Stone artefact production and exchange among the Northern lesser Antilles

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5 Stone acquisition and working at habitation sites

5.1 Geology and occurrence of rock materials

In this section, particular attention is paid to raw material occurrences on the various islands within the northern Lesser Antilles in a more general sense, to complement the description and characterisation of the three rock varieties in Chapter 2. It should be read as an introduction to the following sections, in which I present a diachronic picture of stone procurement and use at different habitation sites.

From a geological point of view the Caribbean can be basically divided into the Greater and Lesser Antilles (see figure 2.3) (Draper *et al.* 1994). The Greater Antilles possesses a relatively longer geological history during which volcanism, marine sedimentation, and metamorphism all have played a significant role. The Lesser Antilles are generally much younger. Among this group of small islands, the rock material provenances can be meaningfully distinguished between the islands of the younger inner volcanic arc and older outer volcanic arc (see figure 2.4). This division groups the predominantly volcanic islands on the inner arc together on the one hand, including the following islands relevant to this study: Saba, St. Eustatius, St. Kitts, Nevis, Montserrat, Basse Terre (Guadeloupe), Les Saintes, Dominica, and Martinique.[1] The more complex outer arc islands include Anguilla, St. Martin, St. Barths, Barbuda, Antigua, Grande Terre, and Marie Galante. La Désirade belongs to neither of the arcs. This latter island is much older in age and its formation is not related to the Lesser Antilles arc volcanism.

Tables 5.1a and b list rock material occurrences for each island. It is clear that among the inner arc islands less variation exists among rock types. These islands are predominantly volcanic in nature, in which igneous rock types fall within the calc-alkaline group. The major occurring rock variety is porphyritic andesite, in addition to minor amounts of basalts, basaltic andesite, dacite, and rhyolite (Rea & Baker 1980; Smith *et al*. 1980). Based on differences in the occurrences of the latter rock types, three groups of islands can be distinguished. One group comprises Saba, St. Eustatius, and Nevis, which almost lack basalt rocks. St. Kitts and Montserrat form the second group, with significant basalt occurrences, related to the Mt. Misery and South Soufriere eruption centres. The third group includes Basse Terre, Dominica, and Martinique, which possess higher proportions of more acidic rock types, such as rhyolites and dacites (Rea & Baker 1980).

Apart from these igneous rock types, on most islands rare limestone deposits are found, varying in size. The Brimstone Hill Formation on St. Kitts and the White Wall Formation on St. Eustatius, as well as Miocene limestone depositions on Martinique are the best-known and most extensive examples of such non-volcanic occurrences of limestone. Most of the other inner arc islands display at least minor limestone deposits as well.

An additional feature of concern to the present study relates to the longer geological history of Martinique relative to its northern volcanic neighbours. As a result of several episodes of volcanic activity, the oldest igneous rock series on Martinique have been exposed to hydrothermal alteration during later phases, changing original rock composition in these areas. This hydrothermal alteration has produced jasper, chalcedony, and other quartz crystal varieties inter-veined or included within the original igneous rock (Bérard & Vernet 1997; Westercamp & Tazieff 1980). Other local quartz or micro-quartz crystal varieties occurring as isolated inclusions are known on Dominica as well (Honeychurch 1995, personal communication 2000). Additional occurrences of such materials may not be excluded, given the often isolated occurrence of these crystal varieties and crystals in general, combined with sometimes limited geological work done on the islands.

The outer arc islands and La Désirade exhibit more variability in rock types, not only on an inter-island but also on an intra-island level. The outer arc islands can broadly be divided into the limestone Antilles, and the composite islands. The former group includes islands that are almost exclusively built-up by a series of limestone deposits. These include Anguilla, Barbuda, Grande Terre, and Marie Galante. The composite group of islands possess more complex geological regions, which can be either volcanic or marine in origin. This group includes St. Martin, St. Barths, Antigua, and La Désirade.[2]

Comparing the limestone Antilles shows that most of them are not totally built up by limestone, but also have isolated outcrops of underlying igneous rock, volcanic debris or tuffs, as is the case for Anguilla, Marie-Galante, and Grande Terre. Furthermore the limestone formations on the different islands vary in nature and age, and must be related to deposition

[1] Only islands the area from Puerto Rico to Martinique are discussed.

[2] Usually, the whole group of outer arc islands are referred to as limestone Antilles, given the presence of extensive limestone formations on all of them. However, I reserve this term for the islands almost exclusively consisting of limestone formations.

	Island	Igneous and intrusive rocks	Carbonaceous sedimentary rocks	Other sedimentary rocks	Metamorphic rocks	Other	References
Greater Antilles	Puerto Rico	basalt andesite porphyry dacite basalt porphery basaltic andesite quartz diorite granodiorite grabbo serpetinite	different types of limestone	bedded chert mudstone sandstone tuff conglomerate breccia	amphibolite	quartz serpentine	Volckmann 1984 [a, b, c]
	Vieques [a]	igneous rock andesitic tuff (quartz) diorite	different types of limestone	-	-	quartz	Meijerhoff 1926
	St. Thomas	keratophyres spilite porphyry volcanic wacke tuff diorite	siliceous limestone	radiolarian tuff and chert breccia andesite breccia	albite-epidote hornfels hornblende hornfels marble	jasper	Alminas *et al.* 1994, Donnelly 1966
	St. John	keratophyre spilite volcanic wacke andesite breccia tuff breccia pegmatite diorite	siliceous limestone limestone	radiolarian tuff and chert	calcic bytownite-hornblende albite-epidote hornfels hornblende hornfels	turquoise barite alunite jarosite quartz	Alminas *et al.* 1994, Donnelly 1966
	Tortola	basaltic anglomerrate andesitic- anglomerate (porphyritic) basalt volcanic breccia chert-like basalt bedded tuff diorite tonalites (grabbo to diorite) dolerite (diabase)	coarse recrystallized limestone	ashy mudstone porcellanitic rock chert	marble	felsite* quartz veins	Martin-Kaye 1959, Earle 1924
	Virgin Gorda	diorite (tonalite) pegmatite	siliceous limestone	-	amphibolite* (pyritiferous) –quartzite* granulite* slate phyllite amphibolitic and feldspathic flagstone* felsitic rock epidosite hornblendic rock recrystallised limestone schist marble	garnet quartz malachite chalcopyrite copper molybdenite haematite	Martin-Kaye 1959, Earle 1924
	Anegada	-	gray, cream, yellow limestone	-	-	-	Martin-Kaye 1959
	St. Croix	grabbo grabboic diorite basaltic-andesite- porphyry (augite)-hornblende diabase pyroxene porphyry dacite	coral limestone (tuffaceous) limestone marl beach rock	montmorillonitic mudstone bedded chert (tuffaceous) mudstone volcanic sandstone tuffaceous sandstone volcanic conglomerate (including spilite and keratophyre)	pyroxene hornfels hornblende albite-epidote hornfels turbidite*	barite	Alminas *et al.* 1994, Lidiak & Jolly 1998, Whetten 1966

Table 5.1a. Rock material occurrences by island within the Virgin Islands and Puerto Rico. Data have been derived from geological reports. In a few occasions archaeological reports and personal observations provided additional information on rock material occurrences. [a] Literature on the geology of Vieques is incomplete and rarely reports rock type occurrences.

Table 5.1b (opposite page). Rock material occurrences by island within northern Lesser Antilles. Data have been derived from geological reports. In a few occasions archaeological reports and personal observations provided additional information on rock material occurrences.

	Island	Igneous and intrusive rocks	Carbonaceous sedimentary rocks	Other sedimentary rocks	Metamorphic rocks	Other	References
Lesser Antilles outer arc	Anguilla	basalt andesite tuff tuff breccia	different types of limestone	-	-		Christman 1953
	St. Martin	(quartz) basalt andesite (porphyry) quartz diorite granite aplite tuff (cherty, calcareous, crystal, shaly, vitric, lithic)	limestone	chert calcareous chert white, green, and dark green chert-like material recrystallised tuff conglomerate	-	jasper quartz manganese	Christman 1953, Bonneton & Vila 1983
	St. Barths	quartz diorite andesite porphyry quartz diorite porphyry dacite basalt basalt porphyry breccia (calcareous) tuff	limestone calcareous sandstone	silicified tuff	-	malachite limonite	Christman 1953
	Barbuda	-	different types of limestone	-	-	-	Brasier & Marther 1975
	Antigua	quartz diorite felsite dacite porphyry andesite basalt tuff agglomerate	different types of limestone	flint chert tuff	-	carnelian malachite calcite quartz jasper barite silicified wood	Martin-Kaye 1959, Mascle & Westercamp 1983, Murphy *et al.* 2000, Weiss 1994; Christman 1972
	Grande Terre (Guadeloupe)	tuff volcanic debris	coral limestone calcarenite beach rock	calcareous tuff conglomerate		calcite	Lasserre 1975
	Marie Galante	tuff	coral limestone	-	-	-	Andreieff *et al.* 1983
Lesser Antilles inner arc	Saba	andesite agglomerate tuff	-	-	-	-	Westermann & Kiel 1963
	St. Eustatius	andesite pumice rhyolite diorite	different types of limestone	-	-	-	Rea & Baker 1980 Westermann & Kiel 1963
	St. Kitts	basalt basaltic andesite andesite rhyolite	different types of limestone	-	-	-	Rea & Baker 1980
	Nevis	basaltic andesite andesite andesitic tuff	-	-	-	copper	Martin-Kaye 1958a, 1969
	Montserrat	basalt basaltic andesite andesite andesitic pumice	calcerous tuff	-	-	-	Rea 1974
	Basse Terre (Guadeloupe)	basalt basaltic andesite andesite dacite pumice	-	-	-	-	Lasserre 1975
	Les Saintes	andesite	-	-	-	-	Lasserre 1975
	Dominica	andesite andesite breccia	limestone				Sigurdsson 1973
	Martinique	basalt tholeiite andesite dacite tuff	coral limestone calcareous tuff	-	-	amethyst jasper chalcedony silicified wood calcite	Westercamp & Tazieff 1980
	La Désirade	basalt rhyolite tronjhemite quartz diorite plagiogranite	limestone	radiolarian chert	meta-basalt metatonalite meta diorite metadacite metarhyolite meta-andesite	copper	Bouysse *et al.* 1983

of carbonate material on locally raised ocean floors or on top of erupted volcanic material.

Inter-island variability is also notable among the composite islands. La Désirade stands by itself in this repect. It is the oldest Lesser Antillean island, with basement rock predating the formation of the outer arc. Its formation is still debated: it either represents an "ophiolitic complex," "an orogenic series," or "a primitive island arc fragment detached from the eastern Greater Antilles" (Montgomery *et al.* 1992). The oldest rock, in the form of radiolarian cherts, dates to the Upper Jurrasic, that is ca. 161.2 – 145.5 million years ago. Other basement rock types include varieties of igneous rock and plutonic rock (quartz diorite) and slightly metamorphosed igneous rock types. Pliocene limestone deposits, similar in age to major limestone formations on neighbouring Grande Terre and Marie-Galante, overlie this basement on la Désirade.

Generally, the oldest rocks on the other composite islands relate to the era of outer arc calc-alkaline volcanic activity, which started during the Eocene, as is evidenced on St. Martin and St. Barths. Antigua, the other composite island, is somewhat younger in age, with Oligocene volcanic and plutonic rock. All three islands to some extent display a similar pattern of formation despite these chronological differences. The oldest rocks relate to periods of increased eruptive activities alternated with periods of marine sedimentation, resulting in predominantly non-carboneous marine bedded depositions (Pointe Blanche Formation on St. Martin, St. Barths Formation on St. Barths, and Central Plain Group on Antigua). After volcanic activity ceased, more extensive carbonate platforms were able to form (Oligocene Antigua Formation on Antigua, Miocene Lowlands Formation on St. Martin). Final formation of present-day outline of the islands resulted from tectonic activity, exposing the submarine rocks, and subsequent erosion.

This more "composite" history of formation resulted in a much wider range of rock materials found on the islands of the outer arc. Plutonic rock in the form of diorite, varieties of calc-alkaline igneous rock, and a whole series of sedimentary rock ranging from (re-crystallised) tuffs, carboneous tuffs, bedded cherts, and different types of limestone occur. In addition, crystal varieties are reported. Notably, the island of Antigua seems to be relatively rich in this regard. Petrified wood, quartz, chalcedony, jasper, flint, barite, malachite, and possibly carnelian are reported to occur. On St. Martin, the presence of jasper and on St. Barths the occurrence of malachite need mention as well.[3]

In relation to the rare regional occurrence of flint (see Chapter 2) the common presence of limestone formations on the different islands is intriguing. Careful comparisons of the different limestone occurrences are listed in table 5.2. These show that carbonate deposition was a local process in close relation to the existence of locally shallow marine waters resulting from island formation and/or raised marine floors. Large submarine carbonate platforms connecting different islands are rare within this region. One example is the Anguilla bank, which possibly connects the St. Martin Lowlands Formation with the Anguilla Formation. In most other cases, carbonate deposition has been related to individual islands. From this it is clear that the Oligocene limestone formation on Antigua stands by itself, as no contemporary limestone deposits are known. This means that flint formation on and near Antigua does not necessarily entail flint formation on other islands. Furthermore, flint likely forms in limestone rock, which has been deposited in low-energetic marine environments. These environments rarely occurred, or at least are seldom preserved on these islands, as is clear from abundant reef limestone deposits on many of them. This helps to explain the infrequent occurrence of flint in the region.

The western part of the study area includes the group of the Virgin Islands and Puerto Rico. These islands were formed during the older Greater Antilles island arc volcanism and as a result, most of the rocks exposed are Cretaceous to Eocene in age, or Cretaceous to Oligocene in the northern Virgin Islands (Larue 1994). Only on Puerto Rico is this island arc of volcanism pre-dated by the southwestern Bermeja Complex, which is Upper Jurrasic in age. It consists of a "dismembered ocean floor and island arc derivates" (Larue 1994,156). Cherts representing the former have been dated to the Kimmeridgian stage (153 – 156 Ma).

Notably, Puerto Rico exposes a very long succession of different volcanic episodes, covering the entire central strip of the island, where different volcanic centres have been identified. On the Virgin Islands, such eruptive centres were most likely not represented and the oldest volcanic rock relates to sub-marine deposited material from a nearby eruption centre (Donnely 1966; Whetten 1966). On the northern Virgin islands, the rocks are both igneous and sedimentary in nature (tuffs).

Table 5.2 (opposite page). Limestone formations by island by age within the northern Lesser Antilles, the Virgin Islands and Puerto Rico. Data have been derived from geological reports.

3 It must be pointed out that among these crystal varieties, the size of crystals is sometimes too small to provide sufficient raw material for stone tool or other artefact making. For example, this accounts for the malachite on Antigua (personal observation 1998).

Island	Limestone Formation	Age	References
Puerto Rico	Parguera Limestone Cotui Limestone Melones Limestone Small lenses in Volcaniclastic rock Lares Limestone Montebello Limestone Angola Limestone Cibao Limestone Los Puertos Limestone Ponce Limestone Aymamon Limestone Quebradillas Limestone	Turanian-Maastrichtian Campanian Maastrichtian Eocene Late Oligocene Early Miocene Early Miocene Early Miocene Middle Miocene Middle Miocene - Early Pliocene Middle Miocene - Late Miocene Early Pliocene	Larue 1994
Vieques	no data available	-	-
St. Thomas	Outer Brass Limestone	Lower Cretaceous	Alminas *et al*. 1994
St. John	Congo Cay Limenstone Member Outer Brass Limestone	Lower Cretaceous Lower Cretaceous	Alminas *et al*. 1994
Tortola	Towers Limestone	Upper Cretaceous	Martin-Kaye 1959
Virgin Gorda	Minor formations	-	
Anegada	Anegada Limestone	Pleistocene	Martin-Kaye 1959
St. Croix	Mudball Jealousy Formation Kingshill Limestone Blessing Formation	Eocene - Oligocene Early - Middle Miocene Middle Miocene - Early Pliocene Pliocene	Larue 1994
Anguilla	Anguilla formation	Early Miocene	Drooger 1951, Christman 1953
St. Martin	Low Lands Formation	Early Miocene	Drooger 1951, Christman 1953
Saba	No limestone formation	-	Westermann & Kiel 1961
St. Barths	St. Barths Formation Occasional limestone lenses	Middle - Late Eocene Miocene	Christman 1953
St. Eustatius	Sugar Loaf White Wall Formation	Pleistocene Pleistocene	Westermann & Kiel 1961
St. Kitts	Brimstone Hill Formation Godwin Gut	Pleistocene Pleistocene (?)	Westermann & Kiel 1961
Nevis	No limestone formation	-	Martin-Kaye 1958, 1969
Barbuda	Codrington Formation Beazer Formation Highlands Formation	Pleistocene Pleistocene Middle Miocene	Brasier & Mather 1975
Antigua	Antigua Formation Limestone in Volcanic Suite	Oligocene Oligocene	Martin-Kaye 1959, Weiss 1994
Montserrat	Roche Buff Sweeney's Bay	Pleistocene Pleistocene	Westermann & Kiel 1961
Grande Terre	Coral limestone Grand Fonds area	Pliocene - Pleistocene Pliocene	Lasserre 1975
Basse Terre	No limestone formation	-	Laserre 1975
La Désirade	Central limestone plateau	Pliocene	Lasserre 1975
Marie Galante	Coral and tuffaceous limestone	Pliocene - Quarternary	Laserre 1975
Les Saintes	No limestone formation	-	Westercamp & Tazieff 1980
Dominica	Limestone lenses	Pleistocene	Sigurdsson 1973
Martinique	Coral limestone Calcareous tuff	Miocene Miocene	Westercamp & Tazieff 1980

In contrast, St. Croix, which was likely farther from these eruptive centres, predominantly consists of sediments in the form of tuffs, volcanic sandstones, agglomerates, and mudstones.

Arc volcanism ended during the late Cretaceous (Maastrichtian) on St. Croix, during the Eocene in Puerto Rico, and probably the Oligocene in the northern Virgin Islands. This was followed by uplifting, deformation, and rotation of the arc formations. The youngest major depositional events corresponded with carbonate platform development, which was late Oligocene to Miocene on Puerto Rico, and late Miocene in the northern Virgin Islands. On St. Croix, early Miocene carbonate was formed in a sedimentation basin.

This longer and more complex geological history has resulted in a wider range of rock materials occurring on these islands. Igneous rock includes keratophyres and spillites (Virgin Islands) along with calc-alkaline rock, basalt, andesite, porphyry, dacite, and serpetinite (Puerto Rico), as well as different plutonic rocks, such as quartz diorite and rare granodiorite and gabbro. Associated sedimentary rocks are tuffs, volcanic sandstones, breccias, agglomerates, mudstones, and bedded cherts. The latter rock can found in the southwestern region of Puerto Rico, as well as in rare outcrops on St. Croix. Almina *et al.* (1994) speak of radiolarian chert occurrences in the northern Virgin Islands, but Donnelly (1966) classifies these rocks as radiolarian tuffs. Moreover, Puerto Rico has an extensive amphibolite occurrence in the southwest, whereas the Virgin Islands have localized metamorphic rocks in the form of hornfels and marble.

This short presentation of rock type occurrences shows that inter-island variability is considerable within the study area, and as a result, the islands provide quite different environments for stone tool making people. The limestone Antilles can be considered as poor environments in this case, as they are generally deprived of relatively hard rock materials. In contrast, a much wider variety of suitable stone materials is available on the composite islands, as well as in the Virgin Islands and Puerto Rico, where both hard siliceous rocks with conchoidal fracturing as well as hard though more random fracturing igneous materials occur. In addition, variation is noticed between the Lesser Antillean and the Greater Antillean islands. In the latter, specific rock types display greater variation, including metamorphic rocks and sandstones, which do not occur on the Lesser Antilles.

5.2 Stone material use

5.2.1 Introduction

The following part of this Chapter provides a description of stone material use and tool production on the different islands within the study area. The presentation is divided into four parts, corresponding with the four main phases of indigenous occupation during the Ceramic Age, from Early Ceramic A to Late Ceramic B. For each of the four phases, I systematically present data on the four main technology sets, as defined in Chapter 3. The fifth technology set consisting of rock material solely modified from burning, whether intentional or not, is left out of the discussion. Furthermore, the data on lithic bead and pendant industries (technology set 2c) are primarily derived from previous research by others.

As outlined above in Chapter 3, data gathered through the systematic analysis of samples of lithic artefacts from different regional sites form the core of this presentation and the data are tabulated in Appendix F. Details on the provenience of the samples within the sites and excavation methodologies applied are presented in Appendix F as well.

If available, published results on other relevant sites are mentioned, primarily for purposes of comparison. In some cases, a detailed level of comparison was possible when researchers used similar methodologies or were familiar with at least some of the raw materials encountered during the present study.

Site	Island	Type of sample	reference
Pearls	*Grenada*	*bead and pendant related artefacts*	Cody 1991
Vivé	Martinique	all lithics (including *lapidary items*)	Berard *et al.* 2001
Cocoyer	Marie-Galante	all lithics	-
Morel	Guadeloupe	all lithics	-
Trants	Trants	flake tool related artefacts	-
Doigs early	Antigua	flake tool related artefacts	-
Royalls	*Antigua*	*flake tool, axe, bead and pendant related artefacts*	Murphy 1999; Murphy *et al.* 2000
Elliots	*Antigua*	*flake tool, axe, bead and pendant related artefacts*	Murphy 1999; Murphy *et al.* 2000
Hichman's	Nevis	flake tool related artefacts	-
Hope Estate	*St. Martin*	*all lithics*	Chauviere 1998 ; Haviser 1993, 1999
Prosperity	*St. Croix*	*bead and pendant related artefacts*	Vescelius & Robinson 1979
Sorcé	Vieques	all lithics (including *lapidary items*)	Narganes 1999
La Hueca	*Vieques*	*all lithics*	Narganes 1995; Rodríguez Ramos 2001
Punta Candelero	*Puerto Rico*	*all lithics*	Rodríguez Lopez 1993; Rodríguez Ramos 2001

Table 5.3. Studied sites from the Early Ceramic A phase. Data from sites in italic have been obtained from literature.

5.2.2 Early Ceramic A

Introduction

Collections varying in size have been studied from five sites dating to this earliest phase of the Ceramic Age. In addition, others have reported on lithic material from another seven sites. Their data are included in this section and used for comparison. Table 5.3 specifies the exact nature of each sample. It shows that in many cases not all lithic artefacts originally collected were studied for the present research.

Flake tool production

Raw materials

Materials used to produce flake tools include a wide variety of fine-grained rock materials, basically falling in the broad group of cherts and chert related rocks. Identified materials are flint, bedded chert, chert, jasper, chalcedony, petrified wood, quartz, and probably a silicified tuff (table 5.4). Looking in detail at the percentages of material per site, it is immediately clear that Long Island flint is predominant at sites on Antigua and on the islands directly surrounding Antigua, such as Montserrat, Guadeloupe, and Nevis. Haviser (1993, 1999) does not distinguish chert varieties for Hope Estate, but mentions that a large part of the flake material may have originated from Long Island there as well. In addition to Long Island flint, a white chert type with an unknown provenance is the second most common variety at most of these sites. I identified this type of chert at Cocoyer, Morel, Trants, Doigs, and Hichman's. In particular, the large samples from Trants and Morel produced significant amounts of this chert, enabling a more detailed description. The white chert varies in texture and grain-size, both within sites as well as between sites. This makes it difficult to say whether this white chert should be considered as a single chert type originating from only one source. Based on its white colour, the absence of clear cortex, and the absence of inclusions, I assumed that this type is not a flint or other biogenic type of chert. It exhibits some similarities with the cherts formed in the tuffs at Shirley Heights on Antigua, although a perfect resemblance with this source material was not established. The high abundance of this chert type at Doigs on Antigua, which is relatively close to Shirley Heights supports this origin, however.

Site / Chert type	Punta Candelero N=1041 %	La Hueca N=1472 %	Sorcé N=468 %	Hich-mann's N=38 %	Doigs early N=234 %	Trants N=996 %	Morel N=1388 %	Cocoyer N=62 %	Vivé N=285 %
Long Island flint	3.0	7.7	1.4	63.2	31.6	57.5	78.0	37.1	0.4
Blackman's Point flint	-	-	-	-	-	0.1	0.1	-	-
Coconut Hall flint	-	-	-	-	-	-	-	-	-
Antigua Form. flint	-	-	-	-	-	0.2	-	1.6	-
White chert	-	-	-	7.9	31.6	27.6	12.1	14.4	-
Petrified wood	-	-	-	-	-	0.3	0.1	-	-
Other chert	46.0	31.8	44.8	15.8	36.8	4.7	9.1	17.7	41.7
Désirade red chert	-	-	-	-	-	-	-	-	-
Jasper	-		-	-	-	0.5	0.6	-	57.9
White quartz	5.3	14.1	43.2	-	-	-	-	-	-
Unidentified chert	-	-	-	13.2	-	5.2	-	29.0	-
Other materials	45.5	45.1	10.5	-	-	-	-	-	-

Table 5.4. Early Ceramic A phase. Relative amount of identified chert types by site.

Unfortunately, chemical analysis did not provide a clear answer to this provenance problem. In the first place, the Discriminant Analysis did not assign analysed artefacts from Trants and Morel to the Shirley Heights source. In addition, the artefacts from Trants and Morel differ with respect to each other. This suggests that multiple sources of white chert were likely exploited during this earlier phase of the Early Ceramic Age. The most likely location of these sources would still be Antigua, where non-biogenic cherts are numerous. The common occurrence of white chert in archaeological contexts on Antigua and islands directly surrounding it, supports this view. Trants, for example produced higher percentages of this material than Morel and Trants is closer. Honeychurch, however, reports the occurrence of non-biogenic types of chert on the more southern part of Dominica as well (1995, personal communication 2000). Archaeological data that would favour such a more southern provenance are lacking for the white chert at the moment.

Apart from these two predominant varieties of chert, the regional sites produced other less abundant cherts, as well. An origin could be specified for some varieties. Trants yielded Corbison Point/Dry Hill Antiguan chert, which was confirmed by chemical analysis. In addition, petrified wood was identified at Trants. It is likely that the petrified wood originates from this locality in Antigua as well, considering the fact that the Trants inhabitants were familiar with the Corbison Point/Dry Hill locality, where petrified wood can be also found. Both varieties only include 1.7% of all flake tool material, however. A slightly more abundant variety (2.4%) likely originates from Blackman's Point in Antigua. At Morel, only a single Blackman's Point specimen (0.1%), two red bedded radiolarian chert pieces originating from La Désirade, and nine red jasper pieces with a possible Martinique provenance were also identified.

It is interesting to note that chert varieties at sites on Antigua itself display a larger variability than at the sites on the other islands discussed above. DeMille (1999) reports for Royalls finding of 15 chert varieties, along with Long Island flint. These have probably all, or at least mostly have an Antiguan origin. At Doigs, Long Island flint only forms a small portion of the sample (32%), whereas white chert is significant as well (32%), along with other varieties (36%). Apparently, the Antigua inhabitants obtained material from different localities on the island, which were all close and relatively easy accessible, whereas the inhabitants on the neighbouring islands only chose or had access to a few specific sources, among which Long Island formed the most important one.

Relatively extensive excavation work at Trants showed that the site was continuously occupied for a considerable period, from approximately 500 BC to AD 400, or later. As the samples I studied came from relatively deep units largely covering this complete period of occupation, I was able to study possible diachronic changes in relation to raw material choice. The results showed that during this long occupational history the use of different stone materials was not significant variable through time. This suggests a very constant and stable social environment, in which access to raw material sources remained the same for hundreds of years. Such a scenario supports the idea of a static circular village lay-out, which also seems to have remained unchanged (Petersen 1996, 354-56). In contrast to the absence of chronological variation in use of stone materials, some spatial variation has been noted. A northern excavation unit N596E571 produced significantly more Long Island flint throughout all its different levels than the three southern units. Whether this means that the village was subdivided into spatially separated social groups, which acted more or less independently and occupied certain areas within the settlement throughout different generations, is open to discussion and needs additional evidence from more lithic studies, as well as analysis of other categories of material culture.

The percentage of Long Island flint becomes considerably lower and white chert is not encountered any more at sites located farther away from Long Island and Antigua, such as Vivé, Sorcé, La Hueca, and Punta Candelero. At Vivé, materials local to Martinique make up the large majority of the flake tool materials. These include red and yellow jaspers, different coloured cherts and a translucent more chalcedonic type of chert. These materials naturally occur at several places on the Martinique, but the closest source can be found at Presqu'île de Caravelle, around 20 km from Vivé (Bérard 1997, 1999).

In addition to these chert varieties, Bérard (1997) has argued that igneous rock was also used for making flake tools, as the Vivé excavations produced a number of flakes made of fine-grained varieties. Despite the fact that associated core artefacts made of a similar igneous rock are lacking, Bérard suggests that these flakes represent a separate production, aimed at the manufacture of large flakes in contrast to the small equivalents made of jasper, chert, and chalcedony. There are no clear indications from Vivé that would disprove this argument (or strongly support it for that matter), but I am not inclined to follow this conclusion. I have several arguments: (a) flake tool production at other sites from the same phase and later phases are not associated with igneous rock; (b) igneous rock is usually associated with the manufacture and use of axes; (c) one igneous rock axe fragment and a single axe preform were identified at Vivé, these two artefacts are made of a different igneous rock variety, more porphyritic in nature; and (d) the igneous flakes lack typical features common among flake tool material, such as reduction of flakes and clear use-wear. Bérard, however, does mention the presence of one flake with possible use-wear. This use-wear is doubtful, as it may be merely ripple marks.

The common association of igneous rock and axe production and the fact that at least some varieties of igneous rock were reduced to produce axes on site at Vivé suggest that the finer grained igneous rock flakes were part of a similar production as well. This interpretation is more in agreement with the fact that fine-grained igneous rock cores are missing at Vivé. Axes, rather than flake cores, were more likely discarded at places outside the village, places where they were used, broken, and lost (e.g., the forest).

At Sorcé on Vieques, the sourcing of different varieties of chert types is more problematic, as source locations cannot always be specified. Apart from the Long island material and a very distinct type of white quartz, which is local to Vieques, I distinguished ten varieties of chert at Sorcé. Two can be easily discriminated, as they are green and red in colour and do not have clear cortical rinds. The analysis of the Punta Candelero and La Hueca lithic artefacts from Puerto Rico and Vieques respectively, by Rodríguez Ramos revealed both of these materials as well (Rodríguez Ramos 2001a). Rodríguez Ramos located a possible source area in the eastern part of Puerto Rico in the municipality of Ceiba, where similar rocks occur in a bedded sequence. These are classified as silicified tuffs. In addition, the green variety also resembles green Mariquita chert from the southwestern part of Puerto Rico. In Chapter 2, I mentioned the occurrence of this material at the Las Palmas source.

