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Are Bordes' Mousterian facies discrete groups in the Iberian Peninsula?

¿Son las facies musterienses de Bordes grupos discretos en la Península Ibérica?

PALABRAS CLAVES: Tipología, Musteriense, Península Ibérica, facies musterienses.
KEY WORDS: Typology, Mousterian, Iberian Peninsula, Mousterian facies.
GAKO-HITZAK: Tipologia, Mousteriarra, Iberiar penintsula, fazies mousteriarrak.

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RESUMEN

Se evalúa la consistencia estadística de las facies Musterienses identificadas en la Península Ibérica (Charentiense, Musteriense típico y Musteriense de denticulados) como grupos discretos bien delimitados, con el objetivo de contrastar la validez de las mismas a la hora de explicar la variabilidad tipológica Musteriense en este territorio.

ABSTRACT

We evaluate the statistical robustness of the Mousterian facies identified in the Iberian Peninsula (Charentian, Typical and Denticulate Mousterian) as discrete typological groups in order to check their validity for explaining the typological Mousterian variability in this territory.

LABURPENA

Iberiar penintsulan identifikatutako fazies mousteriar multzo diskretuen (Charentiarra, Mousteriar arrunta eta Mousteriar dentikulatua) trinkotasun estatistikoa ebaluatzen da artikuluan. Azterketaren xedea, Penintsulako aldakortasun tipologiko Mousteriarra analizatzean, harri multzo horiek duten baliotasuna egiaztatzea da.

1.- INTRODUCTION

Mousterian typological variability has been one of the major topics in Palaeolithic archaeology for a long time. In the mid-twentieth century, F. Bordes defined six Mousterian assemblages, or facies, using an innovative typological approach that has more or less endured up to the present day (BORDES, 1953). After Bordes' description, the discussion first focused on the interpretation of Mousterian facies (BORDES, 1953; BINFORD & BINFORD, 1966; FREEMAN, 1966, 1969-1970; BORDES & SONNEVILLE-BORDES, 1970; DIBBLE, 1984, 1987, 1991; ROLLAND, 1988; MELLARS, 1988, 1989, 1996), and later, on the real existence of such facies (CALLOW & WEBB, 1981; ROLLAND & DIBBLE, 1990; DIBBLE & ROLLAND, 1992; FREEMAN, 1992, 1994, 2005, 2006, 2009; CABRERA & NEIRA, 1994; MOYER & ROLLAND, 2001).

The recent development of technological studies has placed the typological debate in the background. Nevertheless, due to the lack of a unified technological nomenclature, Bordes' typological classification constitutes, at present, the only method we have for making quantitative comparisons between different assemblages.

In this paper, we evaluate the statistical consistency of the Mousterian facies identified in the Iberian Peninsula as discrete clusters (CALLOW & WEBB, 1981 vs FREEMAN, 1994; MOYER & ROLLAND, 2001), in order to check their validity for explaining the typological Mousterian variability in this territory.

2. METHODOLOGY

The analyzed sample consists of 96 Mousterian assemblages from 27 Iberian sites (Figure 1). All these sites, containing at least 50 tools in essential counts (see below), were studied by different researchers using Bordes' typology (BORDES, 1961). The assemblages were assigned to one of the following Mousterian facies: Charentian (Quina or Ferrassie), Typical Mousterian, Mousterian of Acheulean Tradition (MTA) and Denticulate Mousterian.

Table 1 shows the typological features of the Mousterian facies according to Bordes (BORDES, 1953, 1984; BORDES & SONNEVILLE-BORDES, 1970). This classification is largely built around two indices: the essential side-scraper index and the Denticulate group (or GIV), although

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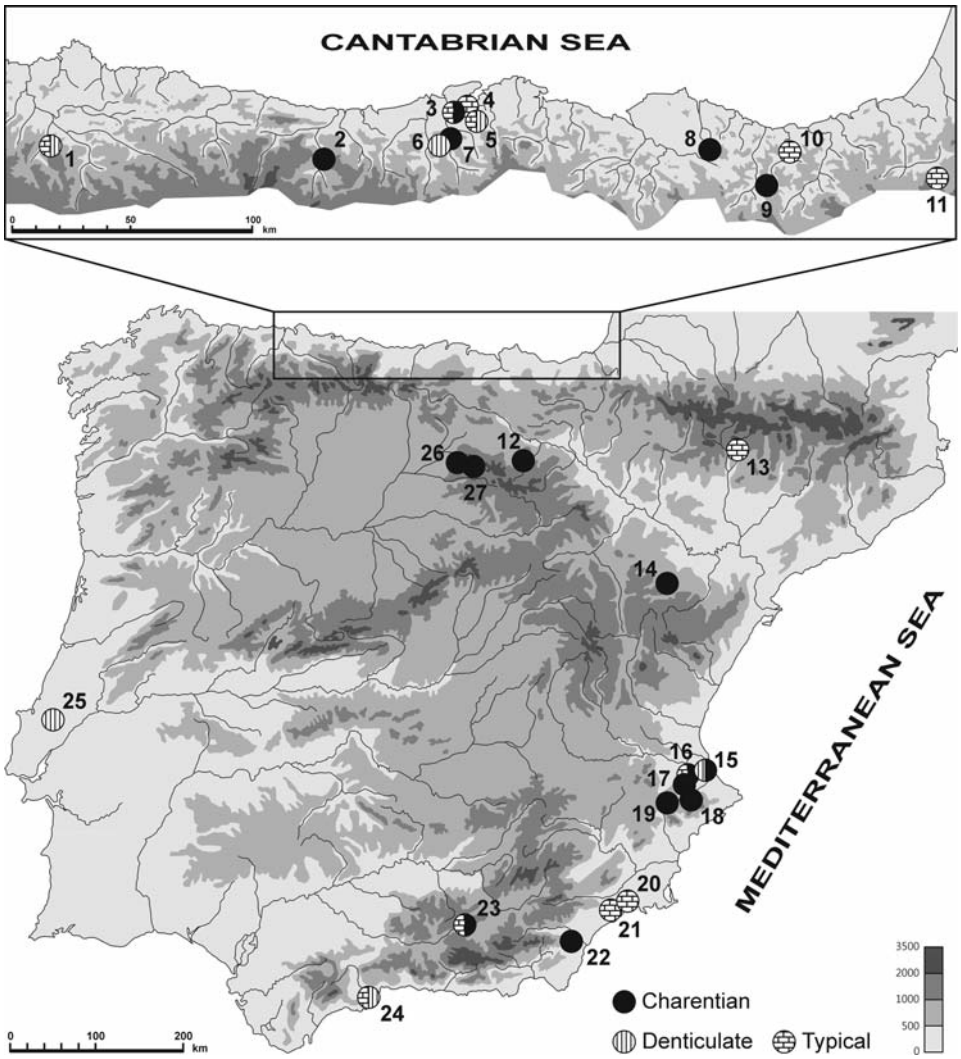

