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INTRODUCTION

Edwards chert of central Texas has long been recognized by archeologists as an important lithic resource throughout prehistory. Artifacts made from Edwards chert have been found either as temporally diagnostic forms or in dated contexts indicative of every time interval from the earliest Paleoindian to the Historic periods. These artifacts are found in abundance on and near the central Texas Edwards Formation outcrop and, particularly during some time intervals, they are found far beyond the source area.

Occurrences of Edwards chert artifacts beyond the outcrop have given rise to considerable speculation about the technological, economic, strategic, social, and political processes that formed this distinctive archeological record. In some instances, Edwards chert is found in areas where chippable stone is scarce or of very poor quality (Shafer 1973; Young and Collins 1989). In others, it is found where knappers had more ready access to other reasonably comparable raw materials (Button 1989; Hofman et al. 1991). Archeologists view much of the Gulf Coastal Plain of Texas as impoverished in locally available chippable stone and note that artifacts of Edwards chert are comparatively common. It is also widely recognized that secondary sources of Edwards chert occur as gravel clasts in places on the coastal plain, but these sources have not been studied in much detail. This project brought to the fore a need for better information on these secondary sources of Edwards chert.

Because the Smith Creek Bridge site is situated in the supposedly chert-impoverished Central Gulf Coastal Plain, the recovery at the beginning of fieldwork of abundant chert flaking debris that included much of the byproduct of early-stage reduction of raw material was surprising. The pattern was what would be expected in a site near an abundant outcrop of raw material. Although other kinds of material were being recovered in small numbers, a vast majority was visually recognizable as "Edwards" chert. Cortical pieces bore the clear signature of high energy stream transport. A nearby source of chert in a gravel deposit was indicated by the abundance and nature of the debitage, but we were confronted with another unexpected aspect of this material—the large sizes of the clasts as indicated by the curvature of the cortical surfaces and the size of some flakes. It was apparent that some primary and secondary cortex flakes at this site had been detached from large cobbles, and such a cobble had been noted in a spoil pile of earth that had been bladed off the site prior to our investigations. That cobble measures 19.6-x-10.5-x-6.9 cm, weighs 2.23 kg, and is of medium yellowish tan "Edwards" chert with a dark brown, uniformly battered cortex (Figure 77a). Its size, shape, and quality are ideally suited for the manufacture of a large biface.

It was immediately apparent that we needed more information on lithic resources available to the prehistoric inhabitants of this site. Such knowledge would also have important regional implications. Preliminary field reconnaissance soon led us to nearby localities where stream cobbles of Edwards chert could be obtained. For the most part the clasts were small, but in one locality pieces greater than 12 cm in maximum dimension were relatively numerous. Although these localities were informative, the materials were being exposed by mechanized gravel-quarrying activities where there did not seem to have been any natural outcrops that could have been effectively utilized aboriginally. This view rests on the assumption that people with primitive digging tools would not exploit subsurface gravel deposits for chert if suitable material were available at the surface in the general area. Also, even though it was clear that most of the chert in these gravels had been derived from the Edwards Formation, its distance from the source raised questions about how much alteration it had undergone since being eroded from the limestone in which it formed.

Thus, two avenues of further research were identified at this stage in our investigation. First, additional field reconnaissance and review of the regional geology were needed to better understand where and in what forms natural outcrops might occur that would have yielded raw material to prehistoric knappers without large-scale quarrying. Second, the question was posed, "could the chemico-physical properties of these secondary deposits of Edwards chert be used to distinguish them from cherts at the primary outcrop?"

This study has the purpose of furthering our understanding of the human ecology of chert and related materials in the Central Gulf Coastal Plain of Texas. It begins with a brief review of previous archeological inquiry on the matter and then presents a general description of the geologic occurrence of chert, quartzite, and silicified wood in the region with an emphasis on the immediate vicinity of the Smith Creek Bridge site. From this closer look, it emerges clearly that as regards prehistoric utilization of siliceous stone on the Central Gulf Coastal Plain, the task of archeological interpretation is significantly more complex and intriguing than previously thought. The complexity derives from the widespread but uneven occurrence, abundance, and large clast-sizes of chert in the region. This complexity greatly exceeds the capacity of this limited study, and much investigation remains to be done, but a beginning has been made. The intrigue is that it may be possible to distinguish primary from secondary occurrences of Edwards chert. This possibility and its implications are discussed at the end of this appendix. Some initial inquiry using neutron activation analyses is the subject of Appendix B.