The remaining eight chert varieties fall within the group of cherts that form the objective of my chert sourcing research described above (see Chapter 2). Despite the large number of potential sources, the majority of these eight chert varieties are not similar to any of the characterised sources. Only two exhibit some similarity with the southwestern Puerto Rico sources, in particular the Las Palmas locality. For five chert varieties I submitted artefacts for geochemical research. The results showed that only one possibly originates from the southwestern Puerto Rican sources, although complete chemical similarity with one of these localities was not obtained. The other four are more similar to the Antigua and St. Kitts sources than to the Puerto Rico ones. One of these probably originates from Little Cove, although this source was not initially identified. However, its macroscopic characteristics do not display definite anomalies with Little Cove material. For the others the source assignment remains unknown, as the outcomes of the Discriminant Analysis yielded sources for which macroscopic characteristics were quite different from the artefacts. This minimally suggests that additional lithic sources are present in the study area or nearby, which are not included in this research. These sources probably should not be sought in the southwestern area of Puerto Rico, as the structural low Ca/Mg ratio for the cherts from this region does not correspond with the artefact data. Considering the low Long Island flint occurrence at Sorcé, an Antigua origin for these cherts is not likely either. Source areas probably are situated closer-by, either in eastern Puerto Rico, on Vieques itself (Rodríguez Ramos personal communication 2000), or in the Virgin Islands, where cherts have been also reported (Almina *et al.* 1994).

Close comparison with the data from La Hueca and Punta Candelero, two sites yielding Huecan style ceramics, shows that they exhibit a similarly large range of chert varieties. The large majority resembles varieties encountered at Sorcé. Still, some differences are noted as well, and these are not only related to raw material choice but also to reduction behaviour (Rodríguez Ramos 2001a).

Reduction and tool production

The technological analysis of the flake tool material from the different sites shows that the lithic materials were worked using an expedient technology, in which both bipolar and direct freehand percussion techniques were employed. Other characteristics shared by the different samples include the production of both large and small flakes, the ad-hoc use of flakes without any further modification in the form of intentional retouch, and the exhaustive reduction of the material in nearly all cases.

Furthermore, it became clear that material was reduced on site and probably was not imported in the form of flakes in most cases. The study of cortical surfaces indicates that in many cases water-worn cobbles, either originating from cobble beaches or streambeds, were collected, along with more inland surface scatters. Small sample size and my unfamiliarity with the nature of the sources for some varieties, including lack of knowledge about cortex or outer surfaces, make it difficult to identify in what form these different chert varieties arrived at the various sites. Long Island flint constitutes an exception in this respect. Cortex count data for this flint type, as discussed in the next Chapter, shows that this flint material arrived at most of the sites in largely unmodified form. Only the Cocoyer material suggests a different situation. There, Long Island flint material might have arrived in the form of large flakes, rather than pre-worked cores, to be reduced for the production of smaller flakes.

An additional feature needs to be mentioned in relation to the acquisition of lithic material and that is possible re-use of Preceramic Age flaked material during the Ceramic Age. Murphy (1999) reports the finding of a Preceramic Age blade from Long Island, that was re-used by the inhabitants of the Royalls site on Antigua. My analysis of flake tool material revealed the very rare occurrence of true blades as well, which definitely cannot be associated with the expedient technology employed during the Early Ceramic phase. This is evident for a blade fragment found at Sorcé because the raw material is unique among the sample studied. At Trants, however, a Long Island blade fragment from the intermediate excavation levels exhibits very worn and blunt edges, which is quite unlike the rest of the Long Island material at this site. This suggests long exposure to wind and water erosion before being collected. In this latter, case the presence of this blade artefact may be attributed to scavenging of Preceramic Age surface material, probably taken from scatters on Long Island, whereas in case of the Sorcé artefact the possibility of exchange with still existing Preceramic Age settlers on the neighbouring island of Puerto Rico should be considered as well.

All samples include flakes displaying use-wear. In the majority, the edges were not modified prior to usage, but in some cases some minor modifications occurred. Recurrent is a single small flake removal creating a concave edge, similar to examples reported by Crock and Bartone (1998), Murphy (1999, 237), and De Mille (1996). Other modifications primarily were intended to change or reduce overall flake shape, rather than work the edge (figures 5.1 and 5.2).

In addition to this production of expedient flake tools, the lithic reduction was aimed at making small flakes. This is clearly shown by a significant number of flakes among the large samples that were reduced to obtain smaller flakes. Clear bi-directional flaking is the predominant form used for reducing these flakes, but more unsystematic reduction was also used, particularly in the form of removing a few flakes from whatever direction possible (figures 5.3 and 5.4). This production of smaller flakes may be related to the making of boards for grating cassava. However, I did not identify any small flakes with actual use-wear, that could be the result of their use as grater teeth. This absence of clear use-wear on smaller flakes is widely recurrent, as also encountered in the study of later material. Crock and Bartone noted a similar absence in their use-wear study for a larger sample from the Trants site (1998, 209-12). They offered two reasons that might explain the absence of the grater board teeth: (a) either the use-wear is too subtle for the identification methods used in their work (and also mine)[4], or (b) the location within the site, where such teeth were used in the grater board has yet to be identified.

Currently Yvonne Lammers-Keijzers (Leiden University) is doing experimental studies and microscopic use-wear analysis, including work specifically related to this type of function. Preliminary results favour the first explanation (Lammers-Keijzers in prep, personal communication 2004). The second explanation, however, should not totally be excluded. Grater boards are usually valued items (Butt Colson 1973; Myers 1981; Thomas 1972, 1981). Modern ethnographic wooden boards are often decorated with painted motifs (Crock and Bartone 1998), making it likely that they will be kept as long as possible. Therefore, the stone teeth will be only renewed in case of malfunctioning or loss. This should result in occasional discard and accidental loss of stone grater teeth at the locations where they are used. Considering their small size, lithic grater teeth will more likely remain there, rather than being swept to surrounding peripheries of the site where other refuse is located and most test-units were excavated in sampling the site.

[4] Crock and Bartone used a 10-30x Bausch and Lomb binocular microscope (1998, 201) and I used a 10x hand lens to identify traces of use-wear.

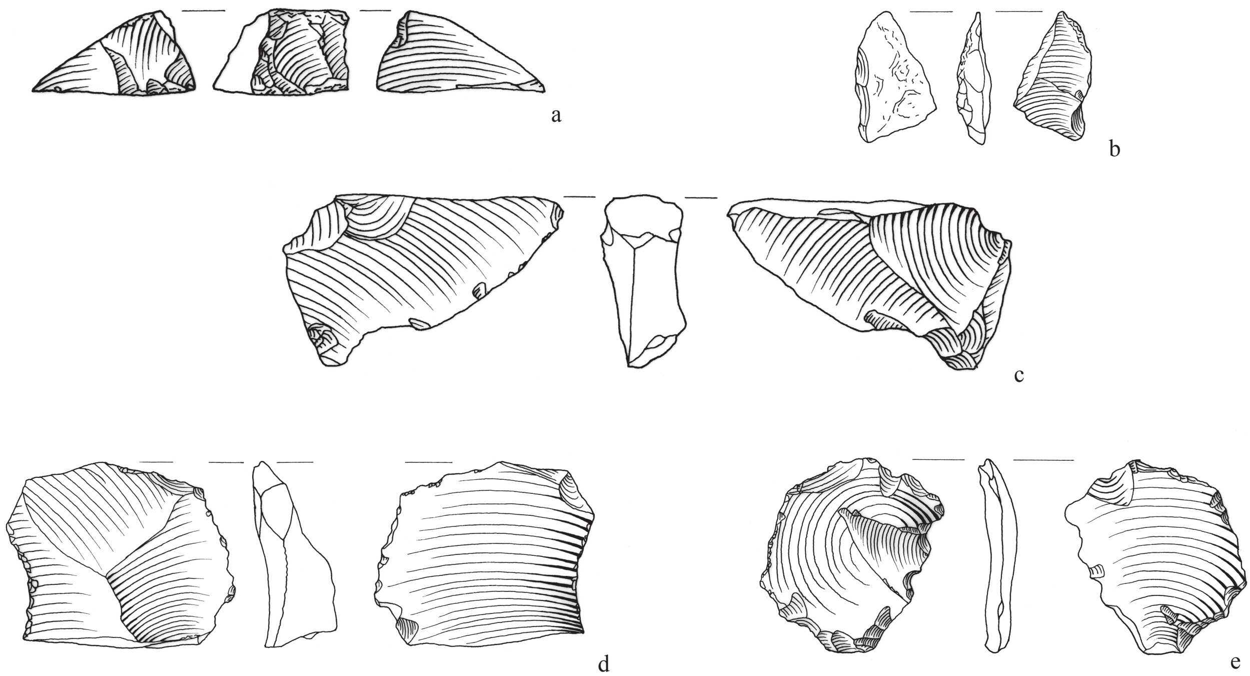


Figure 5.1. Trants, Monserrat. Utilized and modified flakes: a. core on flake; b. flake fragment with unifacial use retouch; c. modified flake with fine use retouch; d. flake fragment with unifacial use retouch; e. complete flake with unifacial intentional retouch (scale 1:1). (Drawings Raf Timmermans)

Core tool production

Axes and Adzes

All sites dating to this early phase of the Early Ceramic Age yielded evidence for the use of axes and/or adzes, although in most cases it only concerns a few artefacts (table 5.5). Interestingly, this phase is the only phase of the Ceramic Age during which adzes (plano-convex edged) were found in considerable numbers alongside axes (biconvex edged). Still, axes clearly outnumber adzes on all sites. Sites yielding these latter tools are basically restricted to the western part of the study area, on the islands of Vieques and Puerto Rico (Rodríguez Ramos 2001a). Also, the Hope Estate site on St. Martin yielded this type of tool (De Waal 1999b). This geographical and chronological trend has only recently been identified, and may be related to different stone working protocols between different regions and through time. It is also intriguing that almost all adzes found on the Lesser Antilles are made of conch shell.

Stone type variability is much larger among the axe and adze category than in case of the flake tool artefacts. Rock type classification by necessity, however, remained at a very general level, i.e. only distinguishing igneous from metamorphic rock, for reasons mentioned in Chapter 3. In most cases, it was possible to specify whether the material is locally occurring in the direct site surroundings or even on the island of discovery, or not. In combination with the production data, this evidence provides strong support for the operation of exchange systems as the means by which local social groups had obtained lithic raw materials and/or finished tools (see below).

Looking at evidence for local production of axes, actual working of lithic material into finished axes took place only at a very limited number of settlements. This contrasts significantly to the general occurrence of on-site flake tool production. Sites yielding such evidence include Vivé, Cocoyer, Sorcé, and Hope Estate. At Vivé, Sorcé, and Hope Estate probable local material was worked. In case of Cocoyer and in case of some of the rock materials found at Sorcé, rocks were used that may not have been local to the island. A difference is noticed in comparing the sites. At first three localities, production debris is not abundant, and basically only includes unfinished preforms. Related flake material is very rare compared to the number of preforms and axes found at Sorcé and absent at Cocoyer. At Vivé, the relation between flake material and preforms is not clear, as a result of various raw materials (see above discussion of igneous flakes at Vivé). This low occurrence of flakes becomes even more striking once it is realised that the formation of flakes may be related to accidental breakage in some

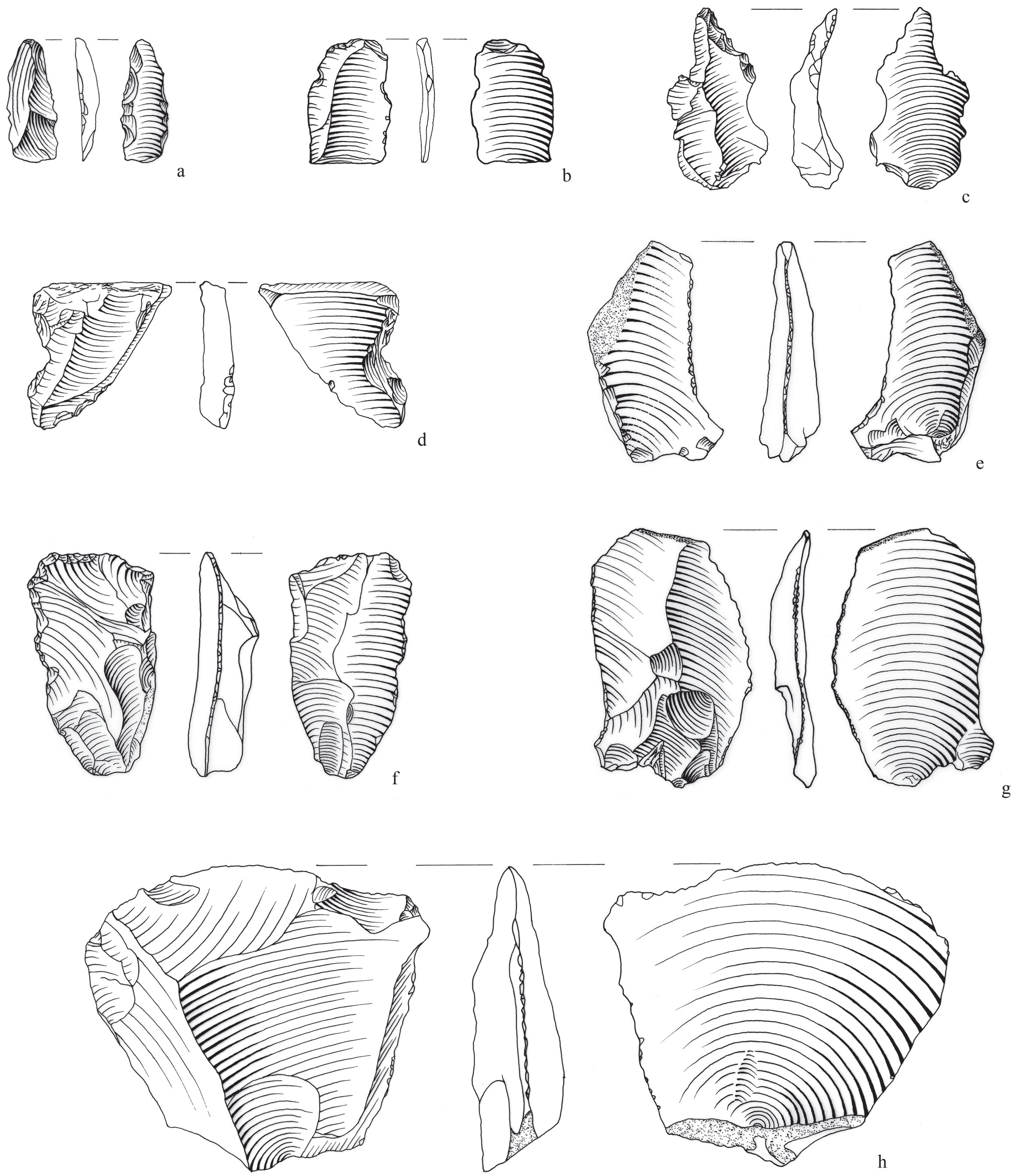


Figure 5.2. Morel, Guadeloupe. Utilized flakes: a. flake fragment with intentional retouch; b. flake fragment with use retouch; c. complete flake with intentional retouch (drill); e. modified flake with utilized curvate edge; e. complete flake with unifacial use retouch; f. modified flake with intentional retouch; g. complete flake with use retouch; h. complete flake with use retouch (scale 1:1). (Drawings Raf Timmermans)

cases as a result of the (heavy) use of axes, rather than intentional formation related to their manufacture. Another cause of these flakes may have been the re-shaping or re-sharpening of exhaustively used axes or adzes. A third possible origin may be related to the use of water-worn pebbles, as this generates flakes with seemingly "ground" dorsal faces, making their

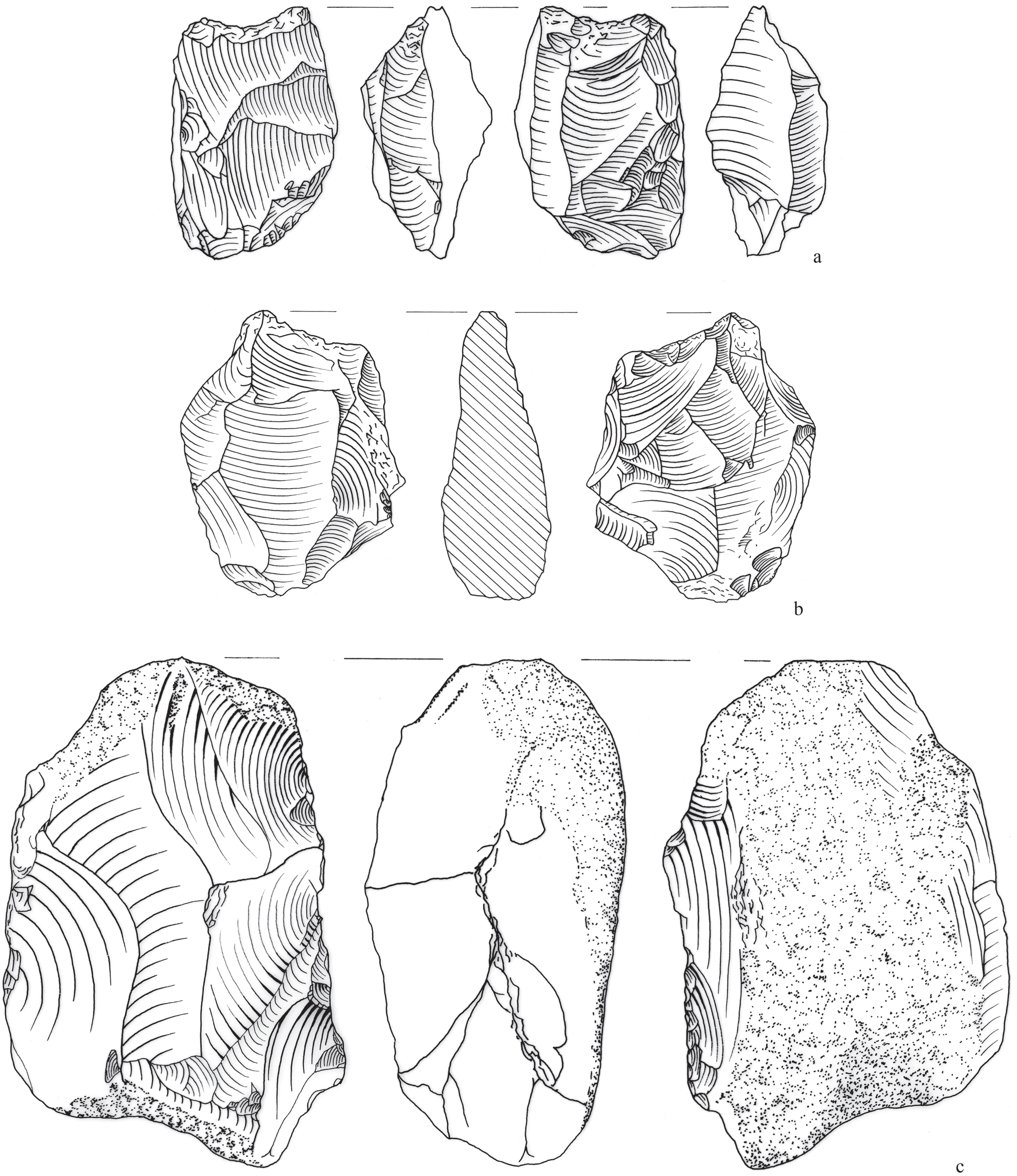


Figure 5.3. Trants, Montserrat. Flake cores: a en b. bipolar cores; c. multiple platformed flake core (scale 1:1). (Drawings Raf Timmermans)

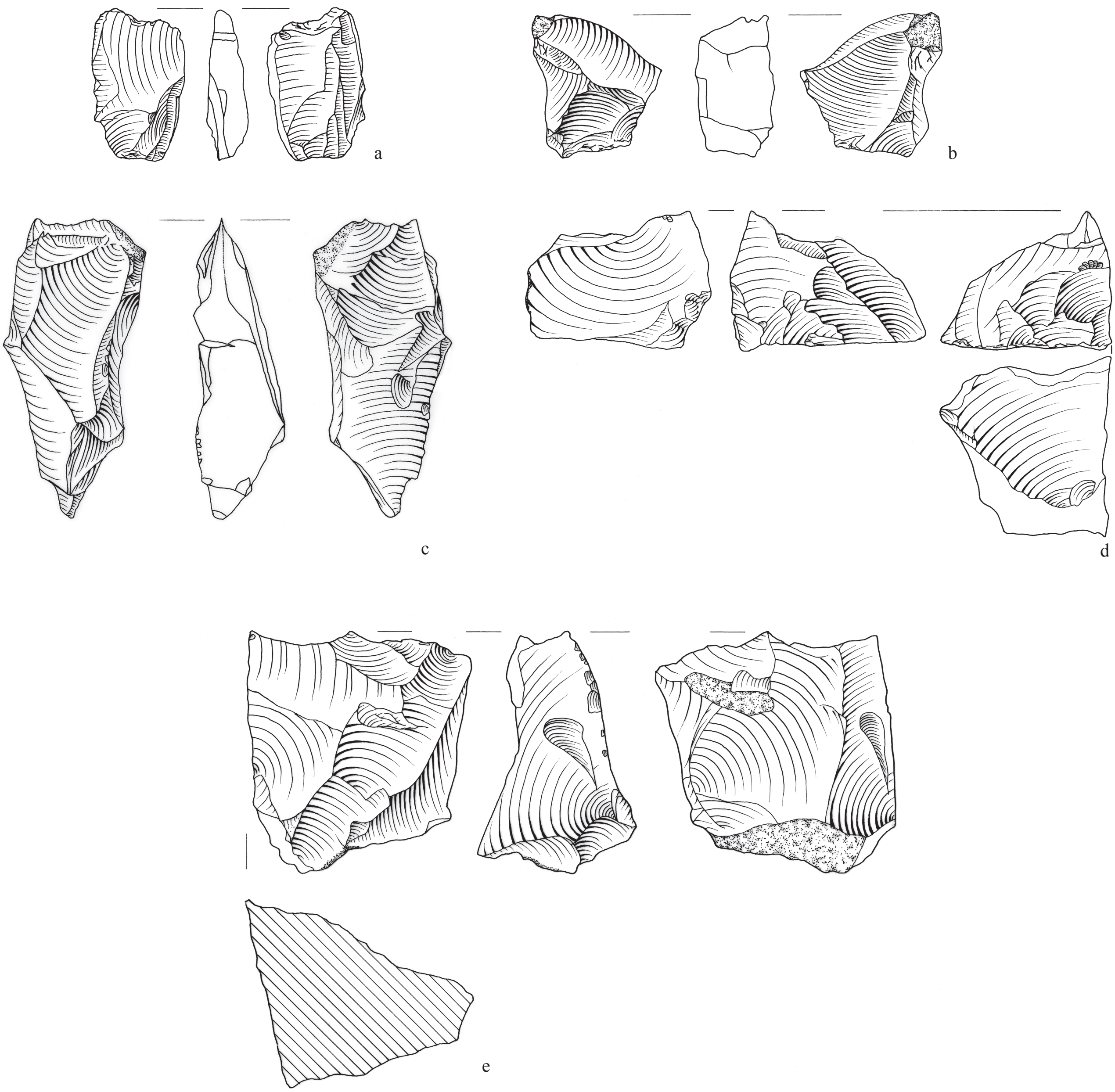


Figure 5.4. Morel, Guadeloupe. Flake cores: a and b. bipolar cores; c and d. cores on flake; e. polyhedral core (scale 1:1). (Drawings Raf Timmermans)

distinction from axe related flakes difficult. This clearly suggests that in case of these three sites the flaking stage of axe and adze manufacture is poorly represented and probably did not solely occur on site, but likely took place elsewhere. This might have been at the source or some other special work-shop site. Archaeological evidence for this latter option is lacking in the region for this phase, however.

Apart from these rock materials used to make axes and adzes, the Sorcé excavations yielded a very specific raw material, a silicified shale (or phyllite), which was worked at the site. It was not possible to specify why this material was reduced due to a lack of finished artefacts, as well as clear preforms. The artefacts include a number of large and relatively flat, flaked core artefacts. Flakes and a few water-worn pebbles were also identified. The pebbles might have served as the

Site	Island	Rock material	Finished axes/adzes N	Preforms N	Flakes and shatter N
Vivé	Martinique	igneous rock	1	1	possibly present
Cocoyer	Marie-Galante	igneous rock	-	1	-
Morel	Guadeloupe	igneous rock	6	-	-
		plutonic rock	1	-	-
		St. Martin greenstone	4	-	-
		metamorphic rock	1	-	-
Royalls	Antigua	igneous rock (basalt+felsic.vol.)	2	-	-
		limestone	1	-	-
Elliots	Antigua	igneous rock	4	-	-
		St. Martin greenstone	present	-	-
		jadeite (different varieties)	6		-
Hichman's	Nevis	metamorphic rock	1	-	-
Hope Estate	St. Martin	igneous rock (basalt+andesite)	minor portion	-	possibly present
		St. Martin greenstone	major portion	numerous	abundant
Sorcé	Vieques	igneous rock	41[a]	14[a]	25
		St. Martin greenstone	10[a]	-	-
		metamorphic rock	8	5	24
		fine-grained rock	10	8	6
La Hueca[b]	Vieques	river rolled volcanics/metamorphic	39	-[c]	-
		St. Martin greenstone	17	-	-
		silicified tuff	12	-	-
		silicified shale	4	-	-
		Peridotite	12	-	-
Punta Candelero[b]	Puerto Rico	river rolled volcanics/metamorphic	16	-[c]	-
		St. Martin greenstone	1	-	-
		silicified tuff	3	-	-

Table 5.5. Early Ceramic A phase. Identified axes and axe manufacture related artefacts by raw material by site. [a] includes both axes as well as adzes; [b] In case of La Hueca and Punta Candelero no distinction was made between axe and adze types, although Rodríguez Ramos (2001) distinguishes 6 different axe and adze forms: La Hueca axe/adze ratio 67/17; Punta Candelero axe/adze ratio 15/5; [c] Rodríguez Ramos (2001, 176) explicitly states that production of ground stone material was not occurring on site, both for local as well for non-local materials.

raw material from which production started. Similar material was identified at the Huecan component of the site as studied by Rodríguez Ramos (2001a), where it was used for making axes. Rodríguez Ramos mentions that this material might be locally available, but he has not been able to identify truly identical materials in the site area.

The Hope Estate site is the only settlement with abundant evidence for axe and adze production activities. Two lithic materials are associated with axe manufacture on site, including the local greenstone and a possibly local andesite. Haviser (1999) explicitly states that the Hope Estate dwellers brought the local greenstone to the site in natural form and worked it into completely finished axes and adzes (see also De Waal (1999b) for different axe and adze types). The number of flakes, blocky fragments, and preforms found at Hope Estate is strikingly high and supports this complete production sequence.

With regard to the andesite, it should be pointed out that Hope Estate did not yield many artefacts relating to the manufacture of igneous rock axes (Chauviere 1998). Only a few andesite core fragments were found, alongside with some flakes. The low number of manufacturing debris resembles igneous rock axe evidence at many other sites and stands in marked contrast to the greenstone material at Hope Estate.

This scanty evidence about the production of axes made of igneous rock, as well as some other materials in the region, demands additional explanation. One of the reasons that igneous debitage is considerably lower in number than in

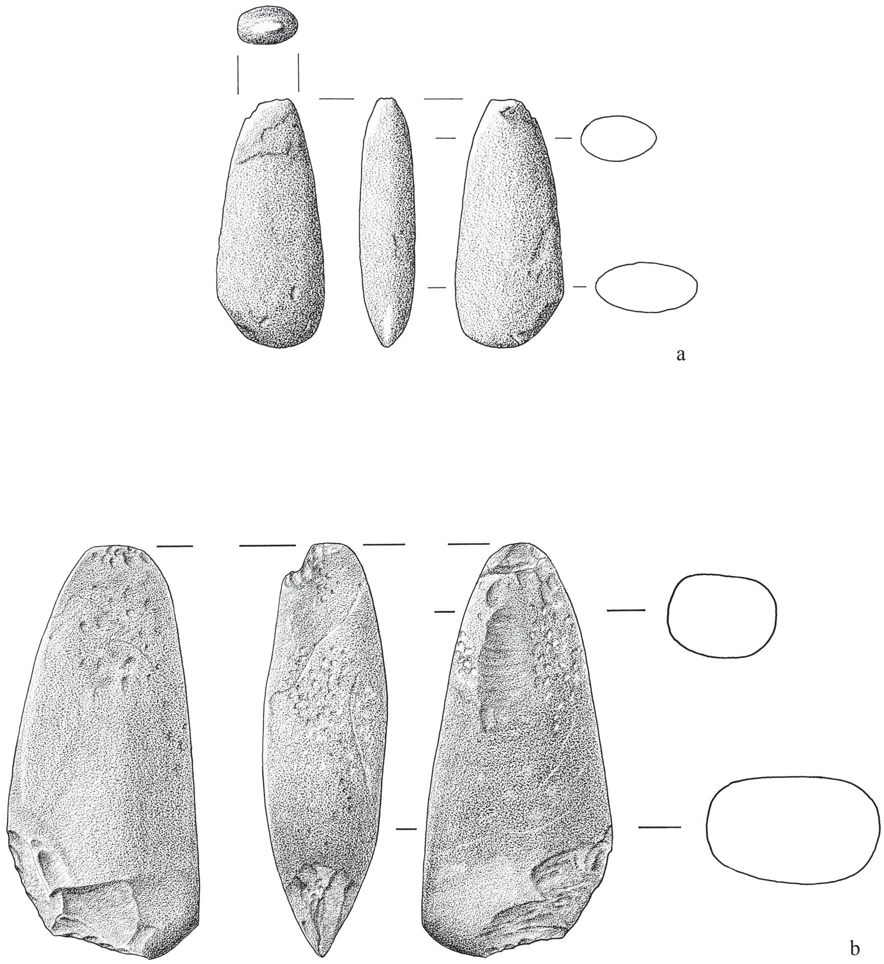


Figure 5.5. Morel, Guadeloupe. Axes: a. St. Martin greenstone complete axe; b. igneous rock axe with damaged edge and signs of hammering at the poll and sides (scale 1:2). (Drawings Raf Timmermans)

case of the greenstone may be related to a difference in the form by which both materials were collected. The presence of water-worn surfaces on some of the igneous rock flakes suggests collection of pebbles from beaches and streambeds. As these pebbles in many cases can have shapes, that (closely) resemble final axe or adze forms, reduction by flaking may have been limited to thinning the object and subsequent edge shaping. The greenstone, on the other hand, was probably obtained in the form of blocks, which is suggested by its clearly bedded nature. The large amount of blocky fragments, probably belonging to an earlier stage of shaping the greenstone also suggests this.