Fig. 1. Map of the Iberian Peninsula illustrating the location of the Mousterian sites discussed in the text. 1. El Conde, 2. Esquilleu, 3. Covalejos, 4. El Pendo, 5. Morín. 6. La Flecha, 7. El Castillo, 8. Axlor, 9. Lezetxiki, 10. Amalda, 11. Mugarduia Norte, 12. Peña Miel, 13. Gabasa, 14. Eudoviges, 15. Bolomor, 16. Cova Negra, 17. Petxina, 18. El Salt, 19. Cochino, 20. Palomarico, 21. Perneras, 22. Zájara I, 23. Carigüela, 24. Bajondillo, 25. Columbeira, 26. La Ermita, 27. Cueva Millán.

the artefact types included in such indices (side-scrapers and denticulates) are unequally treated in the typological list of reference (MONTES & MAZO, 1986). To minimize this inequality, we have used the following typological groups and indices.

Denticulate tools (or simply denticulate). This is the Denticulate group (or GIV) as proposed by Turq (1977). This group includes types 42, 43, 44, 51 and 54, respectively: notches, denticulates, alternate retouched becs, Tayac points and end-notched flakes.

Facies	IL	IRes	IQ	IB	GIII	GIV
MTA						
Subtype A	Variable	20-45	Low	5-40	High	High
Subtype B	Variable	4-20	Low	Low	Variable	>60
Typical	Variable	30-65	Low	Uncommon	Uncommon	High
Denticulate	Variable	4-20	Low	Uncommon	Uncommon	>60
Charentian						
Quina	<16	>50	>12	Uncommon	Uncommon	Low
Ferrassie	>16	>50	6-12	Uncommon	Uncommon	Low

Table 1: Typological features of the Mousterian assemblages, according to F. Bordes (from BORDES, 1953, 1984, BORDES & SONNEVILLE-BORDES, 1970). IL: Levallois Index, IRes: Essential side-scraper Index, IQ: Quina Index, IBi: Hand-axe Index, GIII: Group III (Upper Palaeolithic), GIV: Group IV (Denticulate). Bordes used these techno-typological indices as criteria for delimitating the Mousterian *facies*. Nevertheless, the classification is largely built upon the Essential Side-scraper Index and the Group IV; *there are three main types of cumulative graph for Mousterian assemblages. The first one characterizes assemblages rich in scrapers (more than 50%) and low in denticulates (Quina, Ferrassie and some typical Mousterian reaching the lower limit of this definition)... ... the second is characterized by a moderate percentage of side scrapers and a rather lower percentage of denticulates. It comprises the other part of the Typical Mousterian, and the Mousterian of Acheulian Tradition, sub-type A (with numerous hand-axes)... ...the third one is characterized by the low percentage of side scrapers (from about 4% to 20%) and a strong to very strong percentage of denticulates (up to 60%), always greater than the percentage of scrapers. It comprises the Denticulate Mousterian and the Mousterian of Acheulian Tradition, sub-type B* (BORDES Y SONNEVILLE-BORDES, 1970: 61-62). The other indices (IL, IQ, IB y GIII) play a secondary role in the composition of the assemblages; for instance, the Levallois and Quina indices are only used by Bordes to distinguish the Quina and Ferrassie assemblages, the Hand-axe Index and the Group III to separate the subtypes A and B of MTA (see BORDES 1953: 459).

Mousterian tools (or simply Mousterian). This is the Mousterian group (or GII) as defined by Bordes (1984). Within this group we include Mousterian points (types 6 and 7), limaces (type 8) and side-scrapers (types 9 to 29).

From these groups we have calculated the following typological indices.

Essential Denticulate index or EDI

$$EDI: \frac{\sum types\ (42-44)\ 51,\ 54}{\sum types\ 4, (6-37), (39-44), (51-62)} \times 100$$

Essential typological counts exclude unretouched Levallois artefacts (types 1 to 3), pseudolevallois points (type 5), naturally-backed knives (type 38) and discontinuous retouched flakes (types 45 to 50).

