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Revisiting the lithic industries of El Abra sites (Sabana de Bogotá, Colombia, Northern South America). Implications for its significance and chronology

Brunella Muttillo[a,*], Roberto Lleras Pérez[b], Ettore Rufo[c], Giuseppe Lembo[a]

[a] Missione archeologica italiana, Ministero degli Affari Esteri e della Cooperazione Internazionale (MAECI), Italy
[b] Academia Colombiana de Historia, Bogotá, Colombia
[c] Ministero dell'Istruzione, dell'Università e della Ricerca, Italy

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ABSTRACT

In this paper we present a revision of the lithic industries of El Abra sites (Sabana de Bogotá, Eastern Cordillera, Colombia), among the most ancient and significant sites of Colombia. Dated to 12,400 ± 160 years BP, El Abra is an important reference for the prehistory of the country.

Our review mostly deals with the: a) methodological approach adopted for the study of the lithic industry; b) interpretation of the lithic industry; c) chrono-stratigraphy.

In 2017, 2019 we presented the revision of the lithic assemblages of the oldest levels of El Abra sites (Muttillo et al., 2019, 2017); here we integrate and complete the revision with the analysis of the lithic assemblages of the upper levels. This is the first revision of the historical lithic collections, adopting a technological approach and crossing the data with the chrono-stratigraphic context.

Our results have highlighted several discrepancies and critical elements contained in previous studies, that mostly affect not only the interpretation of the lithic industries but also the chronology of the site, that turned out to be more recent than previously assumed, for at least three thousand years.

1. Introduction

Despite the exponential increase of multidisciplinary researches (archaeological, paleoanthropological, genetic and linguistic) of the last decades, the first human peopling of the Americas is still a matter of intense scientific controversy. Consensus has yet to be reached regarding many aspects which are controversial and poorly understood: the number and timing of dispersions from Siberia within the Americas; the timing of Native Americans divergence from their East Asian ancestors; the precise spatial-temporal pattern of the peopling process; the dispersion routes, subsistence strategies and adaptive responses to different climatic and environmental conditions; cultural and techno-economic behaviors (e.g., Anderson, 2010; Ardelan, 2014; Ardila and Politis, 1989; Beck and Jones, 2010; Braje et al., 2017; Bryan and Gruhn, 2003; De Saint Pierre, 2017; Dillehay, 2008, 1999; Dillehay et al., 1992; Faught, 2017, 2008; Goebel et al., 2008; Llamas et al., 2016; Marangoni et al., 2014; Moreno-Mayar et al., 2018; Pitblado, 2011; Posth et al., 2018; Raghavan et al., 2015; Reich et al., 2012; Steele and Politis, 2009).

Apart for the recently discovered 130,000-year-old Cerutti Mastodon site (southern California, USA) (Holen et al., 2017), not unanimously accepted (Ferraro et al., 2018) and other debated sites such as the sites of the Piauí region, in Brasil, dated to 25,000–20,000 years ago (e.g., Boëda et al., 2014a,b; Lahaye et al., 2015, 2013), current genetic and archaeological evidence suggests a dispersal from a Siberian population toward the Bering Land Bridge not earlier than about 30 ka, moving into eastern Beringia between 26 and 18 ka, spreading southward into the Americas after 17 ka and reaching southern South America by at least 14.5 ka (e.g., Braje et al., 2017; Dawe and Kornfeld, 2017; Dixon, 2013; Goebel et al., 2008; Madsen, 2015; Pedersen et al., 2016; Pitblado, 2011; Rabassa and Federico, 2013; Raff and Bolnick, 2014).

Although the place of initial entry into South America is not known, it must necessarily correspond to the north/north-western part of the current Colombian territory, which links Panama with the rest of the continent. Therefore, in this debate, Colombia, thanks to its strategic geographical position, constitutes a key area to understand the dispersal of early human population moving from Central to South America, through the Isthmus of Panama, which constitutes a sort of bottleneck that opens to an area with a large variety of environments (e.g., Aceituno et al., 2013; Cooke, 1998; Cooke et al., 2013; Delgado et al., 2015; Dickau et al., 2015; Dillehay et al., 1992; Politis, 1999;

* Corresponding author.
E-mail address: brunella.muttillo@gmail.com (B. Muttillo).

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Ranere and López, 2007).

There are many critical issues in the reconstruction of the prehistory of Colombia, that do not allow us to achieve a full and detailed comprehension of chronology, routes of dispersion and the human economic strategies of the earliest inhabitants of the Colombian territory (for a synthesis, see Muttillo et al., 2017).

According to the available evidence, the early peopling of Colombia occurred during the final Late Pleistocene/Early Holocene; more precisely during the Guantiva-El Abra interval (ca. 12,500–10,000/9500 BP), the regional equivalent to the European Allerød-Younger Dryas sequence (van der Hammen and Hooghiemstra, 1995).

Sites dated earlier than 12,500 BP, such as Pubenza (ca. 16,400 BP, Magdalena valley) (Correal et al., 2005) and El Jordán (ca. 12,900 BP, Central Cordillera) (Salgado, 1998; Salgado and Varón Barbosa, 2019) are not unanimously accepted (Aceituno et al., 2013; Delgado et al., 2015) and will not be considered in this paper.

At the current state of the research, El Abra (Sabana de Bogotá, Eastern Cordillera, Colombia) is the oldest site of Colombia with a chronology of 12,400 ± 160 BP and a key-site for the prehistory of the country (Correal et al., 1969; Correal and van der Hammen, 1977; Hurt et al., 1977, 1972; van der Hammen, 1991).

The aim of this paper is to present and discuss the results of our revision of the El Abra historical lithic collections. Our review mostly deals with the: a) methodological approach adopted for the study of the lithic industry; b) interpretation of the lithic industry; c) chrono-stratigraphy.

Here we integrate and complete the revision of the lithic assemblages of the oldest levels of El Abra sites (Muttillo et al., 2017) with the analysis of those of the upper levels.

Our review revealed serious problems that affect not only the interpretation of the lithic assemblages but also the chronology of the site.

2. El Abra rock shelters: a critical review

El Abra rock shelters (Zipaquirá, Cundinamarca Department) were the first stratified sites to be excavated in Colombia between 1967 and 1969, by a team directed by Gonzalo Correal Urrego (Instituto Colombiano de Antropología), Wesley R. Hurt (Indiana University) and Thomas van der Hammen (University of Amsterdam). The rock shelters are located along a corridor between two parallel sandstone escarpments of the Upper Cretaceous into the basin of the extinct Pleistocene lake Bogotá, that now corresponds to the high intermontane plain of the Sabana de Bogotá (Correal et al., 1969; Hurt et al., 1972, 1977) (Fig. 1-A).

Four rock shelters were partially excavated, two of which (El Abra 1 and 4) were affected by vandalism. Therefore, here we refer only to El Abra 2 and El Abra 3 rock shelters, distant from each other ca. 300 m (Hurt et al., 1977).

During the first fieldwork of 1967, the excavation of El Abra 2 and El Abra 3 was carried out through nine artificial levels of 25 cm (top, level 1 - bottom, level 9), replaced by five mayor deposition units during the second fieldwork of 1969 (top, stratigraphic unit E – bottom, stratigraphic unit A).