In addition to evidence about the local production of axes and adzes at habitation sites, many sites produced finished tools, for which local production was not identified. These tools probably represent items obtained through exchange in most cases (figure 5.5). In particularly, this accounts for the greenstone axe material originating on St. Martin, for which clear production at Hope Estate and the distribution of finished tools on surrounding islands provides good support for regional exchange (see next Chapter for further description and discussion). In the case of most other materials no such production loci were identified. In this instance it may be useful to distinguish the igneous rock axes from the metamorphic ones. The former lithics may originate on many of the northern Lesser Antillean islands, where igneous rock is quite abundant. In contrast, metamorphic rock is not reported within the Lesser Antilles, and only occurs on or near the South American mainland (including Trinidad and Tobago) and the Greater Antilles (including the Virgin Islands) and beyond.

This means that the metamorphic axes found at Morel, Royalls, Elliots and Hichman's have rather distant sources. Exact provenance determination is not possible yet, as a result of poor knowledge about sources and broad, non-specific petrographic classification of these artefacts. With regard to sources, ample use of greenstone axes is reported from the South American mainland (Boomert 1979), but also from Jamaica for example (Roobol & Smith 1976). Whether Jamaica possibly provided the source of such axes is unknown, but seems highly unlikely due to late human occupation post-dating this early phase of the Early Ceramic Age. Murphy (1999) even considers a Guatemala origin for one of the greenstone jadeite axes found at Royalls, since it is a jadeite variety that includes pyrite inclusions, only known from that specific Meso-American region (Hargett 1990, 138; Murphy 1999, 122). If this indeed proves to be the actual provenance of this artefact, it provides a very intriguing case, since the transportation route must have gone through the Greater Antilles and they were still occupied by Preceramic Age inhabitants at the time. These people in the Greater Antilles must then have stood in contact with both the Meso-American cultures and the first Ceramic Age settlers of the Antillean islands.

Much work still needs to be done as related to the igneous rock axes found within the Lesser Antilles, specifically for provenance and island distribution. Vivé might have been a site where different varieties of igneous rock were reduced into axes for further exchange to one of the islands deprived of igneous rock, such as for example Morel on Grande Terre. The archaeological data are still too poor to definitely prove this, however. It may be hypothesized that sites on more nearby volcanic islands, such as Basse Terre or Dominica, which so far have received little archaeological investigation, functioned as suppliers for this latter site.

The large number of imported axes and adzes found at Sorcé, La Hueca, and Punta Candelero display various rock types. Exotic varieties include the St. Martin greenstone, as well as fine-grained black igneous rock, identified as peridotite (Rodríguez Ramos 2001a). This latter rock may originate from the Cretaceous serpentine belt of southwestern Puerto Rico. In addition, other rock varieties include green metamorphic rock, silicified tuff, and meta-volcanics. Their exact provenance remains unclear, but most of them likely originate nearby, either in Puerto Rico or the Virgin Islands.

Another subject to be approached is the occurrence of two distal fragments originally part of so called "eared" axes among the Morel and Hope Estate collections. These axe types are well known from museum collections, especially on Guadeloupe and St. Vincent, but are very rare from archaeological excavations (Harris 1983). They are believed to be one of the few remaining cultural traits that persisted from the Preceramic Age. Both specimens have two indentations on both sides and a straight butt-end (figure 5.6). Classified in the scheme of Harris, they either fall in the Butt type 3, "flat cutaway beak" (Harris 1983, 275) (specimen K7, K6), or Butt type 12, "two ears" (ibid, 278) (specimen F15.C). From Harris (1983) we also learn that Edgar Clerc found another specimen at Morel 2 during his excavations in the early 1960s.

The raw material of the recently found axe fragment at Morel is quite rare as most of these types of axes are from a fine-grained dark basalt type of rock, lacking the clear phenocrysts of the Morel specimen. Basse Terre may be a possible source, as Guadeloupe is one of the few islands, that yielded large amounts of this artefact type. Unfortunately most examples lack known find contexts. Furthermore, we do not possess any evidence of local production for these axes. Therefore, it remains unclear how the Morel inhabitants obtained this axe. Given the occurrence of Preceramic Age flint blades at Ceramic Age sites, it is clear that Ceramic Age settlers occasionally scavenged Preceramic Age material. Thus, it is possible that that this axe originated from a Preceramic Age context. It could have been picked up there by the Morel inhabitants, or perhaps obtained through exchange with other communities.

Beads and pendants

One of the most striking features of the Early Ceramic A phase involves the manufacture and use of beads and pendants from various semi-precious stones, of which some originate beyond the Antillean islands. I will not provide an extensive discussion of this industry, as others before me have begun to do so. In particular, I refer to the works of Bérard *et al.* (2001), Haviser (1999), Murphy (1999, Murphy *et al.* 2000), Narganes (1995, 1999), Vescelius & Robinson (1979), and Watters and Scaglion (1994), who presented descriptions of lithic materials and finished items from different sites. In addition, the work of Cody (1991, 1993) and Rodríguez Lopez (1993) are important because they studied the provenance and regional distribution of these materials, including the identification of production loci. Despite these works, various issues still need to be addressed, as Watters (1997b) pointed out before me. These particularly relate to comparing archaeological materials with known sources, to be able to identify with more accuracy the actual provenance of the artefacts and the distribution trajectories that they may have followed.

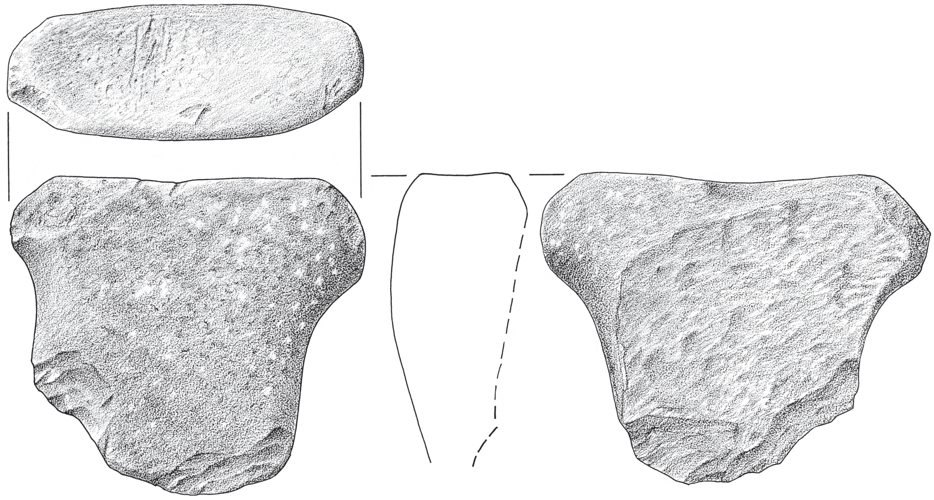


Figure 5.6. Morel, Guadeloupe. Poll part of an igneous rock eared axe (scale 1:2). (Drawing Raf Timmermans)

In short, identified materials include a wide variety of quartz related rocks, such as carnelian, amethyst, citrine, chalcedony, jasper, aventurine, and (milky) quartz. In addition, other gem stone varieties such as turquoise, nephrite, jadeite, amazonite, emerald, malachite, serpentine, barite, and calcite regularly turn up as well. Other rock varieties include diorite, quartzite, marble and different types of limestone (table 5.6 and figure 5.7 for bead examples from Morel). Cody (1991, 1993) has listed possible sources for most of these rock types. As she points out, the difficulty in tracing crystal sources is due to the fact that they are often small in size and volume, and therefore may have disappeared in some places as a result of exhaustive usage during pre-Columbian or historic times. Also, the limited geological work for some islands is another hindrance in finding possible source locations for the semi-precious rocks.

The majority of the listed gem and rock types occur naturally on one or more of the Caribbean islands. Among these "local" materials, however, a few are found in such forms that local exploitation for bead and pendant production during this early times can be questioned. A limited group of materials, on the other hand, reportedly originates only on the South American mainland, where possible sources have been identified in the Guyanas, Brazil, and Venezuela. These materials suggestive of very long distance relations include citrine, nephrite, amazonite, aventurine, and turquoise (Cody 1991, 1993; Rodríguez Lopez 1993). Despite this general agreement on the latter material being foreign to the Caribbean islands, Alminas *et al.* (1994, 31) recently reported the presence of thin veins of turquoise in fine-grained hydrothermal quartz at White Cliffs, St. Johns (US Virgin Islands). Whether the size of the crystals at this locality is large enough to be exploited for bead and pendant production is not clear from this report, but it signifies the possible occurrence of this type of rock in the Antilles.

The finding of similar, rarely occurring materials at a number of sites on different islands supposes the existence of inter-island exchange. This is further supported by differentiation in production activities of materials between these sites. Carnelian bead production, for example, is concentrated around the island of Antigua, where Murphy *et al.* (2000) assumes this variety naturally occurs. At more distant localities, such as Prosperity on the Virgin Islands, only finished beads have been reported.

This inter-island exchange connected a lot of the Lesser Antilles and Virgin Islands and the eastern part of Puerto Rico with the South American mainland. This is not only evidenced by the discovery of South American gem varieties such as nephrite at sites on Puerto Rico, but also from the depiction of animals in pendant form, such as the Andean vulture, a species not endemic to the Caribbean islands (Boomert 2001b).

Site	Island	Rock material	Finished only	Production	Reference
Pearls	Grenada	diorite, amethyst, chalcedony, citrine, (milky) quartz, rock crystal turquoise, nephrite, serpentine	-	diorite, amethyst, chalcedony, citrine, (milky) quartz, rock crystal, turquoise, nephrite, serpentine	Cody 1991
Vivé	Martinique	diorite, carnelian, amethyst, chalcedony, jasper, quartz, quartzite, turquoise, amazonite, jadeite (?), jade, emerald, marble (?)	most are finished	is not specified	Bérard *et al.* 2001
Morel	Guadeloupe	carnelian, amethyst, citrine (?) quartz/chalcedony, limestone	citrine	carnelian, amethyst (?), quartz/chalcedony, limestone (?)	Stevens 2002
Trants	Trants	diorite, carnelian, amethysts, chalcedony, quartz (rock crystal), quartzite, aventurine (?), turquoise, nephrite/jade, serpentine (?), limestone (?)	amethyst, aventurine, turqoise, nephrite/jade, serpentine	diorite, carnelian, quartz (rock crystal)	Watters & Scaglion 1994
Royalls	Antigua	diorite, tuff (?), carnelian, chalcedony, chert, jasper (?), quartz, turquoise, nephrite, serpentine, barite, calcite, limestone	diorite, turquoise, nephrite, serpentine	tuff(?), carnelian, jasper(?) chert, chalcedony, quartz, barite, calcite, limestone	Murphy *et al.* 2000
Elliots	Antigua	diorite, tuff, carnelian, amethyst, chalcedony, chert (?), quartz, malachite, nephrite, serpentine, barite, calcite, limestone	diorite, tuff, amethyst, nephrite, serpentine	carnelian, chalcedony, quartz, malachite, barite, calcite, limestone	Murphy *et al.* 2000
Hope Estate	St. Martin	diorite, carnelian, amethyst, quartz, jadeite/nephrite, calcite	amethyst, quartz, jadeite/nephrite	diorite, carnelian, calcite	Haviser 1999
Prosperity	St. Croix	carnelian, amethyst, (bull) quartz, magnetite quartz, quartz/hornblende, aventurine, turquoise, serpentine, peridot (form of olivine), garnet, actinolite, metamorphosed marl, calcite	is not specified	(bull) quartz, quartz/hornblende, turquoise, calcite	Vescelius & Robinson 1979
La Hueca	Vieques	diorite, agate, carnelian, amethyst, green quartz, rock crystal, aventurine, turquoise, topaz, malachite, nephrite, jadeite, serpentine, calcite	agate, carnelian, amethyst, green quartz, aventurine, turquoise, topaz	rock crystal, malachite, nephrite, jadeite, serpentine, calcite	Narganes 1995
Sorcé	Vieques	diorite, periodotite, carnelian, amethyst, agate, green quartz, rock crystal, aventurine, malachite, turquoise, nephrite, jade(ite?), serpentine, calcite marble	periodotite, carnelian, amethyst, agate, green quartz, aventurine, malachite, turquoise	diorite, rock crystal, nephrite, jade(ite?), serpentine, calcite marble	Narganes 1999
Punta Candelero	Puerto Rico	citrine, (milky) quartz, aventurine, turquoise, local molted jadeite, exotic nephrite (?), serpentine	is not specified	is not specified	Rodríguez Lopez 1993

Table 5.6. Early Ceramic A phase. Identified lapidary items and production remains by raw material by site.

Zemi three-pointer stones

Apart from axes, adzes, beads, and pendants, not many other items where worked into core tools or artefacts during the Early Ceramic A phase. The frequency of stone three-pointer zemis is strikingly low at this time. Only Morel, Elliots, and Sorcé have yielded finished zemis from excavated contexts (figure 5.8). From Trants, a complete calci-rudite zemi is known, but from an un-provenienced context. At Hope Estate, calci-rudite fragments were found that possibly originated from finished zemis. However, these items are associated with the later occupation phase at this site, which coincides with the Early Ceramic B phase.

Narganes Storde (1999) reports the occurrence of four zemis within the cultural deposits at the Sorcé site, in addition to five examples encountered at Tecla, a site situated on Puerto Rico and attributed to the same phase as Sorcé (Narganes Storde 1999). Among both groups of zemis, she identified four different materials, diorite, serpentine, periodotite, and marble. Although Narganes Storde does not specify a provenance for these materials, similar rock varieties occur in Puerto Rico and the Virgin Islands.

Figure 5.7. Morel, Guadeloupe. Left: a carnelian barrel bead (below; 15 mm length) and related manufacture debitage; Right: amethyst bead and bead fragments (lower fragment has a maximum dimension of 23 mm). (Photos Ben Grishaaver)

A closer look at the sites where stone three-pointers were found reveals that they predominantly fall within the later part of this early phase. Early sites such as Fond Brûlé, but also the first occupation phases at Vivé and Hope Estate, have not yielded these stone artefacts. Apparently, the introduction is a typical Antillean phenomenon and occurred with the first migration of horticulturalists into the area. From its absence at the Martinican sites, its first appearance may be dated somewhere after AD 300. All sites yielding these artefacts have a long occupation, which at least partly post-date AD 300.

Shaped grinding and abrading stones

The number of artefacts in this class is low (table 5.7). Vivé yielded some fragments of passive grinding/abrading stones made of a porphyritic igneous rock. These items originally belonged to large flat stones. One of these exhibits evidence of modification prior to being used, considering its unnatural shaped sides. The Morel sample includes a few very flat igneous passive abrading tools as well. Strikingly, the other sites in my study area did not yield any similar artefacts. Some produced tools that can be classified as passive grinding stones, but these are pebbles that were not shaped prior to use. Rodríguez Ramos (2001a) studied large lithic samples from La Hueca and Punta Candelero and he does not report any of these types of grinding and abrading stones.

Morel yielded another type of tool: it is a broken, flat, light green igneous granular rock with its unbroken end running into a blunt point (figure 5.9). Both sides are ground or abraded into flat and thin, (but blunt) edges. Both faces also

Figure 5.8. Morel, Guadeloupe. Igneous rock zemi three-pointer stone (scale 1:1). (Photo Jan Pauptit)

Site	Rock material	Finished tools N			Preforms N	Flakes and shatter N
		active abrading stone	passive abrading stone	other tools		
Vivé	igneous rock	-	3	-	-	possibly present
(Martinique)	pumice	-	1	-	-	-
Cocoyer (Marie-Galante)	no materials	-	-	-	-	-
Morel	igneous rock	1	-	-	-	possibly present[a]
(Guadeloupe)	fine-grained rock	1	1	-	-	possibly present
Sorcé	pumice	2	-	-	-	possibly present
(Vieques)	sandstone	2	-	-	-	-
La Hueca	silicified shale	10	-	6	-	-
(Vieques)	sandstone	-	-	6	-	-
Punta Candelero (Puerto Rico)	silicified shale	41	-	-	-	-

Table 5.7. Early Ceramic A phase. Number of identified shaped grinding and abrading tools and related manufacture debris by raw material by site. [a] Morel: minor amounts of flake and shatter are present, these, however, can also be related to the manufacture of axes.

display evidence of modification. The faces may have been ground to make the object thinner or abraded through some repetitive usage. In the case of the second modification, this object may have served as an active abrading tool similar to the use of a mano in grinding vegetable substances on a metate. If the modification marks are only related to the shaping of the object, then its function remains unclear. The source of this light green rock remains unspecified. La Désirade, where a huge variety of igneous rocks occur, including green ones, as well as Antigua, where green igneous rock is known, may be possible sources for this material.

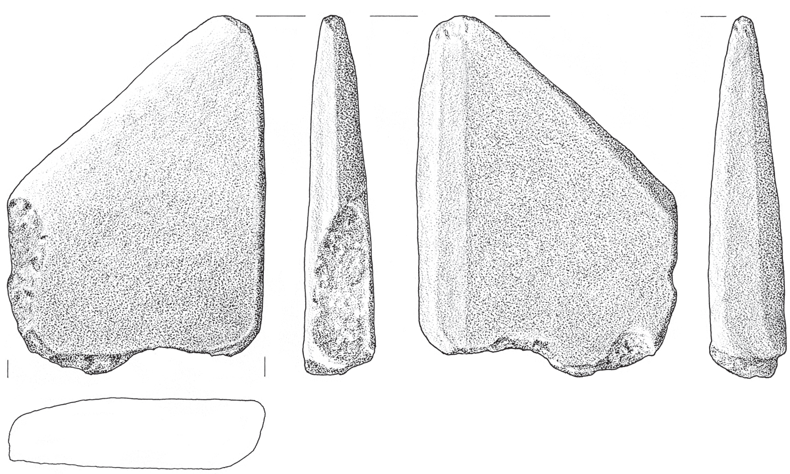


Figure 5.9. Morel, Guadeloupe. Igneous rock fragment of a flat possibly active abrading tool (scale 1:2). (Drawing Raf Timmermans)

Use-modified rock and manuports

Use-modified tools, predominantly in the form of utilized water-worn pebbles, form a significant segment of the lithic collections studied. In addition, the number of pebbles without any evidence of usage is also striking. These latter pebbles represent true manuports originating from elsewhere, as well as pebbles naturally occurring in the site area.

Table 5.8 lists the different tool-types. Following the classification methodology discussed in Chapter 3, only macroscopic identifiable traces of modification were recorded and artefacts were classified to broad functional categories without specifying direction and depth of traces. Preliminary results from microscopic use-wear analysis have shown that many traces resulted from more than a single functional activity (Lammers-Keijzers in prep., personal communication 2001).

Raw materials at the different sites predominantly fall within the igneous rock class for this category of lithic specimens. In addition, limestone, plutonic rock, metamorphic rock, sandstone, chert, quartz, and other fine-grained varieties of an undefined nature occur as well. Igneous rock artefacts display the largest variety of functions. Among the pebbles, the following tool types were identified: hammerstones, anvils, polishing stones, and active and passive abrading stones. Limestone, metamorphic, plutonic, chert, quartz, and jasper pebbles were mainly collected for usage as hammerstones. Rare examples of polishing stones were seen among the limestone, chert, and quartz pebbles. This latter type of tool is commonly associated with fine-grained rock of an undefined nature. Rare sandstone artefacts were used as active and passive abrading stones.

Site	Pebble Material	Tool types (N)						
		non-utilized pebble	hammer stone	anvil	passive abrading stone	active abrading stone	polishing stone	other tool
Vivé (Martinique)	igneous rock	6	1	1	2	-	-	-
Cocoyer (Marie-Galante)	igneous rock	-	1	-	-	-	-	-
Morel (Guadeloupe)	igneous rock	429	20	3	-	26	1	21
	plutonic	52	-	-	-	1	-	-
	metamorphic rock	23	5	-	-	-	-	1
	sandstone	3	-	-	-	1	-	-
	fine-grained rock	-	-	1	-	5	-	-
	chert	3	1	-	-	-	-	-
	quartz	-	1	-	-	-	-	-
	limestone	16	1	-	-	1	-	1
	unidentified rock	1	-	-	-	-	-	-
Sorcé (Vieques)	igneous rock	72	4	2	-	1	26	-
	plutonic	3	1	-	-	-	-	-
	pumice	1	-	-	-	-	-	-
	metamorphic rock	2	-	-	-	-	-	-
	sandstone	-	1	-	-	-	-	-
	fine-grained rock	32	1	-	-	-	9	-
	chert	3	2	-	-	-	2	-
	quartz	25	3	-	-	-	-	-
	limestone	4	-	1	-	-	-	-
	unidentified rock	11	3	-	-	2	4	-
La Hueca (Vieques)	igneous rock	n.s.	present	present	-	-	present	-
	sandstone	n.s.	-	-	present	-	-	-
	fine-grained rock	n.s.	-	-	-	-	present	-
	chert	n.s.	present	-	-	-	-	-
	quartz	n.s.	present	-	-	-	-	-
Punta Candelero (Puerto Rico)	igneous rock	n.s.	present	present	-	-	present	-
	sandstone	n.s.	-	-	present	-	-	-
	fine-grained rock	n.s.	-	-	-	-	-	-
	chert	n.s.	present	-	-	-	-	-
	quartz	n.s.	present	-	-	-	-	-

Table 5.8. Early Ceramic A phase. Number of identified use modified rocks and manuports by raw material, by site. n.s. = not specified.

Contrary to the flake tool and axe/adze materials, many of the lithic varieties at the studied sites either have a local provenance, possibly in the immediate site surroundings, or originate from localities in relatively close proximity. For example, many of the igneous materials found at Vivé and too a lesser degree at Sorcé, La Hueca and Punta Candelero, were probably collected from beaches or stream beds in the vicinity of each site. In the case of Morel, however, as well for the single igneous rock artefact from Cocoyer, the inhabitants had to make boat-trips to the small island of La Désirade or neighbouring volcanic islands such as Basse Terre or les Saintes for the procurement of igneous pebbles. In particular, at the Morel site the majority of the igneous rock resembles the large variety of this rock class natural to the island of La Désirade and easily accessible along many of its beaches. Travel to La Désirade only involves a 25 km boat trip.

Apart from the locally available rock pebbles, the samples from Sorcé, La Hueca and Punta Candelero include some non-local rocks as well. Predominant is the fine-grained black peridotite, similar to the materials used for the axes and adzes, which probably originates in southwestern Puerto Rico. In addition, the chert pebbles and some fine-grained green and light coloured rock varieties likely come from unspecified exotic sources.

Within the class of use-modified artefacts the hammerstones and polishing stones predominate. The Early Ceramic A phase yielded various hammerstone shapes not encountered during later phases. In particular, within the Sorcé and to a lesser degree the Morel sample these different types are well represented. Rodríguez Ramos (2001a) reports a similar variety of hammerstone types for the La Hueca and the Punta Candelero samples:

(a) A round ball shape with use-wear in the form of pits almost totally covering the stone. Only quartz and flint were used for this type of hammer tool.

(b) A round flat shape with six possible locations of use-wear: on both ends, the middle of both faces, and both sides. Igneous rock is predominant among this group; and

(c) An elongated shape with use-wear on one or both ends, and in some cases also on both sides. Igneous rock predominates as well. It should be further noted that a number of re-used artefacts corresponds with this type of hammer tool (figure 5.10).

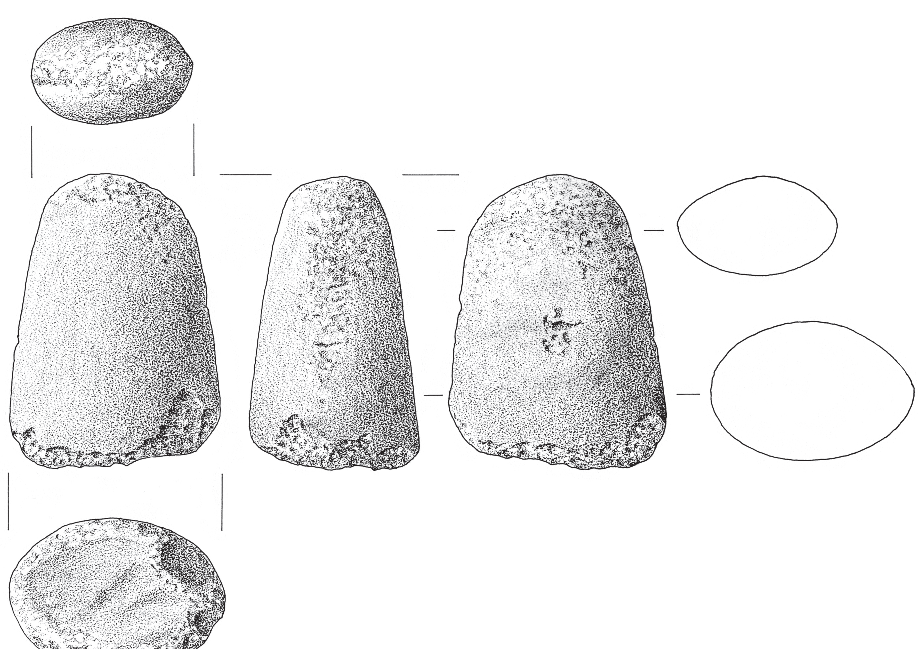


Figure 5.10. Morel, Guadeloupe. Heavily utilized igneous rock hammerstone, exhibiting use-wear on both ends, sides and one face (scale 1:2). (Drawing Raf Timmermans)

Polishing stones are relatively small in size and basically only include fine-grained rock varieties. Black igneous examples from Sorcé, La Hueca, and Punta Candelero, all display clear striated areas (see also Rodríguez Ramos 2001a). In the case of other examples, striations are more difficult to identify.

A variety of abrading stones and rare examples of anvils and passive grinding/abrading stones occur as well. The former group is characterised by significant variation in raw material, size, and location of use marks, suggesting different functions. Anvils are largely made of flat igneous rock pebbles. This is also the case for the passive grinding stones.

Close inspection of the large group of small igneous pebbles found at Morel and originating on La Désirade revealed a black residue, present in a thin band around the stone (figure 5.11) (Stevens 2002). Microscopic analysis of this black residue showed that the substance is organic in nature, and probably was an adhesive to firmly attach something around the rock (Lammers-Keijsers in prep., personal communication 2001). This may have been a rope, suggesting these pebbles may have functioned as fish-net weights, which had firmly been tied to the nets.

The small group of 23 artefacts displaying black residue resembles a larger group, found at Morel, of more than 400 pebbles in size and raw material. These pebbles were mostly excavated in concentrations and may have served the same purpose. In particular, this becomes evident when it is considered that this black residue may have easily eroded from the artefact. For example, some pebbles only have small segments of the original bands displaying this black substance. Another possibility is that this resin was not used on every pebble or that some pebbles were never used and had been collected for future usage. Despite the fact that none of the other sites dating to this phase yielded comparable black residue on pebbles, this particular function may partly explain the strikingly large number of non-modified pebbles excavated at Sorcé.

Comparing the tools among the sites showed that La Hueca and Punta Candelero yielded additional types of lithic tools not encountered at other sites (Rodríguez Ramos 2001a). The most striking example is the edge ground cobble, which is also reported from Preceramic Age contexts. Rodríguez Ramos (2001a) considers the presence of this artefact at these sites as an indication that these two Huecan Saladoid settlements were culturally distinct from their Cedrosan Saladoid neighbours. Again, it is possible that this tool type was picked up by Early Ceramic Age people at a Preceramic Age site. The number of other forms of naturally shaped rock classified as artefacts is small. Only the Sorcé site included a number of red ochre pieces, which probably served as raw material to be pulverised for use as a pigment.

5.2.3 Early Ceramic B

Introduction

Collections varying in size have been studied from nine sites dating to this phase of the Early Ceramic Age (table 5.9). In addition to these sites, Walker (1980) and Crock & Petersen (1999) have reported on lithic samples from another two sites: Sugar Factory Pier and Rendezvous Bay. Furthermore, I exchanged data with Rodríguez Ramos about the later phase of the Punta Candelero site, as well as on the second occupation phase of the Paso del Indio site. Similar to the preceding section the studied samples do not represent all of the complete lithic inventory excavated at these sites (see table 5.9).

Flake tool production

Raw materials

Various fine-grained materials falling into the class of cherts and chert related rocks were again reduced to produce flake tools. Detailed comparison with the previous phase, however, shows that minor changes occurred in some areas with regard to the use of specific chert varieties (table 5.10). This is most apparent in the Guadeloupe – Antigua area, where the white chert almost completely disappeared among most collections. Only at Doigs was a significant number encountered (N=40; 14%). At Anse à l'Eau, the other site with white chert finds, the amount is significantly lower (N=2; 3.3%). Likewise, Corbison Point/Dry Hill chert was not identified in this phase either. In the case of this latter material, its frequency within the Early Ceramic A phase is very low and the difference identified may be merely a result of sample bias.

As a consequence, Early Ceramic B sites on Guadeloupe display a much higher reliance on Long Island flint than before. Similar high percentages of Long Island flint were encountered at sites on St. Kitts, St. Eustatius, and Saba, islands not represented within the earlier phase samples. The abundance of Long Island flint considerably diminishes on St. Martin and beyond, however. At Anse des Pères, for example, only 45% came from Long Island, whereas limited material from the

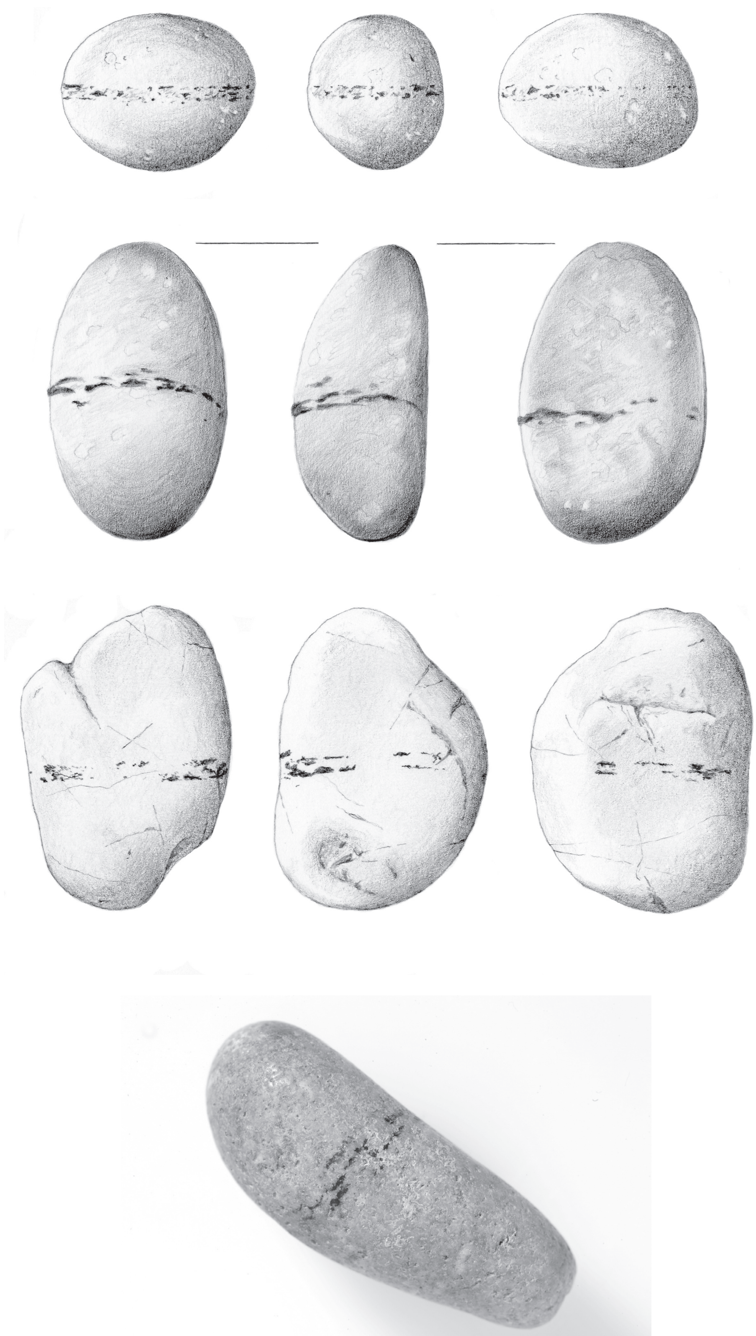


Figure 5.11. Morel, Guadeloupe. Igneous rock pebbles with a thin band of black residue, possibly used as net-weights (scale 1:1). (Drawings Raf Timmermans and photo Ben Grishaaver)

Site	Island	Type of sample	Reference
Diamant	Martinique	all lithics	-
Anse à la Gourde early	Grande Terre	all lithics	-
Anse à l'Eau early	Grande Terre	all lithics	-
Les Sables	La Désirade	all lithics	-
Doigs late	Antigua	flake tool related artefacts	-
Sugar Factory Pier	*St. Kitts*	*all lithics*	Walker 1980a
Golden Rock	St. Eustatius	all lithics	-
Kelbey's Ridge 1	Saba	flake tool related artefacts	-
Anse des Pères	St. Martin	all lithics	-
Rendezvous Bay	*Anguilla*	*all lithics*	Crock & Petersen 1999

Table 5.9. Studied sites from the Early Ceramic B phase. Data from sites in italic have been obtained from literature.

early occupation phases at Rendezvous Bay and Sandy Ground on Anguilla display similar percentages.