The Setting

As detailed above (see Chapter 3), the Smith Creek Bridge site is on the coastal plain of Texas. In Texas, the coastal plain is bounded on the southeast by the Gulf of Mexico and along most of its northwestern extent by the Balcones Escarpment, the prominent southern and eastern margin of the

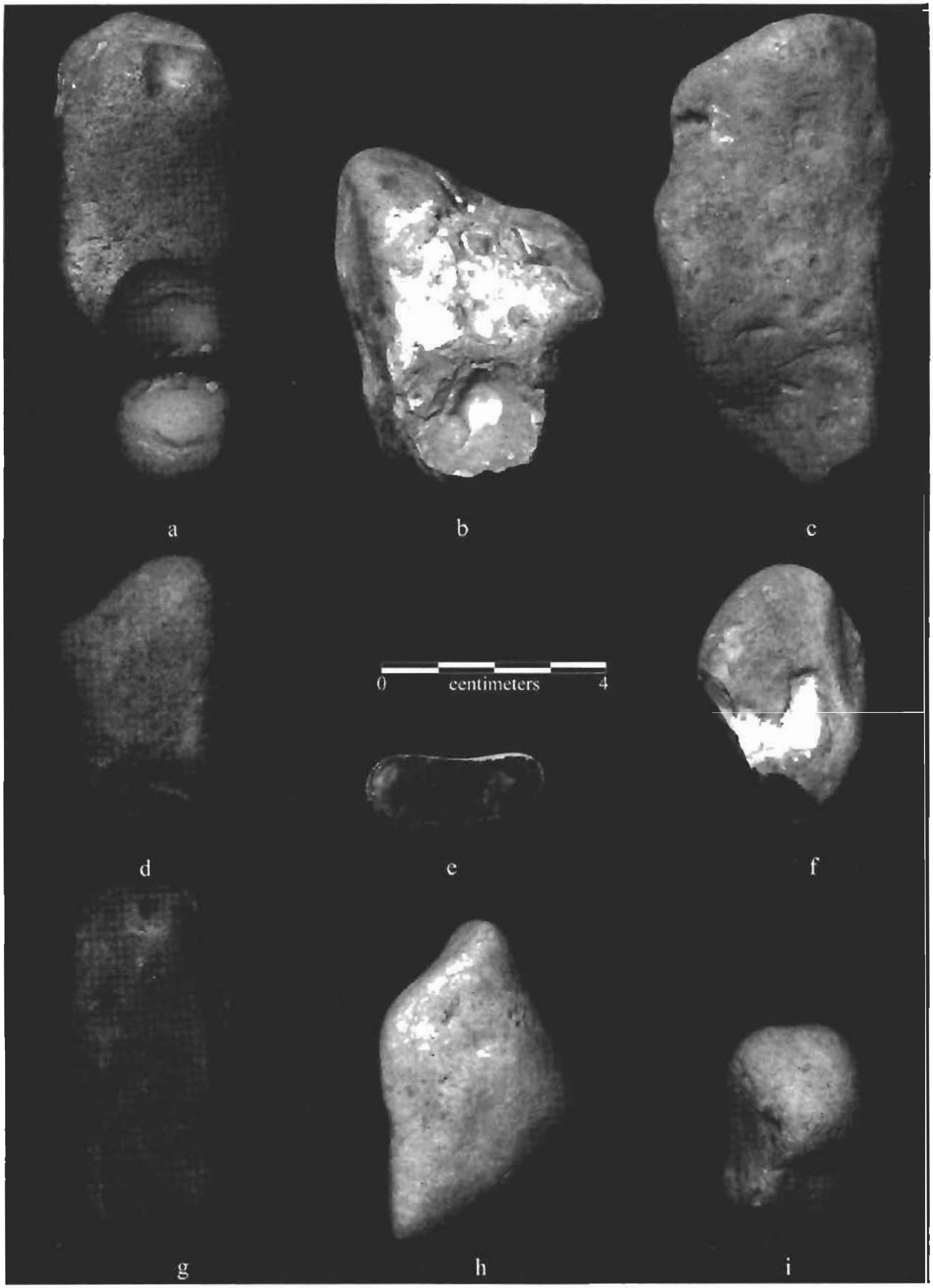


FIGURE 77. Representative clasts of chert from Willis Formation gravel. (a) surface find at Smith Creek Bridge site; (b-e) Alvarez Quarry (Locality 15); (f-i) Koenig-McCrab road cut (Locality 25).

