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# COMMON CONCERNS IN THE ANALYSIS OF LITHIC RAW MATERIAL EXPLOITATION IN THE OLD AND NEW WORLDS

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**Abstract**. Problems with and prospects for the interpretation of lithic raw material exploitation have parallels in the Old and New Worlds. As such, the issues under consideration are less influenced by temporal and geographic considerations than by similarities in prehistoric adaptations and by common interpretive biases of modern scholars. Specific issues that will be examined are the continuing problem of intrasource macroscopic variability, the seemingly timeless challenge of separating evidence of direct procurement from indirect social exchange, and the implications of not fully understanding the range of source diversity on the landscape.

**Resumé**. Les problèmes et les perspectives d'interprétation de l'exploitation des matières premières lithiques sont très similaires dans l'Ancien et le Nouveau Monde. Ainsi, ces questions apparaissent moins influencées par des considérations d'ordre géographique ou chronologique que par les similarités adaptatives des comportements préhistoriques et les biais interprétatifs des chercheurs modernes. Les trois aspects examinés se rapportent au problème de la variabilité macroscopique du silex, aux difficultés sans fin pour distinguer acquisition directe et échange social indirect, aux difficultés d'appréhender totalement la diversité des gîtes de silex dans l'environnement.

## Introduction

It is important to recognize the extent to which problems and issues with the interpretation of lithic raw material exploitation are similar in the both the Old and New Worlds. I would argue that such parallels are influenced less by concerns of time and geography that by realities of prehistoric societies - i.e., similar adjustments to similar challenges - and shared interpretive biases manifested by modern scholars. This observation will be elaborated through the examination of three major issues listed below. The issues will be illustrated by archaeological examples and interpretations from Eastern North America and Europe, but should be broadly applicable to other geographic contexts:
1. The recognition of intrasource variability.
2. The challenge of distinguishing between direct procurement and indirect social exchange.
3. The implications of a poor or less than complete understanding of the range of source diversity across the landscape, with implications for the question of territory.

## Intrasource Macroscopic Variability

Detailed perspectives on lithic source attributions have expanded greatly during the past three decades. These perspectives have benefited in large measure from two specific research trajectories: regional survey and greater reliance on microscopic and geochemical analyses of lithic materials. (This statement does not imply that either approach was unknown prior to the 1970s.) Regional surveys have utilized basic principles of geological categorization and classification to discover a large number of potential sources of lithic raw material and more fundamentally generated an enhanced geographical concept of territory, at least with regards to the specific distribution of a given raw material. The social concept of territory is another matter entirely.

The Dordogne in southwestern France is probably still the most thoroughly surveyed large area in Europe (for example, Rigaud 1982; Larick 1983; Geneste 1985; Turq 1992) but neighboring regions in France and elsewhere in Europe have benefited from expanded and dedicated survey efforts (Kozłowski 1973; Féblot-Augustins *et al.* 2005). New World regional raw material surveys have also progressed both in academic settings (Burke 2002) and in cultural resource management sponsored research (Katz & Bailey 2002). Centralized collections of lithic samples have been created, such as that generated by Rigaud, Conkey, and Demars at the former DAPA in Bordeaux and the ones currently maintained by Biró at the Hungarian National Museum in Budapest or by Fritz (Fritz 2002) at the Carnegie Museum in Pittsburgh. Modern digital formats (Elburg & Van Der Kroft 2004; Féblot-Augustins *et al.* 2005) promote detailed macroscopic visual comparisons of lithic samples.

Microscopic and geochemical analyses have also greatly enhanced our appreciation of the prehistoric past in geographical and social terms. (This topic will be addressed more fully at the end of this article.) Nevertheless, macroscopic examination remains the most common means of attributing raw materials to general source areas and therefore of inferring long distance procurement strategies relating to mobility or exchange. Such evaluations may be informed by micropaleontology and other less subjective means, but macroscopic comparison is and probably will remain for some time the primary means of evaluating the majority of lithic artifacts from archaeological assemblages. This reliance on macroscopic comparisons and the resulting "traditional" attributions may lead to difficulties.