Although there is no precise correspondence between the artificial levels and stratigraphic units, it is possible to assume that: the artificial levels 9, 8, 7, 6 (of the 1967 fieldwork) should approximately correspond to the deposition unit C (of the 1969 fieldwork); the artificial levels 5, 4, 3 should correspond to the deposition unit D; the artificial levels 2 and 1 should correspond to the deposition unit E.

Stratigraphic units C, D and E yielded anthropic evidence. A detailed palynological analysis has allowed the reconstruction of the prevalent paleoclimatic and paleoenvironmental conditions.

The same stratigraphic sequence was recognized for El Abra 2 and El Abra 3.

From bottom to top, the stratigraphic sequence can be summarized as follow (Hurt et al., 1977) (Fig. 1-B):

Stratigraphic unit A (ca. 34,000–32,000 BP): brown-grey sediments related to a climate of stadial type, colder and drier than today. The forest limit was more than 1000 m lower than at present. No evidence of human occupation.

Stratigraphic unit B (32,000–20,000 BP): dark-grey humic clay, with intercalations of volcanic ash. The climate was colder than at present, becoming relatively wet towards the final phase. No evidence of human occupation.

Stratigraphic unit C (20,000–10,000 BP): it is composed of varying sediments laid down during the Late Pleistocene. The climate, that was still cold and dry during the first phase of this unit (subunits C1–C2), became warmer during the deposition of subunit C3 (13,000–11,000 BP associated with the Guantiva Interstadial), causing the spread of open forests, of ponds and lakes and the retreat of the paramo vegetation to higher altitudes. During this warmer and moister interval, the first evidence of human occupation was found (dated to 12,400 ± 160 BP), consisting of 18 flakes. No faunal remains were recovered. At the end of the deposition unit C (subunit C4, 11,000–10,000 BP, associated with the El Abra Stadial) the climate became drier and cooler.

Stratigraphic unit D (10,000–2500? BP): covers the early and middle phases of the Holocene, prior to the introduction of agriculture and ceramics. Its termination is not precisely dated, although the deposition possibly continued about 2500–2000 BP, the estimated date of the introduction of the ceramic in the Sabana de Bogotá. It was divided into three subunits: D1 (ca. 10,000–9000 BP), D2 (ca. 9000 - 7000 BP), D3 (ca. 7000–2500? BP). The climate became warmer and more humid, causing the spread of the forests in the Sabana de Bogotá. There was an increasing evidence of human occupation. Few faunal remains were found in the upper and more recent part of the deposition unit D, mainly deer (*Odocoileus* sp.) and guinea pig (*Cavia porcellus*) and only few bones of rabbit (*Sylvilagus*) and armadillo (*Dasypus*).

Stratigraphic unit E (2500? - colonial/postcolonial times): this is the uppermost part of the stratigraphy, that was laid down during cooler climatic conditions. The pollen profile of unit E revealed a decrease of forests, probably the result of increasing deforestation of the area for agricultural purposes. This unit is highly disturbed and contained objects of Colonial and contemporary manufacture.

Previous studies on El Abra rock shelter's lithic industries were carried out adopting a typological approach. It was an approach focused more on the absence of some iconic pieces (i.e., projectile points and bifacial tools) than on other important technological elements, such as methods, techniques, raw material choices, adaptions to the available material, diversification and/or evolution of technological patterns. A description of the cores, of the debitage products and of all the *chaîne opératoire*, from the raw material procurement to its abandonment, is lacking. Moreover, the available literature lacks a detailed and complete description of the lithic assemblage for each stratigraphic unit. Using this kind of approach, the lithic industries from El Abra rock shelters (from 12,500 BP to ceramic times) were assigned to the *Abriense* tradition, or «edge-trimmed tool tradition», composed of cores, flakes and few retouched tools. The *Abriense* industry, unifacial and poorly elaborated, was linked to the existence of less specialised early Holocene foragers and/or hunter-gatherers (Correal et al., 1977).

However, there are many critical points on this interpretation. For example, our revision of the oldest levels (S.U. C) of El Abra rock shelters put in doubt the effective anthropic nature of the set, considering the prevalence of unworked material and the inaccuracy of the available documentation (Muttillo et al., 2017). Moreover, the same authors (Hurt et al., 1977) complain about some critical points in the reconstruction of the oldest levels (possibility of intrusions of materials in the lower levels from the upper levels).

Concerning the chronology of the site, there are some problems that affect the reliability of the ^{14}C available dataset (Table 1). In this paper