Edwards Plateau (Figure 78). The Smith Creek Bridge site is almost exactly halfway between the Balcones Escarpment at New Braunfels (102 km away) and the nearest point on Aransas Bay (107 km away). The Edwards Plateau and the coastal plain differ topographically, geologically, edaphically, climatically, and biotically in ways important to human adaptations. Of immediate concern here are the geologic contrasts that determine how people acquire stone for the manufacture of tools.

From the escarpment toward the Gulf are bands of progressively younger Tertiary and Quaternary rocks of marine and nonmarine origins. For the most part, these are clastic sediments ranging from clay to sand but some noncherty carbonates occur as well. In contrast, much of the Edwards Plateau is supported by a thick Cretaceous carbonate section composed of many formations, some of which are chert-bearing. Present-day streams transport chert as gravel and smaller-sized clasts from the plateau southeastward across the coastal plain. These sediments are now temporarily stored as alluvium in floodplains and terrace fills. In addition, as early as middle Tertiary times, streams coursing along now-abandoned valleys also transported and deposited quantities of chert-rich gravels. To find chert cobbles today and in all of human history, one must search both along modern stream valleys and in the gravel beds left by ancient streams. The latter deposits are often on the higher parts of the landscape. It is to the details of this lithic landscape and the processes by which it came about that we now turn.