A recent excavation in Pennsylvania in the eastern United States provides a good example. The presence of numerous prehistoric quarries amid the Precambrian to Ordovician formations of the New England Physiographic Province or "Reading Prong" in eastern Pennsylvania were first reported by Mercer (Mercer 1894), were elaborated by Anthony and Roberts (Anthony & Roberts 1988), and examined by Hatch (Hatch 1993). During the spring of 2003 one of these loci - King's Quarry - was threatened with destruction by a residential development and was consequently the focus of extensive rescue surface survey and excavations by the Bureau for Historic Preservation's Commonwealth Archaeology Program. The rescue efforts were directed by Kurt Carr, Doug Mclearen, and Jim Herbstritt (Carr & Mclearen 2004).

The Reading Prong quarries are traditionally famous for yielding one particular type of stone: a cryptocrystalline quartz known as jasper. Prehistoric sites of all time periods in eastern Pennsylvania yield varying quantities of jasper. The early discovery of these quarries and the extensive exploitation of them have resulted in a general tendancy in various parts of eastern North America to consider jasper as having originated in eastern Pennsylvania. Such attributions are on occasion based on geochemical comparisons (Luedtke 1987) while others are based on macroscopic similarities (Adovasio 1993:209). This distinction does not imply that the former are correct or the latter are incorrect, only that the bases for attribution are different.

It is important to remember that sources of jasper exist in other geographic areas of the eastern United States. More importantly for the current evaluation, not all the lithic materials originating at King's Quarry are "jaspers". This observation is in one sense hardly surprising. The geologist for the rescue excavations at King's Quarry, Robert Smith, made a point that is familiar to geologists but often ignored by archaeologists: There is no substantive difference, apart from color, between jasper and other cryptocrystalline quartzes know as cherts. "Jasper" is thus distinguished by yellow, brown, or red colors that may reflect an iron-enhanced geochemical composition (Carr & Mclearen 2004) or, in the case of reddening, heat treatment (Hatch & Miller 1985; Luedtke 1987). A wide range of cherts of other colorations were also mined and exploited at King's Quarry, including translucent "chalcedony" and green, white, gray, and black chert. Whatever else these color distinctions mean, they may relate to different levels of oxidization during environments of deposition, from oxidized red-yellow-green to reduced gray-black.

The archaeological relevance of these observations is that materials traditionally considered jasper, chalcedony, and chert originate at the same geographic location, and varying proportions of certain cherts and "jasper" may have no significance whatsoever in terms of issues such as varying mobility patterns and social exchange. A preference for certain colors such as yellow or red may well have had ideational importance for prehistoric peoples, but that is less an issue of geography than cosmology (Snow 1980; Luedtke 1987). Carr and Mclearen (Carr & Maclearen 2004:13) clearly recognized and acknowledged the importance of studies focusing on quarries and more broadly on lithic source attributions. Considering the range of macroscopic variability present at King's Quarry, they observed that the "black variety could easily be mistaken for cherts of the Ridge and Valley Province and the green could be attributed to the Coxsackie quarries of eastern New York".

Similar potential confusions exist in the Old World. The source area of Pombonne near Bergerac (France) is traditionally a source of gray Maestrichtian chert exclusively (Chadelle 1993, personal communication) but the locus yields a range of colors including red-brown cherts with small circular microfossils (Blades *et al.* 1997:96). Radiolarites from Paleolithic sites in central Europe manifest a wide range of color variation (Kozlowski 1973; Blades 1993) yet it is unclear whether such variation has any substantive geographical significance.

## Direct Procurement and Indirect Social Exchange

Distinguishing between distant lithic materials obtained by direct movement of entire social groups or some subset of a group and the indirect movement of lithics and other materials within social exchange networks remains one of the most difficult issues in archaeology. The distinction is also one of the most important, since it potentially provides an insight on some of the most fundamental organizing principles of forager societies: group mobility, settlement pattern organization, social/ideational intensification, and risk-minimizing strategies.