Essential Mousterian index or EMI:

$$EMI: \frac{\sum types\ (6-29)}{\sum types\ 4, (6-37), (39-44), (51-62)} \times 100$$

Mousterian/Denticulate or M/D: Based on the ratio of scrapers to denticulate tools (Dibble & Rolland 1992). This index measures the relationship between the Mousterian and Denticulate groups. A value greater than 1 indicates disparity in favour of Mousterian tools (types 6 to 29), the higher the value the greater is the rate of Mousterian tools; a value equal to 1 means that there are the same number of Mousterian and Denticulate tools. Finally a value lower than 1 indicates dissimilarity in favour of Denticulate tools (types 42 to 44, 51 and 54), the lower the value the greater is the rate of Denticulate tools.

$$M/D: \frac{\sum types\ 6-29}{\sum\ types\ (42-44)\ 51,\ 54}$$

3. RESULTS

As table 2 shows, the Charentian (46 levels, 47.9%, most of them pertaining to the Quina *subfacies*) and the Typical Mousterian (33 levels, 34.4%) are the best represented *facies* in the Iberian Peninsula, followed well behind by the Denticulate *facies* (n = 17, 17.7%). The MTA was identified in 1971 at levels 13/14, 15, 16 and 17 of Morin Cave (Freeman 1971, according to this author it was a MTA, subtype A, *sui generis* where hand-axes are replaced by cleavers). However, in 1978 Freeman changed this classification to Typical Mousterian (Freeman 1978: 313-315). In this paper we follow the last designation.

The Mousterian (types 6-29) and Denticulate tools (types 42-44, 51 and 54) are well represented in all levels. On average these groups account for 85.5% ± 7% of the essential tools registered in all levels, with minimum and maximum values of 65.3% in Morin 17 inf. and 96.4% in Axlor 3 (Figure 2). All Mousterian assemblages, excluding Morin 17 inf. (EDI + EMI: 65.3), Mugarduia 2 (EDI + EMI: 66.7) and Morin 12 (EDI + EMI: 69.2), have an EDI + EMI value greater than 70. This value can be regarded therefore as a *terminus a quo* of the Mousterian, in other words, the threshold from which a stone tool assemblage can be classified as Mousterian.

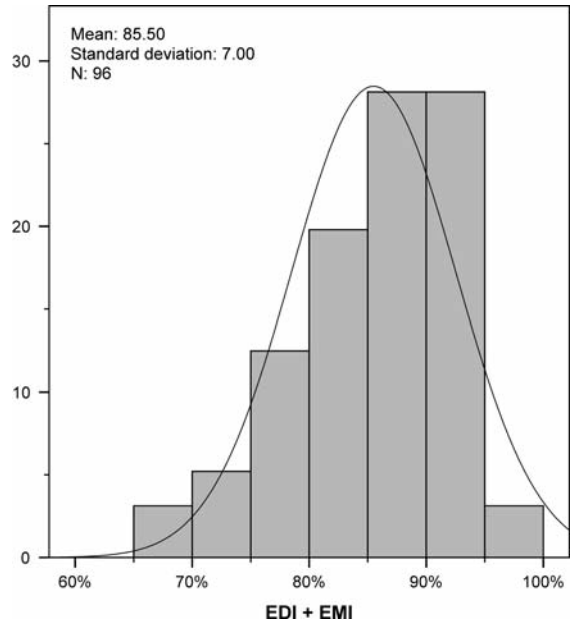

Fig. 2. Frequency distribution of the EDI + EMI indices.

Figure 3 shows the distribution of the EDI and EMI indices in each Mousterian *facies* (mean and standard deviation). The distribution of such indices is reversed (the greater the EMI value the lower is the EDI value) and continuous (without breaking points), from Charentian to Denticulate Mousterian, or *vice versa*, from Denticulate Mousterian to Charentian, with, commonly, only one standard deviation of overlap between successive *facies*.

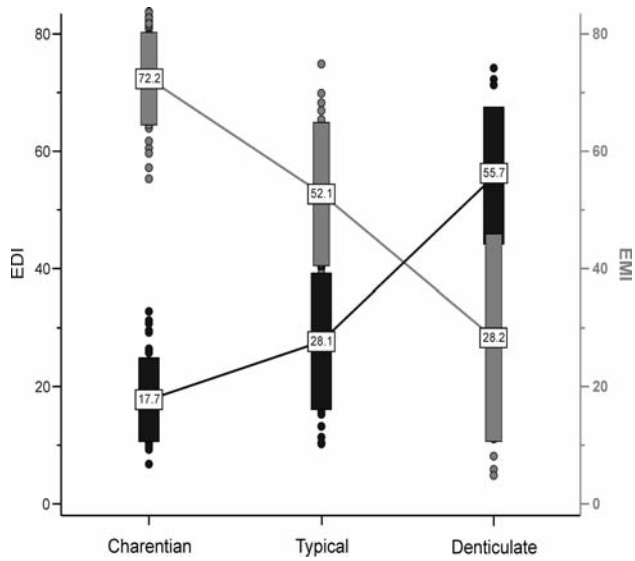

Fig. 3. Mean and standard deviation of the EDI and EMI indices, for Mousterian *facies*.