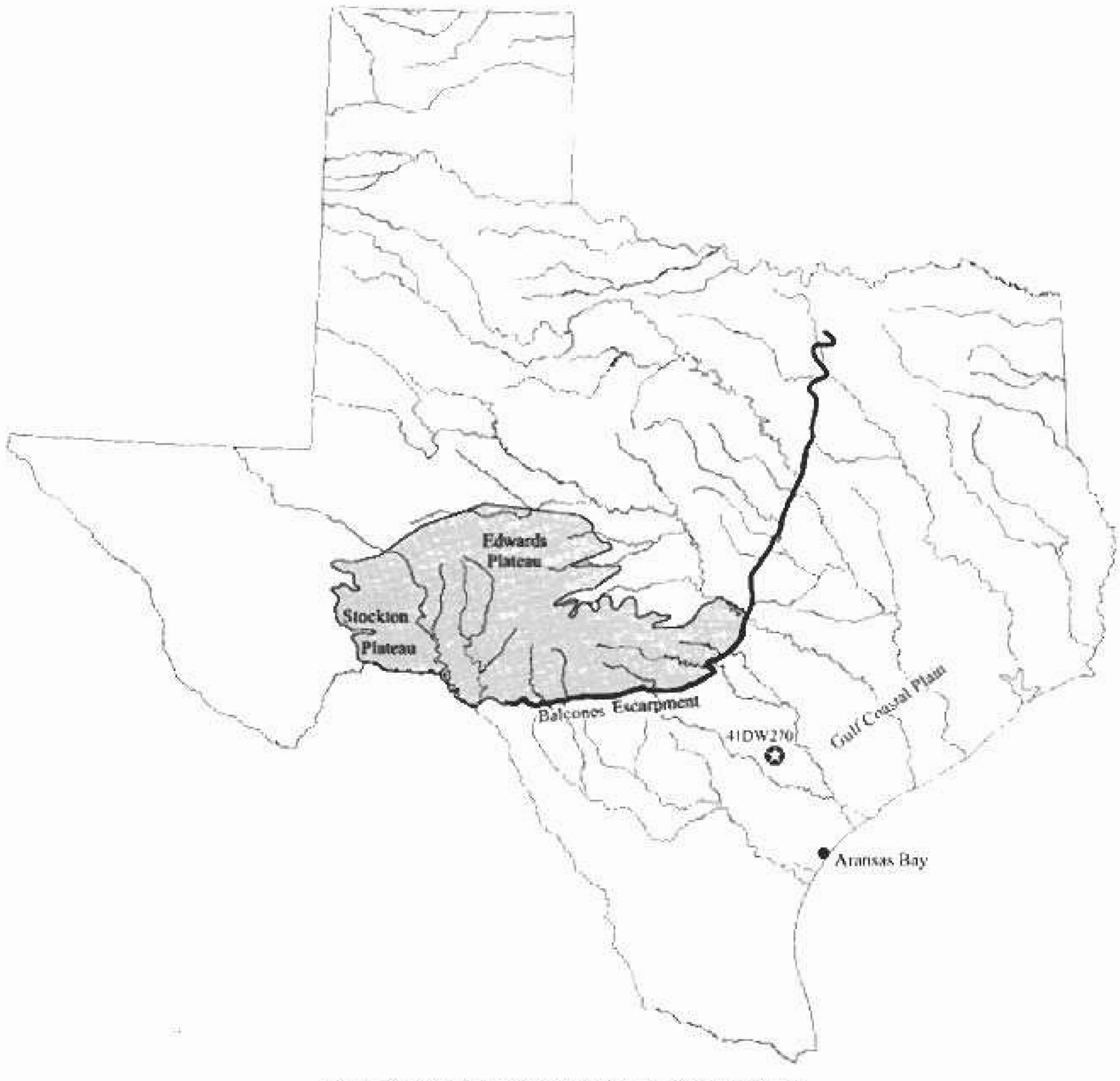


FIGURE 78. Major physiographic features discussed in text.

Archeological Characterizations of Chert on the Central Gulf Coastal Plain of Texas

A powerful tool in archeological interpretation is the ability to trace the source of exotic earth materials found as artifacts in a site or region. Reliability in such determinations is generally best when based on definitive physicochemical analyses (e.g., Borradaile et al. 1998; Harbottle 1982; Shackley 1998), of which copper (e.g., Dungworth 1997; Gale and Stoss-Gale 1975), jade (Lange 1993), ochre (e.g., Smith and Pell 1997), ceramic clay and temper (e.g., Hammond et al. 1976; Masucci and Macfarlane 1997), various igneous and metamorphic rocks (e.g., Hermes and Ritchie 1997; Jones et al. 1997; Lillios 1997), pipestone (e.g., Hughes et al. 1998), and obsidian (e.g., Asaro et al. 1978; Griffin et al. 1969; Hammond et al. 1984; Stross et al. 1983; Tenorio et al. 1998) are examples. For the most part, chert and related materials have been far less tractable (Aspinall and Feather 1972; Craddock et al. 1983; de Bruin et al. 1972; Glover and Lee 1984; Hess 1996; Luedtke 1992; Malyk-Seligvanova et al. 1998; Shackley 1998). Some cherts and related materials (e.g., Ohio Flint Ridge, Alibates) are quite distinctive and can be identified fairly reliably on visual criteria; numerous others are distinctive enough to be visually recognizable to an experienced observer (e.g., Indiana Hornstone, Niobrara jasper, Knife River flint, Edwards chert), but the reliability of these identifications is variable. Many cherts, perhaps the majority, are not readily identifiable on visual criteria. Comparatively simple analytical techniques, such as petrographic examination of thin sections or application of ultra-violet radiation, are sometimes useful. Recently, more sophisticated analytical techniques, especially neutron activation analysis (NAA), have enabled reliable sourcing of chert (Banks 1990; Luedtke 1979, 1992), but it is usually not practical to perform these on large numbers of specimens.

Archeologists have characterized chert availability on the Central Gulf Coastal Plain as neither abundant nor particularly good. Banks (1990), who has produced the most comprehensive treatise on the occurrence of cherts in the south central part of the United States, offers a stark contrast between the Coastal Plains Province and the adjacent Edwards Plateau of Central Texas, referring to the former as "resource-poor" (Banks 1990:49) and the latter as "one of the largest sources of chert in the United States" (Banks 1990:59). Banks's study is grounded more in geology than in archeology, and he accurately notes that gravel deposits offered the main sources of chippable stone on the coastal plain, but as discussed in greater detail below, he underestimates the extent and quality of some of these gravel sources. Archeologists familiar with the two areas express similar views and often base inferences about trade or other cultural behavior on overestimated contrasts between chert availability on the plateau and the coastal plain.

Geology of the Occurrences of Chert on the Central Gulf Coastal Plain of Texas

Chert occurs only as secondary clasts in Tertiary and Quaternary fluvial geologic deposits on the Gulf Coastal Plain and can be considered in two major groupings—those found along currently active streams and those left by ancient streams in locations that are no longer part of the drainage system. This dichotomy has more meaning in terms of human utilization of the chert than it does in terms of the nature and origin of the cherts themselves, because much of the gravel in the modern streams is being reworked from older gravels.