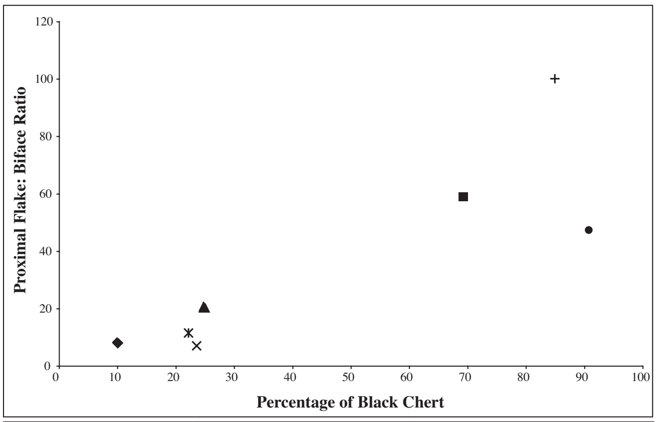
Soffer (Soffer 1985) extended an earlier framework proposed by Renfrew (Renfrew 1977) that argued for patterns of "down-the-line" distributions (material quantities decrease in direct proportion to distance from material source) and "directional" distributions (certain distant materials may be present in greater quantities than those from closer sources). The former distributions were considered consistent with "distance decay" arising from movement and direct procurement, while the latter may reflect selective procurement or indirect social movement of materials. Such patterns are complicated by the reality that different aspects of the archaeological material record may reflect different modes of procurement. Lithic raw materials for flaked tools, for example, may have been obtained directly during the course of group seasonal or annual movements while shells and other "exotic" materials may reflect indirect socially-oriented procurement. Such concepts ultimately bear upon the nature of forager mobility and settlement pattern structure, as Steward (Steward 1968), Binford (Binford 1980), and many subsequent scholars have noted.

A few other examples of attempts to sort out lithic procurement patterns are relevant. Gould (Gouyld 1980) cited data from the Western Desert of Australia, where the presence of "inferior" distant materials in lithic-rich areas was seen as an indication of social exchange. Gamble (Gamble 1986:336) invoked this argument to propose the existence of socially-oriented material exchange in the Late Paleolithic of central Europe, based on the presence in southern Poland of supposedly "inferior" radiolarites attributed to Slovakian sources. Finally, it should be noted that Meltzer (Meltzer 1989) explored the influence of equifinality (different approaches resulting in similar or identical outcomes) on the problem of distinguishing modes of procurement. He argued that direct procurement was most clearly indicated when all lithic materials were derived from the same source, and social exchange may be isolated when different "styles" are present in an archaeological assemblage.

An aspect of the problem and its relationship with the question of macroscopic similarity may be illustrated with another example from eastern North America. Archaeological sites dating to the later prehistoric period were discovered during a 1990s survey of a proposed highway corridor in southwestern Pennsylvania and northern West Virginia. Several larger sites were identified at the western base of Chestnut Ridge on or near streams flowing westward from the ridge into the Cheat and Monongahela rivers. The maximum distance between sites at the ends of the corridor was 15 km, and it is interesting to note that sites at the southern end (103 and 114) and northern end (426) were dominated by black-colored chert. Two sites between the ends (411 and 418) and a component on the T2 terrace at site 426 had more varied lithic components.

Black cherts in southwestern Pennsylvania and West Virginia have traditionally been attributed to well-known sources along the Kanawha River valley in central West Virginia, approximately 100 km south of the corridor sites in question. However, the lithic economy reflected in these site assemblages calls such traditional macroscopic attributions into question. When the ratio of flakes with proximal ends to bifacial points is regressed against the percentage of black cherts in the assemblages (fig. 1), a clear separation is indicated.