Site	Level	MF	Tools	Dt	Mt	EDI	EMI	M/D	Ref
Amalda	VII	T	174	61	79	35.06	45.40	1.30	**1**
Axlor	3	Ch	223	28	187	12.56	83.86	6.68	**2**
Axlor	4	Ch	1005	124	803	12.34	79.90	6.48	**2**
Axlor	5	Ch	225	33	178	14.67	79.11	5.39	**2**
Axlor	6	Ch	181	27	147	14.92	81.22	5.44	**2**
Axlor	7	Ch	51	8	37	15.69	72.55	4.63	**2**
Bajondillo	14	D	77	35	20	45.45	25.97	0.57	**3**
Bajondillo	15	T	171	53	84	30.99	49.12	1.58	**3**
Bajondillo	16	T	76	8	57	10.53	75.00	7.13	**3**
Bajondillo	17	T	179	20	119	11.17	66.48	5.95	**3**
Bolomor	Ia	D	421	195	190	46.32	45.13	0.97	**4**
Bolomor	Ib/Ic	D	146	55	71	37.67	48.63	1.29	**4**
Bolomor	II	Ch	239	75	145	31.38	60.67	1.93	**4**
Bolomor	III	Ch	82	27	47	32.93	57.32	1.74	**4**
Bolomor	IV	D	367	180	158	49.05	43.05	0.88	**4**
Bolomor	V	D	85	36	43	42.35	50.59	1.19	**4**
Bolomor	XII	D	57	26	26	45.61	45.61	1.00	**4**
Bolomor	XVII	D	79	31	43	39.24	54.43	1.39	**4**
Carigüela	V-2	T	84	32	40	38.10	47.62	1.25	**5**
Carigüela	V-3	T	148	62	57	41.89	38.51	0.92	**5**
Carigüela	V-4	T	91	14	55	15.38	60.44	3.93	**5**
Carigüela	V-5	T	187	58	105	31.02	56.15	1.81	**5**
Carigüela	V-6	T	107	38	42	35.51	39.25	1.11	**5**
Carigüela	VI-2	T	54	15	30	27.78	55.56	2.00	**5**
Carigüela	VI-3/4	T	90	12	63	13.33	70.00	5.25	**5**
Carigüela	VI-7	T	167	32	95	19.16	56.89	2.97	**5**
Carigüela	VI-8	Ch	161	21	117	13.04	72.67	5.57	**5**
Carigüela	VIIb-1	T	252	40	169	15.87	67.06	4.23	**5**
Carigüela	VIIb-2/3	T	254	51	156	20.08	61.42	3.06	**5**
Carigüela	XI-1	T	69	18	37	26.09	53.62	2.06	**5**
Carigüela	XI12/13	T	65	15	40	23.08	61.54	2.67	**5**
Carigüela	XI-8/10	T	61	15	38	24.59	62.30	2.53	**5**
Cochino	III	Ch	99	11	83	11.11	83.84	7.55	**6**
Columbeira	7	D	235	129	93	54.89	39.57	0.72	**7**
Columbeira	8	D	304	206	80	67.76	26.32	0.39	**7**
Cova Negra	I	Ch	384	39	307	10.16	79.95	7.87	**6**
Cova Negra	II	Ch	87	10	73	11.49	83.91	7.30	**6**
Cova Negra	III	Ch	169	18	129	10.65	76.33	7.17	**6**
Cova Negra	IV	Ch	82	11	62	13.41	75.61	5.64	**6**
Cova Negra	V	Ch	77	19	48	24.68	62.34	2.53	**6**
Cova Negra	VI	Ch	99	24	64	24.24	64.65	2.67	**6**
Cova Negra	VII	Ch	149	28	102	18.79	68.46	3.64	**6**
Cova Negra	VIII	T	122	22	84	18.03	68.85	3.82	**6**
Cova Negra	IX	Ch	81	14	50	17.28	61.73	3.57	**6**
Cova Negra	X	Ch	64	17	41	26.56	64.06	2.41	**6**
Cova Negra	XIII	Ch	54	7	38	12.96	70.37	5.43	**6**
Covalejos	I	T	94	40	39	42.55	41.49	0.98	**8**
Covalejos	J	Ch	133	22	94	16.54	70.68	4.27	**8**
Covalejos	K	Ch	69	7	51	10.14	73.91	7.29	**8**
El Castillo	20	Ch	613	158	386	25.77	62.97	2.44	**9**
El Castillo	22	Ch	681	116	472	17.03	69.31	4.07	**9**
El Castillo	Alfa	Ch	745	230	413	30.87	55.44	1.80	**10**
El Conde	C	D	359	259	22	72.14	6.13	0.08	**11**
El Conde	D	D	141	105	16	74.47	11.35	0.15	**11**
El Conde	E	T	63	20	30	31.75	47.62	1.50	**11**
El Pendo	XII-XI	D	96	63	14	65.63	14.58	0.22	**12**
El Pendo	XVI	D	172	100	46	58.14	26.74	0.46	**12**
El Salt	1	Ch	81	10	65	12.35	80.25	6.50	**13**

