the best known being the Hacienda Coconuco. Similar sites exist at other haciendas and settlements in the region, but these relate to the last two centuries. For the Historic period there are well-documented references from Conquest and Colonial times to the volcanic eruptions of Puracé, which affected the area in different ways and which have stayed in the memories of the inhabitants. There were for example pyroclastic falls which caused great damage to the crops, remnants of which are preserved in the moss covering certain trees above 3100 m. People also recall the eruptions of 1949, when schoolchildren died in a fall of large pyroclasts (volcanic bombs) close to the crater (Espinosa, 2011).

Archaeological prospection in Puracé did not produce many sites from the Historic period, but we did encounter pre-Hispanic sites re-occupied in historic times by colonials working in the sulphur mine and on the local haciendas. Other sites, at Alto Los Pinos and Poblazón, were reoccupied by the indigenous people themselves, though this situation is uncommon among native communities owing to respect for their ancestors. The most notable site of the Colonial era was Hacienda Coconuco, property of General Tomás C. Mosquera (Helguera, 1970). Excavations carried out in the domestic sector (kitchen) of the mansion produced an abundance of ceramic material including imported, indigenous, African and local pottery. The finer pottery and porcelain was imported from Europe during the eighteenth and nineteenth centuries (Figs. 21 and 22).

## 8. Conclusions and discussion

Archaeological investigation of Indian reservation territories in the

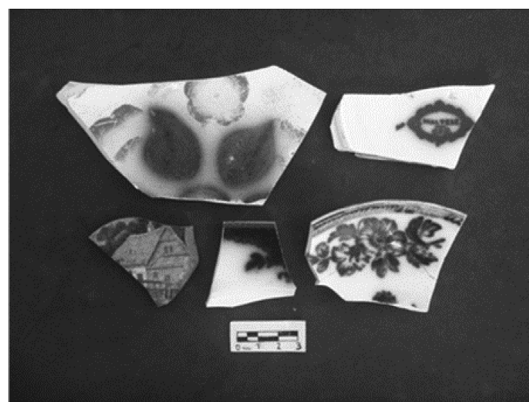


Fig. 22. Colonial printed pottery. Hacienda Coconuco.

region of the Puracé volcano shows that the pre-Hispanic and historic societies settled in this region in the past were exposed repeatedly to natural phenomena of a volcanic nature. The Coconucos Volcanic Chain, of which Puracé is a part, has a long geological history which has generated eruptions throughout the Holocene era to the present day. Archaeological sites in the region include settlements from various chronological periods: Hunter-Gatherers, Regional Development, Late and Historic. The pre-Hispanic and historic societies living near the Puracé volcano were exposed to the threat of natural phenomena, particularly of volcanic origin. These volcanic phenomena associated with human settlements are comparable to those studied in other regions of South and Central America (Ceruti, 2010); (Hall and Mothes, 1998); (Harris, 2000); (Morrissey and Mastin, 2000); (Sheets, 2002); (Sheets, 1999).

Groups of farmer-potters were present in Puracé from 2400 B.P. Although few sites or samples were found, it can be deduced from analysis that these societies were competent potters who cultivated maize (*Zea mays*). Clearly this period needs further study to improve our understanding of the settlements. Equally, although no direct evidence was found at these sites of archaeological occupations sealed by volcanic deposits, nor of massive volcanic destruction, their inhabitants must have witnessed one of Puracé's most important eruptions in about 2100 B.P. The dates indicate that around this time there were pyroclastic falls, pyroclastic surges and flows of scoria through most of the river valleys and streams rising on the flanks of the volcano forming deposits of material, still visible today, at distances of more than 10 km from the crater (Monsalve et al., 2000).