In fact, movement of clasts across the landscape by streams is an intermittent process with gravel lying immobilized for extended periods between brief episodes of transport (Schumm 1977). Except for the length of the intervals, this pattern is similar for clasts in a single stream where the gravel rests in the bed of the stream between flood episodes, gravels stranded in floodplain or terrace deposits between deposition and return of the channel alignment to cut into and remobilize older deposits, and gravels left for extended periods between abandonment by one stream system and eventual development of a newer system. All three of these alternatives are manifest on the Gulf Coastal Plain. Some chert in the gravel beds of modern streams may have left the outcrop within the last several millennia whereas some of the older gravel deposits may contain chert that was eroded from the bedrock on the order of five or more million years ago and has been stranded in its present location for one or two million years. The bedrock origins of chert gravels on the coastal plains are primarily Lower Cretaceous limestones to the north, northwest, and west.

A very generalized geologic map of chert occurrences in the southeastern third of Texas (Figure 79) displays primary and secondary sources of those cherts most readily accessible to peoples living on the Gulf Coastal Plain. This map is derived from the 18 Geologic Atlas of Texas sheets listed in Table 58. Six informal map units are depicted for the purposes of this discussion. Each of these is described below.

MAP UNITS

Qal-Qt Late Quaternary alluvium and Quaternary fluviatile terraces, undivided. Intermittently along the major streams crossing the coastal plain are active gravel bars, gravel deposits in floodplains, and gravel lenses in terraces of various ages (see Figure 79). These are not mapped individually and the areas of potential occurrence are only shown for the major streams. Lesser streams that have eroded into Tertiary or earlier Quaternary gravels also contain localized Qal-Qt gravels. Published descriptions of the gravels along the present streams are not very informative as regards the sizes, shapes, and qualities of chert clasts, and no