Site	Level	MF	Tools	Dt	Mt	EDI	EMI	M/D	Ref
El Salt	2	Ch	73	7	62	9.59	84.93	8.86	**13**
El Salt	3	Ch	208	26	170	12.50	81.73	6.54	**13**
El Salt	4	Ch	95	9	76	9.47	80.00	8.44	**13**
El Salt	5	Ch	115	8	95	6.96	82.61	11.88	**13**
El Salt	6	Ch	92	9	75	9.78	81.52	8.33	**13**
Esquilleu	XI	Ch	105	11	87	10.48	82.86	7.91	**14**
Eudoviges	5	Ch	191	49	127	25.65	66.49	2.59	**15**
Eudoviges	7+6	Ch	134	19	102	14.18	76.12	5.37	**15**
Gabasa	D	T	87	9	57	10.34	65.52	6.33	**16**
Gabasa	E	T	97	21	58	21.65	59.79	2.76	**16**
Gabasa	F	T	49	15	23	30.61	46.94	1.53	**16**
Gabasa	G	T	64	16	38	25.00	59.38	2.38	**16**
La Ermita	5a	Ch	174	29	118	16.67	67.82	4.07	**17**
La Ermita	5b	Ch	118	35	73	29.66	61.86	2.09	**17**
La Flecha	1-3	D	366	262	44	71.58	12.02	0.17	**18**
Lezetxiki	III	Ch	353	65	234	18.41	66.29	3.60	**19**
Lezetxiki	IV	Ch	183	22	138	12.02	75.41	6.27	**19**
Millán	1b	Ch	94	23	64	24.47	68.09	2.78	**17**
Morín	11	D	180	99	29	55.00	16.11	0.29	**20**
Morín	12	D	253	162	13	64.03	5.14	0.08	**20**
Morín	13/14	T	87	48	27	55.17	31.03	0.56	**20**
Morín	15	T	97	34	46	35.05	47.42	1.35	**20**
Morín	16	T	298	113	116	37.92	38.93	1.03	**20**
Morín	17	T	363	172	89	47.38	24.52	0.52	**20**
Morín	17 inf	D	95	54	8	56.84	8.42	0.15	**20**
Mugarduia	2	T	87	29	29	33.33	33.33	1.00	**21**
Palomarico	Inf	T	82	33	30	40.24	36.59	0.91	**5**
Peña Miel	E	Ch	57	13	40	22.81	70.18	3.08	**22**
Peña Miel	G	Ch	376	85	262	22.61	69.68	3.08	**22**
Perneras	α	T	100	30	41	30.00	41.00	1.37	**5**
Perneras	β	T	201	58	117	28.86	58.21	2.02	**5**
Perneras	γ	T	89	17	54	19.10	60.67	3.18	**5**
Petxina	Sup	Ch	92	27	55	29.35	59.78	2.04	**6**
Petxina	2	Ch	85	22	55	25.88	64.71	2.50	**6**
Zájara I	1	Ch	204	54	127	26.47	62.25	2.35	**23**
Zájara I	2	Ch	336	38	269	11.31	80.06	7.08	**23**
Zájara I	3	Ch	109	17	78	15.60	71.56	4.59	**23**
Zájara I	5	Ch	73	13	51	17.81	69.86	3.92	**23**
Total	**-**	**-**	**16743**	**4883**	**9557**	**-**	**-**	**-**	**-**

	Count		EDI		EMI		EDI + EMI	
Facies	n	%	Mean	σ	Mean	σ	Mean	σ
Charentian	46	47.9	17.7	7.2	72.2	8.1	89.9	3.3
Typical	33	34.4	28.1	11.1	52.1	12.3	80.2	4.9
Denticulate	17	17.7	55.7	12.0	28.2	17.4	83.9	9.7
Total	96	100	28.0	16.7	57.5	20.0	85.5	7.0

Table 2: Typological features of the Iberian Mousterian sites. **Mousterian Facies (MF):** CH. Charentian (Quina, Ferrassie and Paracharentian), T. Typical Mousterian, D. Denticulate Mousterian. **Tools:** Essential tool count: 4 + 6-37 + 39-44 + 51-62, **Denticulate tools (Dt):** Types 42 to 44, 51 and 54 of Bordes' Lower and Middle Palaeolithic typology. **Mousterian tools (Mt):** Types 6 to 29 of Bordes' typology. **EDI:** Essential Denticulate index, **EMI:** Essential Mousterian index, **M/D:** Mousterian to Denticulate ratio. **Reference: 1.** Baldeón 1984; **2.** Baldeón 1999; **3.** Cortés 2007; **4.** Fernández Peris 2007; **5.** Vega 1988; **6.** Villaverde 1984; **7.** Raposo y Cardoso 1998; **8.** Martín Blanco *et alii* 2006; **9.** Cabrera 1984; **10.** Benito del Rey 1975; **11.** Freeman 1977; **12.** Freeman 1980; **13.** Barton 1988; **14.** Carrión 2002; **15.** Barandiarán 1975-1976; **16.** Montes 1988; **17.** Moure y García Soto 1983; **18.** Freeman y González Echegaray 1967; **19.** Baldeón 1993; **20.** Freeman 1978; **21.** Barandiarán y Montes 1991-1992; **22.** Utrilla y Montes 1987; **23.** Vega 1980.

This continuity between levels assigned to different facies is better perceived when we ignore the typological facies to which they belong. Figure 4 illustrates the distribution of the Mousterian assemblages according to the EDI and EMI indices. As this figure shows, all levels are distributed in an orderly and continuous way (without abrupt changes or inflections). The relationship between such variables is statistically significant, and explains about 89% of the variability observed in the EDI index (F: 762.704 p-value < 0.000 R^2: 0.890, Table 3). This succession refutes the existence of well-differentiated typological facies (i.e. clustered) as all levels are ordered in a continuous way, and suggests, accor-

	Sum of Squares	df	Mean Square	F value	p-value	R	R^2	Adj. R^2
Regression	23547.095	1	23547.095	762.704	6.81E-47	0.944	0.890	0.889
Residual	2902.077	94	30,873					
Total	26449.171	95						

Table 3: Summary of the linear regression model. Analysis of variance (ANOVA). df: degrees of freedom; R. correlation coefficient; R^2 coefficient of determination; Adj. R^2 Adjusted coefficient of determination.

	Sum of Squares	df	Mean Square	F value	p-value	R	R^2	Adj. R^2
Regression	25157.385	1	25157.385	1830.639	1.98E-63	0.975	0.951	0.951
Residual	1291.786	94	13.742					
Total	26449.171	95						

Table 4: Summary of the logarithmic regression model. Analysis of variance (ANOVA). df: degrees of freedom; R. correlation coefficient; R^2 coefficient of determination; Adj. R^2 Adjusted coefficient of determination.

ding to Moyer & Rolland (2001: 41), that *the assemblage types proposed by Bordes represent grades of a continuously distributed, but internally heterogeneous group.*

But we can improve this relationship by changing the EMI index for the M/D ratio (i.e. the ratio of Mousterian tools to Denticulate). Figure 5 shows the distribution of the Mousterian levels according to such indices. As observed in this scatter plot, all Mousterian levels are well-fitted to the regression curve. Once again, the relationship between the variables is statistically significant, explaining about 95.1% of the variability observed in the EDI index (F: 1830.639 p-value < 0.000 R2: 0.951, Table 4).