Other finds, in areas north-west of the volcano, suggest that this eruptive activity could have led to temporary abandonment of the territory with displacement, possibly towards the Coconuco region, out of reach of the pyroclastic flows. This apparently led to a strategic change in settlement pattern with occupation of high hills, away from the river beds. As mentioned in the section on the archaeology of the Puracé reserve, this could be seen as an early and partial strategy aimed at mitigating the risk of volcanic threat. The best examples observed in the study are Chichiguará, Pagüimbio, Cristales, Chiliglo Alto and El Mirador, in the area circumscribed by the Vinagre, Anambío and Agua Blanca rivers, with various settlements above 3000 m on high hills and gentle slopes corresponding to the Late period, estimated at between 1500 and 500 B.P.

The archaeological finds indicate certain tendencies in the occupation of nucleated sites. It is notable that when settlement begins, low densities of cultural materials are recorded; however, from a certain period, possibly around 800 B.P., an increase in material production is evident at several of these high Andean sites located above 3100 m. This aspect may reflect changes in population density at these sites which lasted into historic times, strongly influenced by European colonization of the territory. Towards the end of the occupations low

levels of cultural material are recorded, indicating abandonment of the sites, probably on account of the effects of acculturation and colonization. Some of these sites contain ceramic artifacts of European manufacture, associated with others of indigenous production or with elements of African origin (Patiño, 2012).

It is concluded that in this Late period the societies settled on the flanks of the Puracé volcano experienced some of its eruptions. Clear examples are the sites of Pagüimbio and Alto Anambío. At the first site there is evidence of a possible mud flow with associated archaeological material; the density of sherds suggests that the site was reoccupied after the event. This must have occurred around 780 B.P. The site of Alto Anambío on the other hand appears to have been affected by phenomena associated with the dome explosion around 600 B.P. The sites were not gravely affected, but it is possible they were abandoned temporarily and later reoccupied. The settlements in these cold, humid zones must have been closely linked to agricultural practices in the fertile volcanic soils of the region. An advantage of volcanic eruptions is their proven effect on soil fertility, as volcanic ash contains minerals and other chemical elements necessary to plants. Past peoples recognized the value of these Andean locations for settlement and the development of their cultures based on agriculture in a volcanic environment (IGAC, 2009); (Oberem, 1981); (Monsalve et al., 2012).

Several authors, including Hall and Mothes (1998), Knapp (1988) and Oberem (1981), explain similar adaptations in northern Ecuador in terms of the high agrarian productivity developed in lands fertilized by volcanic ash falls. Puracé is no exception: its fertile soils were also productive and continue to be so, especially for the crops of maize (*Zea mays*) sown by its peoples since pre-Hispanic times. Cultivated maize appears in the form of phytoliths in several strata at the sites of Chichiguará and Alto Los Pinos, in association with squash. This could explain not only the escalation in indigenous demography, but also other cultural aspects which arise quite suddenly in connection with power, land control, technological development and the production of surpluses: in other words, the formalization of exchange and trade routes among neighbouring chiefly societies in the Colombian Massif. Ethnoarchaeological studies suggest that the most desirable products originating in the different climatic zones of vertical economies were maize, beans, cassava, coca, cotton and *chonta* palm; others, from more distant regions, included salt, chert, gold and copper (Bernal, 2000); (Bernal, 2011); (Drennan, 2000); (Langebaeck and Piazzini, 2003); (Gnecco, 1995); (Romoli, 1962). Obsidian was a product intensively exchanged by Andean cultures settled in the volcanic zones between Colombia and Ecuador (Knight et al., 2011) (Salazar, 1992) and the pre-Hispanic cultures in our area of study exploited various sources around the Puracé volcano. Obsidian from these sources are found at many sites in Popayán but has also been identified on the Pacific coast during the Regional Development period (Gnecco et al., 1998).

Lastly, the collaborative nature of our work with the communities was a learning process, not only with regard to volcanic threat in the Indian reservations, but also concerning the ancestral cosmogony which reinforces traditions, myths and legends. The results obtained are helping to provide greater awareness of the effects of past volcanic action, people's response to such phenomena and their processes of resilience. All these contribute to historical knowledge and memory of the ancestral populations of the Kokonuko people in the Indian reservations of Puracé.