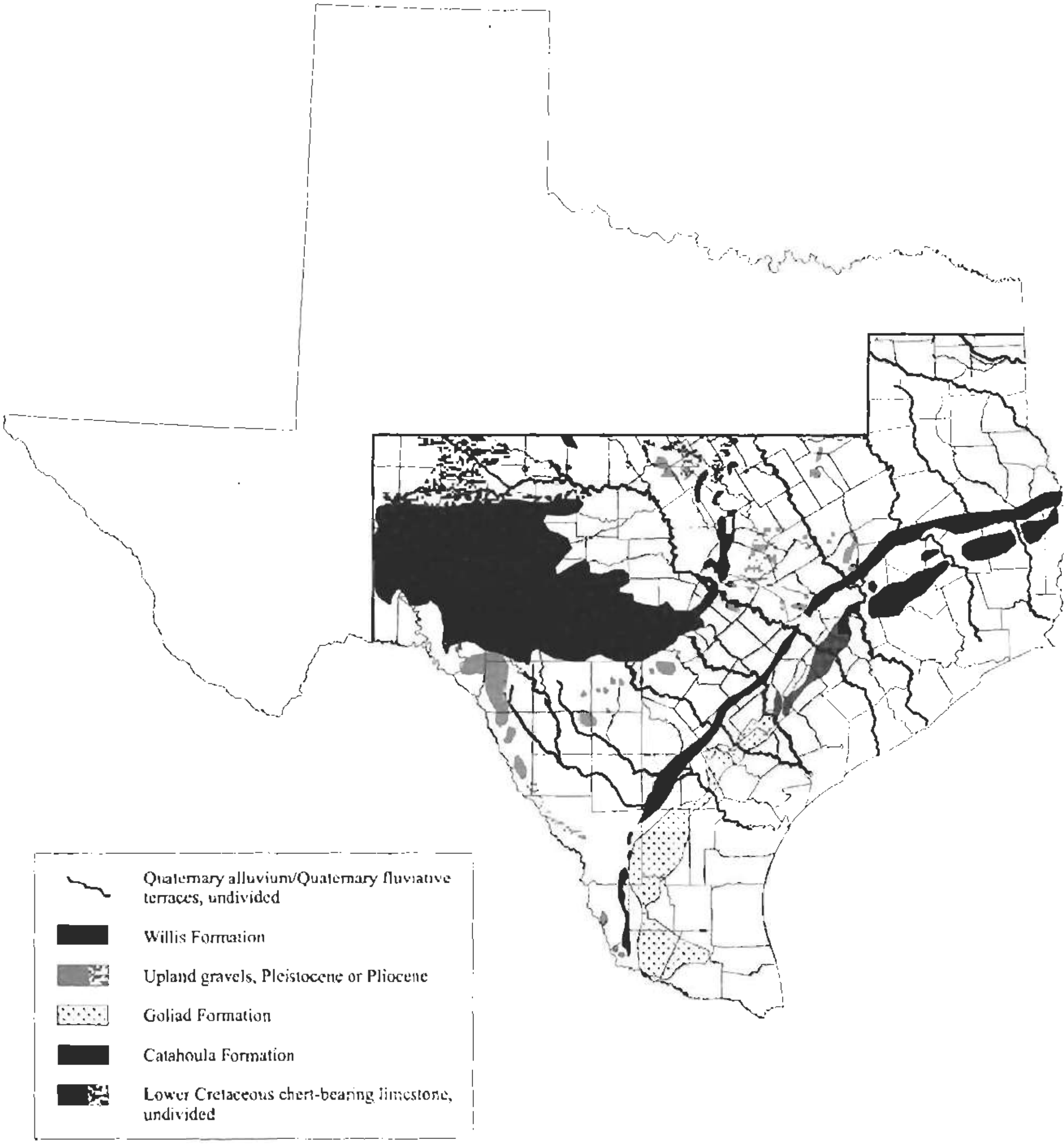


FIGURE 79. Map of geologic units discussed in text.

systematic effort has been made as part of this study to document the nature of these gravels. However, casual observations at numerous localities (archeological excavations, natural exposures, road cuts, and gravel quarries) on the Sabine, Trinity, Brazos, Colorado, Guadalupe, San Antonio, Frio, Nueces, and Rio Grande Rivers and their tributaries over recent years allow some general comments. Chert clasts suitable for knapping can be acquired along most streams but not uniformly nor always easily. Gradients across most of the coastal plain are quite low and water depths are substantial in some places. Stream beds may be sandy and have extensive gravel bars whereas overbank areas of deposition are composed mostly of sand, silt, and clay. Even the beds of streams are muddy in places. Access to stone, then, is limited to those areas where gravel beds are neither draped with mud nor submerged too deeply in water. Gravel exposures are more readily accessible in the following settings:

(1) near the Balcones Escarpment where gradients adjust from the steeper descents of the Edwards Plateau to the flatter topography of the coastal plain, chert-rich gravel is prolific;

TABLE 58
Name and Bibliographic Reference of Geologic Atlas of Texas Sheets Consulted in the Preparation of Regional Geologic Map (see Figure 79)

Geologic Atlas Sheet	Reference
Tyler	Barnes 1975a
San Angelo	Barnes 1974a
Brownwood	Barnes 1986
Waco	Barnes 1979
Palestine	Barnes 1993
Sonora	Barnes 1981a
Llano	Barnes 1981b
Austin	Barnes 1981c
Beaumont	Barnes 1992
Del Rio	Barnes 1977
San Antonio	Barnes 1983
Seguin	Barnes 1974b
Houston	Barnes 1982
Crystal City-Eagle Pass	Barnes 1976a
Beeville-Bay City	Barnes 1987
Laredo	Barnes 1976b
Corpus Christi	Barnes 1975b
McAllen-Brownsville	Barnes 1976c

(2) in places along those streams, particularly in the more western reaches of the coastal plain, where high-energy flood events are common (e.g., the Nueces and Frio Rivers), gravel is abundant, water is typically shallow and mud draping is relatively uncommon;

(3) in those stretches of rivers that are cutting into ancient deposits of gravel (e.g., along the Guadalupe in Victoria County), chert cobbles are commonly exposed; and

(4) chert cobbles are sometimes more readily accessible in very localized places where water is shallow and swift across gravel bars and mud drapes rarely form, such as where streams cross a resistant bedrock unit.

Generally, from the knapper's perspective, chert clasts on the coastal plain are of good quality stone (medium- to fine-grained cherts are common) and battering during transport has virtually eliminated pieces with internal flaws and fractures. Some knappers (e.g., Bob Patten [personal communication 1998]) note a phenomenon they refer to as "resilicification" to account for the fact that cherts in streams often exhibit better flaking qualities than their counterparts in the bedrock source area, and this may be expressed in some of the materials on the coastal plain. Size is the greatest limiting factor for most of the chert gravel clasts. Although abundant pieces of fine-grained chert may be found in some stream gravels, they are often too small (less than 5 cm in maximum dimension) to be of much use.