The regression model that best explains the data is logarithmic, and its equation is:

$$y = -14.99 \ln(x) + 39.69$$

where x stands for M/D ratio, y represents the EDI value, and ln is the symbol used to express the natural logarithm.

As the relationship between the variables is negative, its meaning is as follows: as the M/D ratio increases the EDI index decreases. Furthermore, the transformation of the assemblages rich in Denticulate tools into assemblages rich in Mousterian tools occurs continuously without abrupt changes at a constant rate expressed by 1.0.

When we include in this model the Mousterian facies to which the assemblages belong, the robustness of the Bordes' facies becomes very weak, suggesting they are an arbitrary division of a continuous process of change (Figure 6). Thus, the distinction between the Charentian and the Typical Mousterian gets blurred and the same thing may be said about the Typical Mousterian compared to the Denticulate facies.

Moreover, if we perform a cluster analysis of the EDI and M/D indices, in order to check the statistical consistency of the Mousterian facies, the resulting groups, which must be interpreted as artificial divisions of a continuous process of change, do not look anything like the assemblages, or facies, we tried to rebuild (Figure 7). According to this test we can distinguish three groups, or clusters, whose inter-group distance is over 5. Cluster I consists of 31 levels assigned to the Charentian (75.6%) and 10 classified as Typical Mousterian (24.4%), cluster II contains 15 Charentian levels (34.1%), 22 Typical (50%) and 7 Denticulate levels (15.9%), and, finally, cluster III includes 10 Denticulate levels (90.9%) and 1 Typical (9.1%).

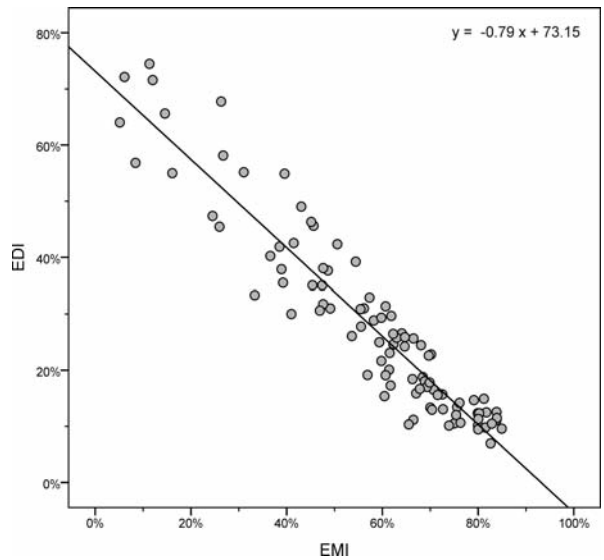

Fig. 4. Distribution of the Mousterian levels according to the EDI and EMI indices.

From these outcomes, the typological variability of the Iberian Mousterian can be reinterpreted as a progressive and continuous transformation of the Denticulate tools into Mousterian tools, rather than a set of discrete typological groups, or facies, as tools vary their shape with resharpening, the so-called Frison effect (Dibble 1987, 1991, 1995; Verjux 1988; Hiscock & Attenbrow 2005). In other words, there is a continuous intergradation of the assemblages rich in Denticulate tools into assemblages rich in Mousterian tools, and/or *vice versa* of the Mousterian tools into Denticulate tools. At present, there is no reason to think the curve is unidirectional.

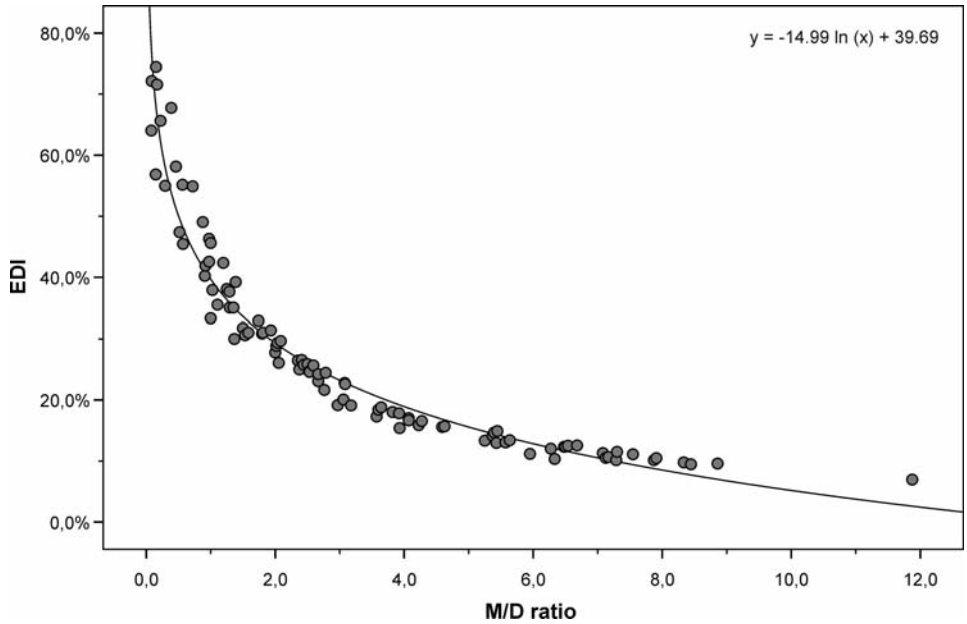

Fig. 5. Distribution of the Mousterian levels according to the EDI and M/D indices.