## Acknowledgements

This study was made possible thanks to funding from the Servicio Geológico Colombiano, SGC (Contract No. 004, 2013) and to its Technical Sub-Director Dr. Martha Calvache. Thanks, are also due to the Grupo Estudios Arqueológicos Regionales y Patrimonio, GEARP, Department of Anthropology, University of Cauca; to the officials and indigenous communities of the four reservations visited during the study; to Marianne Cardale for her comments on this chapter, and to

three academic colleagues; to Linda Mowat for the translation from Spanish into English. A version of the whole study was published in 2015 by the University of Cauca as a book entitled *Arqueología y Vulcanismo en la Región del Puracé, Cauca*.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.quaint.2018.04.014>.

## References

- Alvarado, G., Soto, G., 2008. Volcanoes in the pre-Columbian life, legend, and archaeology of Costa Rica (Central America). *J. Volcanol. Geotherm. Res.* 356–362.
- Barona, G., 1995. La Maldición de Midas en una Región del Mundo Colonial: Popayán, 1730-1830. Fondo Mixto para la Promoción de la Cultura y las Artes del Cauca, Cali.
- Bernal, A., 2000. La circulación de productos entre los Pastos en el siglo XVI. *Rev. del Área Intermedia* 2, 125–152.
- Bernal, A., 2011. In: *Cronología cerámica y caracterización de asentamientos prehispánicos en el centro andino del departamento de Nariño*. Investigaciones arqueológicas en Yacuanquer y Pasto, vol. 5 Instituto Colombiano de Antropología e Historia, Bogotá.
- Cerón, P., 1996. Los Coconuco. In: *Geografía Humana de Colombia, Región Andina Central*. Geogr. Humana Colomb. (Región Andina) 1, 181–220.
- Ceruti, M.C., 2010. Los volcanes sagrados en el folclore y la arqueología de Costa Rica. *Mitológicas* XXV, 39–50.
- Colmenares, G., 1979. *Historia Económica y Social de Colombia II: Popayán una Sociedad Esclavista, 1600-1800*. La Carreta, Bogotá.
- Correal, G., Van der Hammen, T., 1977. Investigaciones arqueológicas en los abrigos rocosos del Tequendama 11.000 Años de prehistoria en la altiplanicie de Bogotá. Banco Popular, Bogotá.
- Dickau, R., Aceituno, F., Loaiza, N., López, C., Cano, M., Herrera, L., Ranere, A., 2015. Radiocarbon chronology of terminal Pleistocene to middle Holocene human occupation in the middle Cauca Valley, Colombia. *Quat. Int.* 363, 43–54.
- Drennan, R., 2000. *Las Sociedades Prehispánicas del Alto Magdalena*. Instituto Colombiano de Antropología e Historia, Bogotá.
- Espinosa, A., 2011. *Erupciones Históricas de los Volcanes Colombianos, 1550-2000*. Ministerio de Educación Nacional, Bogotá.
- Faust, F., 1989-90. *Etnografía y Etnología de Coconuco y Sotará*. *Rev. Colomb. Antropol.* XXVII, 54–90.
- Faust, F., 1991. La Cultura de los Indígenas del Macizo Colombiano y Protección de la Naturaleza en el Parque Nacional de Puracé. *Noved. Colomb.* 3, 54–62.