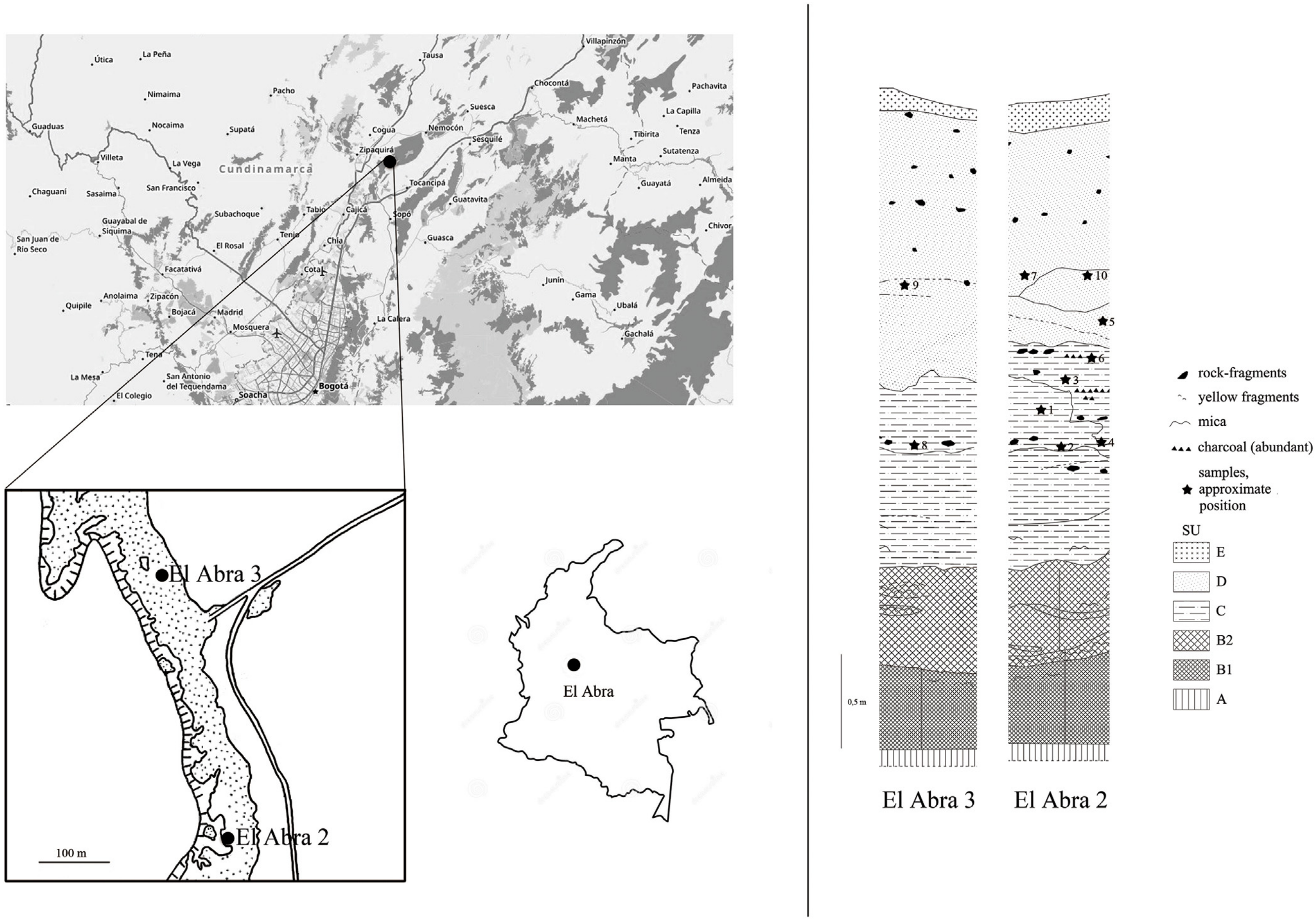

Fig. 1. A: Geographical location of El Abra rock shelters; B: stratigraphic columns of El Abra 2 and El Abra 3 sites (modified from Hurt et al., 1977).

we refer to the reassessment proposed by Delgado et al., in 2015, in which six dates of El Abra 2 were discarded (Table 1, with *): the date of 12,400 ± 160 BP was rejected because it was mild outlier compared to the complete distribution of measured ^{14}C ages dataset corresponding to the Pleistocene/Holocene transition sites; other five dates were rejected considering the exceedingly high sigma values (i.e. laboratory uncertainty) (Delgado et al., 2015: 58).

The oldest date for the site, i.e. 12,400 ± 160 BP associated with the subunit C3 (corresponding to the artificial level 7), is not acceptable even on the basis of the analysis of the lithic industry: according to our revision, the dated sample is associated with a sterile level, which has not yielded artefacts (Muttillo et al., 2017).

Moreover, the same authors (Hurt et al., 1977) state that only from the unit D onwards human evidence becomes more certain and consistent.

Despite all the limitations of the documentation, in this paper we try to provide more information on the El Abra lithic industries and to reassess the chronostratigraphic context.

3. Materials and methods

Considering that we found many gaps in the documentation and that many pieces were not labelled, we could not analyse all the pieces but only those with a clear and secure reference to the stratigraphic

Table 1
^{14}C dates from El Abra rock shelters.

N.[a]	Site	Code	SU	Level	^{14}C date	1σ	Calib BP[b]		References
1	El Abra 2	GrN-5556	C	7	12,400[c]	160	15,133	13,999	Correal et al. (1969); Hurt et al. (1972); Hurt et al. (1977)
2	El Abra 2	GrN-5941	C	8	11,210	90	13,260	12,838	Hurt et al. (1977)
3	El Abra 2	B-2134	C	6	10,720[c]	400	13,319	11,320	Hurt et al. (1972); Hurt et al. (1977)
4	El Abra 2	GrN-5557	C	8	9420[d]	110	11,100	10,374	Correal et al. (1969)
5	El Abra 2	GrN-5561	D	5	9340	90	10,765	10,253	Correal et al. (1969); Hurt et al. (1977)
6	El Abra 2	GrN-5746	D	6?	9325	100	10,781	10,241	Hurt et al. (1972); Hurt et al. (1977)
7	El Abra 2	GrN-5710	D	4	9025	90	10,425	9887	Hurt et al. (1977)
8	El Abra 3	B-2133	C	8	8810[c]	430	11,126	8950	Hurt et al. (1972); Hurt et al. (1977)
9	El Abra 3	B-2137	D	5	8760[c]	350	10,767	8976	Hurt et al. (1972); Hurt et al. (1977)
10	El Abra 2	GrN-col.82	D	4	8670[c]	400	10,715	8630	Correal et al. (1969)

[a] These numbers are reported in Fig. 1 – B.
[b] All calibrated results have 2 sigma calibration with program Calib Rev 7.0.0 (Calibration data set used: intCal13.14c).
[c] Rejected by Delgado et al. (2015).
[d] Date discarded by Correal et al. (1969) based on chronological and stratigraphical considerations (not mentioned in Hurt et al., 1977).

sequence. In this sense, the best documented set was the one related to the first excavation campaign (1967), in which almost all the lithic material was marked with the reference to the artificial levels.

Therefore, in this paper we present a review of the lithic assemblages referred to the artificial levels 5, 4, 3 of El Abra 2 and El Abra 3 (excavated in 1967), which correspond to the unit D (denomination introduced in 1969, during the second excavation fieldwork). In 1967 the sites were investigated on a very limited extension: 3,5 × 1 m for El Abra 2; 4 × 2 m for El Abra 3 (Correal et al., 1969).

The results of the revision of the lower levels of El Abra (stratigraphic unit C, corresponding to the artificial levels 6–9) has already been published in 2017 (Muttillo et al., 2017).

The material referred to the levels 1 and 2 (that correspond to the S.U. E) was discarded and not included in the analysis because «the very uppermost strata are highly disturbed» and contain « objects of Colonial and contemporary manufacture» (Hurt et al., 1977: 4).

Therefore, with this paper, we complete the study of the lithic industries of El Abra rock shelters.

The total amount of analysed pieces is 89 from El Abra 2 and 138 from El Abra 3, stored in the Instituto Colombiano de Antropológía e Historia in Bogotá and in the Instituto de Ciencias Naturales - Universidad Nacional de Colombia in Bogotá.

A techno-economic approach has been followed in the study of lithic industries, previously analysed through a purely typological approach. The analysis has been focused on the reconstruction of the *chaîne opératoire*, the logical and organised sequence of technical steps, from the supply of raw materials through the stages of production and use, until the discard of the tool (e.g., Boëda, 1991; Boëda et al., 1990; Inizan et al., 1999; Leroi-Gourhan, 1964; Pelegrin, 1985; Perlés, 1991).

The analysis has considered the following elements: distinction between worked and unworked material, which includes natural material such as blocks, cobbles, pebbles, angular fragments; analysis of unmodified material (shape, size, raw material type) in order to evaluate the availability and procurement of raw material; analysis of the physical state of the lithic artefacts (state of preservation; state of integrity); technological determination of worked material (flakes, retouched tools, cores, debris or indeterminable fragments) and positioning inside the *chaîne opératoire*; identification of the different debitage methods and knapping techniques.

The retouching, i.e. the intentional modification of the blank edge (s) to manufacture a tool, was analysed taking into account the incidence and characteristics of the following parameters: delineation, extension, angle, localisation, morphology, position and distribution (Inizan et al., 1999).

The debitage method was inferred through the combined analysis of flakes and cores.

For the flakes, in addition to the examination of all the main morphometric characteristics, the analysis was particularly focused on the observation of the dorsal scar patterns and on the characteristics of the butt and the flaking angle and on the presence/absence of cortex, in order to determine the stages of lithic reduction.