The assemblages with varied cherts (i.e., those with lower black chert percentages) have comparatively larger numbers of bifaces (from 11 to 54) and consequently lower flake ratios. Those assemblages that are dominated by black chert have fewer bifaces (less than five) and higher flake ratios. (It should be noted that the flake:biface ratio for site 114 was actually 319:1, which is much higher than that presented for graphic resolution in fig. 1). Another factor should be considered: Assemblages with varied cherts and higher quantities of bifaces are associated with sites containing storage pits and hearths. These data suggest the existence of logistically-oriented multipurpose camps probably related to seasonal exploitation of mast (tree nuts) and hunting of animal resources on or near the western slope of Chestnut Ridge. The assemblages dominated by black chert appear to be secondary lithic reduction stations, possibly within the same logistically-oriented settlement system or systems.




| site | flake:biface | pct. black chert |
|---|---|---|
| 426T2 | 8,1 | 10 |
| 426T3 | 59 | 69,2 |
| 411 | 20,5 | 24,8 |
| 418Wd | 6,9 | 23,6 |
| 418low | 11,4 | 22,2 |
| 103 | 47,4 | 90,7 |
| 114 | 100 | 85 |

***Figure 1.*** A comparison of proximal flake-to-biface ratios and percentages of locally-available? black chert from seven later prehistoric archaeological assemblages in southwestern Pennsylvania and northern West Virginia. The association between higher flake ratios and greater amounts of black chert suggests that three loci are secondary reduction areas. The four loci with low flake ratios and more varied raw materials are interpreted as base camp locations on the basis of lithic and site component data.

If the site components dominated by black cherts are in fact secondary reduction loci, it is reasonable to question whether those cherts were derived from the Kanawha River valley over 100 km to the south or, as seems more likely, were obtained more locally. Limited survey in the area with colleagues Kurt Carr and William Johnson revealed cobbles of coarse-grained black chert in secondary stream deposits near sites 103 and 114 at the southern end of the corridor. More extensive survey by Brian Fritz has revealed at least one source of black chert in a neighboring Pennsylvania county. Neutron activation analysis to compare artifacts from the assemblages with samples from Kanawha and local sources is pending, but the presence of such local materials supports the suggestion of more local acquisition initially indicated by factors of lithic economy.

The basic assumption, not to say bias, reflected in this statement is that lithic assemblages that are dominated by distant cherts, which is of course a geographically-variable concept, are relatively rare occurances, particularly if one considers the entire assemblage and not simply the tools or points. This statement does not ignore the evidence of sites where distant materials do appear to dominate the assemblages. Such sites are associated with various time periods and geographic locations: late Aurignacian loci at Tvarozná (Blades 1993) and Pavlovian occupations at Dolní Věstonice (Svoboda 1991) in the Czech Republic, Magdalenian at Enlène in the French Pyrénées (Lacombe 1998), and various Paleoindian loci in North America (Meltzer 1989) including Shoop in

Pennsylvania (Carr 1989, but see Moeller 1989) represent just some of these sites. These loci revealed that something very interesting was happening in terms of social organization, settlement pattern structure, mobility pattern, etc.

However, the majority of lithic materials in archaeological assemblages from most time periods and in most geographic settings were obtained from locally-available sources. Such localized procurement is reflected in the lithic economy by more waste flakes, larger flakes, greater numbers of cores, and/or reduced proportions of retouched tools. Materials derived from distant sources are in general reflected in smaller percentages of unretouched flakes, few or no cores, and higher ratios of retouched to unretouched pieces that would be consistent with a "down-the-line" distribution (see Geneste 1985 and Turq 1992 for thoroughly-documented Middle Paleolithic examples of this pattern). The intensive utilization of the scrapers and other tools at Shoop (Carr 1989) would certainly be consistent with such utilization patterns, as is the small size of cores at Dolní Věstonice (Svoboda 1991). The relatively large quantity of waste flakes to tools indicated to Tomásková (1991) that the Pavlovian inhabitants were not compelled to economize in the use of their apparently distantly-derived material, which is an interesting aspect of this spectacular collection of site loci.

Apparent conflicts between lithic economic measures and "traditional" raw material factors should be considered important notes of caution. When measures of lithic economy are consistent with those expected for the utilization of locally-obtained materials, the materials were in fact most likely acquired from local sources. Such reasoning is of course somewhat circular and self-fulfilling, but some of the danger may be lessened if we remain open to the possibility of distant material dominance, particularly if attributions to distant sources are reinforced by microscopic or geochemical comparisons.