In relation to the use of Long Island flint on the island of Antigua itself, the picture is still somewhat vague due to the limited data available. Diachronic variability at the Doigs site along the south coast shows that its percentage increases within the later deposits within a single test-unit analysed, corresponding with this phase. At Mill Reef, where occupation started around this phase well into the Late Ceramic Age, around 68% of flake material is from Long Island, while the remainder originated from other sources local to the island (De Mille 2001).

Data from sites within the Saba – Guadeloupe region show that the exploitation of other Antigua sources and chert materials from other islands remained very limited during this phase. Generally individual varieties other than Long Island do not exceed 5% for most sites. Identified sources include Little Cove or Soldier Point, Blackman's Point, the northeastern part of La Désirade, possibly St. Kitts, and possibly Martinique. With regard to these latter origins, the possible low occurrence of St. Kitts flint at Sugar Factory Pier and on the surrounding islands is striking. Unlike Martinique, where the use of local material inferior to Long island flint is predominant (see below), this is not the case on St. Kitts. I have questioned the true natural nature of the Great Salt Pond and Sugar Factory Pier flint sources on St. Kitts (see Appendix A). However, I was unable to find definite proof for an artificial origin (i.e. ballast dropping during Historic times). If these flint varieties are indeed natural to St. Kitts, this would suggest that the Sugar Factory Pier inhabitants had much easier access to the Long Island material than did the Martinicans. This easy access allowed them to almost totally neglect their Kittian flints, which are scattered in the immediate surroundings of the Sugar Factory Pier settlement. In addition, most sites yielded chert

Site / Chert type	Anse des Pères N=201 %	Kelbey's Ridge 1 N=80 %	Golden Rock N=676 %	Doigs late N=292 %	Anse à l'Eau early N=119 %	Anse à la Gourde early N=15 %	Diamant N=177 %
Long Island flint	45.3	62.5	71.3	54.8	50.4	100	0.6
Blackman's Point flint	-	-	0.3	0.7	0.8	-	-
Coconut Hall flint	-	-	0.4	-	-	-	-
Antigua Form. flint	-	-	1.4	-	0.8	-	-
White chert	-	-	-	13.7	1.7	-	-
Petrified wood	-	-	-	-	1.7	-	6.2
Other chert	35.8	26.3	19.8	30.8	18.6	-	32.8
Désirade red chert	-	-	-	-	1.7	-	-
Jasper	1.5	-	0.6	-	-	-	55.9
White quartz	8.0	-	-	-	-	-	4.5
Unidentified chert	9.5	11.3	6.1	-	25.2	-	-

Table 5.10. Early Ceramic B phase. Relative amount of identified chert types by site.

varieties for which I could not specify a source. In general, these are (slightly) translucent ones, to some extent resembling chalcedony.

On Martinique, the heavy reliance on local chert varieties continued during this phase, similar to the earlier occupation at Vivé. The total amount of local rock at Diamant is approximately 100%, which is similar to Vivé, although the Diamant site differed in the ratios of local materials, probably as a result of the exploitation of other source areas on Martinique, closer to the Diamant site itself. The presence of only one Long Island flake points to the limited acquisition of exotic cherts.

Within the western part of the study area (Puerto Rico and the Virgin Islands), comparison with the earlier phase is hampered by the absence of analysed samples. Rodríguez Ramos, who examined some material from the Cuevas occupation at both Punta Candelero and Paso del Indio sites, noted continuation of the use of chert and flint materials for flake tool production. Despite this continuation, Rodríguez Ramos saw some changes in the raw materials used, with the later phase exhibiting a smaller range. Still, he also identified the use of Long Island flint at both sites (Rodríguez Ramos 2001a, 2005).

Reduction and tool production

Technological analysis did not reveal a significant change from the preceding phase for the Early Ceramic phase B. Chert was reduced on site following a similar expedient technology, both employing bipolar and direct freehand percussion techniques (figure 5.12). The small average size of flake material and cores found on islands surrounding Antigua shows that the materials were worked exhaustively, during which reduction of large flakes to obtain smaller flakes was a commonly employed strategy. At Diamant, a similar small size of flaked materials was encountered, probably due to small natural size of local material available.

Use of flakes occurred in most cases without prior edge modification, although rare examples of secondary edge working were identified. Formal tool types, however, are again lacking. The relatively large flaked lithic sample from Golden Rock includes a wide variety of utilized flakes (figure 5.13). Edge shapes exhibiting use-wear suggest that cutting, scraping, and drilling formed recurrent tasks for which these tools were employed. The presence of utilized cores at Golden Rock provides a good example of the opportunistic usage of these fine-grained materials even after they served as cores.

Cortex data on flakes show that Long Island flint arrived at Golden Rock in unmodified form (see next Chapter). With regard to other varieties, the limited number of artefacts, and the limited knowledge of cortical surfaces for unknown varieties hampered proper insight into the reduction stage at which material arrived on site. Generally, cortical flakes are present among the different samples, suggesting that arrival of unmodified material should be considered as a likely option.

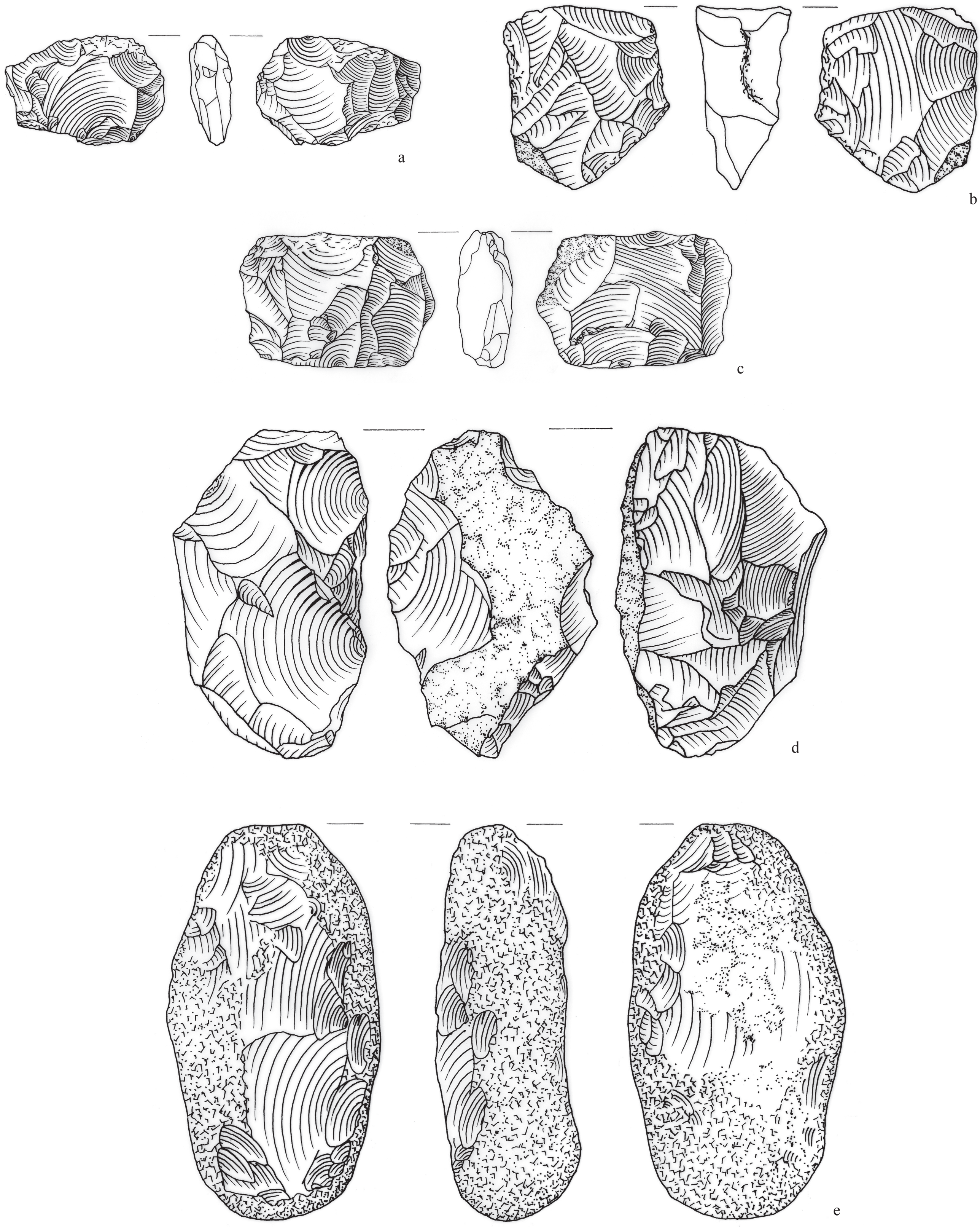
Core tool production

Axes and adzes

The number of axes and adzes found is generally low at each site, but there are a few exceptions (table 5.11). Anse des Pères and Golden Rock yielded a relatively high number of artefacts, which can be largely attributed to local axe manufacture. Comparison with the preceding phase reveals both differences and similarities. Again, the absence of adzes within the Lesser Antilles sites is notable, whereas on Puerto Rico the use of this plano-convex tool still occurred, as is shown by its presence within the corresponding phase at Paso del Indio (Rodríguez Ramos, personal communication 2001). Furthermore, greenstone from St. Martin and different varieties of igneous rock are the predominant rock types at the different sites. In contrast, metamorphic rock is less generally present. Only the Golden Rock site yielded several examples, whereas in the preceding phase all Puerto Rican sites and most Lesser Antilles sites produced some such artefacts. As a result of the low numbers generally it is difficult to establish whether this difference is significant or not.

In contrast to the Early Ceramic A phase, the Early Ceramic B phase yielded considerable evidence of on-site axe manufacture. This increase can be mainly attributed to the expansion of St. Martin greenstone axe fabrication to islands surrounding St. Martin. Sites yielding evidence of axe production are Golden Rock on St. Eustatius (figure 5.14), Rendezvous Bay on Anguilla (Crock & Petersen 1999), and Sugar factory Pier on St. Kitts (Walker 1980). Saba may be included as well, and more detailed analysis of a complete sample of lithic artefacts may attest this in the future.

Evidence relating to the working of igneous rocks is more abundant as well. In particular, the Anse des Pères site on St. Martin yielded a considerable number of preforms and flakes. Within this group, a distinction can be made between the working of water-worn pebbles into axes, including a variety of rock types (figure 5.15), and the reduction of dark coloured fine-grained basalt blocks. The former group probably was obtained from the cobble beach adjacent to the site, whereas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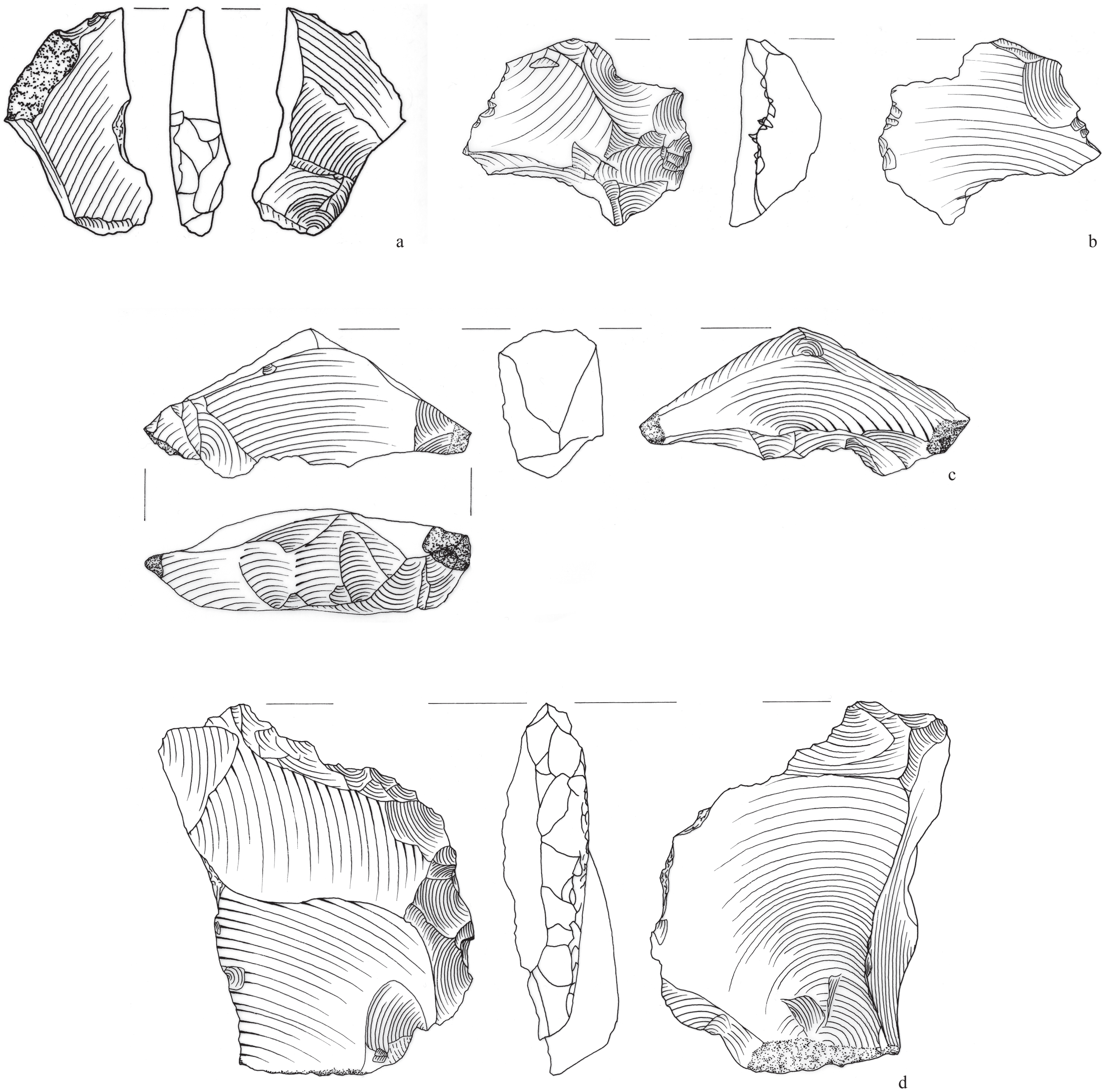


Figure 5.13. Golden Rock, St. Eustatius. Utilized and modified flakes; a. modified flake with use-retouch along a curvate edge; b. core on flake with use retouch; c. bipolarly split flake; d. modified flake with unifacial intentional retouch (scale 1:1). (Drawings Raf Timmermans)

Figure 5.12 (opposite page). Golden Rock, St. Eustatius. Flake cores: a, b, and c. bidirectional bipolar cores; d. polyhedral core; e. flake core later used as hammerstone with use-wear along the entire circumference of the stone (scale 1:1). (Drawings Raf Timmermans)

Site	Island	Rock material	Finished axes/adzes N	Preforms N	Flakes and shatter N
Diamant	Martinique	igneous rock	5	2	63
		St. Martin greenstone	1	-	-
Anse à la Gourde early	Grande Terre	igneous rock	4[a]	2[a]	1[b]
		St. Martin greenstone	3[a]	-	-
Anse à l'Eau	Grande Terre	igneous rock	2	-	5
Les Sables	La Désirade	possibly igneous rock	2	-	-
Sugar Factory Pier[c]	St. Kitts	igneous rock (purple andesite)	1	-	-
		grey porphyritic andesite	-	1	-
		St. Martin greenstone	several	-	32
		finegrained rock	1	-	-
Golden Rock	St. Eustatius	igneous rock	13[c]	4	19
		St. Martin greenstone	66	70	392[e]
		Metamorphic	12	1	8
Kelbey's Ridge 1[f]	Saba	St. Martin greenstone	-	present	present
Anse des Pères	St. Martin	igneous rock	-	9	129
		St. Martin greenstone	23	11	333
		unidentified	-	1	24

Table 5.11. Early Ceramic B phase. Identified axes and axe production related artefacts by raw material by site. [a] Anse à la Gourde: three igneous rock and three greenstone axes are not from test-unit sample, but from other contexts; [b] igneous rock flake is from other material than finished axes; [c] Data from Walker (1980); [d] The Golden Rock sample includes 2 tuff axes; [e] Greenstone shatter and flakes does not include 61(fragmentary) unidentified core artefacts; [f] Material from Kelbey's Ridge 1 has only been superficially and very minimally looked at, this initial inspection, however, confirmed the presence of St. Martin greenstone axe manufacture debris.

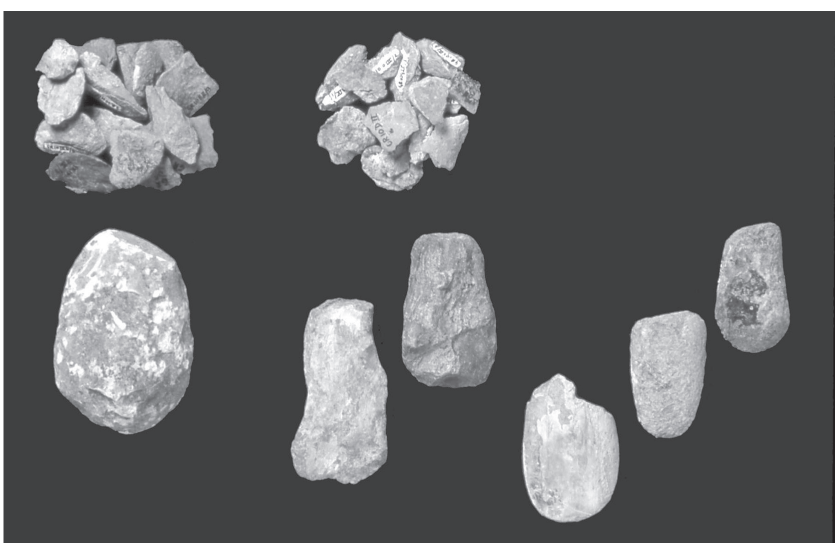


Figure 5.14. Golden Rock, St. Eustatius. St. Martin greenstone axes (lower right) and related manufacture debitage comprising preforms (centre and lower left) and flakes (top). (Photo Jan Pauptit)

Figure 5.15. Anse des Pères, St. Martin. Igneous rock axe preform with one face still bearing the original water-worn surface suggesting procurement of pebbles as raw material for axe manufacture (scale 1:2). (Photos jan Pauptit)

the latter group resembles local material originating on the northern part of the island, as mentioned by Haviser (1999, 200 fig.13.6).

In addition, two other sites produced igneous rock debitage associated with axe production. The Diamant site on Martinique produced clear evidence of axe making out of local igneous water-worn pebbles. At Golden Rock, only some fine-grained flakes resembling a small number of axe preforms can be related to local axe making.

The acquisition of finished tools was attested to at the majority of sites and these not only include sites lacking evidence of local production. Also, settlements with evidence for on-site axe making yielded finished items for which no related debitage was found and which were made from exotic rocks. In particular, the high number of imported tools at the Golden Rock site is striking, when it is recognised that local greenstone and igneous rock were worked into axes as well (figure 5.16). This combination of import and local production may indicate various things. Either distinct materials were used for different purposes, or their presence is explainable from a social perspective. It was a result of the participation of Statia inhabitants in a regular exchange network, in which these items did not necessarily meet a functional demand, but rather, they fulfilled a predominant social role, as gifts to bind exchange partners, for example.

Some sites point to the import of axes made out of a fine-grained variety of greenstone that is different from the St. Martin greenstone, and which probably represents an igneous rock. This shows that this material had a regional importance within the northern Lesser Antilles more broadly. Sites yielding these finished items included Anse à la Gourde, les Sables, and Diamant (figure 5.17).

Beads and pendants

One of the most striking differences in stone working between the Early Ceramic A and later phases relates to the making of stone beads and pendants. The difference is twofold. Firstly, stone beads and in particular stone pendants become less frequent during later phases, particularly in the Early Ceramic B phase. Secondly, a number of specific gem stone varieties disappeared, with predominantly local varieties remaining as raw materials for bead making (table 5.12).

The first difference is most clearly shown by a comparison of the Golden Rock site dating to the Early Ceramic B phase with the sites on Vieques and Puerto Rico dating to the preceding phase. Not a single pendant and only two beads

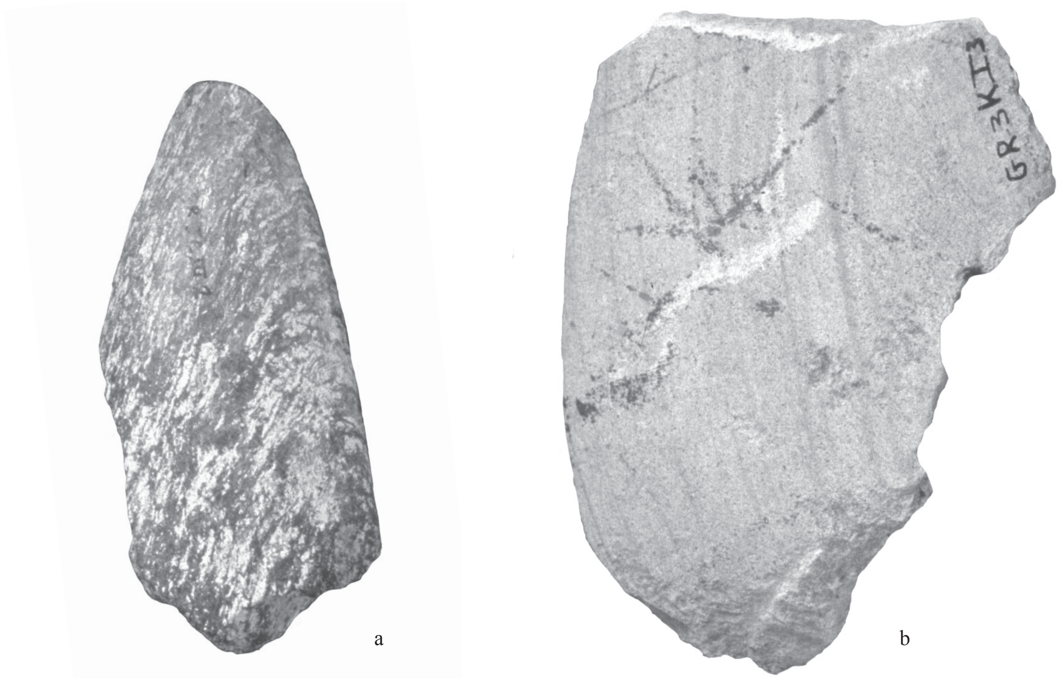


Figure 5.16. Golden Rock, St. Eustatius. Two axe fragments made of exotic metamorphic rocks (scale 1:1). (Photos Jan Pauptit)

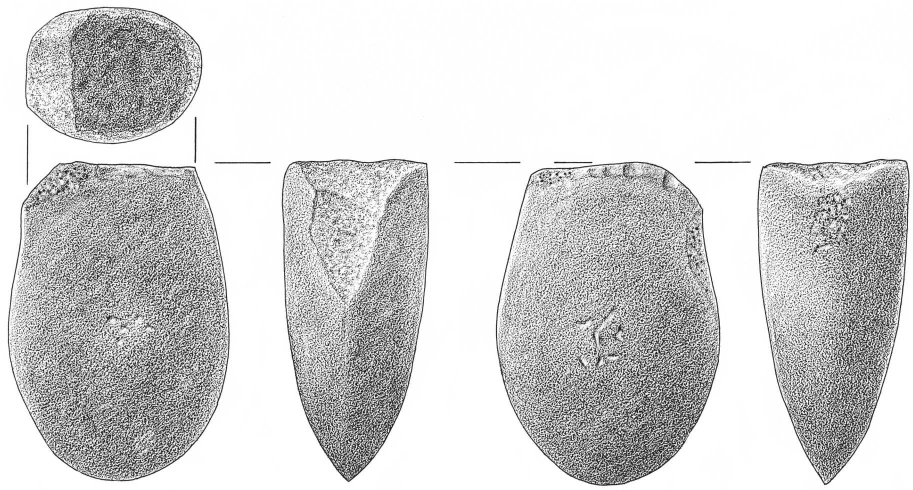


Figure 5.17. Anse à la Gourde early occupation phase, Guadeloupe. Igneous rock axe fragment with evidence of use-wear suggesting later use as a hammerstone (scale 1:2). (Drawing Erick van Driel)

were recovered at Golden Rock out of a total of more than 3500 stone artefacts excavated from a 352 m² midden area.[5] This markedly contrasts to a reported average density of 2.3 lapidary items per m² found at La Hueca (Oliver 1999, 293). The

5 These do not include the numerous quartz beads originally part of a necklace, which were found at one of the burials (Versteeg & Schinkel 1992).

Site	Island	Rock material	Finished only	Production	Reference
Diamant	Martinique	no items found	-	-	Bérard & Vernet 1999
Anse à la Gourde early	Grande Terre	no items found	-	-	-
Anse à l'Eau early	Grande Terre	no items found	-	-	-
Les Sables	La Désirade	no items found	-	-	-
Sugar Factory Pier	St. Kitts	quartz, serpentine, unidentified rocks, calcite	quartz, serpentine, unidentified rocks	calcite	Walker 1980a
Golden Rock	St. Eustatius	limestone, rock crystal, meta-morphic rock	-	limestone, rock crystal, meta-morphic rock	Versteeg & Schinkel 1992
Kelbey's Ridge 1	Saba	no items found	-	-	-
Anse des Pères	St. Martin	green unidentified rock	green unidentified rock	-	-
Rendezvous Bay	Anguilla	calcite	-	calcite	Crock & Petersen 1999

Table 5.12. Early Ceramic B phase. Identified lapidary items and production remains by raw material by site.

difference is exaggerated to some extent by the use of a larger mesh-size at Golden Rock. However, it cannot explain the total absence of pendants and barrel beads, which largely exceed the Golden Rock mesh-size in their dimensions. Low occurrence of beads and an absence of pendants are attested as well during limited test-excavations at Anse des Pères, where smaller mesh-sizes were used (Knippenberg 1999b, c).

With regard to stone varieties, the following repetitively used ones during the Early Ceramic A disappeared, or became considerably rare within the second phase: carnelian, amethyst, citrine, aventurine, and turquoise. Considering their disappearance at around AD 400, these varieties can be used as chronological markers.

The few beads related to the Early Ceramic B phase are made of quartz (Golden Rock) and a green stone variety (Anse des Pères). In addition, Walker (1980, 177-179) reports the finding of several beads made of quartz, a white and a green rock, as well as one greenstone pendant at the Sugar Factory Pier site. Furthermore, he mentions the occurrence of some calcite crystals. With regard to this latter crystal variety, it is yet unclear whether calcite beads found at Rendezvous Bay and Sandy Ground should be attributed to this phase as well (Crock 2000; Crock & Petersen 1999). They probably belong to the later occupations at these sites, as is suggested by the finding of calcite in only the upper levels of Sandy Ground. Furthermore, relatively large quantities of calcite crystals and amorphous pieces found at later sites on Anguilla, such as Barnes Bay and Shoal Bay East, may suggest that local calcite production is mainly attributable to the following Late Ceramic A phase (see below). Local bead production using any of other rock varieties was not identified among the different studied samples for this phase.

This marked difference with the preceding phase, in particular the disappearance of certain gem stones possibly originating in South America, as well as certain pendant forms with a South American "signature," suggests the termination of most long-distance contacts, which were characteristic during the Early Ceramic A phase.

Zemi three-pointer stones

In contrast to the preceding phase, during which zemis and zemi making were only rarely practised, one site dated to the the Early Ceramic B produced clear evidence of stone zemi usage and probable manufacture as well (table 5.13). At the Golden Rock site, zemis are recurrent and include a number of different stone varieties, both local and non-local. Among the 11 complete and 2 fragmentary examples, limestone, calci-rudite, pumice, igneous rock, and an unidentified rock variety, probably a tuff or igneous rock, are found (figure 5.18). Debitage relating to the manufacture of zemis is rare. Still, some of the items may have been locally fabricated. This particularly accounts for the pumice. This material occurs on the island and its relatively soft nature may have made grinding it a relatively easy task, and as a result evidence of any preceding flaking stage probably was limited or totally absent.