For the cores, the analysis was focused on the recognition of the: number of flaking surfaces and their relationships; management of the volume of the core; presence/absence of prepared striking platforms, identification of the causes of abandonment and of the last debitage products.

In the identification of the methods we followed the distinction proposed by Gallotti and Peretto (2014), which crosses the number of flaking surfaces (unifacial: one flaking surface; bifacial: two adjacent flaking surfaces; multifacial: more than two adjacent flaking surfaces; peripheral: one continuous peripheral flaking surface) with the direction of flaking (unidirectional, bidirectional, centripetal/cordal - from a continuous peripheral striking platform - and multidirectional - from separate striking platforms).

4. Results

4.1. Techno-economic analysis of the upper levels (levels 5–3, S.U. D)

According to previous studies, the raw material was classified as chert, indurated siltstone and sandstone (Hurt et al., 1977), which is locally available.

In the Sabana de Bogotá, chert occurs in primary and secondary deposition: in tabular form in outcrops; in tabular forms and chunks in slopes near the outcrops; in the form of cobbles in the river terraces of the Bogotá river and its tributaries (Hurt et al., 1977).

Chert (of different colours: reddish, brownish, grey, beige, white) was recovered in secondary position in form of pebbles, tabular blocks or chunks.

The unworked material is mainly composed of natural fragments of sandstone, few small pebbles of chert and few heat detachments (in El Abra 3), not displaying any trace of human intervention and/or modifications.

Chert is the best represented raw material along the entire unit D in El Abra 2 and 3; occasional is the exploitation of indurated siltstone. Meanwhile, the rare occurrence of sandstone is not related to human activity (Fig. 2).

The lithic assemblages from the unit D of the two rock shelters are

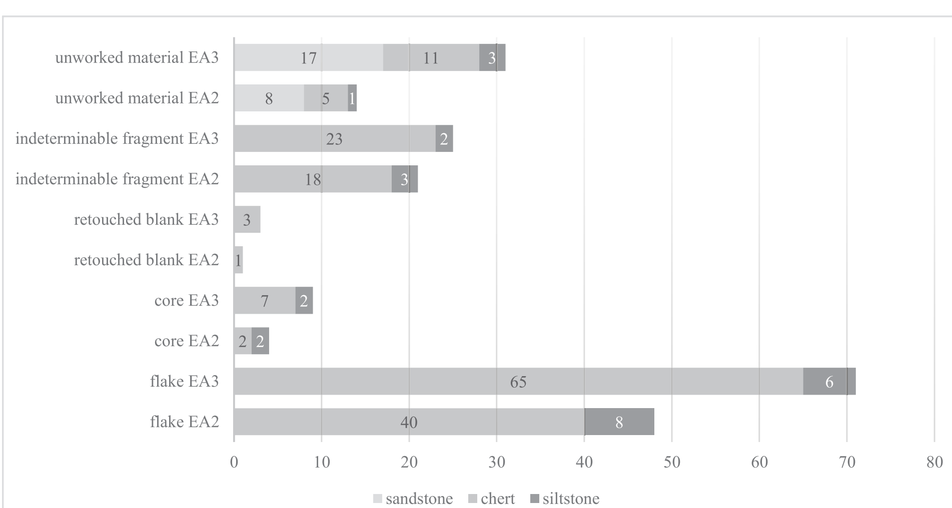

Fig. 2. Raw material exploitation grouped by technological categories in El Abra 2 (EA2) and El Abra 3 (EA3).

Table 2
El Abra 2, stratigraphic unit D, artificial levels 5, 4, 3: composition of the lithic assemblages.

S. U. D	Level 5	Level 4	Level 3
flake	13	21	14
core	2	1	1
retouched blank	–	1	1
indeterminable fragment	4	8	9
Total worked material	***19***	***31***	***25***
natural fragment	9	2	2
pebble	1	–	–
Total unworked material	***10***	***2***	***2***
Total	**29**	**33**	**27**

relatively fresh: pseudo retouches are rare and not very deep. A light patina covers the entire sets.

4.1.1. El Abra 2

4.1.1.1. Level 5. The lithic assemblage recovered in the level 5 is extremely scarce. The worked material just amounts to 19 objects, composed by flakes ($n = 13$), cores ($n = 2$) and indeterminable fragments ($n = 4$). The unworked material ($n = 10$) is composed of natural fragments of sandstone, unmodified, and of a small pebble of chert (Table 2).

Flakes are mainly in chert and only to a lesser extent in indurated siltstone. They were obtained by percussion, without any particular preparation of the core, as testified by the prevalence of plain and natural butts. They are broken in the half of the cases ($n = 6$); the breakage probably occurred during the flaking. There are a hinged flake and a plunging flake; six flakes preserve part of the cortex.