- Faust, F., 2004. *Viajes por los Paisajes Míticos de Colombia. Historias de los Encantos Boyacá, Tolima y Cauca*. Universidad del Cauca, Popayán.
- Gnecco, C., 1995. Relaciones de intercambio y bienes de elite entre los cacicazgos del suroccidente de Colombia. In: Langebaeck, C., Cárdenas, F. (Eds.), *Cacicques, Intercambio y Poder: Interacción Regional en el Área Intermedia de las Américas*. Universidad de Los Andes, Bogotá, pp. 175–196.
- Gnecco, C., 2000. *Ocupación Temprana de los Bosques Tropicales de Montaña*. Universidad del Cauca, Popayán.
- Gnecco, C., Patiño, D., Doriguel, O., Bellon-Gurlet, L., Poupeau, G., Glascock, M., 1998. La articulación prehispánica costa-andes en el suroccidente de Colombia vista a través de las redes de circulación de obsidiana. In: Cárdenas, F., Bray, T. (Eds.), *Intercambio y Comercio entre la Costa, Andes y Selva*. Universidad de Los Andes, Bogotá, pp. 49–66.
- Hall, M., Mothes, P., 1998. La Actividad Volcánica del Holoceno en el Ecuador y Colombia Austral: impedimento al Desarrollo de las Sociedades Pasadas. In: Mothes, P. (Ed.), *Actividad Volcánica y Pueblos Precolombinos en el Ecuador*, pp. 11–40 (Quito: Abya-Yala).
- Hall, M., Mothes, P., 2008. Volcanic impediments in the progressive development of pre-Columbian civilizations in the Ecuadorian Andes. *J. Volcanol. Geotherm. Res.* 176 (3), 344–355.
- Harris, S.L., 2000. *Archaeology and Volcanism*. En *Encyclopedia of Volcanos*. Academic Press, San Diego, California, pp. 1301–1314.
- Helguera, J.L., 1970. Coconuco: datos y documentos para la historia de una gran hacienda cancana 11832, 1842 y 1876. *Anu. Colomb. Hist. Soc. Cult.*, vol. 5, 189–203.
- Herrera, L.F., Drennan, R., Uribe, C., 1989. *Prehispanic Chiefdoms in the Valle de La Plata*. Universidad de Los Andes, UNIVersidad de Pittsburgh, Bogotá.
- IGAC, 1975. *Suelos de Ceniza Volcánica del Cauca*. Santafe de Bogotá, Bogotá.
- IGAC, 1993. *Cauca, Características Geográficas*. Bogotá: Subdivisión de Geografía. Santafe de Bogotá, Bogotá.
- IGAC, 2009. *Estudio General de Suelos y Zonificación de Tierras*. Departamento del Cauca. Bogotá: Imprenta Nacional.
- Knapp, G., 1988. *Ecología Cultural Prehispánica del Ecuador*. Banco Central, Quito.
- Knight, C., Cuellar, A., Glascock, M., Hall, M., Mothes, P., 2011. Obsidian source characterization in the Cordillera Real and eastern piedmont of the north Ecuadorian Andes. *J. Archaeol. Sci.* 38 (5), 1069–1079.
- Langebaeck, C., Piazzini, C., 2003. *Procesos de Poblamiento en Yacuanquer-Nariño: Una investigación arqueológica sobre la microverticalidad en los andes colombianos (siglos X a XVIII d.C.)*. Corcas Editores Ltda, Bogotá.
- Lehmann, H., 1953. *Archaeologie du sud-ouest Colombien*. *Journal de la Société des Américanistes*. *Journal de la Société des Américanistes*, Paris.