## Source Diversity, Territory, and Geochemical Characterization

When considering the issue of territory, it is useful to envision simultaneous functional concepts that may have very different geographic scales. The territory of "subsistence" is the area within which a hunter-gatherer group obtains the faunal and floral resources to fulfill its immediate or short term need for caloric intake. The size is highly variable, as is the frequency of movement within or between such territories and the overall structure that conditions mobility, such as residential or logistical. However, the area in general would be rather small in geographic scope, and lithic resources procured during such subsistence activities would thus originate fairly close to any residential camp or logistical base. These lithic resources are those encountered during intensive geological surveys of the landscape surrounding archaeological sites.

The territory of "seasonal/annual mobility" is also related to subsistence needs, but may be expected to encompass broader and (for prehistoric groups) roughly predictable geographic areas to exploit shifting resource concentrations in seasonal environments. (Hunter-gatherer groups in aseasonal environments with homogeneous resource distributions have more restricted annual mobility territories.) When lithics or other materials are attributed to geographical locations at a "distance" from the camp or base, the presence of such materials at an archaeological locus may both reflect and assist in the definition of the seasonal/annual territory. A "down-the-line" distribution is most consistent with the movement of materials within the territory of mobility. Other explanations of course exist, such as stochastic or random movements for small amounts of materials and perhaps direct procurement for larger proportional amounts.

The territory of "material/social exchange" may not be relevant to a particular geographical location or cultural group, or may be isomorphic with those of mobility and even subsistence. The demonstration of "directional" distributions during the Late Paleolithic in Europe (see, for example, Féblot-Augustins 1997a, 1997b; Lacombe 1998) may provide examples of such exchange, but were possible outcomes of long distance group movements on seasonal, annual, or longer time scales.

The movement of marine shells over hundreds of kilometers from the Atlantic and Mediterranean coasts into southwestern France has been documented (Taborin 1993). Such movement is reinforced by the identification of a source in Charente called "micro-brêche" chert by André Morala that appears in Aurignacian archaeological assemblages in the Périgord. This material may be same as that called "Grain de mil" chert (Lacombe 1998) that appears in sites in the Pyrénées. The movement of varied materials from assorted directions and distances on the Russian Plain during the Late Paleolithic (Soffer 1985) provides an example of the extent to which different modes of acquisition arising from mobility/direct procurement or socially-oriented exchange may co-exist and be reflected in different aspects of the material record.

The preceding sections support the prevailing wisdom that macroscopic indentifications are unreliable bases for attributing lithic materials to specific source locations.The question inevitably becomes what alternative approaches may be used to more reliably determine source attributions leading to a greater understanding of prehistoric territories. More objective means of attribution are relevant to the definition of all territory scales, but particularly more extensive ones associated with mobility and social exchange.

Microscopic thin-section analyses have proven to be effective and relatively economic, particularly in conjunction with macroscopic or microscopic investigations of foraminifers, Radiolaria, sponges, and other microfaunal species (Geneste 1985; Lacombe 1998). Geochemical approaches have ranged from x-ray fluorescence (Burke 2002, Hatch 1993) through instrumental neutron activation analysis (Luedtke 1978, 1979, 1980, 1987; Luedtke & Meyers 1984; Hoard *et al.* 1992, 1993; Blades *et al.* 1997; Glascock 2000).

X-ray fluorescence (XRF) analysis is a rapid and non-destructive means of analyzing larger obsidian artifacts, while instrumental neutron activiation analysis (INAA) is considered superior for smaller obsidian artifacts, basalts, and ceramics (Glascock 2003) and has been employed in the characterization of cherts with mixed results. The use of inductively coupled plasma-mass spectrometry with laser ablation (LA-ICP-MS) has not proven successful in distinguishing obsidian in areas with numerous chemically similar sources (Glascock 2003). Bressy and Floss (Bressy & Floss 2004) have undertaken trace element analysis of central European cherts using LA-ICP-MS and Lacombe (Lacombe 2004) used this methodology to examine chert sources in the Pyrénées. Elekes *et al.* (Elekes *et al.* 2000) undertook proton-induced gamma-ray emission (PIGE) and x-ray emission (PIXE) analyses to compare radiolarite archaeological and source samples from central Europe and Greece.