Limestone and igneous rock are also available on St. Eustatius (Westermann & Kiel 1961). At present, however, it cannot be stated whether the specific raw materials used for the zemis have a local origin or not. The variety of limestone

Site	Island	Rock material	Finished zemis N	Preforms N	Flakes and shatter N
Diamant	Martinique	no items found	-	-	-
Anse à la Gourde early	Grande Terre	no items found	-	-	-
Anse à l'Eau	Grande Terre	no items found	-	-	-
Les Sables	La Désirade	no items found	-	-	-
Sugar Factory Pier [a]	St. Kitts	no items found	-	-	-
Golden Rock	St. Eustatius	igneous rock	1	-	-
		pumice	3	-	-
		calci-rudite	4	-	1
		limestone	4	-	-
		other	1	-	-
Kelbey's Ridge 1	Saba	no items found	-	-	-
Anse des Pères	St. Martin	no items found	-	-	-
Rendezvous Bay [b]	Anguilla	calci-rudite	possibly	possibly	possibly

Table 5.13. Early Ceramic B phase. Identified zemi three pointer stones and production remains by raw material by site. [a] Data from Walker (1980a); [b] Data from Crock & Petersen (1999).

types among the zemis may suggest that at least some of them were obtained from elsewhere. Also, the two igneous rock zemis differ in material and these materials are distinct from the large bulk of igneous rock used at Golden Rock. In addition, related debitage in the form of flakes and preforms is absent, also suggesting an exotic provenance for these zemis. The four calci-rudite artefacts clearly resemble the material from St. Martin, exhibiting the typical mixture of light and dark grains cemented in a fine-grained matrix. In addition to the calci-rudite zemis, one undifferentiated flat piece of rock, probably a flake fragment, made of similar material was also identified. This rarity of debitage points to arrival of finished calci-rudite zemis at Golden Rock.

A striking feature of the group of zemis at Golden Rock is their relatively small size, with the maximum dimension ranging from 21 to 52 mm. This finding is supportive of the general notion that the oldest zemis are small and generally become larger during Late Ceramic times. Three recurrent shapes were identified: a simple one, a zemi with an incision on its base, and one with an inflected base. Only among this latter type, two examples have thin incisions at the top.

A considerable number of zemis have been found at Rendezvous Bay on Anguilla (Crock & Petersen 1999). Particularly in relation to calci-rudite zemi manufacture, this site must have played an important role, as argued by Crock and Petersen. The long occupation encompassing large portions of the Early Ceramic B and Late Ceramic A, makes it difficult to precisely date the recovered artefacts, however. A major portion of the zemi production and finished zemis probably can be dated to the Late Ceramic Age occupation. Still, Crock and Petersen also mention the finding of a pedestalled example, which they consider to be Saladoid, so falling within the Early Ceramic B phase. Ongoing research at this site may well specify if calci-rudite zemi production actually can be dated this early. If this can be established, it would provide a possible explanation for the origin of the finished Golden Rock examples, for which a production place has not to be identified (see next Chapter).

Apart from these two sites, zemis are absent among the other collections dated to this phase. This may be a result of sample bias, considering the generally rare occurrence of this type of artefact. Collections of most sites do include more than 250 lithic artefacts, the average number of stone items per zemi at Golden Rock. The sample size at the Anse des Pères site, however, exceeds this number by far and the absence suggests a clear difference. This becomes even more striking if one realises that Anse des Pères is situated only a few hundred metres from the Pointe Arago locality, the present source of the calci-rudite material.

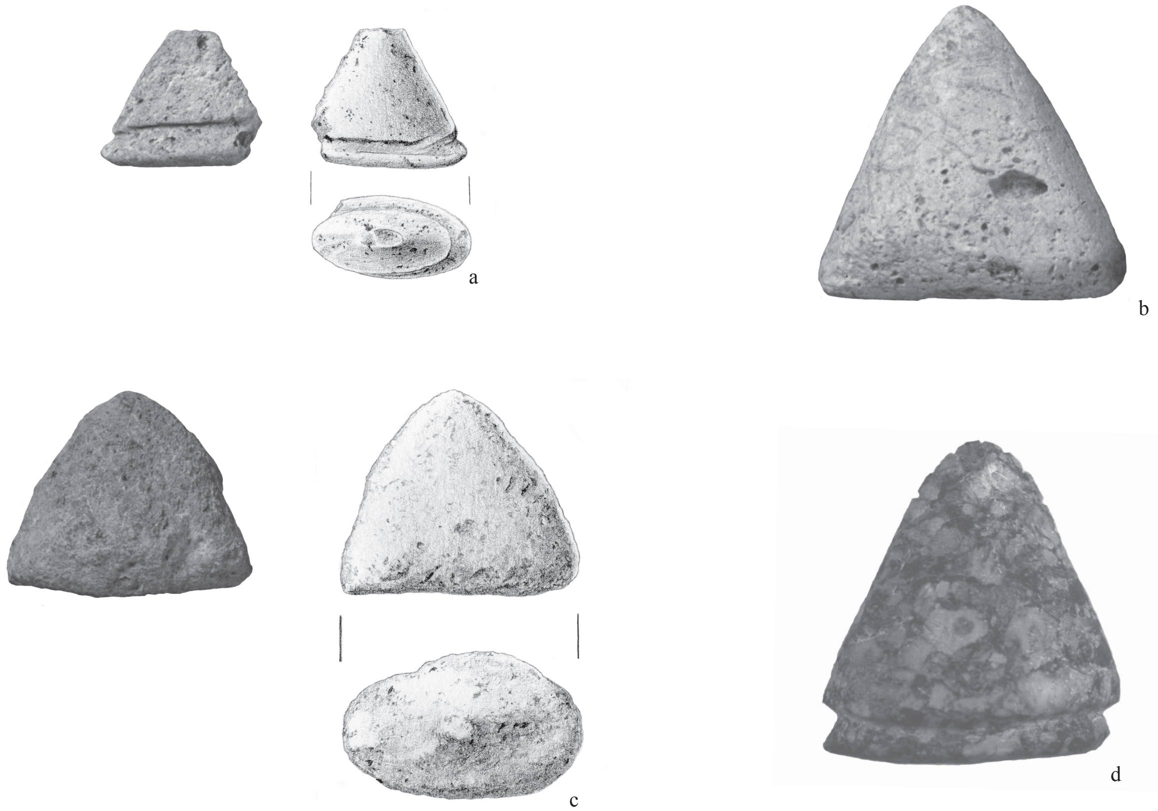


Figure 5.18. Golden Rock, St. Eustatius. Zemi three-pointer stones: a. pumice zemi with inflected base; b. limestone zemi; c. igneous rock zemi; d. calci-rudite zemi with incision on the top (scale 1:1). (Photos a, b and c Jan Pauptit; Drawings Raf Timmermans)

Shaped grinding and abrading stones

This phase includes a number of sites where relatively extensive use was made of shaped passive grinding stones and use-modified examples (tables 5.14 and 15). Being rare during the preceding phase, the large sample from Golden Rock, and the much smaller sample from the Saladoid occupation at Anse à la Gourde contain a significant number of predominantly fragmentary grinding slabs. The even smaller lithic sample from Diamant yielded a few fragmentary artefacts as well. Golden Rock is remarkable because of its high abundance of grinding and abrading stones and by the fact that these tools were locally made. Despite the notion that the number of complete items is very small, the large number of rock fragments with a flat or concave smooth surface clearly resulting from abrasion, points to a common use of passive grinding or abrading slabs at this village.

Different materials were identified among these artefacts. The largest group is formed by igneous rock, which includes two recurrent rock varieties and a large group of mainly individual pieces. Among the igneous rocks, a dark porphyritic variety is predominant, exhibiting clear and large phenocrysts, whereas the other variety is light coloured, containing small phenocrysts. Other recurrent materials are beach-rock and a yellow crumbly rock, which possibly represents a weathered igneous rock. Most of these materials are local to St. Eustatius. The beach-rock, which is built up by a mixture of calcareous and volcanic sand grains, exhibits similarities with the present sand composition along the eastern coast of St. Eustatius (personal observation 1999), although the actual occurrence of beach-rock has not been reported on the island (Westerman & Kiel 1961). The light igneous rock has been identified among rock material scattered on the surface within the Cultuurvlakte (personal observation 1999). For the dark coloured rock, no specific source location can be specified, although some of the phenocrysts identified in it, such as feldspar and hornblende, correspond with mineral contents of igneous rock on the island (Westermann & Kiel 1961).

Site	Rock material	Finished tools N			Preforms N	Flakes and shatter N
		active abrading stone	passive abrading stone	other tools		
Diamant	igneous rock	1	2	-	-	possibly present
(Martinique)	pumice	1	-	-	-	-
Anse à la Gourde	igneous rock	-	4	-	-	-
(Guadeloupe)	beach-rock	-	1	-	-	possibly present
Anse à l'Eau (Guadeloupe)	unidentified rock	1	2	-	-	-
Les Sables	igneous rock	-	6	-	-	possibly present
(La Désirade)	limestone		1	-	-	-
Sugar Factory Pier	igneous rock	-	23	2	-	present
(St. Kitts)	fine-grained rock	-	-	4	-	-
Golden Rock	igneous rock	2	185	51	-	<49
(St. Eustatius)	pumice	9	-	-	-	-
	yellow stone	-	21	-	-	-
	tuff	-	2	3	-	-
	limestone	-	1	2	-	possibly present
	beach-rock	-	-	1	-	-
	unidentified rock	3	7	8	-	possibly present
Anse des Pères	igneous rock	-	1	-	-	-
(St. Martin)	St. Martin greenstone	5	-	1	-	present

Table 5.14. Early Ceramic B phase. Number of identified shaped grinding and abrading tools and related manufacture debris by raw material by site.

Among these tools broadly, four types of abrading stones can be distinguished:

1) Large flat stone pieces with a concave abraded surface and slightly raised rim part. An almost complete example originated in one of the posthole features (F 201) within the habitation area of the site (figures 5.19 and 5.20). After its use as a grinding stone, it functioned as stone packing around the wooden post of this feature (Schinkel 1992, 159 fig. 131). Generally, the dark porphyritic as well as the yellow crumbly rock are associated with this shape;

2) Flat stone pieces with flat abraded surfaces without a raised or a distinct rim part. This type is mainly found among both igneous varieties;

3) Large flat water-worn pebbles, often exhibiting a slightly convex used surface. This type is mainly found among the beach-rock artefacts. One example provides insight to its original function, as it exhibits residue of red ochre on its used face. Rare examples were found among the porphyritic igneous variety. This type of tool actually belongs to the use-modified group of artefacts, but it is discussed here for a better overview of passive grinding stones; and

4) Flat stones with an oblique abraded face. Only a few examples were identified and predominantly include rare, often fine-grained rock varieties.

Some uncertainties remain concerning the making and shaping of these artefacts. The fragmentary nature and the extended use-life of most of them have blurred most evidence of any shaping activities. Also, the sample does not include large numbers of clear manufacturing debitage in the form of flakes or shatter. This does not account for the light igneous rock variety, which includes a major portion of small blocky pieces and some flat rocks with abraded surfaces. As this rock variety occurs nearby the site, it is not always easy to distinguish production debris from natural rock. Some pieces suggest artificial breaking. Combined with the few passive abrading stones with clearly used surfaces, some evidence suggests that the rocks were shaped to some extent.

For the other rock categories, especially the dark porphyritic one, some artefacts suggest intentional shaping as well. For the most part, their unnatural flat shapes and the presence of steep angles between sides and used faces indicate this. Depending on the nature of the source localities visited, rock slabs were removed from outcrops, in the case of primary

Site	Pebble Material	Tool types (N)						
		non-utilized pebble	hammer stone	anvil	passive abrading stone	active abrading stone	polishing stone	other tool
Diamant	igneous rock	4	5	-	-	-	-	-
(Martinique)	fine-grained rock	-	-	-	-	-	1	-
Anse à la Gourde early	igneous rock	23	9	-	-	1	-	-
(Guadeloupe)	plutonic rock	-	1	-	-	-	-	-
	limestone	10	1	-	-	-	-	-
	beach-rock	1	-	-	-	-	-	-
	unidentified rock	1	-	-	-	-	-	-
Anse à l'Eau early	igneous rock	14	4	1	-	-	3	-
(Guadeloupe)	plutonic rock	3	-	-	-	-	1	-
	fine-grained rock	-	-	-	-	-	3	-
	chert	1	-	-	-	-	-	-
	quartz	2	-	-	-	-	-	-
	unidentified rock	-	-	-	-	-	1	-
Les Sables	igneous rock	39	5	-	1	2	2	-
(La Désirade)	plutonic rock	1	-	-	-	-	-	-
	unidentified	1	-	-	-	-	-	-
Sugar Factory Pier	igneous rock	n.s.	1	Numerous [a]	-	-	11	-
	tuff	n.s.	14	-	-	-	-	-
(St. Kitts)	chert	n.s.	1	-	-	-	-	-
	beach-rock	n.s.	-	1	1	-	-	-
Golden Rock	igneous rock	478	69	6	3	19	17	4
(St. Eustatius)	pumice	10	-	-	-	2	-	2
	plutonic rock	1	-	-	-	-	-	-
	yellow stone	1	-	-	-	-	-	-
	fine-grained rock	18	1	-	-	2	45	-
	St. Martin greenstone	10	10	-	-	-	1	-
	chert	2	2	-	-	-	-	-
	quartz	-	2	-	-	-	-	-
	limestone	22	4	-	-	-	-	-
	beach-rock	-	-	-	40	-	-	-
	unidentified rock	12	3	1	-	-	3	-
Anse des Pères	igneous rock	49	4	-	1	8	9	-
(St. Martin)	plutonic rock	6	2	1	-	3	-	-
	fine-grained rock	18	2	-	-	1	20	-
	unidentified rock	12	-	-	-	1	11	-

Table 5.15. Early Ceramic B phase. Number of identified use modified rocks and manuports by raw material, by site. [a] Walker (1980a) mentions 13 anvils, both water-worn as well as tabular shaped; n.s. = not specified.

sources with the help of rock splitting through rapid heating and cooling. Alternatively, in the case of secondary scatters, large boulders were split and shaped by removing a few large flakes. The absence of irregularities in the form of ridges from original flaking scars suggests that the toolmakers employed some kind of pecking technique to remove these irregularities.

The initial shaping stage, in which large flakes were removed to give the tool its overall shape, probably did not occur at Golden Rock itself and was likely done at the source location. This would explain the low occurrence of related flakes, which cannot account for the large number of metate fragments found. Considering the large size of at least some of the tools, this behaviour would have reduced a lot of unnecessary weight to be carried.

In contrast to the use of predominant local rock at Golden Rock, most passive grinding stones made of igneous rock at Anse à la Gourde have an exotic origin. One complete example and five fragments were identified. The neighbouring island of La Désirade is the most likely origin. The shape of the complete example, made of a green rock, is rather exceptional, being

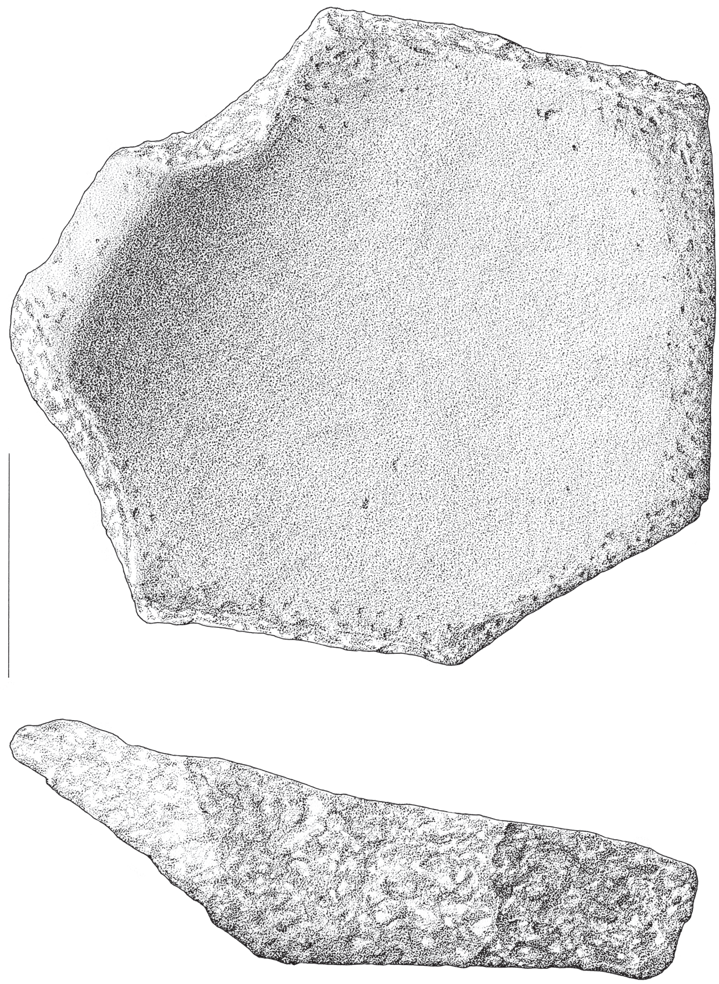


Figure 5.19. Golden Rock, St. Eustatius. Passive grinding slab (metate) made of igneous rock (scale 1:4). (Drawing Raf Timmermans)

thick with an elongated abraded area (figure 5.21). This suggests its use as passive tool, against which axes or other objects were ground. Originally, the stone must have been a large, slightly rounded boulder, which likely was split in two, to create a grinding face. The non-used surfaces of this rock are irregular, suggesting that it was not elaborately shaped and finished. Some of the ridges at least suggest that the raw material underwent some crude shaping by removing large portions.

The other fragments are made of various rock types and originally belonged to thinner tools. One artefact is made of a somewhat crumbly yellow stone material, possibly a weathered igneous rock that resembles some material encountered at Golden Rock. Its provenance, however, remains unknown. Other rock materials include probable local limestone beach-rock and exotic dark granular igneous rock. The granular igneous rock was also identified among some fragments of passive grinding stones found at Les Sables on La Désirade. The Diamant collection only includes two passive grinding stone fragments of local igneous rock.

A striking artefact type at Anse à la Gourde is a flat ground or abraded object made of a moderate grained, light greenish grey, possibly igneous rock (figure 5.22). It resembles the flat green artefact found at Morel, which was described above. This flat object exhibits traces of abrasion or grinding on the two faces, both convex in outline, which meet in a blunt edge-like end. Similar to the Morel example, it is difficult to discern to what extent this object was intentionally ground, or whether repetitive usage caused its present form. The excavations yielded more and larger examples of these flat tools from un-

Figure 5.20. Golden Rock, St. Eustatius. Photo of passive grinding slab (metate) made of igneous rock (scale 1:4). (Photo Jan Pauptit)

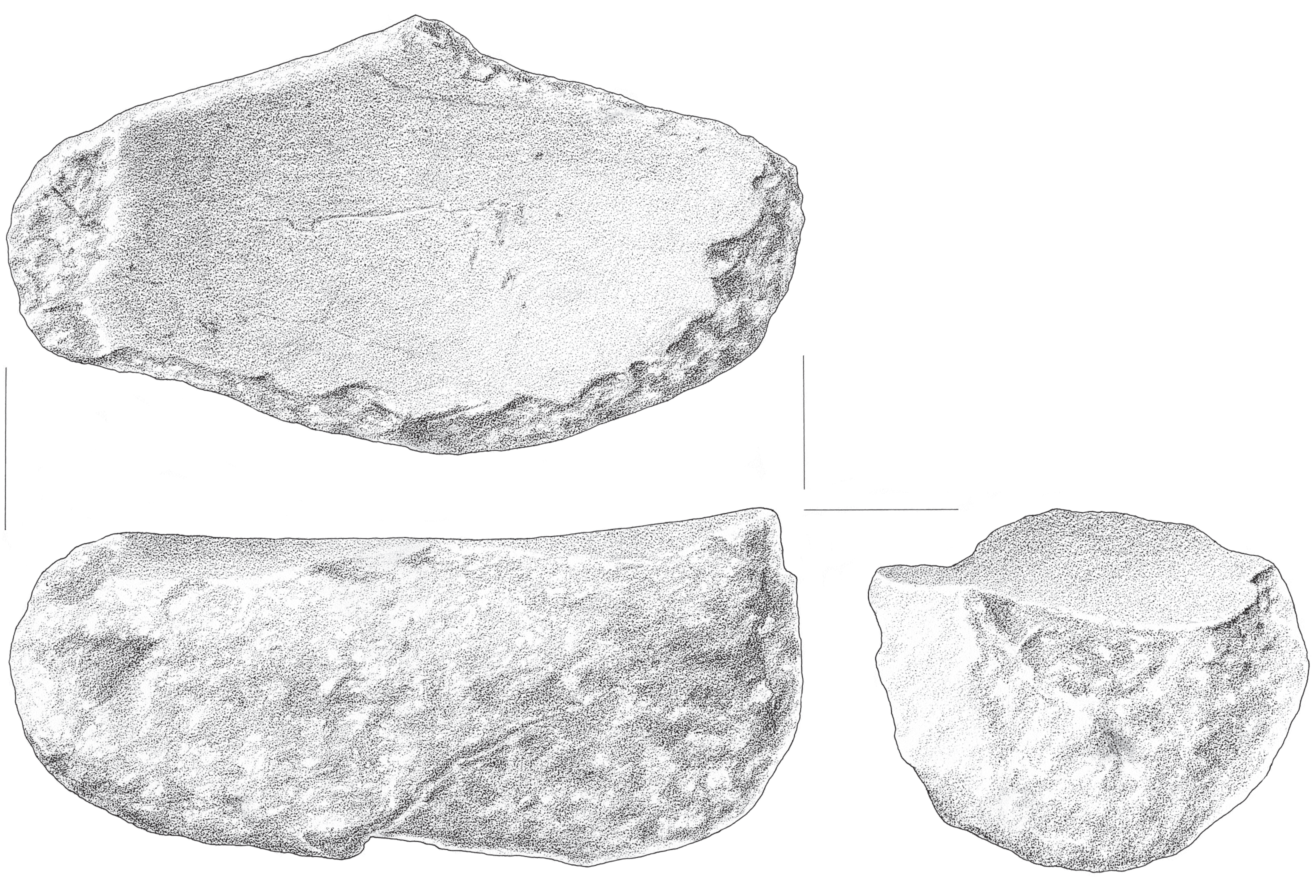


Figure 5.21. Anse à la Gourde early occupation phase, Guadeloupe. Igneous rock passive grinding stone (scale 1:2). (Drawing Raf Timmermans)

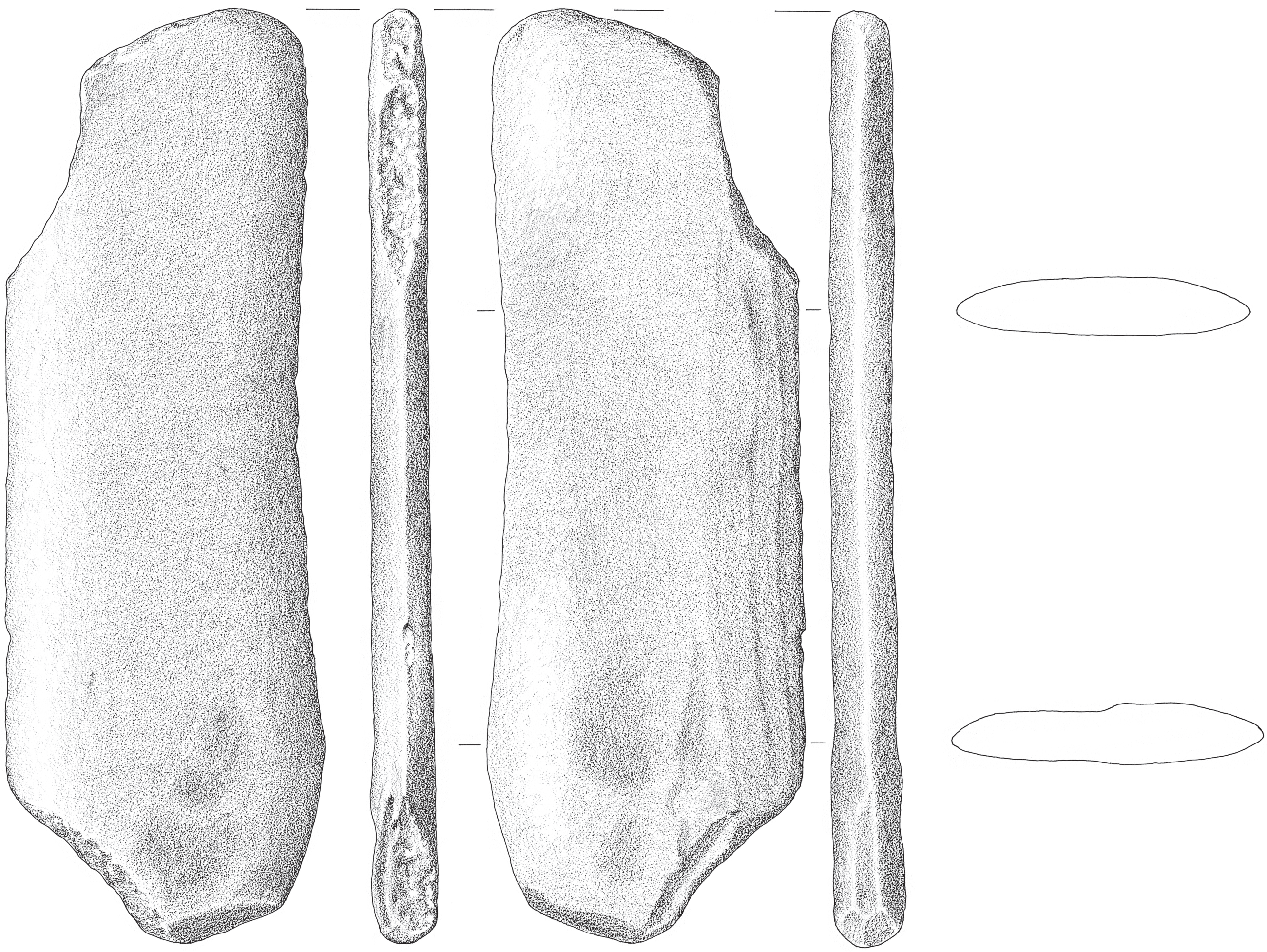


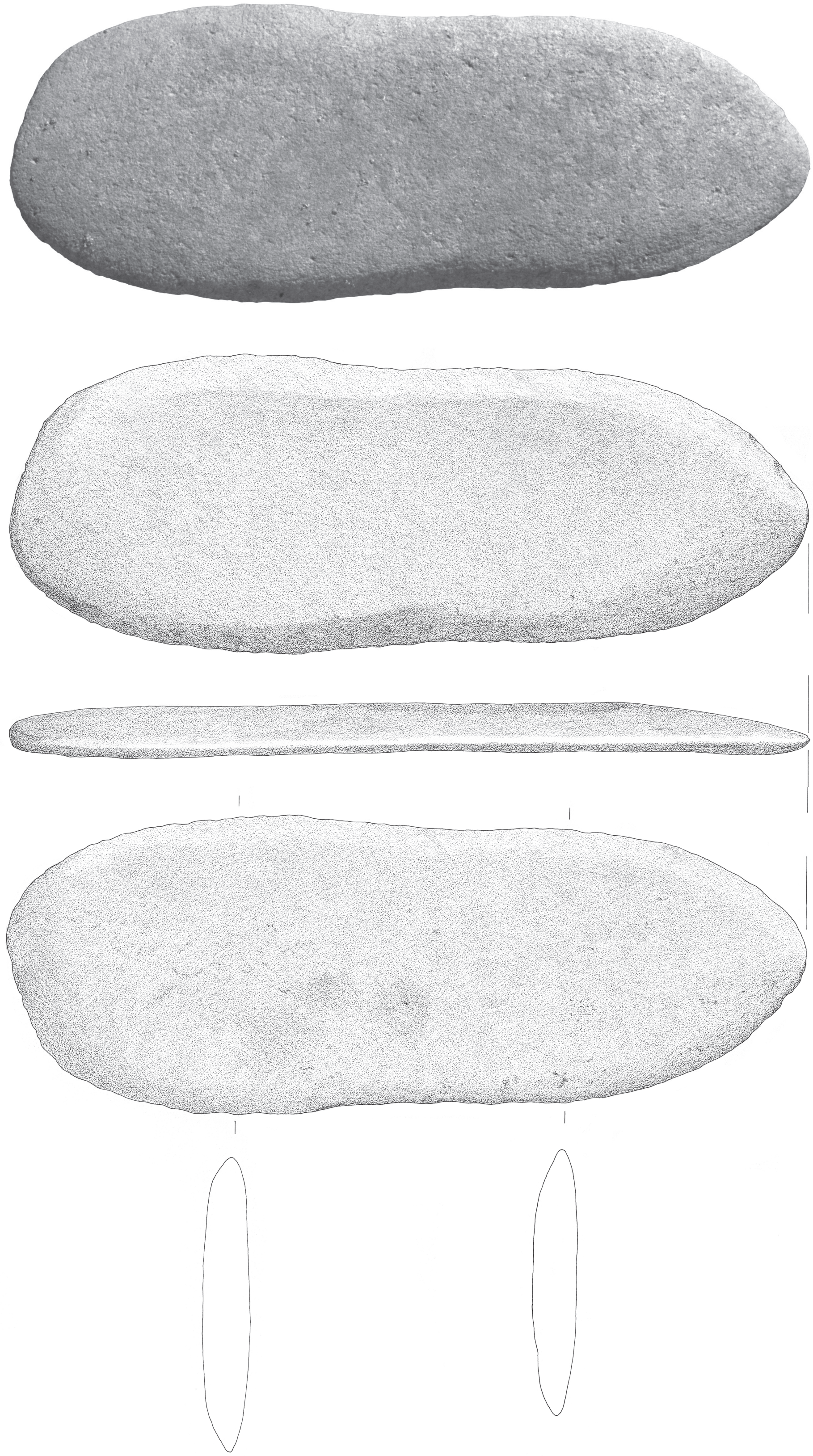
Figure 5.22. Anse à la Gourde early occupation phase, Guadeloupe. Igneous rock flat possible active grinding stone (scale 1:2). (Drawing Raf Timmermans)

screened and less well-dated contexts. All are complete or fragments of finished artefacts. An exceptional example measures 350 x 132 x 20 mm, with one round and a one pointed end. Initial shaping through grinding must have certainly played a role in the formation of this artefact (figure 5.23).

The most likely function of this kind of tool would have been hand-held as an active grinder for grinding vegetal substances, similar to manos in Meso-America. The complete and almost complete passive grinding/abrading stones found at Anse à la Gourde, however, do not correspond with these green flat artefacts in size and concavity, suggesting that the function of these flat rocks is not related to the passive tools. The origin of this material remains to be identified, but green, light coloured igneous rocks are found on La Désirade and Antigua (personal observation 1998, 1999).

Looking broadly at the relatively rich sample of passive grinding stones from this phase, many have a local origin and inter-island transport and exchange of these tools does not seem to have been common. Despite the significant presence of locally made dark igneous tools on Golden Rock, examples made of this variety were not found at other sites. This suggests that the making of these tools at Golden Rock was for local use only. The only varieties that have turned up at more than one site are the granular igneous rock, probably originating from La Désirade and found at Les Sables and Anse à la Gourde, and the yellow crumbly rock found at Golden Rock and Anse à la Gourde.