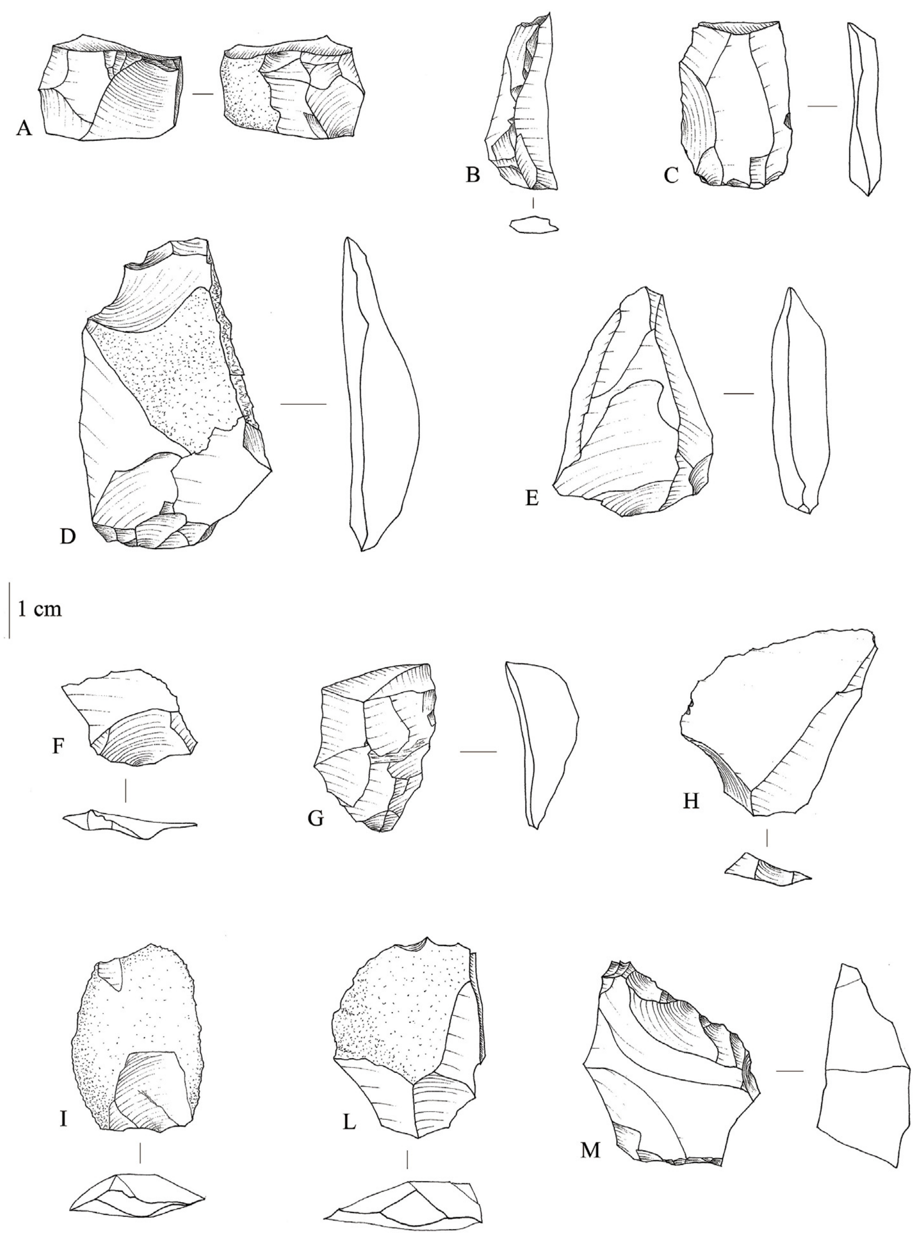

Fig. 3. El Abra 2. A (level 4): multifacial multidirectional core (level 4); B (level 5): edge core flake; C-D (level 3): flakes with orthogonal scars on the dorsale face; E (level 5), F (level 4), G (level 3), H (level 4): flakes with centripetal/tangential scars on the dorsal face; I-L (level 4): cortical flakes; M (level 4): convex transverse side scraper (drawings: B. Muttillo).

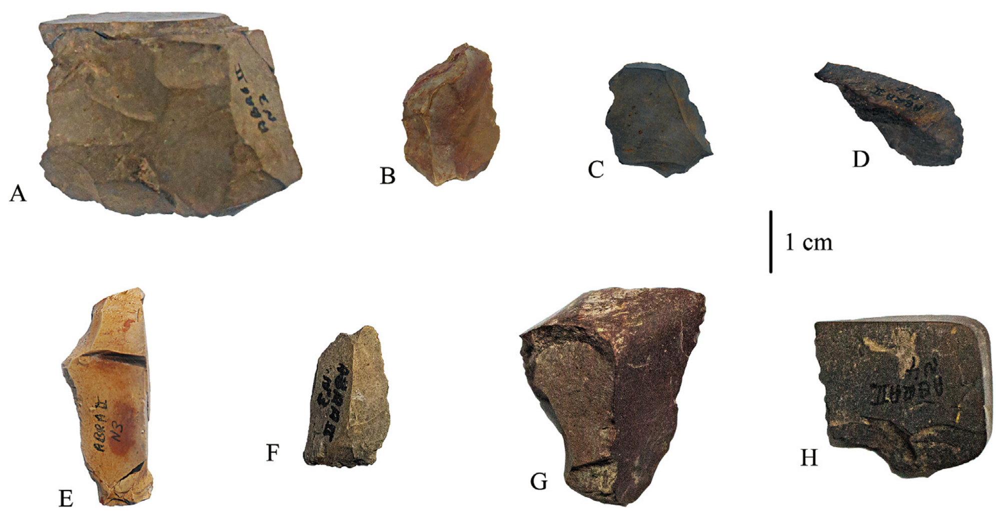

Fig. 4. El Abra 2. A (level 3): unifacial centripetal core; B–C (level 3): flakes with centripetal/tangential scars on the dorsal face; D (level 4), E-F (level 3): flakes with centripetal/tangential scars on the dorsal face; G-H (level 4): cortical flakes (photo: G. Lembo).

Table 3
El Abra 3, stratigraphic unit D, artificial levels 5, 4, 3: composition of the lithic assemblages.

S. U. D	Level 5	Level 4	Level 3
flake	1	35	35
core	1	4	4
retouched blank	1	1	–
indeterminable fragment	2	14	9
Total worked material	***5***	***54***	***48***
natural fragment	12	7	8
heat detachment	–	1	2
pebble	1	–	–
Total unworked material	***13***	***8***	***10***
Total	**18**	**62**	**58**

Flakes are small sized with a length/width ratio around 1:1. Only a product differs from this trend, that is a flake of chert that could be considered a blade from a morphological point of view, having a length more than the double of the width. However, it is not the product of a laminar debitage; it seems to be an occasional product, an elongated edge core flake extracted to re-configure the surface convexity of the core (Fig. 3-B).

There is a prevalence of orthogonal scars on the dorsal face of the flakes, followed by unipolar and centripetal/tangential in equal measure.

The two cores (in chert and indurated siltstone) were exploited through a multifacial multidirectional method, with the exploitation of 2–3 not prepared striking platforms (Fig. 3-A). They were abandoned due to the exhaustion of raw material.

4.1.1.2. Level 4. In the level 4 the number of worked material slightly increases (n = 31) compared to the underlying level. Only two natural fragments of sandstone were recovered (Table 2).

Flakes (n = 21) were obtained through percussion, without any preparation of the core, as confirmed by the exclusive presence of plain and natural butts. The raw material is chert, only in two case indurated siltstone. In the majority of the cases flakes are complete and preserve small portions of natural surfaces; there are a hinged flake, a plunging flake and an initial flake (*éclat d'entame*) of a pebble of chert (Fig. 3-I).

Flakes are small sized and exhibit mainly orthogonal and unipolar scars on the dorsal face, followed by centripetal/tangential and bipolar organization of the scars. However, only a fragment of core was recovered in the set, exhibiting a multifacial multidirectional exploitation.

There is only one retouched blank in the lithic assemblage revised, that is a convex transverse side scraper (Fig. 3-M) obtained by retouching a plunging flake of chert. Retouching is scaled, total, direct, distal, long and semi-abrupt.

4.1.1.3. Level 3. The worked material found in the level 3 amounts to 25 objects, mainly composed of flakes (n = 14) and indeterminable fragments (n = 9). There are one core and one retouched blank (Table 2).

Flakes are in chert and entire in most cases (only three are in indurated siltstone and only three are broken). In three cases they derive from the exploitation of a small pebble of chert, of which preserve the cortex. The butts are mainly plain and natural; only in two cases they are dihedral.

The organisation of the scars on the dorsal face is mainly unipolar and orthogonal, followed by centripetal/tangential. Two plunging flakes were recognized in the set, plausibly related to a centripetal exploitation of the core, a technical expedient to reconfigure the convexities of the core.

There is only one core of chert exploited through an unifacial centripetal method (Fig. 4-A): a peripheral striking platform, partially prepared by few removals, was exploited and finally abandoned because of the exhaustion of raw material.

The only retouched blank present in the revised material is a denticulate, obtained with a direct, scaled, short and semi-abrupt retouching of a flake of chert.

4.1.2. El Abra 3

4.1.2.1. Level 5. The set of the level 5 is extremely scarce and not significant: it is mostly composed of unworked material (n = 13), i.e. natural fragments of sandstone of variable dimensions and a small pebble of chert, without any trace of use; the worked material is reduced to a flake, a retouched blank, a core and two indeterminable fragments (Table 3).