The characterization of cherts has remained a challenge. No technique has emerged that both addresses the great degree of intrasource variation within a source or source area and is sufficiently economical to merit widespread application. During a broader study of Aurignacian lithic economy, INAA of Maestrichtian cherts from secondary deposits in the vicinity of Bergerac in the Dordogne Valley of southwestern France was undertaken (Blades *et al.* 1997). Nine source areas were examined (six near Bergerac, one in the Couze Valley to the southeast, two near the Isle Valley to the northwest) from which 102 source specimens were recovered. These samples were analyzed for the presence of 31 elements (tabl. 1).

Absolute concentrations of these elements indicated that the sources were geochemically very similar and further reflected a considerable amount of intrasource variation often found in cherts. Low-frequency elements (Sr, Zn, Zr, Ca, and K) were excluded, and log base 10 values for the remaining 26 elements were employed in a principal components analysis to identify those combinations that contributed most to variability in the data set. The analysis did not suggest any reasonable means of determining subgroups, suggesting the Bergerac sample should be characterized as a single source of highly variable compostion.

INAA data from 30 Aurignacian flakes were compared with the source samples. A 90 percent confidence ellipse for the source group (o) is shown in Figure 2, with the archaeological flakes (+) also indicated. Two artifacts from the site of Hui (nos. 24 and 25) and one from le Piage Level J (no. 12), approximately 70 km east of Bergerac, fell outside of the confidence ellipse on the PC1/PC2 comparison, but so did a small number of source samples. An artifact from le

| Element | Mean | Stand. Dev. | Observations (N) | Minimum | Maximum |
|---|---|---|---|---|---|
| As | 4.783 | 6.185 | 98 | 0.320 | 52.005 |
| Ba | 103.765 | 163.664 | 59 | 6.890 | 903.960 |
| La | 1.569 | 1.789 | 102 | 0.283 | 15.746 |
| Lu | 0.014 | 0.015 | 98 | 0.003 | 0.123 |
| Nd | 1.861 | 1.802 | 102 | 0.222 | 13.536 |
| Sm | 0.384 | 0.348 | 102 | 0.080 | 2.913 |
| U | 0.626 | 0.995 | 102 | 0.052 | 8.971 |
| Yb | 0.086 | 0.113 | 102 | 0.018 | 0.933 |
| Ce | 3.047 | 3.475 | 102 | 0.418 | 24.198 |
| Co | 3.815 | 26.795 | 102 | 0.028 | 271.146 |
| Cr | 7.746 | 4.901 | 102 | 1.303 | 24.779 |
| Cs | 0.061 | 0.045 | 102 | 0.014 | 0.323 |
| Eu | 0.073 | 0.074 | 102 | 0.014 | 0.649 |
| Fe | 638.755 | 673.163 | 102 | 53.100 | 4550.300 |
| Hf | 0.092 | 0.084 | 102 | 0.025 | 0.619 |
| Rb | 1.090 | 0.728 | 97 | 0.254 | 5.976 |
| Sb | 0.440 | 0.275 | 102 | 0.060 | 1.546 |
| Sc | 0.968 | 0.674 | 102 | 0.076 | 3.080 |
| Sr | 14.809 | 39.243 | 21 | 2.190 | 185.440 |
| Ta | 0.013 | 0.013 | 91 | 0.003 | 0.095 |
| Tb | 0.040 | 0.031 | 84 | 0.003 | 0.185 |
| Th | 0.663 | 0.386 | 102 | 0.052 | 2.819 |
| Zn | 2.694 | 1.967 | 60 | 0.540 | 8.080 |
| Zr | • | • | 1 | +INF | -INF |
| Al | 1817.682 | 363.746 | 102 | 1109.600 | 3007.600 |
| Ca | 2 7291.820 | 58177.225 | 5 | 249.800 | 131346.100 |
| Dy | 0.229 | 0.225 | 86 | 0.056 | 1.472 |
| K | 328.852 | 195.257 | 21 | 152.200 | 1014.900 |
| Mn | 2.076 | 4.219 | 102 | 0.203 | 35.400 |
| Na | 158.745 | 55.508 | 102 | 91.630 | 399.870 |
| V | 4.666 | 2.912 | 55 | 0.940 | 20.160 |