Figure 5.23 (opposite page). Anse à la Gourde early occupation phase, Guadeloupe. Igneous rock flat possible active grinding stone (scale 1:3). (Photo Ben Grishaaver and Drawing Raf Timmermans)



Use-modified rock and manuports

Use-modified materials and manuports continued to form a significant part of the archaeological collections studied in this phase. Most of these items are water-worn pebbles of many different sizes. In relation to the first group, igneous rock represents the largest group of used pebbles, but other types of rock include limestone, beach-rock, fine-grained rock, and rarely plutonic rock, metamorphic rock, chert, quartz, greenstone, and pumice (table 5.15). The largest variety in tools is seen among the igneous rocks, evident as hammerstones, anvils, active abrading stones, polishing stones, and passive abrading stones. Fine-grained rock is predominantly associated with the use of polishing stones, whereas the rare materials, such as plutonic rock, limestone, chert, greenstone, and quartz, were used as hammerstones. Pumice and beach-rock respectively, were used as active and passive abrading/grinding stones. Metamorphic rocks were used for hammering, polishing, and abrading. A closer look reveals that generally the hard and tough materials are associated with hammering tools, a notable exception being limestone. Fine-grained hard rock was used for polishing, and the coarser varieties of igneous rock, vesicular pumice, and granular beach-rock were basically found among the abrading or grinding tools.

Comparison of the different sites reveals significant inter-site variation with regard to raw materials. Although igneous rock occurs at most sites, the actual varieties encountered differ among sites. This inter-site variation is likely the result of the variation in local island specific geology. This group of artefacts, more than the tools from other technology sets, was obtained from nearby localities. Therefore, its usage was strongly dependent on local geology. These nearby sources were not necessarily situated within the immediate site surroundings, however. Anse à la Gourde and Anse à l'Eau, for example, are situated within an almost exclusively limestone region along the northern coast of Grande Terre. This was as a poor setting for procurement of these types of tools. As a result, the local inhabitants, like their Morel predecessors, obtained most of their use-modified and non-modified pebbles from the small island of La Désirade.

At Golden Rock, the situation is totally different. Most of the rock varieties encountered are igneous in nature, and can be found on St. Eustatius itself relatively close to the site (figure 5.24). Also, pebbles found at Anse des Pères fall within the relatively large range of varieties scattered on the cobble beach adjacent to the site. In the case of this site, therefore, it should be questioned whether the non-modified pebbles are actually manuports, or whether they simply represent natural material scattered in the site-area.

Apart from transport of pebbles from La Désirade to the Grande Terre sites, there is one recurrent pebble variety that generally does not occur locally on many of the islands of discovery and which probably was transported over considerable distances. These are the fine-grained pebbles used as polishing stones. The Golden Rock and Anse des Pères sites yielded a considerable number of small polished pebbles displaying very fine striae, made of green, grey-green, grey, to almost white varieties. A few resembled the greenstone from St. Martin used for making axes, while others were almost cherty in nature. Considering the large variety of fine-grained rock on St. Martin in the form of re-crystallised tuffs or cherty tuffs displaying these colours (Christman 1953; personal observation 1993, 1999), St. Martin is a likely source for these pebbles. This may also account for some of the pebbles found at the Grande Terre sites, although other varieties not resembling the possible St. Martin ones were seen as well. This exotic nature of many of the polishing stones relates well with anthropological reports about indigenous peoples in the Amazon, who highly value these objects (figure 5.25) (e.g., Yde 1965; Renzo Duin, personal communication 1999).

Pebbles without any signs of modification or use can be considered as true manuports in many cases, because they were brought from elsewhere. This applies to most of the rocks found at Anse à la Gourde, Anse à l'Eau, and Golden Rock. Only at Anse des Pères and possibly Diamant, pebbles are naturally occurring in the site area. Therefore, it can be questioned whether they were deliberately collected and taken to the site in these cases.

The possible usage of non-modified pebbles as fish-net weights, as was argued for a large portion of pebbles at Morel, should be considered again. Among the pebbles found at Anse à la Gourde, one actually contains the remains of a similar black residue, as was encountered at Morel. Furthermore, many of the pebbles from Anse à la Gourde and Anse à l'Eau fall in the size range and are of the same material as the black residue pebbles. At Golden Rock, large numbers of similar small sized pebbles also occur, which may suggest a similar usage. If these pebbles were indeed used for this purpose, it would explain their high frequency in the archaeological record, in particular at the Grande Terre sites.

Figure 5.24. Golden Rock, St. Eustatius. Flat igneous rock pebble used as an anvil (scale 1:2). (Photo Jan Pauptit)

5.2.4 Late Ceramic A

Introduction

A total of 13 Late Ceramic A sites were studied in the present research, which is considerably more than from the other phases. However, many of the samples analysed only consist of a relatively small number of artefacts, largely a result of limited excavations (table 5.16). Written reports provided additional data about six sites. In addition, Rodríguez Ramos (personal communication 2000) exchanged data on the Paso del Indio site and Mark Nokkert (personal communication 2002) informed me about the finding of St. Martin greenstone axes at Coconut Walk on Nevis.

Flake tool production

Raw materials

The data on flake tool production activities relating to Late Ceramic A phase in many ways resemble those from the preceding phase. Some differences are also noted. Chert and chert related varieties continue to be the basic rock materials used for making flake tools (table 5.17). Only in case of the Paso del Indio site, Rodríguez Ramos (2005) reports the use of cobbles from meta-volcanic material. Among the samples, flint, chert, bedded chert, jasper, petrified wood, quartz, and chalcedony were identified. Again, Long Island flint continues to be the major flake tool material in the Anguilla – Guadeloupe region. However, beyond this region this high quality flint is not reported anymore. This clearly contrasts with the preceding phases.

Within the Anguilla – Guadeloupe region, Long Island flint was identified among all samples in varying percentages. It accounts for more than 50% of all flake tool material for sites on Antigua, Guadeloupe, St. Eustatius, and Saba, and it is less frequent at sites on Anguilla and at the Godet site on St. Eustatius. The percentage found at this latter site must be treated with caution, however, as the sample size is very small. Inter-site variation with regard to raw material

Figure 5.25. Golden Rock, St. Eustatius. Small fine-grained rock pebbles used as polishing stones (scale 1:1). (Photo Jan Pauptit)

frequencies reveals some interesting results, despite the predominance of Long Island flint at most sites. Looking at the different Antigua sites, considerable variation occurs in the abundance of Long Island flint. The Blackman's Point and the Coconut Hall settlements display a markedly lower percentage of Long Island flint than the Jumby Bay and Claremont sites. This difference can be attributed to the availability of local flint material in the immediate surroundings of Blackman's Point and Coconut Hall (see Chapter 2 and appendix A). As a result, almost equal amounts of these local flints, Coconut Hall flint in case of the Coconut Hall site and Blackman's Point flint in case of the Blackman's Point site, are represented, along with the use of Long Island flint.

Claremont, situated on the southern coast of Antigua in a region devoid of flint and chert, displays an almost exclusive usage of Long Island flint. This evidently shows that on a regional scale Long Island remained the most desired material, but apparently people were searching for nearby alternatives and exploiting these, if possible. The fact that procurement of local sources became an integral part of Ceramic Age flake tool production behaviour is most clearly evidenced at the Blackman's Point site. This site yielded a Preceramic Age occupation as well (Nicholson 1976; Martin Fuess, personal communication 2001). Study of the lithic material from this phase revealed two interesting differences. One was related to a change in lithic technology. Reduction of flint during the Preceramic Age was focussed on the production of blades, a recurrent feature during this era, contrasting with the expedient flake tool technology of the Ceramic Age. The second difference relates to the use of raw materials. During the Preceramic Age, the Blackman's Point dwellers had only reduced Long Island flint. No local Blackman's Point material was encountered, which significantly differs from its high abundance within the Ceramic Age occupation of this site.

This change in raw material choice may have had a social cause, apart from the fact that the Ceramic Age expedient flake technology hardly poses any limitations on raw material qualities. Settlement on Long Island, evidenced by the Jumby Bay site, may have restricted their access to the Long Island flint. This may have induced people to use alternatives when available. Therefore, it may have also formed one of the reasons for settlement at Blackman's Point and Coconut Hall.

Similar to the Claremont site, the settlements on the surrounding islands also displayed a preference for Long Island flint, in most cases possessing higher percentages of this flint type than the Blackman's Point and Coconut Hall sites. Interestingly, however, flints from these latter two sources also turn up in low abundances at a number of sites. Coconut Hall flint forms a relatively large portion of the flake tool material at the Late Ceramic A occupation phases of the two sites studied

Site	Island	Type of sample	Reference
Anse Trabaud	Martinique	all lithics	-
Grande Anse	*les Saintes*	*axe related artefacts*	Hofman 1995
Du Phare	Petites Terres	all lithics (small sample)	-
Anse à la Gourde middle	Grande Terre	all lithics	-
Anse à la Gourde late	Grande Terre	all lithics	-
Anse à l'Eau late	Grande Terre	all lithics (small sample)	-
Escalier	La Désirade	all lithics (small sample)	-
Claremont	Antigua	flake tool related artefacts	
Muddy Bay	*Antigua*	*flake-tool related artefacts*	De Mille 1996, 2001
Coconut Hall	Antigua	flake-tool related artefacts	-
Blackman's Point	Antigua	flake-tool related artefacts	-
Jumby Bay	Antigua	all lithics	-
Coconut Walk	Nevis	axe related artefacts	-
Godet	St. Eustatius	all lithics (small sample)	-
Smoke Alley	St. Eustatius	all lithics (small sample)	-
Spring Bay 3	Saba	flake tool related artefacts	-
Cupecoy Bay	*St. Martin*	*all lithics*	Haviser 1987
Rendezvous Bay	*Anguilla*	*all lithics*	Crock & Petersen 1999
Sandy Ground	Anguilla	all lithics	-
Barnes Bay	Anguilla	all lithics	-
Sandy Hill	*Anguilla*	*all lithics*	Crock 2000

Table 5.16. Studied sites from the Late Ceramic A phase. Data from sites in italic have been obtained from literature.

from the northern coast of Grande Terre, Anse à la Gourde (both main occupation phases) and Anse à l'Eau. It was also found, in smaller quantities though, at Blackman's Point, Spring Bay 3, Smoke Alley, Godet, Sandy Ground and possibly, Barnes Bay. Blackman's Point flint is generally less abundant and shows up at Anse à la Gourde, Smoke Alley, Spring Bay 3, Barnes Bay, and possibly Sandy Ground. Other Antigua varieties that were identified among the different samples include Little Cove/Soldier Point flint (at Anse à la Gourde and Sandy Ground) and possibly Corbison Point/Dry Hill (at Godet).

In addition to these Antigua cherts and flints, various sites produced other cherts and possibly flints, varying in amount. In most cases, sources for these siliceous rocks could not be established; only one red chert artefact from Anse à la Gourde is assigned to the bedded radiolarian chert source in the northeastern part of La Désirade (Bodu 1984; Montgomery *et al.* 1992). Initially, Bodu (1984) regarded this source as possibly of regional significance, based on evidence of lithic exploitation at the locality itself. Recent research on La Désirade by De Waal (2006) and my findings on raw material usage in the surrounding region shows that the local red chert did not constitute a frequently used material on La Désirade itself and beyond. This suggests that the red chert was only rarely exploited during this phase, which immediately raises the question of how to interpret the data about exploitation activities of Bodu (1984). Studying his results in detail reveals that locally flaked red chert is not present in such high concentrations, as encountered at other exploited lithic sources, which is shown by work on Martinique (La Savanne des Pétrifications) and Long Island, for example (Bérard & Vernet 1997; Van Gijn 1996;

Site	Barnes Bay	Sandy Ground	Spring Bay 3	Smoke Alley	Godet	Jumby Bay	Black-man's Point	Coconut Hall	Clare-mont	Anse à la Gourde middle	Anse à la Gourde late	Anse Trabaud
	N=420	N=316	N=149	N=28	N=24	N=953	N=212	N=229	N=40	N=158	N=38	N=45
Chert type	%	%	%	%	%	%	%	%	%	%	%	%
Long Island flint	20.7	18.7	73.8	71.4	37.5	98.8	40.1	54.6	80.0	53.8	55.3	-
Blackman's Point flint	0.2	-	2.0	-	-	-	48.1	-	-	2.5	-	-
Coconut Hall flint	1.7	1.3	2.7	-	8.3	-	0.5	34.5	-	12.0	5.3	-
Antigua Form. flint	0.5	2.5	-	-	-	-	-	-	-	3.2	-	-
White chert	55.7	14.6	-	-	4.2	-	1.4	-	-	-	-	64.4
Petrified wood	-	-	-	-	-	-	-	-	-	-	-	22.2
Other chert	16.7	46.5	15.4	21.4	41.7	0.2	1.4	0.4	2.5	18.9	18.4	13.3
Désirade red chert	-	-	-	-	-	-	-	-	-	0.6	5.3	-
Jasper	-	-	-	-	4.2	-	0.5	-	5.0	5.1	-	-
White quartz	4.5	14.6	0.7	-	-	-	-	-	2.5	-	-	-
Unidentified chert	-	1.6	5.4	7.1	4.2	-	8.0	10.5	10.0	3.8	15.8	-

Table 5.17. Late Ceramic A phase. Relative amount of identified chert types by site.

Verpoorte 1993; see Chapter 4). Therefore, these low-density flake scatters may have been a result of chert working for local use at the source area itself, rather than systematic exploitation involving pre-working of large quantities of material for use elsewhere. Attributing these flake scatters to Preceramic Age usage of this source may be another explanation. Unfortunately, this cannot be tested archaeologically as a result of the likely disappearance of local habitation sites dated to this phase (De Waal 2006).

Among the large group of unknown other chert varieties, two found at the Sandy Ground and Barnes Bay sites on Anguilla deserve additional attention, as they make up relatively significant portions of the samples. A translucent brown chert with white inclusions (possibly fossils) is the most common variety at Sandy Ground (more than 40%), but it only accounts for around 5% of all flake material at Barnes Bay. A white dull chert, of which the predominant part is relatively fine-grained but which has a coarser variety almost quartzite like in texture, dominates the Barnes Bay flake tool material (60%). At Sandy Ground, only the finer variety was found, accounting for a little less than 15%.

The brown translucent chert exhibits some similarities to a variety encountered at Sorcé. This suggests that its source might be sought more in a western direction from Anguilla, among the Virgin Islands and Puerto Rico, for example, rather than among the Lesser Antilles. On the other hand, among the Sandy Ground sample flaked artefacts from this material are on average larger in size and possess more cortex, relative to the Long Island artefacts there. This may suggest a source in closer proximity to Anguilla than Long Island and raises the question whether it might be local to the island itself. This is a possibility, considering the almost exclusive limestone geological build-up of the island. Crock, however, did not encounter any natural occurrences of chert or flint when doing his archaeological fieldwork on the island during the past ten years (Crock personal communication 1999; see also Crock 2000), nor has anyone else ever reported local flint on Anguilla (e.g, Christman 1953; Douglas 1986, 1991).

The white chert likely originates from a non-biogenic geological formation, similar to the cherts formed in the tuffs near Shirley Heights on Antigua. It is therefore probably not natural to Anguilla. A near-by St. Martin origin, where non-biogenic chert varieties such as jasper occur (Christman 1953; Staargaard 1952) may not be excluded *a priori*, but it is not supported by archaeological evidence. Natural occurrence of this type of material on Vieques, which was used by the Sorcé and La Hueca inhabitants during the Early Ceramic A phase, in any case suggests similar materials may also occur there, although the white chert does not resemble the locally available quartz (see Early Ceramic A section; Rodríguez Ramos 2001a). Unfortunately, the poor knowledge of the occurrence of regional rock types in general and my unfamiliarity with archaeological material from the Virgin Islands and Puerto Rico suggests that additional study is needed.

At the multi-component site of Paso del Indio, in the middle of Puerto Rico, the Late Ceramic A phase displays a marked change from the preceding one in the almost sole use of the meta-volcanics, available nearby the site. During the earlier Cuevas occupation, imported chert and flint varieties are the predominant group of rocks among the flake tools (Rodríguez Ramos 2005). At Anse Trabaud on Martinique, on the southern border of my study area, the flaked stone consists exclusively of local chert, which were obtained from the nearby Savannes des Pétrification locality, only 1 to 2 km from the site (Bérard 1999, 2001; Bérard & Vernet 1997).

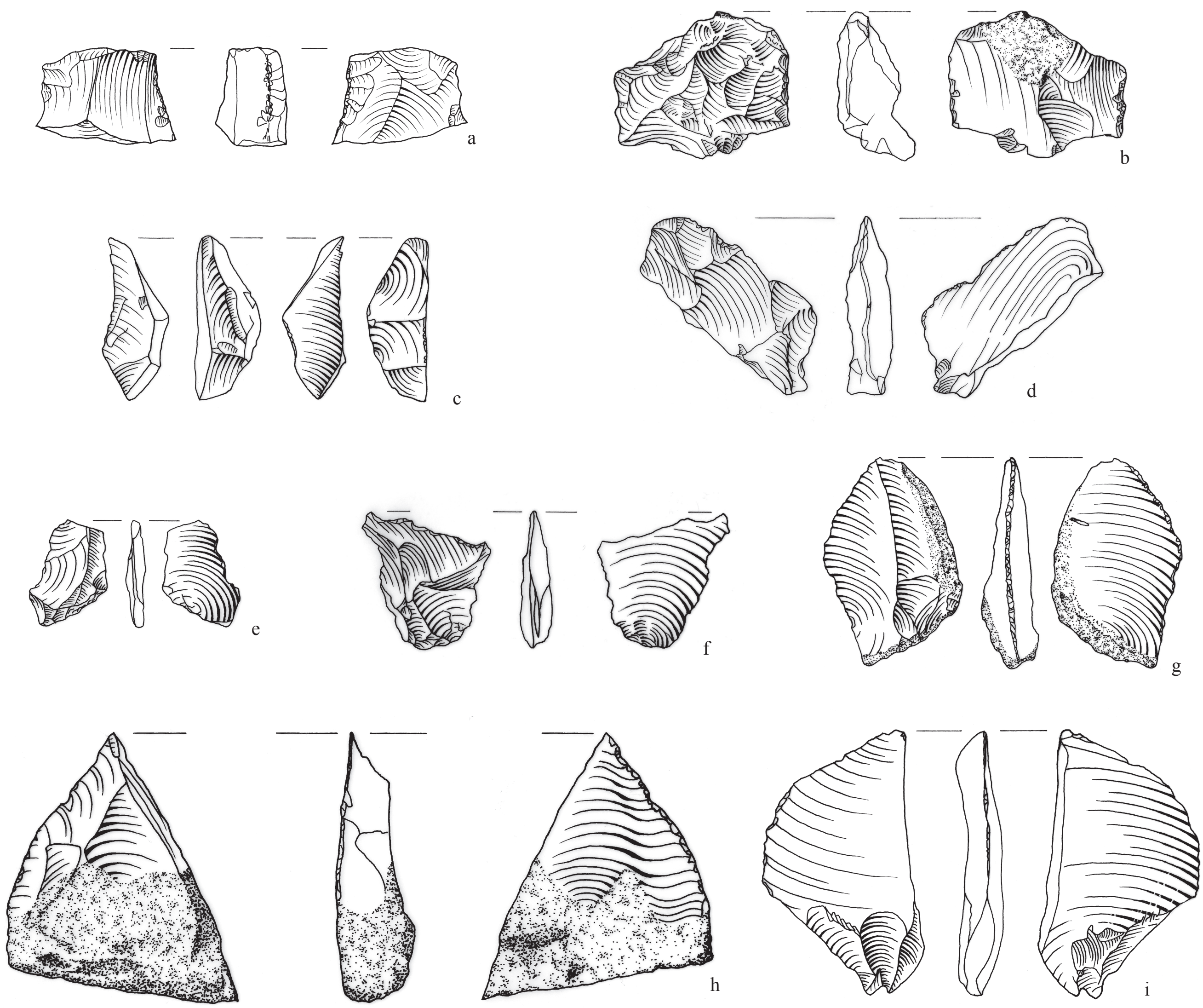


Figure 5.26. Anse à la Gourde middle (a,b,d,e,g-i) and late (c,f) occupation phases, Guadeloupe. Flint cores and flakes: a en b. bipolar cores; c. bipolarly split flake fragment ; d. flake fragment with use retouch; e-h. complete flakes with use retouch; i. modified flake with use reouch (scale 1:1). (Drawings Raf Timmermans)

Reduction and tool production

The flake tool production during this phase continues to be expedient, aimed at production of a variable set of flakes to be used without any or minimal modification. Identified flaking techniques include the direct freehand percussion and bipolar ones (figure 5.26). Contrary to this view of continuity, Bérard (2001; Bérard & Vernet 1997) argues for a change in reduction during this phase toward the production of predominantly large flakes, instead of small ones. He bases this primarily on the larger average flake size at the Anse Trabaud site, as compared to those from the preceding occupations at Vivé and Diamant. Taking mesh-size differences into account, larger flakes are indeed more predominant at Anse Trabaud and cores do not suggest production of small flakes. Notwithstanding these differences, the larger size of flaked material may have been the result of the availability of larger cobbles at La Savanne des Pétrifications and the close proximity of this source to the Anse Trabaud site, when compared to source areas exploited by the Vivé and Diamant dwellers. Moreover, easy availability to source areas is of significance when studying size differences, as is clear from flake size comparison of the Jumby Bay and Sugar Mill sites on Long Island with settlements on surrounding islands (see below). If it is further noted that among the samples of the northern Lesser Antilles, small flake production still was part of the objective of the chert and flint reduction, there is no clear evidence that technology indeed experienced changes from the Early Ceramic B phase to Late Ceramic A phase.

Similar to the preceding phase, the limited data suggest core reduction and flake production on-site, indicated by the presence of cores, flakes and shatter at the studied settlements. Looking at Long Island flint, the recurrent high percentages of flakes displaying cortex on their dorsal surfaces suggest arrival of unmodified cobbles. Only the lower percentages of cortex at Spring Bay 3 on Saba and Barnes Bay on Anguilla suggest pre-worked material arrived at these sites (see Chapter 6).

Core tool production

Axes and adzes

This phase marks the extensive usage of St. Martin greenstone as raw material for axes within the northern Lesser Antilles relative to the other materials. It was already noted that the number of habitation sites where this greenstone material was worked increased during the preceding Early Ceramic B phase and that it expanded regionally over a larger area during that period. The Late Ceramic A phase specifically exhibits a marked increase of habitation sites on Anguilla with evidence of axe production. However, the total region where greenstone axes were made had not become larger relative to the Early Ceramic B phase.

This significance of greenstone axes immediately becomes evident when comparing the axe occurrences from both phases (tables 5.11 and 5.18). Within the northern Lesser Antilles, notably the region from Anguilla to Guadeloupe, it was now the predominant axe material, even appearing in very small excavated samples. Other materials occur only rarely.

In relation to the use of other materials, the latest three occupations at Anse à la Gourde, all falling within the Late Ceramic A phase, provide the richest inventory of used axes. In addition to a considerable number of St. Martin greenstone axes (figure 5.27), over 40 specimens, the excavations produced a limited number of metamorphic examples, predominantly green in colour, a plutonic one, and some fine-grained igneous rock ones (figures 5.28). Comparison of this sample with material from the preceding Early Ceramic B occupation shows that greenstone increased relatively during the later phases. This holds also for metamorphic materials, which are rarely found among Early Ceramic B samples.

Sandy Ground and Barnes Bay are, apart from Anse à la Gourde, the only two sites in the Anguilla-Guadeloupe region, that yielded axe artefacts of a rock type other than the St. Martin greenstone. The materials used are fine-grained dark grey rock types, probably of an igneous nature. The number of such items, however, is very small.

The provenance of many of these other axes remains unknown. The metamorphic items originate from regions beyond the northern Lesser Antilles, either the Greater Antilles or the South American mainland. The igneous rock specimens probably come from less distant sources. St. Martin is the likely source for the Anguilla sites, as materials resembling these fine-grained igneous rock varieties were seen on this neighbouring island. The provenance of the igneous axes from Anse à la Gourde remains unspecified. The nearby islands of La Désirade, Basse Terre, or Montserrat should be considered as most likely sources. In relation to these latter varieties, it should be noted that the plutonic rock axe closely resembles an axe found at Morel. This suggests that in addition to the continuous use of St. Martin greenstone for axe making, other materials were utilized as well for considerable periods.

The abundance of greenstone axes decreases beyond the Anguilla – Guadeloupe region. At the Paso del Indio site, a single such axe was found among many other materials. At Anse Trabaud, a single such fragment was identified among other local varieties. This site on Martinique is one of the few sites from this phase that actually produced evidence of axe manufacture from raw materials other than St. Martin greenstone. Barnes Bay and Sandy Ground are the other sites that yielded such evidence. The worked material consisted in all cases of igneous rock, which was primarily obtained as water-worn cobles. In general, the production debris is limited. Such a low occurrence resembles evidence at sites reported from the earlier phases. It apparently is a common feature that may be a result of the similarity between raw material shape (rounded pebbles), and the desired final axe shape. Material likely originated from local sources at the Anse Trabaud site, and in the case of Anguilla, the sources were on nearby St. Martin, as suggested above.

Beads and pendants

Beads form the major category of decorative lapidary items during the Late Ceramic A phase, similar to the preceding Early Ceramic B phase. The large number of excavated examples suggests an increased usage during this phase. The recurrent

Site	Island	Rock material	Finished axes/adzes N	Preforms N	Flakes and shatter N
Anse Trabaud	Martinique	St. Martin greenstone	1	-	-
		igneous rock	1	2	<5
Grande Anse	Les Saintes	St. Martin greenstone	1	-	-
Du Phare	Petites Terres	St. Martin greenstone	1	-	-
Anse à la Gourde middle	Grande Terre	St. Martin greenstone	5	-	2
		meta-morphic rock (greenstone)	4	-	-
		igneous rock (fine)	1	-	possibly present
Anse à la Gourde late	Grande Terre	St. Martin greenstone	2	-	-
		meta-morphic rock	1	-	-
Anse à l'Eau	Grande Terre	St. Martin greenstone	1	-	-
Escalier	La Désirade	St. Martin greenstone	1	-	-
Jumby Bay	Antigua	St. Martin greenstone	1	-	-
Coconut Walk	Nevis	St. Martin greenstone	2	-	-
Godet	St. Eustatius	St. Martin greenstone	1	2	1
Smoke Alley	St. Eustatius	St. Martin greenstone	-	2	16
Cupecoy Bay [a]	St. Martin	St. Martin greenstone	abundant	n.s.	abundant
Sandy Ground	Anguilla	St. Martin greenstone	10	11	158
		igneous rock	-	1	<8
Barnes Bay	Anguilla	St. Martin greenstone	3	10	89
		igneous rock	1	-	<12
Sandy Hill [b]	Anguilla	St. Martin greenstone	47	12	301

Table 5.18. Late Ceramic A phase. Identified axes and axe production related artefacts by raw material by site. [a] Data from Haviser (1987); [b] Data from Crock & Petersen (1999).

appearance on Anguilla particularly supports this. Comparison of the sites within the northern Lesser Antilles shows that basically two raw material varieties are predominant: calcite and diorite (table 5.19 and figure 5.29). In addition, limestone rarely occurs as well, while for a small number of beads the raw materials were not identified (Crock 2000).

It can be assumed that calcite was commonly available within the Lesser Antilles, considering the extensive presence of limestone deposits on many of the islands. The local provenance of this crystal variety is supported by the relatively high abundance of calcite among archaeological material from sites on Anguilla and also Cupecoy Bay on St. Martin, both islands with extensive limestone (Crock 2000; Crock & Petersen 1999; Haviser 1987). Samples from Sandy Ground, Barnes Bay, and Shoal Bay East are characterised by a high number of small natural (fragmentary) pieces in the form of angular crystals, as well as more amorphous calcite. These latter pieces resemble stalagmites in shape, but generally do not exceed 2.7 cm in size. In addition, rare worked pieces, in the form of flaked items, ground but unfinished bead preforms, and finished beads complement the collections, clearly suggesting local calcite bead production at these sites. Whether the relatively abundant pieces of unworked natural calcite served as a raw material for future bead making is unclear. The high number clearly contrasts with the low amount of worked material and this differs from reported frequencies related to, for example, carnelian bead working material at the Early Ceramic A site of Trants (Crock & Bartone 1998). Therefore, the unworked materials may have served other purposes, or simply represent a natural scattering of calcite within the soils of Anguilla.

In contrast to the clear evidence of calcite bead making on Anguilla and to a lesser extent on St. Martin, loci of diorite bead making have not been identified in the study area. All reported and identified diorite beads within the collections

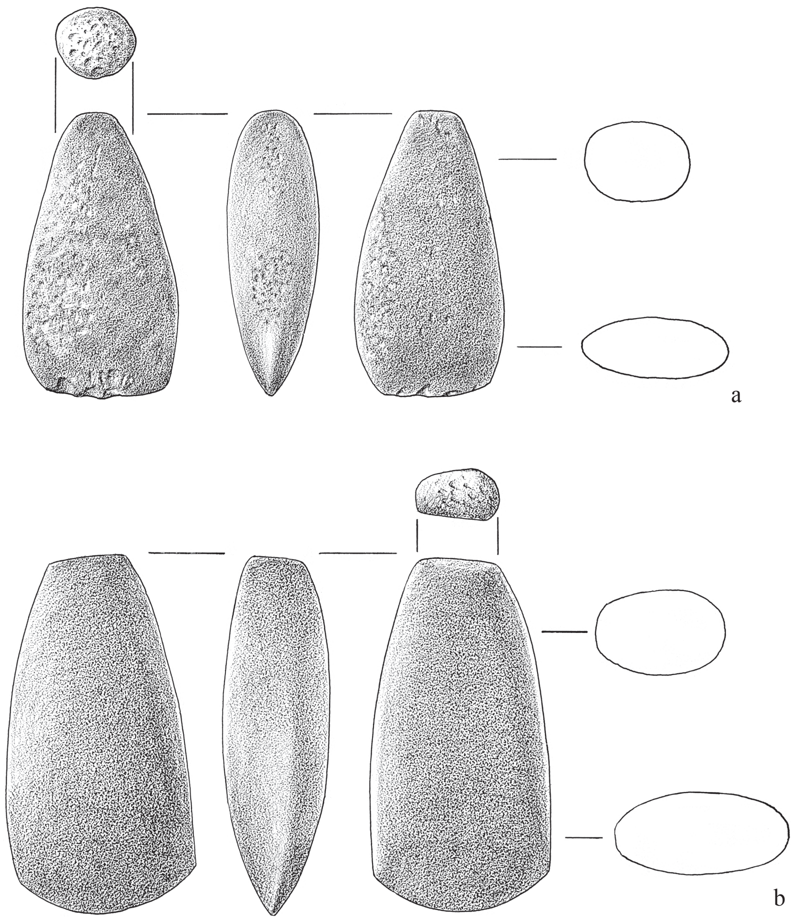


Figure 5.28. Anse à la Gourde middle occupation phase, Guadeloupe. a. Green metamorphic rock axe; b. Dark igneous rock axe (scale 1:2). (Drawings Erick van Driel)

are finished items. Close Similarities among the different beads suggest a single origin. The absence of any production on these islands makes it likely that its source has to be sought outside the region of the northern Lesser Antilles, although diorite can be naturally found on some of the islands, for example, St. Martin, Antigua, and La Désirade (Christman 1953, 1972; Bouysse *et al.* 1983). Close comparison with published illustrations of diorite beads dated to the Early Ceramic A phase (Watters & Scaglion 1994, figures 5, 6, 8, and 12) shows that this diorite may represent another variety, in which the proportion of white crystals is considerably larger than within the variety of the Late Ceramic A samples encountered at Anse à la Gourde, Jumby Bay, and Kelbey's Ridge 2. Furthermore, the material from Trants indicates that diorite beads were finished on site, as evidenced by the presence of a number of unfinished examples (Watters & Scaglion 1994). In combination with the high abundance among lapidary items at Trants and general occurrence at Royalls and Elliots on Antigua, these observations suggest that during the Early Ceramic A, rock local to the Lesser Antilles was used.