- Longhena, M., Alva, W., 2005. Perú Antiguo. Ediciones Folio, Barcelona.
- Marzal, P., 1978. Town in the Empire: Government, Politics, and Society in Seventeenth Century Popayán. University of Texas Press, Austin, Texas.
- Monsalve, M.L., Pulgarin, B., 1993. Mapa preliminar de amenaza volcánica del volcán Puracé. *Rev. Ingeominas* 1 (2), 3–27.
- Monsalve, M.L., Pulgarin, B., 1999. Cadena Volcánica de los Coconucos (Colombia), centros Eruptivos y Productos Recientes. *Bol. Geol. Ingeominas* 37, 17–51.
- Monsalve, M.L., Pulgarin, B., Narvaez, B., Aguirre, L., Laverde, C., 2012. Geología y Estratigrafía del Volcán Puracé Actual. Ms, Colombia. Bogotá.
- Morrissey, M.M., Mastin, L., 2000. Vulcanian eruptions. In: Sigurdsson, H. (Ed.), *Encyclopedia of Volcanos*. Academic Press, San Diego, California, pp. 463–475.
- Oberem, U., 1981. El acceso a recursos naturales de diferentes ecologías en la sierra ecuatoriana. In: Moreno, S., Oberem, U. (Eds.), *Contribución a la Etnohistoria Ecuatoriana*. Gallo capitán, Otavalo, pp. 45–72.
- Patiño, D., 1990. Pobladores Prehispánicos del Cauca, Colombia. *Inf. Antropológicos* 4, 35–52.
- Patiño, D., 2009. Arqueología de Las Guacas. Cauca, Popayán.
- Patiño, D., 2012. Patrimonio y Arqueología Histórica: Una Mirada desde la Popayán Colonial. Universidad del Cauca, Popayán.
- Patiño, D., Hernández, M.C., 2014. Pueblos prehispánicos del macizo colombiano. In: *Estudios de Cultura e Historia Andina: Hacia Hatun Yanamarca*. Artes Gráficas, Cali, pp. 37–57.
- Portela, H., 2000. El Pensamiento de las Aguas de las Montañas: Coconucos, Guambianos, Paeces y Yanaconas. Universidad del Cauca, Popayán.
- Pulgari, B., Monsalve, M.L., Torres, P., Cepeda, H., 1996. ¿La Cadena volcánica de los Coconucos, producto de vulcanismo resurgente? ¿La Cadena volcánica los Coconucos, Prod. Vulcan. resurgente? 367–377 Bogotá.
- Romoli, K., 1962. El suroeste del Cauca y sus indios al tiempo de la conquista española. *Rev. Colomb. Antropol.* XI, 241–303.
- Salazar, E., 1992. El intercambio de obsidiana en el Ecuador precolombino: perspectivas teórico-metodológicas. In: Politis, G. (Ed.), *Arqueología en América Latina Hoy*. Biblioteca Banco de La República, Bogotá.
- Salomons, J.B., 1996. Paleocology of Volcanic Soil in Colombian Central Cordillera (Parque Nacional Natural de los Nevados). *Diss. Bot.* 95 15–216.
- Sheets, P., 1999. The effects of explosive volcanism and ancient Egalitarian, ranked societies in Middle America. In: Smith, O., Hoffman (Eds.), *The Angry Earth: Disaster in Anthropological Perspective*. Routledge, New York.
- Sheets, P., 2001. The effects of explosive volcanism on simple to complex societies in ancient middle America. In: Markgraf, V. (Ed.), *Interhemispheric Climate Linkages*. Academic Press.
- Sheets, P., 2002. Before the Volcano Erupted, the Ancient Cerén Village in Central America. University of Texas Press, Austin.
- Torres, P., Pulgarin, L., Cepeda, H., 1999. Caldera de Paletará: aproximación a la fuente de las ignimbritas del Cauca y Huila (Colombia). *Bol. Geol. Ingeominas* 37, 1–15.
- Urdaneta, M., 1988. Investigaciones arqueológicas en el resguardo indígena de Guambia. *Bol. del Mus. del Oro* 22, 35–82.
- Urdaneta, M., 1991. Huellas de Pishau en el resguardo de Guambia: ensayando caminos para su estudio. *Bol. del Mus. del Oro* 31, 3–30.
- Van der Hammen, T., 1974. The Pleistocene changes of vegetation and climate in tropical south America. *J. Biogeogr.* 1 (1), 3–26.
- Yepes, A., 2017. Las Huacas del Volcán Chimborazo (Ecuador) y sus relaciones de visibilidad con Santuarios de Altura Prehispánicos. *Anthropos* 112, 127–152.