The flake is not diagnostic: it is a small hinged flake of chert with orthogonal scars on the dorsal face. The retouched blank is a small notch obtained with a direct, semi-abrupt and scaled retouching (Fig. 6-F).

The small core was exploited through an unifacial centripetal method from a peripheral natural striking platform of a pebble of chert (Fig. 5-B). The pebble was abandoned due to the exhaustion of the convexities and the last products are small sub-quadrangular hinged flakes that have exhausted their convexities.

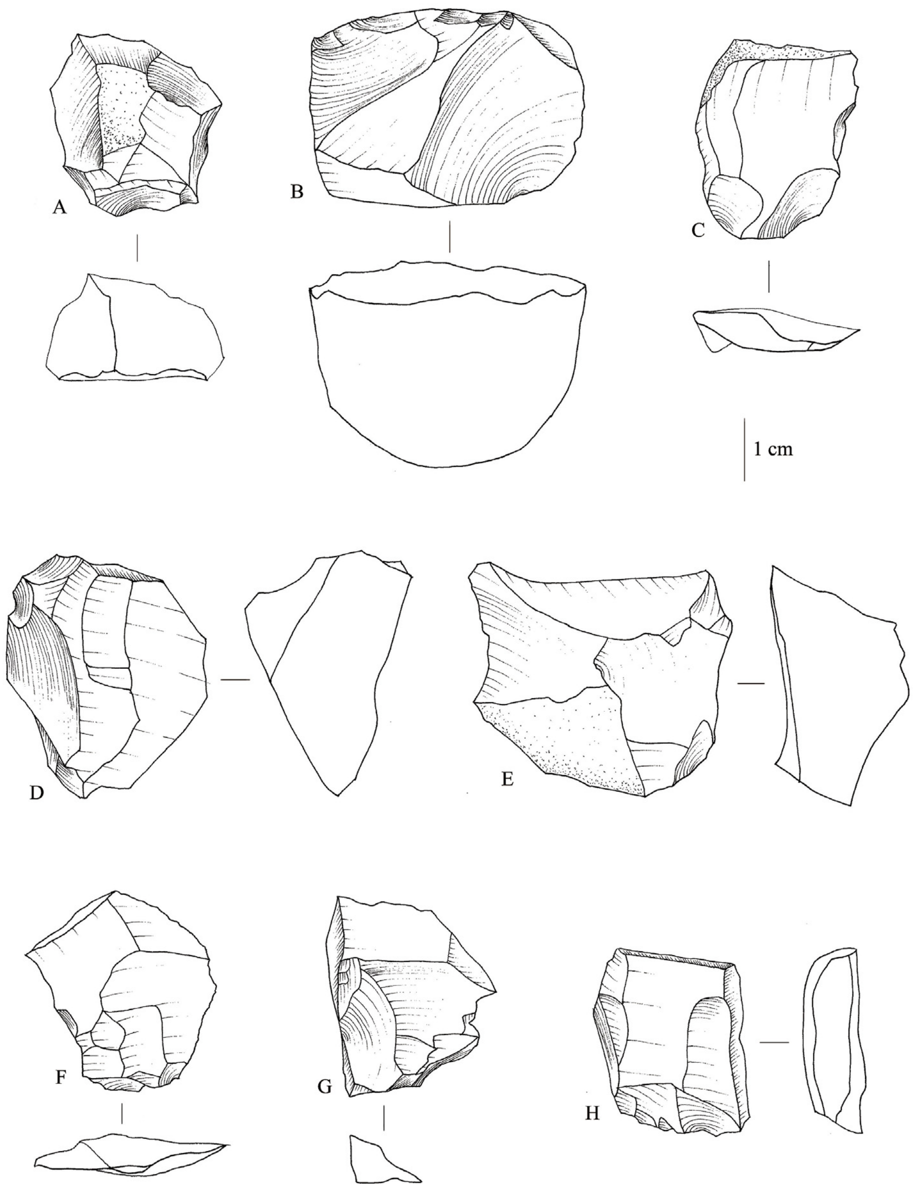

Fig. 5. El Abra 3. A (level 3): centripetal core; B (level 5): unifacial centripetal core on a pebble; C (level 3), H (level 5): flake with orthogonal scars on the dorsal face; D (level 3): laminar core; E-F (level 4): flakes with centripetal/tangential scars on the dorsal face; G (level 4): plunging flake (drawings: B. Muttillo).

4.1.2.2. Level 4. The worked material in the level 4 considerably increases compared to the level 5. It is composed of a fair number of flakes ($n = 35$), 4 cores, one retouched blank and some indeterminable fragments ($n = 14$) (Table 3).

The unworked material consists in few natural fragments of sandstone and a heat detachment.

Flakes are mainly in chert (only three of them are in indurated siltstone) and small sized, with a length/width ratio around 1:1, except for two products that could be considered blades from a morphological point of view (with a length more than the double of the width). Knapping accidents are rare: broken flakes are not very frequent, as well as hinged and plunging flakes.

The exploitation of pebbles (Fig. 6-A) and tabular blocks of chert is attested in several cases, by cortical flakes (three of which are initial flakes) and cores that preserve natural surfaces.

There is a prevalence of plain butts, followed by natural butts and only one dihedral butt. The organisation of the scars on the dorsal face is mainly orthogonal and only to a lesser extent unipolar, centripetal/tangential and bipolar.

Only one flake was modified in order to create a composite tool: notch and endscraper, obtained through a scaled, denticulate and semi-abrupt retouching, direct and inverse.

The primary forms are tabular blocks of chert, exploited through an unipolar unidirectional method, from a single natural striking platform (in a case) or two opposite natural striking platforms (in two cases).

4.1.2.3. Level 3. The composition of the level 3 can be, more or less, assimilated to that of the level 4, both as worked and as unworked material, i.e. few natural fragments of sandstone and two heat detachment.

The number of the flakes and the cores of the level 3 is the same of those of the previous level; as well as the features of the flakes are basically the same of the level 4 (Table 3).

Flakes are small sized, generally in chert (except for three in indurated siltstone) and entire. Knapping accidents are not frequent.