Figure 5.27(opposite page). Anse à la Gourde middle occupation phase, Guadeloupe. St. Martin greenstone axes (scale 1:2). (Drawings Raf Timmermans)

Site	Island	Rock material	Finished only	Production	Reference
Anse Trabaud	Martinique	no items found	-	-	
Du Phare	Petite Terre	no items found	-	-	
Anse à la Gourde middle	Grande Terre	calcite, rock crystal, igneous rock	rock crystal, igneous rock	possibly calcite	
Anse à la Gourde late	Grande Terre	no items found	-	-	
Anse à l'Eau late	Grande Terre	no items found	-	-	
Escalier	La Désirade	no items found	-	-	
Muddy Bay	Antigua	no items found	-	-	Murphy 1999
Mill Reef	Antigua	diorite	diorite	-	
Jumby Bay	Antigua	diorite	diorite	-	
Godet	St. Eustatius	no items found	-	-	
Smoke Alley	St. Eustatius	no items found	-	-	
Spring Bay 3	Saba	diorite	diorite	-	Hoogland 1996
Cupecoy Bay	St. Martin	calcite	-	calcite	Haviser 1987
Sandy Ground	Anguilla	calcite, diorite, unidentified rock	diorite	calcite	
Barnes Bay	Anguilla	calcite, diorite, feldspar, unidentified rock	diorite	calcite	Crock 2000
Sandy Hill	Anguilla	calcite, limestone, diorite, unidentified rock	limestone, diorite, unidentified rock	calcite	Crock 2000

Table 5.19. Late Ceramic A phase. Identified lapidary items and production remains by raw material by site.

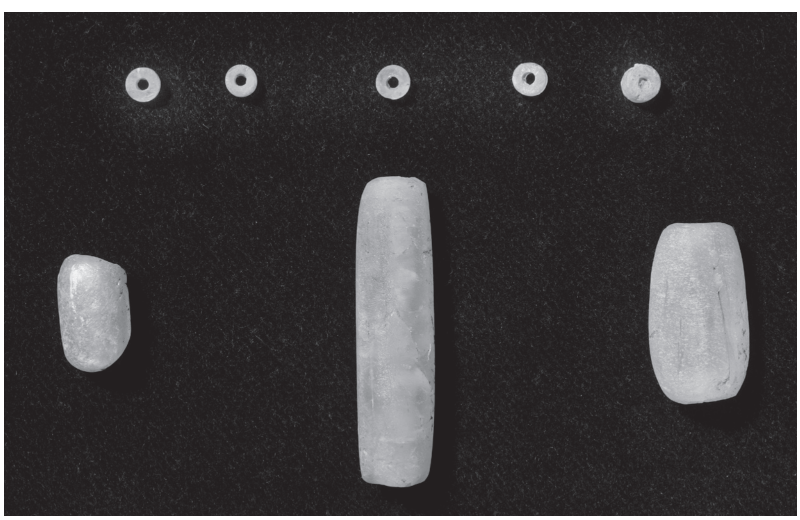


Figure 5.29. Anse à la Gourde middle occupation phase, Guadeloupe. Calcite beads (scale 1:1). (Photo Ben Grishaaver)

Zemi three-pointer stones

The Late Ceramic A phase marks one of the most productive periods with regard to zemi usage within the northern Lesser Antilles. In particular, the island of Anguilla stands out on the basis of its zemi-rich artefact collections from different island sites. This may be partly a result of the repeated efforts of the Anguilla Archaeological and Historical Society (AAHS) followed by research of John Crock and Jim Petersen, who all put a lot of work into mapping sites, surveying sites, and cataloguing artefact collections (Crock 2000; Crock & Petersen 1999; Douglas 1986, 1991). On the other hand, local production of these artefacts on Anguilla also likely produced a much higher actual frequency, than, for example, on Saba that did not yield such a rich zemi artefact inventory, in spite of extensive systematic archaeological research (Hofman 1993; Hoogland 1996).

Looking at zemi raw materials, basically three rock types stand out: calci-rudite, calcite, and limestone (table 5.20). The former two rock types are distinct varieties, while the latter represents a rock class, covering a broad range of varieties. In addition igneous rock and quartz examples were occasionally identified as well. These materials largely resemble the variety of rock types used at the Early Ceramic B site of Golden Rock and suggest continuation of raw material choice. Only the presence of pumice at Golden Rock, which was not found anywhere during the phase discussed here and calcite, which was not encountered at Golden Rock, are the marked differences. These are likely the result of the local geological environment at Golden Rock, where pumice is available and calcite is not.

This phase provides the first unequivocal evidence of local on site working of raw material into three-pointers. Worked materials include both calci-rudite and limestone. With regard to the former rock type, sites on Anguilla and to a lesser extent on St. Martin produced abundant artefactual data relating to zemi production in the form of flakes, unspecified fragments, preforms, and finished zemis (figure 5.30). Sites with abundant evidence of zemi manufacture are Rendezvous Bay, Sandy Ground, and Barnes Bay on Anguilla, and Cupecoy Bay on St. Martin. In addition, limited samples from surface collecting at Island Harbour, Little Harbour, and Lockrum on Anguilla (Crock & Petersen 1999) and possibly at Pointe Terre Basse, Red Bay, and Great Kay on St. Martin (Haviser 1987) also suggest on-site working. These sites perfectly surround the Pointe Arago source on St. Martin (figure 5.31). It should be noted that only sites on the western part of St. Martin have yielded evidence of zemi production. This indicates that access to Pointe Arago was only possible from within a limited region. A closer look at the calci-rudite artefacts from Sandy Ground and Barnes Bay reveals that part of the material was collected from a secondary context, as indicated by worn outer surfaces. Considering the low occurrence of distinguishable outer surfaces, it may well be that primary material was commonly obtained as well.

The recovery of finished calci-rudite items at a number of sites, such as Spring Bay, Anse à la Gourde (figure 5.32), Anse à l'Eau, and Paso del Indio (Rodríguez Ramos 2005), all far from the Pointe Arago source, in combination with these production places, demonstrates the existence of exchange relationships between these two groups of sites. This is an important topic for further discussion (see next Chapter).

Limestone is the other predominant material that available evidence suggests that it was worked into zemi three-pointers at a number of sites. Correct identification of such local production is to some degree hampered by variability in limestone rock varieties encountered among the different zemis at a single site, making it difficult to relate flake material with preforms and finished objects. Sites that minimally yielded evidence of limestone working and the presence of preforms and finished limestone zemis comprise Anse à la Gourde on Grande Terre, and Sandy Ground, Barnes Bay, Sandy Hill, and Rendezvous Bay on Anguilla. All these sites are situated within limestone regions and rock varieties are likely local to the direct site surroundings

At Anse à la Gourde, basically two types of limestone were found: a calcareous sandstone (beach rock) (figures 5.33 and 5.34) and a calcareous mudstone. The sandstone variety likely is local to the area in view of the common availability of beach rock along the northern coast of Grande Terre (Russell 1960; Troelstra & Beets 2001). However, this type of beach-rock differs from the common underlying bedrock in the site area by its stronger cementation, in which the carbonate sandstone grains were "melted" and cannot be separated individually. The other limestone type resembles limestone available in the direct site vicinity. The majority of the limestone zemis from this site can be attributed to the Troumassoid 1 and 2 occupations, the latest Suazan Troumassoid occupation only yielded a single fragmentary artefact. Furthermore, these zemis generally exceed their Saladoid equivalents in size and are more variable in shape, which is shown by a comparison with the Golden Rock artefacts (see figure 5.18 and 5.32-34).

In the case of the Anguilla artefacts, material variability is obvious, but the different limestone varieties are macroscopically less distinct than among the Anse à la Gourde artefacts. Most of the material was likely locally obtained, but exact source locations cannot be specified. Some of the flaked material exhibits water-worn surfaces, indicating that cobble beaches were exploited. With regard to the calcite zemis from Anguilla, the data are very scanty. The high numbers of

Site	Island	Rock material	Finished zemis N	Preforms N	Flakes and shatter N
Anse Trabaud	Martinique	no items found	-	-	-
Grande Anse	Les Saintes	no items found	-	-	-
Du Phare	Petite Terre	no items found	-	-	-
Anse à la Gourde middle	Grande Terre	igneous rock	1	-	-
		calci-rudite	1	-	-
		limestone	1	2	<66
Anse à la Gourde late	Grande Terre	calci-rudite	3	-	-
			1	-	possibly
Anse à l'Eau	Grande Terre	calci-rudite	1	-	-
Escalier	La Désirade	no items found	-	-	-
Muddy Bay [a]	Antigua	no items found	-	-	-
Jumby Bay	Antigua	no items found	-	-	-
Godet	St. Eustatius	no items found	-	-	-
Smoke Alley	St. Eustatius	no items found	-	-	-
Spring Bay 3	Saba	calci-rudite	1	-	-
Cupecoy Bay [b]	St. Martin	calci-rudite	1	-	present
Sandy Ground	Anguilla	calci-rudite	1	1 ?	156
		limestone	2	-	<23
Barnes Bay	Anguilla	calci-rudite	1	1	84
		limestone	-	-	<32
Sandy Hill [c]	Anguilla	calci-rudite	2	-	8

Table 5.20. Late Ceramic A phase. Identified zemi three pointer stones and production remains by raw material by site. [a] Data from Murphy (1999); [b] Data from Haviser (1987); [c] Data from Crock & Petersen (1999).

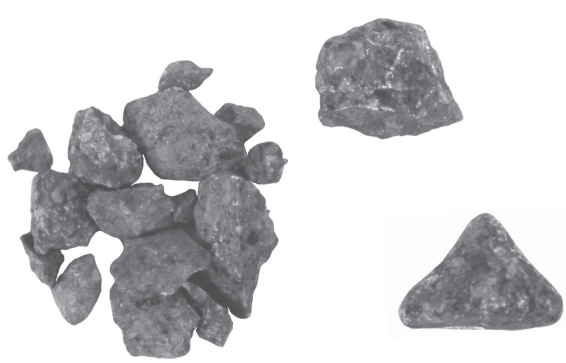


Figure 5.30. Sandy Ground, Anguilla. Calci-rudite zemi three pointer manufacture remains: debris (on the left), a preform (on the top right) and a single finished example (at the bottom right) (scale 1:2).

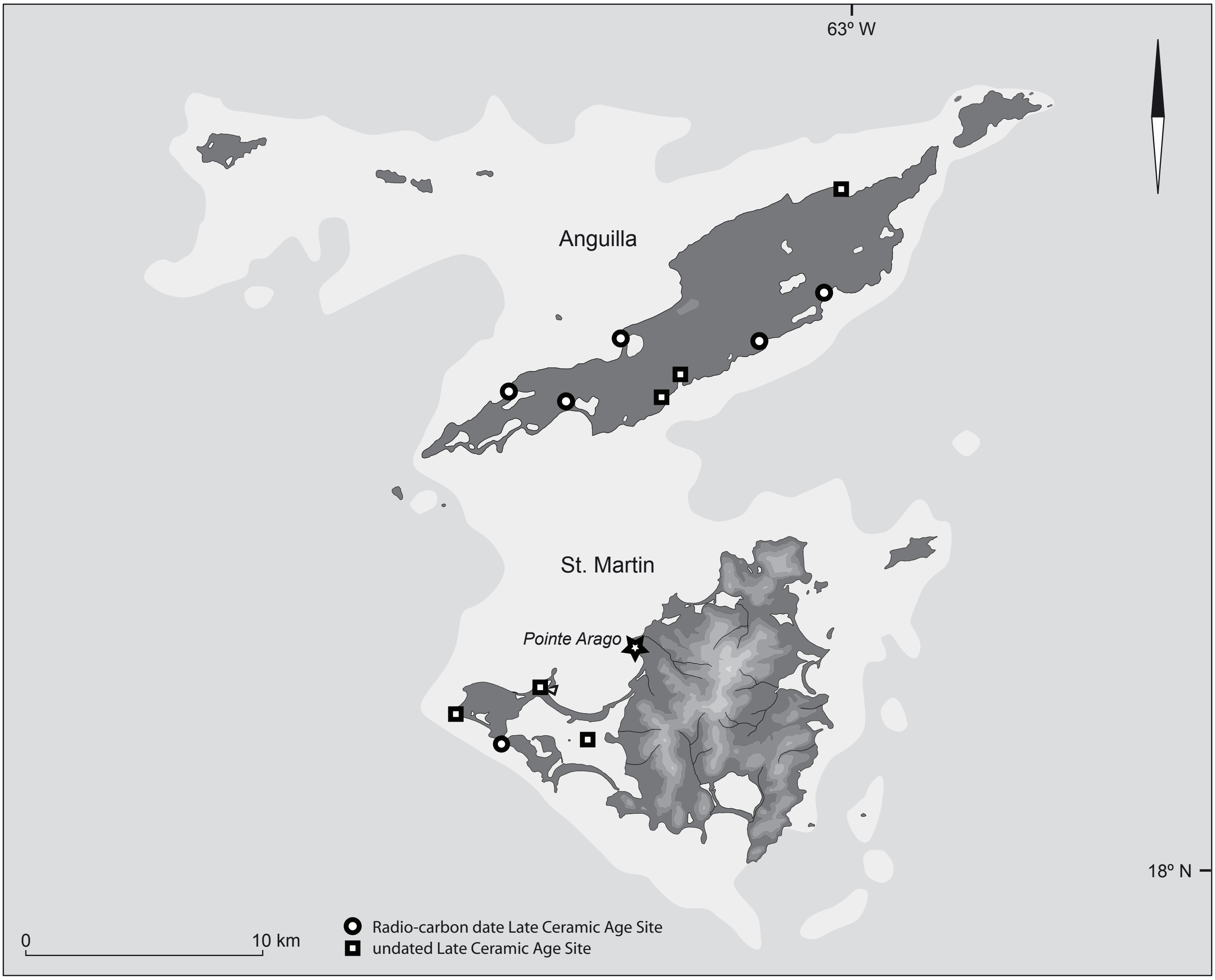


Figure 5.31. Map of Anguilla and St. Martin showing the location of Late Ceramic Age sites with evidence of calci-rudite zemi manufacture.

calcite pieces mentioned in the previous section on bead manufacture cannot be related to calcite zemi manufacture, because of their significantly smaller size. Only one site, Forest North produced a calcite-zemi preform (Crock 2000). Still, a local provenance of the material should be considered as very likely.

In addition to these materials, igneous rock and quartz zemis were only found as finished items at the site of Anse à la Gourde (figure 5.35). Considering the absence of related debitage and their exotic provenance, they were likely imported from yet unknown origins.

Shaped grinding and abrading stones

This phase does not include a similarly rich site like Golden Rock attributable to the preceding phase with regard to passive grinding stones. Studied sites on the same island of St. Eustatius, Godet and Smoke Alley, did not yield any complete examples, nor fragments of rock types associated with these artefacts (table 5.21). Although the small sample size from both sites hinders sound comparison, each of the two samples should have at least contained four to five such artefacts, if a similarly abundant occurrence as at Golden Rock was the case.

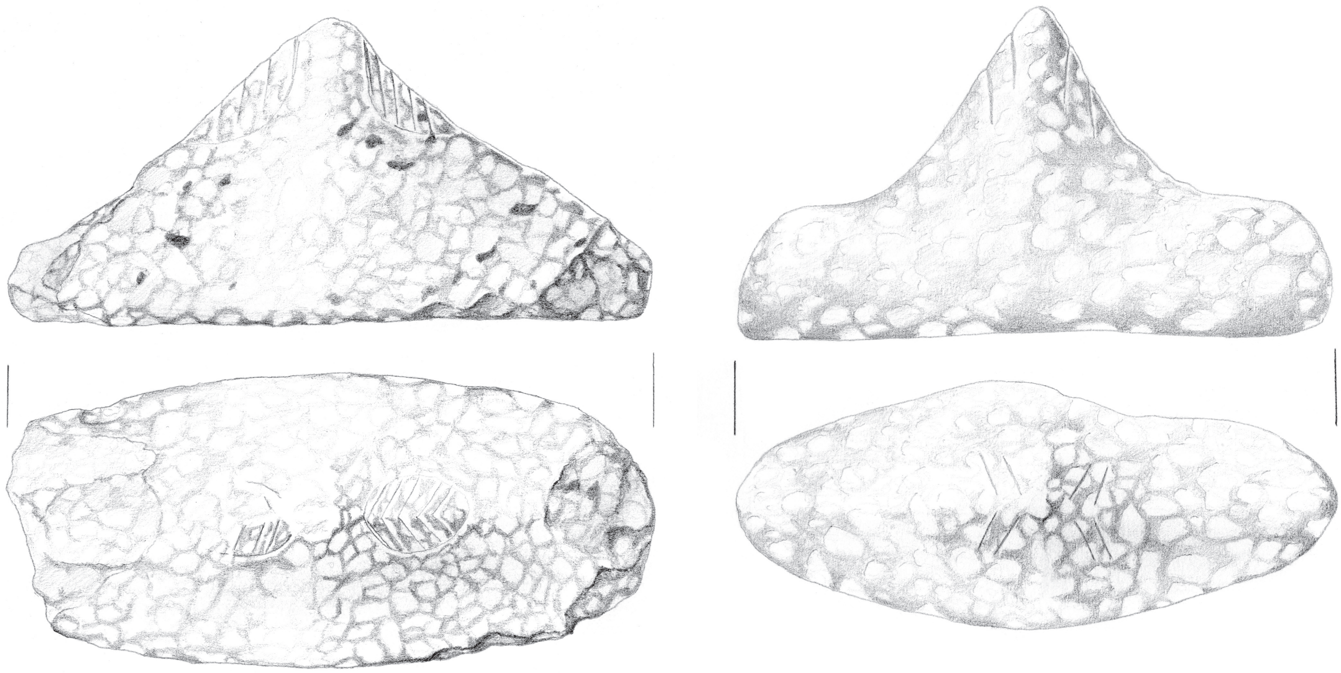


Figure 5.32. Anse à la Gourde middle and late occupation phases, Guadeloupe. Calci-rudite zemi three pointer stones (scale 1:1). (Drawings Raf Timmermans) See figure 2.27 for photos of both zemis.

Only excavations at Anse à la Gourde produced a significant number of such artefacts, largely fragments (figure 5.36). Due to their incomplete nature, it was often difficult to determine whether these rocks were shaped prior to use or not. It was minimally obvious that they did not originate from water-worn pebbles. Fragments with a concave smooth surface, clearly the result of abrasion, are predominant and include coarse grained igneous rock varieties, beach-rock, and a number of unidentified often burnt rock, also likely igneous in nature. Clear stones for the grinding of tools, such as axes, were not identified.

Other sites that only yielded a small number of passive grinding stone fragments are Anse Trabaud, where local igneous rock was used, and Sandy Ground and Barnes Bay, where igneous rock was obtained from elsewhere. Interestingly, Sandy Ground yielded one artefact made of yellow rock, which is similar to a variety infrequently encountered at the Early Ceramic B site of Golden Rock.

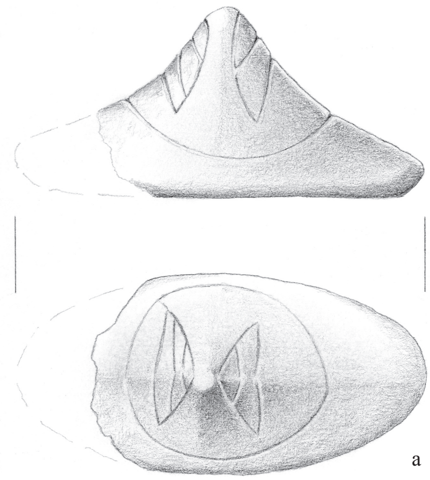
Limited excavations on the small island of La Désirade yielded additional examples of passive grinding stones. Within the sample of the Aéroport site, a granular material, likely igneous rock, was encountered that was almost identical to a variety repeatedly used at Anse à la Gourde and the Early Ceramic B site of Les Sables. In addition to the yellow rock, this again supports continued use of a limited number of raw material types for the making of these tools. Unfortunately, a source location cannot be specified for this material, but it was probably situated on La Désirade.

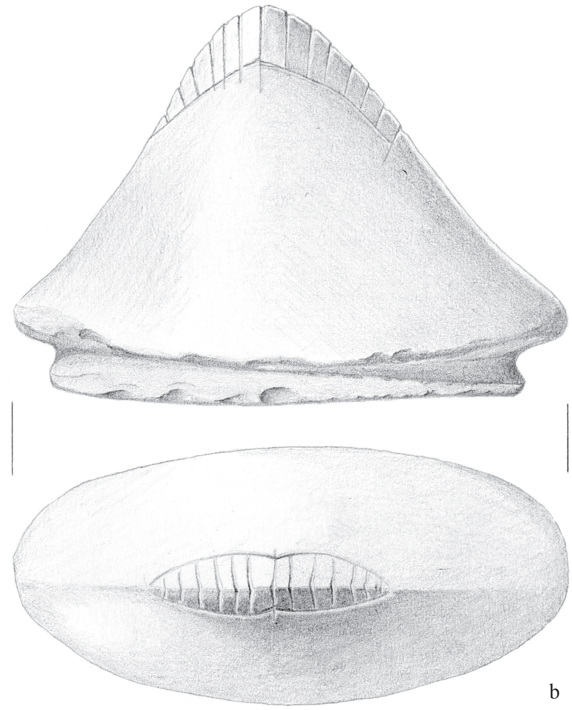
The relatively large sample from Anse à la Gourde included a small number of light green fragments exhibiting a convex abraded surface, similar to examples found within the Early Ceramic B occupation of this site and at Morel. I hypothesized above that they may have been used as active abrading or grinding stones resembling manos tools in Meso-America. This type of tool was only found at the northern Grande Terre sites of Morel and Anse à la Gourde. In particular, in light of their absence among some large artefact samples, as at Golden Rock and Sorcé, for example, a very localized appearance can be suggested. Whether this difference relates to different functional activities at these Grande Terre sites, or it relates to different stone working habits, is unclear and needs to be studied in the future.

Figure 5.33 (opposite page). Anse à la Gourde middle and late occupation phases, Guadeloupe. Beach-rock zemi three pointer stone (scale 1:1). (Photo Jan Pauptit and drawing Raf Timmermans)

Figure 5.34. Anse à la Gourde middle and late occupation phases, Guadeloupe. Beach-rock zemi three pointer stone (scale 1:1). (Photo Jan Pauptit and drawing Raf Timmermans)

Figure 5.35 (opposite page). Anse à la Gourde middle and late occupation phases, Guadeloupe. Igneous rock zemi three pointer stones (scale 1:1). (Drawings Raf Timmermans and photo Jan Pauptit)


a


b


c

Site	Rock material	Finished tools N			Preforms N	Flakes and shatter N
		active abrading stone	passive abrading stone	other tools		
Anse Trabaud	igneous rock	-	6	-	-	possibly present
(Martinique)	chert	-	-	1	-	-
Du Phare (Petites Terres)	igneous rock	-	2	-	-	possibly present
Anse à la Gourde	igneous rock	1	5	1	-	possibly present
middle	limestone	-	-	1	-	possibly present
(Guadeloupe)	beach-rock	1	2	1	-	-
	unidentified rock	-	7	1	-	-
Anse à la Gourde	igneous rock	-	3	-	-	possibly present
late	limestone	-	-	1	-	possibly present
(Guadeloupe)	unidentified rock	-	1	-	-	-
Anse à l'Eau late	limestone	1	-	-	-	-
(Guadeloupe)	unidentified rock	-	1	-	-	-
Escalier (La Désirade)	no materials	-	-	-	-	-
Jumby Bay (Antigua)	no materials	-	-	-	-	-
Godet (St. Eustatius)	no materials	-	-	-	-	-
Smoke Alley (St. Eustatius)	no materials	-	-	-	-	-
Cupecoy Bay (St. Martin)	igneous rock	-	1	-	-	-
Sandy Ground (Anguilla)	igneous rock	-	4	-	-	-
Barnes Bay	igneous rock	-	8	-	-	possibly present
(Anguilla)	unidentified rock	1	-	-	-	-

Table 5.21. Late Ceramic A phase. Number of identified shaped grinding and abrading tools and related manufacture debris by raw material by site.

Use-modified rock and manuports

Characteristics relating to use-modified pebbles and pebbles without any modification from this phase resemble in many ways the situation of the preceding period. Notable similarities include the use of rocks originating from nearby sources, the predominance of igneous rock artefacts among this group, and association of specific tool types with certain rock types. In detail, the rock types identified besides igneous rock include limestone, beach-rock, undefined fine-grained rock, chert, plutonic rock, and possibly sandstone (table 5.22). Apart from limestone, the occurrence of these latter types among the collections is rare.

Igneous rock again displays the most variability in tool types, including hammerstones, anvils, active and passive abrading/grinding stones, and polishing stones (figure 5.37 and 5.38). Among the limestone pebbles more tool types were found than in the preceding phase, probably owing to the fact that most studied collections come from limestone islands. Tool types include hammerstones, active abrading/grinding stone, a polishing stone and a passive abrading/grinding stone. Fine-grained rock is only associated with the polishing stones as was the case within the preceding phase. These fine-grained polishing stones were not identified much, probably owing to the small size of the lithic samples from sites on and nearby St. Martin.

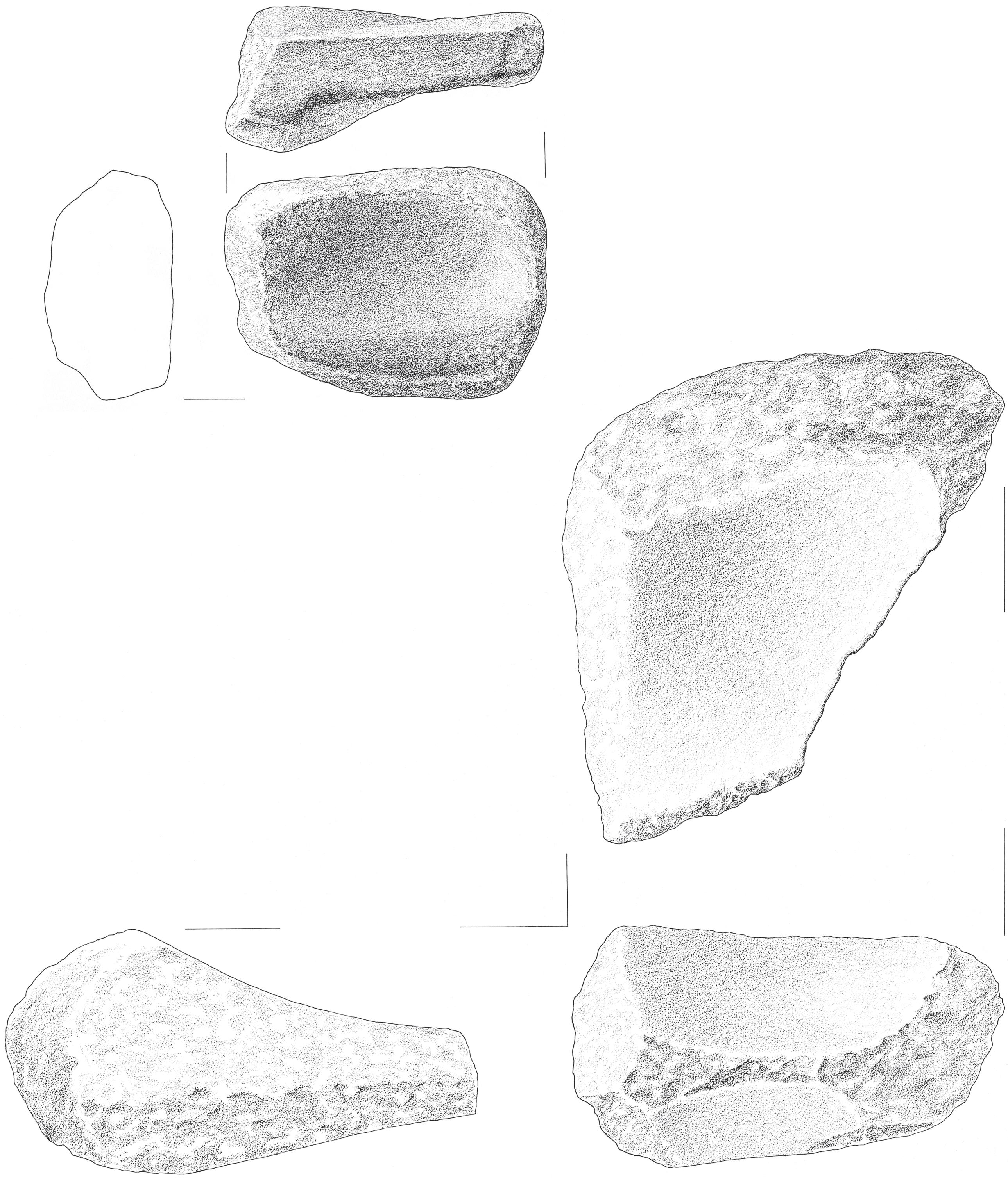


Figure 5.36. Anse à la Gourde middle and late occupation phases, Guadeloupe. Igneous rock passive grinding stones (scale 1:2). (Drawings Raf Timmermans)

Site	Pebble Material	Tool types (N)						
		non-utilized pebble	hammer stone	anvil	passive abrading stone	active abrading stone	polishing stone	other tool
Anse Trabaud (Martinique)	igneous rock	23	2	-	1	2	4	-
Du Phare (Petite Terre)	igneous rock	3	-	-	-	-	-	-
Anse à la Gourde middle (Guadeloupe)	igneous rock	81	13	1	4	2	20	
	pumice	1	-	-	-	-	-	-
	fine-grained rock	18	-	-	-	-	1	-
	sandstone	1	1	-	-	1	-	-
	limestone	212	6	-	-	1	1	-
	beach-rock	2	-	-	1	2	-	-
	unidentified rock	15	-	-	-	-	-	-
Anse à la Gourde late (Guadeloupe)	igneous rock	26	9	-	-	1	-	-
	metamorphic rock	1	-	-	-	-	-	-
	fine-grained rock	2	-	-	-	-	-	-
	limestone	5	-	-	-	-	1	1
	unidentified rock	3	-	-	-	1	-	-
Anse à l'Eau late (Guadeloupe)	igneous rock	7	-	-	-	-	1	-
	plutonic rock	1	-	-	-	-	-	-
Escalier (La Désirade)	igenous rock	69	2	-	-	5	1	1
	limestone	1	-	-	-	1	-	-
Jumby Bay (Antigua)	flint	4	3	-	-	-	-	-
Godet (St. Eustatius)	igenous rock	22	10	1	-	1	-	-
	fine-grained rock	-	-	-	-	-	2	-
	chert	-	-	-	-	-	1	-
Smoke Alley (St. Eustatius)	igneous rock	5	-	-	-	1	-	-
	pumice	1	-	-	-	-	-	-
	fine-gained rock	1	-	-	-	-	1	-
Cupecoy Bay (St. Martin)	igneous rock	n.s.	2	-	-	-	-	-
Sandy Ground (Anguilla)	igneous rock	3	1	-	-	1	1	-
	St. Martin greenstone	1	-	-	-	-	-	-
	chert	-	-	-	-	1	-	-
	limestone	3	1	-	-	-	-	-
	unidentified rock	1	-	-	-	-	-	-
Barnes Bay (Anguilla)	igneous rock	4	1	-	-	-	-	-
	St. Martin greenstone	3	1	-	-	-	-	-
	limestone	7	2	-	1	-	-	-

Table 5.22. Late Ceramic A phase. Number of identified use modified rocks and manuports by raw material, by site. n.s. = not specified.