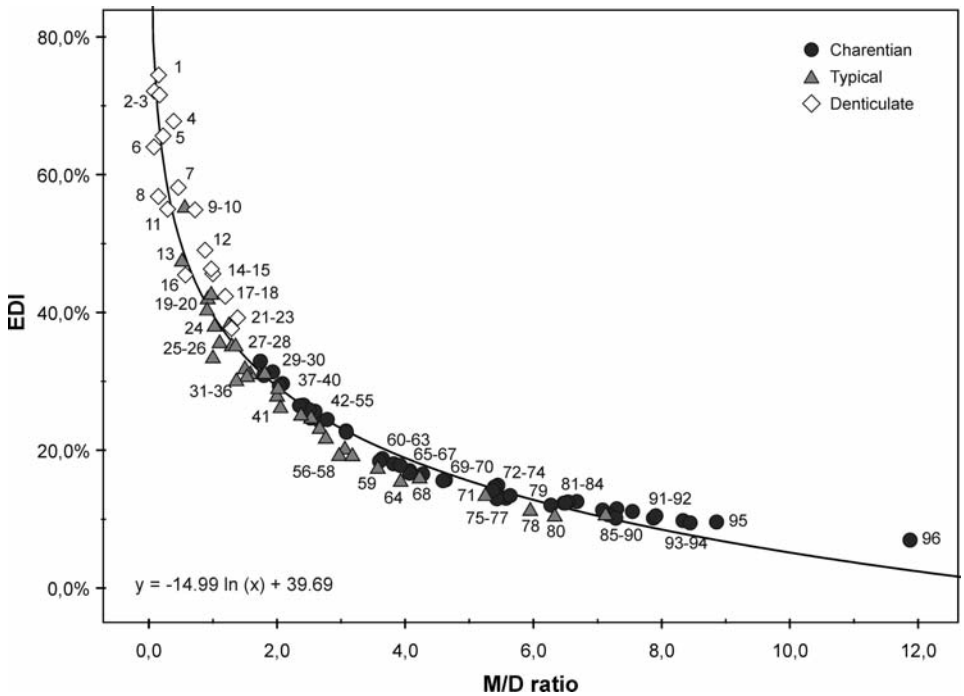

Fig. 6. Distribution of the Mousterian levels according to the EDI and M/D indices, for typological facies.

Sites. 1. El Conde D, **2.** El Conde C, **3.** La Flecha 1-3, **4.** Columbeira 8, **5.** El Pendo XII-XI, **6.** Morín 12, **7.** El Pendo XVI, **8.** Morín 17 inf, **9.**Columbeira 7, **10.** Morín 13/14, **11.** Morín 11, **12.** Bolomor IV, **13.** Morín 17, **14.** Bolomor XII, **15.** Bolomor Ia, **16.** Bajondillo 14, **17.** Covalejos I, **18.** Bolomor V, **19.** Carigüela V-3, **20.** Palomarico inf, **21.** Bolomor XVII, **22.** Bolomor Ib/Ic, **23.** Carigüela V-2, **24.** Morín 16, **25.** Mugarduia 2, **26.** Carigüela V-6, **27.** Amalda VII, **28.** Morín 15, **29.** Bolomor III, **30.** Bolomor II, **31.** Bajondillo 15, **32.** Carigüela V-5, **33.** El Castillo alfa, **34.** El Conde E, **35.** Gabasa f, **36.** Perneras alfa, **37.** La Ermita 5b, **38.** Petxina 2, **39.** Perneras beta, **40.** Carigüela VI-2, **41.** Carigüela XI-1, **42.** Cova Negra X, **43.** El Castillo 20, **44.** Cova Negra IX, **45.** Eudoviges 5, **46.** Petxina sup, **47.** Gabasa g, **48.** Carigüela XI-8/10, **49.** Millán 1b, **50.** Cova Negra V, **51.** Carigüela XI-12/13, **52.** Peña Miel e, **53.** Peña Miel g, **54.** Zájara I 1, **55.** Gabasa e, **56.** Carigüela VIIb-2/3, **57.** Carigüela VI-7, **58.** Perneras gamma, **59.** Cova Negra VIII, **60.** Lezetxiki III, **61.** Cova Negra VI, **62.** Cova Negra VII, , **63.** Zájara I 5, **64.** Carigüela V-4, **65.** El Castillo 22, **66.** La Ermita 5a, **67.** Covalejos J, **68.** Carigüela VIIb-1, **69.** Zájara I 3, **70.** Axlor 7, **71.** Carigüela VI-3/4, **72.** Eudoviges 7+6, **73.** Axlor 5, **74.** Axlor 6, **75.** Cova Negra XIII, **76.** Carigüela VI-8, **77.** Cova Negra IV, **78.** Bajondillo 17, **79.** Lezetxiki 4, **80.** Gabasa d, **81.** Axlor 4, **82.** El Salt 1, **83.** El Salt 3, **84.** Axlor 3, **85.** Zájara I 2, **86.** Bajondillo 16, **87.** Cova Negra III, **88.** Cova Negra II, **89.** Covalejos K, **90.** Cochino III, **91.** Cova Negra I, **92.** Esquilleu XI, **93.** El Salt 6, **94.** El Salt 4, **95.** El Salt 2, **96.** El Salt 5.