There is a prevalence of orthogonal scars on the dorsal face,

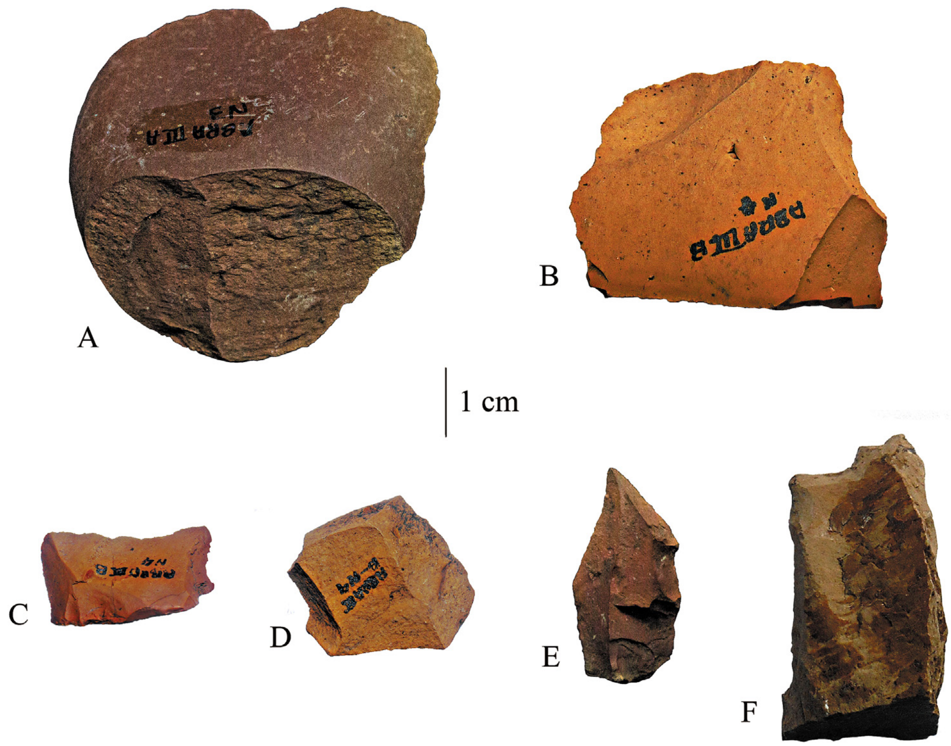

Fig. 6. El Abra 3. A (level 3): cortical flake; B (level 4): retouched flake; C-D (level 4): flakes with orthogonal scars on the dorsal face; E (level 3): flake with unipolar scars on the dorsal face; F (level 5): retouched blank (photo: G. Lembo).

followed by a fair number of flakes with unipolar scars and rare with centripetal/tangential. They have plain and natural butts in most cases, punctiform, lineal and dihedral just in single cases. In the half of the flakes there are traces of cortex of the primary forms of raw material, i.e. pebbles (in five cases) and tabular blocks (in two cases) of chert.

The debitage methods employed are: multifacial multidirectional (3 and 5 not prepared surfaces, orthogonal and adjacent), for the exploitation of two pebbles of chert; centripetal, for the exploitation of a tabular block of chert, from two natural surfaces (2 not prepared opposites peripheral surfaces).

The innovative element with respect to all the analysed levels is the presence of a small laminar core in white chert (Fig. 5-D), devoted to the production of blades and bladelets, probably by percussion, from a prepared striking platform.

5. Discussion

5.1. Lithic interpretation

Despite the limits related to the inaccuracy of the documentation that affected our re-analysis, the revision of the sets has allowed to add more data to our understanding of the industries, in terms of raw material procurement, methods of debitage and strategy of adaption to the initial block.

Here we present a synthesis of the results referred to the two rock shelters.

The lithic industries in all the levels revised are in chert and, only to a lesser extent, in indurated siltstone. The presence of the sandstone in the lithic assemblage is of natural origin, plausibly resulting from the detachment from the wall of the rock shelters (Hurt et al., 1977). Sandstone is unsuitable for knapping and, contrary to what is believed, it has never been flaked, not even occasionally (Muttillo et al., 2017), nor used in El Abra rock shelters (Muttillo et al., 2019).

The number of worked material in the most ancient level (level 5) is extremely low, in both El Abra 2 (n = 19) and El Abra 3 (n = 5), but it slightly increases along the stratigraphic sequence (Tables 2–3).

Flakes are the most abundant products in all the levels, whilst the cores are few and the presence of retouched pieces is occasional.

The *chaine opératoire* is not complete in none of the revised levels: not all the phases of the debitage are attested in the set. Moreover, most of the products refers to an advanced stage of debitage, as confirmed by the scarcity of cortical flakes, the reduced dimensions of the flakes and by the organization of the scars on the dorsal face. However, the fragmentation of the reduction sequence is probably the consequence of the reduced area of excavation and the scarce number of pieces.

Flakes were obtained by percussion, without any preparation of the core, as confirmed by the prevalence of plain butts. Their characteristics depend on the different methods adopted. In general, their dimensions are reduced with a great frequency of the products with a 1:1 length/width ratio, that is compatible with the identified debitage methods and with an advanced stage of debitage.

Different methods of debitage were identified, i.e. unifacial unidirectional, centripetal unifacial, multifacial multidirectional, laminar.

These methods were applied in order to exploit different type of raw material, adapting to the geometry of the initial block of raw material, mainly (sub)spherical pebbles of chert and tabular blocks of chert and siltstone. Platform preparation is generally absent or limited to a few removals. It testifies a great ability to adapt to the raw material, using different models of exploitation, according to the different morphometry of the original blank.

The cores are few and small sized and they were generally exploited until the exhaustion of the raw material.

The best scheme to exploit sub-spherical pebbles seems to have been the follow: detaching an initial flake that removes the 'cap' of the pebble in order to create a suitable platform; then exploiting the rounded surface through a series of centripetal removals from the peripheral natural platform of the blank, or from a striking platform rectified by only a few removals, until convexities are exhausted.

For the exploitation of tabular blocks of chert (or siltstone in rare case) knappers applied a different scheme to adapt to the morphology

Table 4
Main ^{14}C dates from Colombia at the Pleistocene/Holocene transition (modified from Delgado et al., 2015). Here are reported only the oldest dates for each site, except for El Abra 2 ([d]).

N.[a]	Site	Code	^{14}C date	1σ	Tecnique	Setting	Region	References
1	Tibitó	GrN-9375	11,740	110	B–C[b]	Open air	Altiplano Cundiboyacense	Correal (1981)
2	El Abra 2[d]	GrN-5941	11,210	90	B–C	Rockshelter	Altiplano Cundiboyacense	Hurt et al. (1977)
3	Tequendama I	GrN-6270	10,730	105	B–C	Rockshelter	Altiplano Cundiboyacense	Correal and van der Hammen (1977)
4	Nare	Beta-146798	10,400	60	AMS[c]	Open air	Middle Magdalena	López (2008)
5	La Palestina 2	Beta-40855	10,400	90	B–C	Open air	Middle Magdalena	López (2008)
6	San Juan de Bedout	Beta-40852	10,350	90	B–C	Open air	Middle Magdalena	López (2008)
7	PIII0I-52	Beta-205293	10,260	50	AMS	Open air	Central Cordillera	Otero de Santos (2006)
8	El Guatìn	Beta-355213	10,130	50	AMS	Open air	Central Cordillera	Restrepo (2013)
9	El Jazmin	Ua-24497	10,120	70	B–C	Open air	Central Cordillera	Aceituno and Loaiza (2007)
10	Sueva I	GrN-8111	10,090	90	B–C	Rockshelter	Altiplano Cundiboyacense	Correal (1979)
11	La Morena	Beta-245566	10,060	60	B–C	Open air	Central Cordillera	Santos (2010)
12	San Isidro	Beta-65878	10,050	100	B–C	Open air	Central Cordillera	Gnecco (2003)
13	La Palestina 1	n.d.	9820	115	B–C	Open air	Middle Magdalena	López (2008)
14	66PER001	Beta-121972	9730	100	B–C	Open air	Central Cordillera	Cano (2004)
15	Salento 24	Beta-146613	9680	100	B–C	Open air	Central Cordillera	Tabares and Rojas (2000)
16	Sauzalito	Beta-23476	9670	150	B–C	Open air	Western Cordillera	Salgado (1998)
17	La Trinidad Corte I	CEDAD LTL 4267A	9542	50	AMS	Open air	Central Cordillera	Restrepo (2013)
18	La Selva Risaralda	Beta-87188	9490	110	B–C	Open air	Central Cordillera	Rodríguez (2002)
19	Gachala	GrN-8448	9360	45	B–C	Rockshelter	Altiplano Cundiboyacense	Correal (1979)
20	El Abra 2[d]	GrN-5661	9340	40	B–C	Rockshelter	Altiplano Cundiboyacense	Hurt et al. (1977)
21	La Trinidad Corte II	CEDAD LTL 4845A	9333	65	B–C	Open air	Central Cordillera	Restrepo (2013)
22	La Pochola	LTL-4223A	9312	55	B–C	Open air	Central Cordillera	Dickau et al. (2015)
23	Peña Roja	Beta-52964	9250	140	B–C	Open air	Western Cordillera Amazon Basin	Cavelier et al. (1995)
24	Genova	Beta-355217	9230	40	AMS	Open air	Central Cordillera	Restrepo (2013)
25	La Montañita	Beta-355214	9230	50	AMS	Open air	Central Cordillera	Restrepo (2013)