As already pointed out, procurement of most of such pebbles occurred at localities relatively close to the sites. The Anse Trabaud, Godet, and Smoke Alley inhabitants, living on the coasts of volcanic islands, probably obtained their pebbles from the immediate site surroundings. In contrast, the inhabitants of the Grande Terre and Anguilla sites made boat-trips to nearby islands for pebble collecting. The Anse à la Gourde and Anse à l'Eau people continued to largely collect their needed materials from La Désirade, as evident in the low diachronic variation among rocks from these sites. Still other islands providing igneous rock such as Basse Terre and Montserrat may have been visited on rare occasions as well. The Sandy Ground and Barnes Bay inhabitants probably collected their pebbles from St. Martin, where a large variety can be found.

Figure 5.37. Anse à la Gourde middle and late occupation phases, Guadeloupe. Igneous rock hammerstones (scale 1:2). (Drawings Raf Timmermans)

This collecting may have co-occurred with procurement of greenstone material used for axe-manufacture. A minor portion of pebbles used at the Anguilla and Grande Terre sites, represented by the limestone and rare beach-rock examples, were obtained locally, probably within the immediate site surroundings.

In addition to the use-modified pebbles, non-modified pebbles were also found, particularly at the Anse à la Gourde site, where their occurrence continued to be a striking feature of the site inventory. Unlike the earlier occupation phase at this site and at Morel, the later phases of Anse à la Gourde did not yield any pebbles with remains of black residue, interpreted

a

b

Figure 5.38. Anse à la Gourde middle and late occupation phases, Guadeloupe. Igneous rock hammerstone (b) and hammerstone/anvil (a) (scale 1:2). (Drawings Raf Timmermans)

as fish-net weights. Similar to the earlier phases, however, was the small pebble size and use of the same rock types. This indicates that either the black adhesive was no longer used to attach the pebbles, or post-depositional processes removed the residues from the pebbles in these deposits. Considering the rare finding of this black residue within the earlier phase at Anse à la Gourde, it is likely that post-depositional processes are responsible for its absence in this phase.

5.2.5 Late Ceramic B

Introduction

The number of sites attributed to the Late Ceramic B phase is small within the northern Lesser Antilles in general, and as a result not many sites dated to this phase could be analysed. A total of only four sites were studied, while Rodríguez Ramos (2005, personal communication 2001) provided data on the latest occupation phase of the Paso del Indio site (table 5.23). Moreover, some sites include a small number of artefacts, limiting overall comparison and conclusions.

Site	Island	Type of sample	Reference
Morne Souffleur	La Désirade	all lithics	-
Sugar Mill	Long Island	all lithics	-
Kelbey's Ridge 2	Saba	flake tool related artefacts	-
Shoal Bay East	Anguilla	all lithics	-

Table 5.23. Studied sites from the Late Ceramic B phase.

Flake tool production

The limited sample from the latest phase of the pre-Columbian era does not deviate significantly from the preceding one relative to flake tool production. Varieties of chert continue to form the predominant material used within the northern Lesser Antilles (table 5.24) and on Puerto Rico, the Paso del Indio site displays the exploitation of similar local meta-volcanic materials (Rodríguez Ramos 2005, personal communication 2001). A closer look at the Kelbey's Ridge site reveals an almost identical abundance of Long Island flint (70.5%) compared to older sites on Saba, suggesting that the use of and access to this material remained the same. In contrast, the limited data from Anguilla point to an increasing abundance of Long Island flint through time. Shoal Bay East produced higher percentages of Long Island flint than the earlier Barnes Bay and Sandy Ground sites. Furthermore, comparison of the material within Shoal Bay East itself displays an increase of Long Island within the upper site levels, although these levels produced very little material in general.

At Morne Souffleur, the absence of Long Island flint is striking, but the size of the sample excavated is small. Most flaked material is made of local red chert or local igneous rock. Due to the small number of artefacts, it could not be specified with what kind of production these latter igneous flakes are related to. In addition, Kelbey's Ridge 2 yielded still some other chert and flint types. Other than Long Island flint, this group displays considerable variability, which made it difficult to distinguish discrete varieties. Interestingly, the use of other Antigua sources was not identified.

As discussed above in Chapter 4, stone working at both sites on Long Island was very similar with regard to the choice of raw material, expedient reduction, and low occurrence of bipolar flaking, suggesting that the technological behaviour did not change through time. This is supported by data from Saba as well, which resemble the technological features of the earlier Spring Bay 3 site in many respects. Again, the smaller size of flaked material on sites further away from Long Island is noticed when compared to the material found of the source itself. A higher abundance of bipolar flakes is present as well, clearly supporting the view that the presence or absence of the use of this technique not necessarily is related to a cultural difference, but rather is dependent on availability of raw material. Similar to the earlier phases, Long Island flint was transported in unmodified natural form to Saba, as indicated by high percentage of cortical flake at Kelbey's Ridge 2.

Site Chert type	Shoal Bay East N=26 %	Kelbey's Ridge 2 N=112 %	Sugar Mill N=432 %
Long Island flint	65.4	70.5	100.0
Blackman's Point flint	-	-	-
Coconut Hall flint	3.8	-	-
Antigua Form. flint	3.8	-	-
White chert	-	-	-
Petrified wood	-	-	-
Other chert	42.3	19.6	-
Désirade red chert	-	-	-
Jasper	-	-	-
White quartz	-	-	-
Unidentified chert	3.8	9.8	-

Table 5.24. Late Ceramic B phase. Relative amount of identified chert types by site.

Site	axes	zemis	lapidary items	use-modified rocks	other shaped tools
Morne Souffleur (La Désirade)	1 finished St. Martin greenstone axe only	no items found	no items found	use of igneous rock for hammering and abrading	no items found
Sugar Mill (Long Island)	no items found	no items found	no worked items found, only 1 calcite crystal	one igneous hammerstone only	no items found
Kelbey's Ridge 2 (Saba)	not studied, possibly St. Martin greenstone axe production	not studied	4 diorite beads, no production debris	not studied	not studied
Shoal Bay East (Anguilla)	greenstone axe production	no items in sample[a]	1 metamorphic bead pre-form	no items in sample	no items in sample

Table 5.25. Stone artefact use and manufacture at four Late Ceramic B phase sites within the northern Lesser Antilles. [a] In addition to the analysed sample for this dissertation previous survey work at Shoal Bay East by AAHS members has produced numerous zemi three pointer stones, made out of a variety of materials, such as calcite, limestone, calci-rudite and quartz (Crock & Petersen 1999).

Core tool production

Axes and adzes

The amount of axes and axe related material is very small. Only St. Martin greenstone is associated with the use of axes during this phase (table 5.25). Similar to the earlier sites on Anguilla, Shoal Bay East yielded greenstone debitage indicating local axe fabrication. Whether greenstone axe manufacture also occurred on Saba cannot be specified yet, but it is likely, considering the occurrence of greenstone material there at Kelbey's Ridge 2. A single finished corroded example found at Morne Souffleur indicates that these tools still were traded among the northern Lesser Antilles.

Beads and pendants

Use of local mineral and rock varieties for making beads continued during this phase. Only two sites yielded bead material (see table 5.25). These are Kelbey's Ridge 2 and Shoal Bay East. At the former site, the excavation of large 4 x 4 m test-units produced four diorite beads (see Hoogland 1996, 155-156, fig. 6.24a,c). The raw material resembled that of the diorite bead found at Jumby Bay and may suggest a similar provenance.

At Shoal Bay East, the later occupation levels yielded numerous calcite pieces and fragments, similar to the earlier occupation there. Most of the material either represents natural rock, or broken natural rock. As argued for the Late Ceramic A phase, this natural rock may have been collected for bead making at the site. The finding of some calcite beads suggests this. In addition to these beads, the Kelbey's Ridge 2 site yielded a slightly angular water-worn pebble, perforated at the top (Hoogland 1996, 155-156 fig. 6.24d). Both faces as well as the bottom exhibit evidence of flattening. This piece might have been worn as a pendant or it may have served as a weight for weaving cotton.

Zemi three-pointer stones

None of the samples from the studied sites include zemi or artefacts related to zemi making in stone (see table 5.25). Crock and Petersen, however, report the finding of both calci-rudite, limestone, calcite and quartz zemis at Shoal Bay East and various other Anguillian sites (Crock 2000; Crock & Petersen 1999). These are mostly surface finds. Despite the finding of finished artefacts, the absence of evidence relating to calci-rudite making at this site may be noteworthy. This distinguishes the Shoal Bay East site from the other sites on Anguilla, that are discussed in this work. Close comparison of the material evidence and dates shows that calci-rudite material abundances decreased through time. Early sites, such as Rendezvous Bay and Sandy Ground produced a significant number of artefacts that strongly supports on-site zemi manufacture. Manufacture of zemis occurred on the somewhat later occupied Barnes Bay site as well. The Sandy Hill site, which strongly overlaps with the later period of occupation at Barnes Bay, displays a significantly lower number of the calci-rudite material. A decrease through time is tentatively supported by the near absence at Shoal Bay East, where occupation post-dates 1000 AD well into historic times (Crock 2000).

Use-modified rock and manuports

The low number of identified use-modified pebbles only includes a few hammerstones, and an active and a passive abrading stone, all made of igneous rock (see table 5.25). Most were found at Morne Souffleur on La Désirade, where similar varieties naturally occur. The only other site that produced use-modified material for this phase was Sugar Mill, where a single non-local igneous pebble was used as a hammerstone. The fact that samples are small and in some cases incomplete is made clear by an absence of shaped passive grinding tools.

5.3 Discussion

5.3.1 Diachronic summary

The presentation on Pre-Columbian use of stone materials and tool productions shows that in general raw material choice and production behaviour remained relatively similar throughout the sequential phases of the Ceramic Age within the northern Lesser Antilles. Some modest and often local changes were noted, however. Only in relation to the lapidary industry a significant difference was evident, which occurred during the transition from the Early Ceramic A to Early Ceramic B phase. Tables 5.25 to 5.28 list the most important features regarding stone working and acquisition for each site within each of the four different phases. I want to emphasize that sound diachronic comparison is hampered by the fact that not all islands are represented by a site for each of the four phases. This means that in some cases sites from different islands are compared to examine diachronic variation. Considering inter-island variability in geological context, dissimilarities between sites on different islands are not necessarily indicative of changes in use and inter-island contacts through time, but they may be the result of the distinct geological conditions of the islands, and/or different distances to the exploited exotic lithic sources.

To overcome this problem of geological and geographical variability, I attempted to compare sites from the same island or from the same region within a single island. The Guadeloupe sites along the northern coast of Grande Terre form an excellent case study for this purpose, as occupation covered three of the four phases discussed in this work. Morel yielded data for the later part of the Early Ceramic A, whereas the long-term occupations at Anse à la Gourde and Anse à l'Eau covered the entire Early Ceramic B and Late Ceramic A phases. Only the last phase is not represented. Comparing the different phases shows that raw material choice overall did not change much, supporting the remark made above: similar tools were produced and used throughout the different phases. Some differences, however, are noted as well.

Among the flake tool material, Long Island flint remained the predominant rock type throughout all phases. Only the less abundant chert types exhibit diachronic variation. Within the earliest phase, white chert, for which a provenance remained to be determined, formed the second most abundant variety, whereas it totally disappeared during the later phases. The later phases displayed the use of Corbison Point flint, which was not found at Morel. Interestingly, Blackman's Point and La Désirade chert appeared in almost all phases, albeit in very small numbers.

The continued use of Long Island flint along the northern coast of Grande Terre markedly differed from a clear alteration in raw materials used at, for example, the Paso del Indio site in Puerto Rico, where long-term occupation also provided the opportunity to study diachronic changes. Rodríguez Ramos (2005) reports a significant change from the predominant use of non-local cherts within the Late Ceramic B phase toward the almost exclusive use of local igneous materials during later occupations. This example shows that interregional variability was present, suggesting that the Grande Terre case is not exemplary for the entire study area discussed here.

The diachronic comparison of the use of axes at the Grande Terre sites is somewhat hampered by the small number of items. St. Martin greenstone was present in all phases, evidently supporting its regional significance through time. In addition, igneous rock was also present during most phases. However, the material displays variation within phases and between phases. Unfortunately, incomplete knowledge about the provenances and intra-source variability severely limits a proper understanding of possible changes in lithic acquisition. Axes made of metamorphic rock exhibit more variation through time. So far, the Early Ceramic B phase did not produce a single item of such material. Considering the fact that these items are not local to the region, this may suggest more limited access to long-distance contacts during this phase.

Most significant change within this northern Grande Terre region is related to the use of certain gem stone varieties during the earliest phase, which were no longer represented during the later phases. This change was already discussed above and in this specific case, particularly applies to the use of carnelian and amethyst.

Comparison of the production and use of zemis suffers from the same low frequency of artefacts as among axe

Site	local material and on-site manufacture	exotic material and on-site manufacture	exotic products
Vivé	* Chert and chalcedony flake tool manufacture * Igneous axe manufacture * Igneous pebble use * Igneous metates	* Long Island flint flake tool manufacture	* Semi-precious beads and pendants
Cocoyer	-	* Long Island and white chert flake tool manufacture	no data
Morel	* Limestone pebble use	* Long Island and white chert flake tool manufacture * La Désirade Igneous pebble use * Carnelian bead manufacture	* St. Martin greenstone axes * Igneous rock axes * Semi-precious beads and pendants
Trants	no data	* Long Island and white chert flake tool manufacture * Carnelian and diorite bead manufacture	* Semi-precious stone beads and pendants
Doigs early	* Chert and flint flake tool manufacture	* Long Island flint flake tool manufacture	no data
Royalls	* Chert and flint flake tool manufacture	* Long Island flint flake tool manufacture * Carnelian bead manufacture	* Metamorphic axes * Semi-precious stone beads and pendants
Hichman's	-	* Long Island flint and other chert flake tool manufacture	-
Hope Estate	* St. Martin greenstone axe manufacture * Igneous axe manufacture * Igneous and fine-grained rock pebble use	* Long Island flint and other chert flake tool manufacture	* Semi-precious stone bead and pendants
Sorcé	* Quartz flake tool manufacture	* Long Island flake tool manufacture * Puerto Rican chert flake tool manufacture * Igneous rock axe manufacture	* St. Martin greenstone axes * Metamorphic rock axes * Fine-grained polishing stones
La Hueca	* Quartz flake tool manufacture	* Long Island flake tool manufacture * Puerto Rican chert flake tool manufacture	* St. Martin greenstone axes * Metamorphic rock axes * Fine-grained polishing stones

Table 5.26. Stone working and acquisition at Early Ceramic A phase sites.

Site	local material and on-site manufacture	exotic material and on-site manufacture	exotic products
Diamant	* Chalcedony and jasper flake tool manufacture * Igneous rock axe manufacture * Igneous rock metate use/manufacture * Igneous rock pebble use	* Long Island flint flake tool manufacture (?)	* St. Martin greenstone axes
Anse à la Gourde early	* Beach-rock metate use/manufacture * Limestone pebble use	* Long Island flint and other chert flake tool manufacture * Igneous rock axe manufacture (?)	* St. Martin greenstone axes * Igneous rock metates * La Désirade igneous rock pebble use
Anse à l'Eau	-	* Long Island flint and other chert flake tool manufacture	* Igneous rock axes * Metates * La Désirade igneous rock pebble use
les Sables	* Igneous rock pebble use	no data	* Igneous rock axes
Doigs late	* Chert flake tool manufacture	* Long Island flint and other chert flake tool manufacture	no data
Sugar Factory Pier	* St. Kitts flint flake tool manufacture (?) * Igneous rock pebble use	* Long Island flint flake tool manufacture * St. Martin greenstone axe manufacture	* Igneous rock axes * Fine-grained axes
Golden Rock	* Igneous rock metate manufacture * Igneous rock pebble use * Pumice zemi manufacture (?) * Beach-rock pebble use (?)	* Long Island flint flake tool manufacture * St. Martin greenstone axe manufacture * Igneous rock axe manufacture	* Metamorphic rock axes * Fine-grained polishing stones * Calci-rudite, limestone, igneous rock and other rock zemis
Kelbey's Ridge 1	* Igneous rock pebble use	* Long Island flint flake tool manufacture * St. Martin greenstone axe manufacture	no data
Anse des Pères	* St. Martin greenstone axe manufacture * Igneous rock axe manufacture * Igneous and fine-grained rock pebble use	* Long Island flint flake tool manufacture	* Semi-precious stone beads

Table 5.27. Stone working and acquisition at Early Ceramic B phase sites.

Site	local material and on-site manufacture	exotic material and on-site manufacture	exotic products
Anse Trabaud	* Chalcedony and jasper flake tool manufacture * Igneous rock axe manufacture * Possible igneous rock metate manufacture * Igneous rock pebble use	-	* St. Martin greenstone axes
Grande Anse	no data	no data	* St. Martin greenstone axes
Du Phare	-	* Igneous rock metate manufacture	* St. Martin greenstone axes * La Désirade igneous rock pebble tools
Anse à la Gourde middle	* Calcite bead manufacture (?) * Limestone zemi manufacture * Limestone and beach-rock pebble use	* Long Island and Coconut Hall flint and other chert flake tool manufacture * Possible igneous rock metate manufacture	* Igneous rock and rock crystal beads * St. Martin greenstone and meta-morphic rock axes * Calci-rudite and igneous rock zemis * La Désirade igneous rock pebble tools
Anse à la Gourde late	* Possible limestone zemi manufacture (?) * Limestone pebble use	* Long Island flint and other chert flake tool manufacture * Possible igneous rock metate manufacture	* St. Martin greenstone and meta-morphic rock axes * Calci-rudite zemis * La Désirade igneous rock pebble tools
Anse à l'Eau	-	* Long Island flint and other chert flake tool manufacture	* St. Martin greenstone axes * Calci-rudite zemis * La Désirade igneous rock pebble tools
Escalier	* Igneous rock pebble use	-	* St. Martin greenstone axes
Claremont	no data	* Long Island flint flake tool manufacture	no data
Coconut Hall	* Coconut Hall flint flake tool manufacture	* Long Island flint flake tool manufacture	no data
Blackman's Point	* Blackman's Point flint flake tool manufacture	* Long Island flint chert flake tool manufacture	no data
Jumby Bay	* Long Island flint flake tool manufacture * Long Island flint pebble use	-	* Diorite beads * St. Martin greenstone axes
Coconut Walk	no data	no data	* St. Martin greenstone axes
Godet	* Igneous rock pebble use	* Long Island flint and other chert flake tool manufacture * St. Martin greenstone axe manufacture	* Fine-grained rock pebble tools
Smoke Alley	* Igneous rock pebble use	* Long Island flint and other chert flake tool manufacture * St. Martin greenstone axe manufacture	* Fine-grained rock pebble tools
Spring Bay 3	no data	* Long Island flint and other chert flake tool manufacture	* Diorite beads * Calci-rudite zemis
Cupecoy Bay	* Calcite bead manufacture * St. Martin greenstone axe manufacture * Calci-rudite zemi manufacture * Igneous rock pebble use	* Long Island flint flake tool manufacture	-
Rendezvous Bay	* Unspecified limestone working	* Calci-rudite zemi manufacture * Long Island flint and other chert flake tool manufacture * St. Martin greenstone axe manufacture	no data
Sandy Ground	* Calcite bead manufacture * Limestone zemi manufacture * Limestone pebble use	* Long Island flint, white and other chert flake tool manufacture * St. Martin greenstone and possible igneous rock axe manufacture * Calci-rudite zemi manufacture	* Diorite beads * Igneous metates * Igneous rock pebble tools
Barnes Bay	* Calcite bead manufacture * Possible limestone zemi manufacture * Limestone pebble use	* Long Island flint, white and other chert flake tool manufacture * St. Martin greenstone and possible igneous rock axe manufacture * Calci-rudite zemi manufacture	* Diorite beads * Igneous rock metates * Igneous rock pebble tools
Sandy Hill	* Calcite bead manufacture * Calci-rudite zemi manufacture	* Long Island flint and other chert flake tool manufacture * St. Martin greenstone axe manufacture * Calci-rudite zemi manufacture	* Diorite beads

Table 5.28. Stone working and acquisition at Late Ceramic A phase sites.

materials. Still, the fact that among the considerably larger sample from Morel only one zemi was represented signifies a change relative to the later phases, where smaller samples include more examples. The possible production and use of limestone zemis during the Late Ceramic A is worth mention, and seemingly supports the general notion that limestone became an important material during the later phases. Also the recovery of calci-rudite zemis during the Late Ceramic A phase within this region, corresponds to the evidence of clear production places during this period, which were absent during the Early Ceramic A phase.

Passive grinding/abrading stones rarely occur within the large sample of Morel. This markedly differs from the later phases, when these tools regularly turn up. This seemingly indicates a change in subsistence practices, if it is assumed that the majority of these items are related to food processing, rather than tool or bead and pendant grinding. Whether the increase of this tool type during the later phases is suggestive for the introduction of maize or the use of wild roots or panicoid seeds is speculative, but definitely needs further investigation (cf. Newsom 1993).

The pebble tools and non-modified pebbles present a relatively continuous use of similar materials, probably owing to the nearby availability of these rock types. Small fine-grained igneous pebbles, including the ones displaying black residue, are found during all phases and exhibit a similar material variability, resembling rock from La Désirade. In addition, larger items of the same rock types also occur throughout all samples. Still some subtle differences are also noted. The Early Ceramic B sample from Anse à la Gourde contains relatively more granular types of igneous rock pebbles. Whether this difference can be attributed to the exploitation of different beaches on La Désirade, where the composition of pebbles is slightly distinct, or whether it points to the use of other volcanic source islands is still unclear.

5.3.2 Organization of production

Above, I described stone tool and artefact manufacture within the different sites for each of the four phases distinguished in this study. Still some important issues need to be addressed. These relate to the points made above in Chapter 1, particularly relative to the efficiency of the production process as an indicator of changing exchange mechanisms. In other words, it may be asked whether evidence can be found that suggests that efficiency was increased or diminished during specific phases. Torrence (1986) has argued that efficiency can be increased when production becomes more sophisticated, standardized, specialised, or simplified. In relation to sophistication and standardization, my results at the moment are too limited to obtain any clear insight. At present, the data do not suggest an increase of sophistication through the use of more subtle flaking techniques, or of a more variable tool-kit. In relation to standardization, the available evidence about greenstone axe production, however, suggests that this tool became more standardized in shape during the later phases. Comparing the Hope Estate tools, and the ones from La Hueca, Punta Candelero, and Sorcé dated to the Early Ceramic A, with the tools from later phases reveals a decrease in the number of shapes and edge types. During the later phases, the petaloid celt became the predominant axe-type. Among these later petaloid celts, variability in size and shape is still evident, as shown by the variable sized set of axes found at Anse à la Gourde (figure 5.39; see also figure 5.27).

The concept of specialization needs some additional comments, as it incorporates two aspects that are relevant to this study. On the one hand, the introduction of specialists increases the efficiency of stone tool production and on the other hand, the presence of specialists demands a different social structure. In relation to the first aspect Torrence, distinguishes craft-specialists from industrial specialists, the former being skilled craftsmen making highly individualistic products, the latter being able to make products at great efficiency. With regard to this second aspect discrimination between part-time and full-time specialists is important. The former may be able to still operate within an egalitarian society on a household or community level, whereas the latter needs to be compensated for not participating in general subsistence activities by payment from elites or participation in a market system.

Examining the different stone tool technologies within the northern Lesser Antilles relative to specialisation, a basic distinction can be made between flake tool production and core tool or core artefact production. The former production occurred at every site, whereas the latter only occurred at a limited number of sites and in particular, are related to greenstone axe and calci-rudite zemi production.

Taking a closer look at flake tool production, the evidence suggests that it remained at the household level throughout the entire Ceramic Age. This view is supported by the fact that production took place at each site and that the manufacture of tools can be classified as expedient. It is an ad-hoc means of producing a variable set of flakes, which only minimally underwent secondary modification. All signs pointing to standardization of core reduction or tool shaping are absent. As such, it can be regarded as a relatively fast and easy means of tool production not demanding much training and

Figure 5.39. Anse à la Gourde middle and late occupation phases, Guadeloupe. Different sized and shaped St. Martin greenstone axes (scale 1:2). (Photo Ben Grishaaver)

therefore, likely to have been performed by several people in each community.

The limited number of production loci of axes and zemis, along with the general exchange to sites in the surrounding region (see below for discussion), minimally suggests a specialisation on the village level for the making of these artefacts. The variation among sizes and shapes of the imported petaloid axes at Anse à la Gourde indicates that standardization of the products only occurred to the level of a general petaloid form and that variation existed within this form. This can be either explained by the existence of craft-specialists producing individual variation among these tools, or by a household production involving a considerable number of people within each community.

I used data from a number of sites on Anguilla to obtain more insight into the number of tools produced in individual settlements. This provides an evaluation of the existence of full-time specialisation among these communities. Crock estimated the amount of St. Martin greenstone transported to these sites per year to be worked into axes on the basis of systematic shovel testing at each site (Crock 2000, 235). Using confidence intervals, his figures range from 5 to 16 kg/year for the Barnes Bay site and 27 to 82 kg/year for the Sandy Ground site. From the lithic analysis of the Sandy Ground sample, which includes the highest number of greenstone material, I found a number of 1.0 to 3.3 tools produced per one kg of greenstone, depending on the definition of what was a tool.[6] It must be stressed that the number of tools left at Sandy Ground only represents a portion of the total number of axes made at this site, considering the fact that some were surely exchanged and others were discarded or lost elsewhere, e.g., in the forest where they were used. This means that the range of

6 The lower figure only includes artefacts displaying some (portion of a) ground edge, while the higher figure includes all butt (poll) parts identified as well. The problem with classifying this latter type of artefact as a tool, lies in the fact that not all axes had completely ground butt (polls) parts, making a distinction between preform and finished tool very difficult, when only this butt (poll) portion is available.

1.0 to 3.3 axes only represents the minimum range. Therefore, I used the higher figure of 3.3 axes per kg to calculate annual axe production. This gives a production rate of 87 to 265 tools per year at Sandy Ground, whereas at Barnes Bay a similar axe per mass number gives a range of 17 to 53 tools. If it is assumed that the making of an axe, including the final grinding phase, will on average not take longer than 11 hours work (one and a half days)[7], then a single person working on a part-time basis is able to accomplish the entire annual production at Barnes Bay. This does not hold for the Sandy Ground production. The realisation of the maximum annual production minimally needs more than one person working on a full-time basis. This leaves the existence of full-time specialisation open, although it will be in the exceptional case of only one or two axe makers living in the village and being responsible for the maximum number of tools specified here. However, if it is assumed that five or more persons were involved in axe making, then part-time manufacture might be sufficient to produce the maximum number of tools.

Notwithstanding the fact that full-time specialisation is difficult to demonstrate on the basis of these data, the considerable axe production at Sandy Ground shows that axe making formed a significant part of daily life in this village. This significance clearly should be related to the exchange value that these tools represented (see below). Axe production clearly formed an enterprise that involved several people from a single village. Therefore, it is likely that it was organised on a community level in some way.

Neither of the other core artefact production technologies equals or exceeds the greenstone axe production in number of artefacts and amount of material, as reported for the Anguilla sites. Rare remains of igneous axe production were only identified at a very limited number of sites, as noted above. This accounts also for limestone zemi production. Only the recurrent evidence of calci-rudite zemi production on Anguilla and western St. Martin is an example of a more structured production process in space and time. Comparison of the amounts of calci-rudite with the greenstone material in this region shows that calci-rudite by no means equals the abundance of greenstone material. This is also supported by the data on the calci-rudite zemi distribution within the surrounding region (see below). This suggests that neither of these production sequences involved the participation of full-time specialists. Considering the religious significance of the stone three-pointers, it is likely that the manufacture of these artefacts was allowed to only certain people within a particular village, possessing the proper religious and ritual knowledge.

5.4 Conclusions

The diachronic summary and detailed presentation show that stone tool technology within the northern Lesser Antilles did not experience much change with regard to the way of tool production and tools used during the four phases of the Ceramic Age. Most changes were related to the use of different materials, which likely must be associated with changing social relations. These changes either gave people the opportunity to get access to non-local sources, or forced them to be excluded from such access. Regarding this, I particularly think of the disappearance of the semi-precious bead and pendant industry, changing occurrence of metamorphic axes, and alternations in the distribution patterns of Long Island flint and St. Martin greenstone over time. Some changes may have had other causes related to changing subsistence strategies, or different cultural behaviours. In relation to the former, I refer to the possible increase of passive grinding stones during later phases. With regard to the latter I must mention the use of stone adzes in the western part of this study region (Puerto Rico and Vieques), notably during the earliest Ceramic Age phase. In the Lesser Antilles, where shell adzes appear to have been largely used, the stone equivalents are almost absent.

Stone tool and artefact production remained an activity performed on a household level or was a part-time craft specialisation, at most. On a settlement level certain sites operated as places where certain artefact types were being made, whereas others did not, but evidence does not suggest that this community specialisation involved the existence of full-time specialists. Still the considerable number of axes produced at some sites at least makes it clear that axe-manufacture formed a significant part of daily life at these settlement sites. Therefore, it may have been an activity that was organised at the village level, rather than at the individual level or single persons operating individually.

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[7] The time of 11 hours is a very conservative number. Experimental work on axe manufacture has shown that the grinding stage will take most of the time (Madsen 1984; Petrequin & Jeunesse 1995). It further demonstrated that the speed of the grinding is dependent on the type of material to be ground and the material used as grinding slab. Experiments in which both harder materials were used and larger axes ground than is the case in the Lesser Antilles generally did not exceed 10 hours and in most cases were considerably shorter (Madsen 1984; Petrequin & Jeunesse 1995).