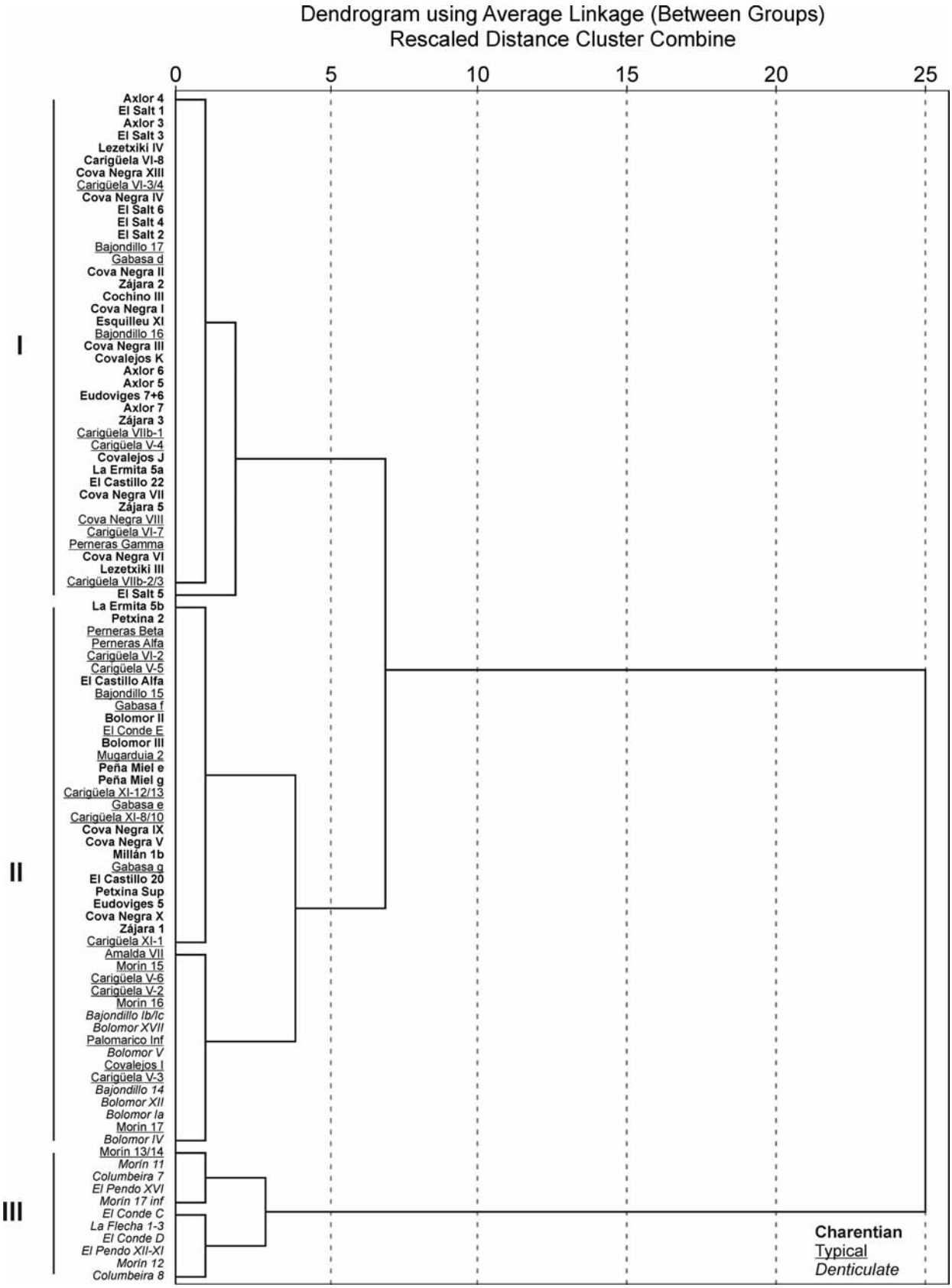

Fig. 7. Hierarchical cluster analysis of the EDI and M/D indices. In bold the Charentian sites, underlined the Typical Mousterian sites, and in italics the Denticulate sites.

All these results refute the existence of Mousterian facies as discrete groups and reinforce the continuity model proposed by some authors in the 1980s and 1990s (Dibble 1984, 1987, 1991; Rolland 1988; Rolland & Dibble 1990; Dibble & Rolland 1992; Freeman 1992, 1994, 2005, 2006, 2009; Cabrera & Neira 1994; Moyer & Rolland 2001).

4. DISCUSSION

According to these results, Bordes' facies are not statistically discrete groups, as all Mousterian sites are continuously distributed in the typological curve (Figure 6). Nevertheless, it is one thing to have proved that the typological distribution of the Mousterian assemblages in the Iberian Peninsula is continuous, and quite another to determine the factors behind this particular distribution, or to establish the causes that might explain the position of individual archaeological levels along such a continuum. These factors must be anthropological in nature: they could be related to the activities performed at the sites, to the longevity of occupation, to the availability of raw materials or, perhaps, to population mobility or environmental responses.

However, evaluating these factors (functional, raw material variability, intensity of occupation, etc.) is, at the moment, a difficult task, due to the lack of specific studies of many Mousterian sites in the Iberian Peninsula: sedimentological and functional analysis, raw material procurement strategies, faunal studies, etc. Furthermore sometimes it is not easy to determine the analytical parameters of the study: when we have to distinguish a temporary occupation from a prolonged one, or a prolonged occupation from a sum of temporary occupations. Moreover, at present, there is no widespread agreement about the best way to classify the unretouched flakes, making it difficult to check some interesting hypotheses such as, for instance, the differential transformation of unretouched flakes into tools (Rolland 1988, Moyer & Rolland 2001).

Although Bordes' typology can be used to explore the Mousterian typological variability, at present, the division of Mousterian into different facies is meaningless and at the current state of research can only lead us to confusion and misunderstanding (Freeman 1994).

5. ACKNOWLEDGEMENTS

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