[a] These numbers are reported in Fig. 7.
[b] Beta Counting.
[c] Accelerator Mass Spectrometry.
[d] El Abra 2 is here present with two dates: 11,210 ± 90 and 9340 ± 40. According to our review, we discard the oldest one.

of the raw material: exploitation of one natural surface (not prepared) through a series of unifacial and unidirectional detachments from a peripheral flat natural surface (unifacial unidirectional exploitation or unifacial centripetal); exploitation of two opposites flat natural surfaces (not prepared) through a series of centripetal removals; exploitation of 2–5 plans (orthogonal, opposite or natural, not necessarily adjacent) not prepared with a series of unidirectional removals from each plan (multifacial multidirectional).

Only a laminar core of chert was recovered in the level 3 of El Abra 3, with a clear volumetric conception and a platform prepared for the extraction of blades and bladelets. However, no blades were identified in the same levels. The presence of a laminar core is very important because testifies for a totally different conception of exploitation of raw material, not a surface but a volumetric conception.

Retouched pieces, although very rare (only 4 in the entire S.U. D), are present: a notch in the oldest level (in El Abra 3, level 5), a side-scraper, a denticulate and a composite tool, obtained by a scaled retouching of a flake.

Unfortunately, our reconstructions cannot go much further: the assemblages are extremely poor and fragmented and come from an extremely reduced area of excavation (only a few square meters).

However, despite all the limits, our revision revealed that the presumed *Abriense* class or tradition, that we would prefer to call «industry» or «core and flake industry», it is much more complex than previously assumed.

Moreover, the presumed unchanged tradition which persists from preceramic to ceramic times is discredited by the analysis of the stratigraphic sequence: the only reliable unit is the S. U. D, here revised: the unit C is not convincing and has many problems (Muttillo et al., 2017); the unit E is disturbed (Hurt et al., 1977). Therefore, there are no signals of the persistence of this tradition through time.

Does it still make sense to talk about *Abriense*? It seems to deal with an expedient technology (Nieuwenhuis, 2002) that appears to be relatively common in early multi-purpose technologies throughout South

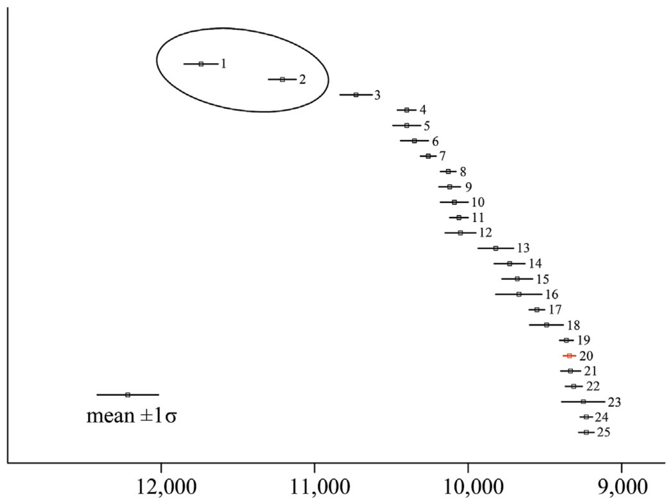

Fig. 7. Range plot with uncalibrated ^{14}C dates from Colombia at the Pleistocene/Holocene transition (modified from Delgado et al., 2015). Here are reported only the oldest dates for each site, except for El Abra 2 (see Table 4). According to our review, the oldest acceptable date for El Abra 2 is 9340 ± 40 BP, here in red and with number 20. We consider questioned evidence the sites circled: Tibitó, for the presence of a single dating, that is not sufficient and reliable (Aceituno et al., 2013; Delgado et al., 2015) and for the almost total absence of worked material in the presumed anthropic levels (Muttillo et al., 2017; Muttillo et al., 2019); the date of 11,210 ± 90 of El Abra 2, for the reasons mentioned in the text. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

America (e.g., Dillehay et al., 2015).

5.2. A more recent chronology

Revising the ^{14}C dataset available, the oldest date acceptable for El Abra 2 should be the one of 11,210 ± 90 (GrN-5941) referred to the unit C (Table 1). However, this date must be discarded because it is associated to the level 8, which has not yielded artefacts (only 8 geofacts, according to our previous revision) (Muttillo et al., 2017). Therefore, the oldest reliable date available for the site is the one of 9340 ± 90 (GrN-5561), calibrated to 10,765–10,253 BP (Table 1).

For El Abra 3 the oldest available dates (8810 ± 430 and 8760 ± 350 BP) are not acceptable due to the exceedingly high sigma values (Delgado et al., 2015).

In conclusion, the most ancient date for El Abra rock shelters is more recent than previously assumed for at least three thousand years.

The new chronology is more in line with the available dataset of radiometric dating at the Pleistocene/Holocene transition in Colombia (Table 4; Fig. 7). In fact, before 11,000 BP, there is a weak and punctuated evidence (Fig. 7).

6. Conclusions

Our re-analysis of El Abra lithic industries conducted so far provided interesting data: a) the almost exclusive absence of artefacts in the oldest levels (Muttillo et al., 2017); b) the absence of use-wear traces on the presumed artefacts of the lower levels (Muttillo et al., 2019); c) a lithic industry not so simple as previously assumed; d) a more recent chronology for the site.

With this revision, El Abra becomes coeval with most of the earliest Colombian sites. Therefore, the diversity of the El Abra lithic industries cannot be due to a greater antiquity, but other factors must be considered (e.g., paleoenvironmental constraints, raw material availability, different populations, etc.).

However, an exhaustive comprehension of the technology of the earliest groups that inhabited the Sabana de Bogotá, is not possible at the present state of the research considering the gaps in the documentation and the problems with the chronostratigraphic context. Therefore, it is of fundamental importance to re-excavate such an important site, in order to collect new reliable and original information and to date it.

Declaration of competing interest

- All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.
- This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.
- The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript
- The following authors have affiliations with organizations with direct or indirect financial interest in the subject matter discussed in the manuscript

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