***Table 1.*** Descriptive Statistics for Bergerac Source Samples (PPM).

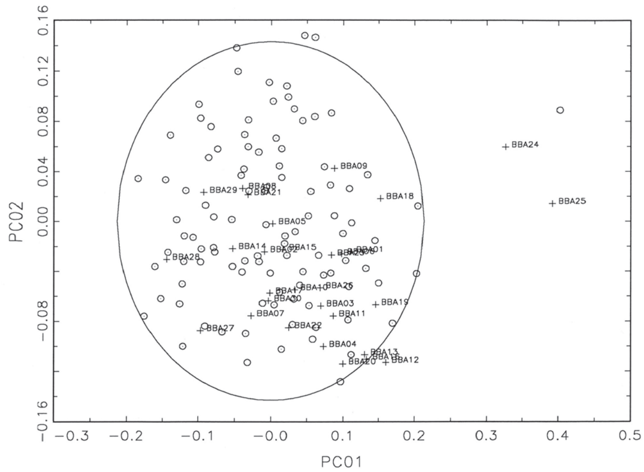



***Figure 2.*** The NAA 90 percent confidence ellipse for the Bergerac source group (o) with the Aurignacian archaeological flakes (+) also shown. Two artifacts from Hui (nos. 24 and 25) and one from le Piage Level J (no. 12) fell outside of the PC1/PC2 confidence ellipse, as did a few source samples from the Bergerac area.

Piage Level F (no. 1) had a sufficiently low probability of association to be excluded as Bergeracois, but five more from Level F and three others from Level J had higher probability percentages that suggested geological origins near Bergerac.

The samples from Hui, approximately 70 km south of Bergerac, provided the greatest contrast. Three artifacts reflected relatively high probabilities (42, 51, and 63 percent) but two had probability percentages of 0.09 and 0.0. The latter two flakes may be eliminated from the Bergerac source group. It therefore seems likely that the Aurignacian occupants of Hui and probably of le Piage encountered and exploited Maestrichtian deposits at locations beyond the Bergerac area. On a more sobering note, five Aurignacian artifacts from la Ferrassie and le Facteur that were initially considered not be from Bergerac were analyzed. All had low probability percentages, but only two could be excluded from the diverse Bergerac source group.

Apart from demonstrating the considerable range of geochemical variability present in Bergerac cherts, these INAA data suggest other materials that resemble Bergeracois are present in archaeological assemblages in southern France. Lacombe (Lacombe 2004) confronted this issue in the Pyrénées where Montsaunès Maestrichtian chert originates. Lacombe used fluorescence microscopy to separate U-rich Bergeracois from Mg-rich Montsaunès chert. (The INAA data presented in table 1 indicate a consistent presence of U in the Bergerac source group.) A greater lithic resource diversity on the prehistoric landscape is therefore indicated, with implications for modern concepts of territory and movement of materials within territories (Morala 1989; Féblot-Augustins 1997a, 1997b; Lacombe 1998).

## Conclusion

None of the issues discussed herein are new ones, but they continue to bedevil attempts to comprehend the prehistoric past through analysis of the lithic material record. A reliance on broad-based analyses that incorporate paleoenvironmental and faunal data in addition to those from lithic economy and technology should be embedded within more general archaeological and anthropological theory on hunter-gatherer behavior. Technological practices and boundaries, whether reflected in lithic or organic materials or symbolic manifestations, may prove effective in defining territories on a macroscale. Since lithic materials have the potential to be associated with a specific geological source or source area on the landscape, assemblages of stone artifacts will always be examined for insight into fundamental hunter-gatherer needs of subsistence, mobility, and social interaction as reflected in material procurement and exchange. Therein lie the problems with and prospects for lithic raw material interpretation.

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