Qw Willis Formation. This unit is mapped on most atlas sheets as Quaternary (Pleistocene), but on the Palestine (Barnes 1993) and Beeville-Bay City (Barnes 1987) sheets, it is mapped as Pliocene ("Pw"). It crops out in a narrow band parallel to the coast and roughly 100 to 120 km inland between the Sabine and Guadalupe Rivers (see Figure 79). This is the most important source of chert in the Central Gulf Coastal Plain and its characteristics in the vicinity of the Smith Creek Bridge site are discussed in more detail in the following section. According to Barnes (1974b), the Willis Formation consists of gravel, sand, silt, and clay with gravel content generally decreasing coastward. In places the formation is up to 100 feet in thickness. The gravel ("locally cobble-size") is mostly siliceous (chert, quartzite, and some petrified wood). Barnes notes that this unit may in part correlate with Uvalde Gravel.

T-Qu Late Tertiary (Pliocene?) or Quaternary (Pleistocene) upland gravels, undivided. Numerous discontinuous deposits of gravels are found on uplands on the coastal plain. Some of these have been given the formation name, Uvalde Gravel (T-Qu) and others are mapped as "caliche cemented gravel" (Qhg) or "high gravel deposits" (also Qhg). For present purposes, an informal mapping of these as a single unit is preferred, and three distinctive patterns can be seen in their distribution (see Figure 79). One area parallels the modern Rio Grande from south central Val Verde to western Starr Counties. In all likelihood these were deposited in ancestral channels of the Rio Grande. Another area is along the axis of the Colorado River from central Tom Green to southern Brown Counties, again probably indicative of a stream system ancestral to that of the Colorado. Of particular interest to this study are extensive gravel deposits in fans coastward from the Balcones Escarpment, forming a great arc from Zavala to Limestone Counties. Most of the dispersed gravels have been mapped as being of Pleistocene age, but some are assigned to the Pliocene—another issue of greater geological than archeological concern. These gravels were transported by and deposited in channels of ancient stream systems that are no longer active. In places they have resulted in inverted relief, that is, gravel in channels that were once the lowest point on the landscape resisted later erosion and today support some of the region's higher elevations. Upland gravels have many of the same characteristics noted earlier for gravels in the present stream systems with two notable differences. Chert clasts locally are often moderately large, even at considerable distances from the bedrock source areas. There are also some extensive exposures of these gravels (up to several square kilometers in extent) on hilltops and slopes with tens of thousands of chert clasts visible at the surface (as for example, some of the "Uvalde Gravel" outcrops in Webb and Maverick Counties). Where these deposits occur, they provide a ready source of chippable stone.

Pg Goliad Formation. An extensive outcrop of clay, sand, sandstone, marl, and conglomerate, in places cemented with caliche, comprises the Goliad Formation. It crops out in an arc parallel to, and roughly 100 km inland from, the coast between the Guadalupe River and the Rio Grande. This unit is described as containing black and red chert and it has sometimes been considered a source of chippable stone, however, most of the siliceous clasts are less than 2 cm in maximum dimension and would be suited for very few kinds of chipped stone applications. Near its southwestern extent are localized gravel deposits that probably correlate with nearby Uvalde Gravel outcrops and in De Witt County there are small outcrops of Willis Formation gravel in the outcrop belt of the Goliad. These have probably been mistakenly attributed to the Goliad and given rise to notions that the Goliad is potentially a source of chippable stone (e.g., see Collins 1991:336). For the most part, however, the Goliad itself does not afford chippable stone clasts of sufficient size for knapping.

Mc Catahoula Formation. The Catahoula sandstone crops out in a narrow band about 120 km inland of the coast from the Rio Grande into Louisiana. This unit has also been ascribed status as a source of chippable chert and other kinds of stone, in this case by Banks (1990:49-51), but much of the formation lacks such material, particularly in the central part of the Gulf Coastal Plain. Chert reportedly occurs in the Catahoula near the Rio Grande, quartzite near the confluences of the Atascosa and the Frio Rivers with the Nueces River, and quartzite in eastern Texas and Louisiana (Banks 1990). In the vicinity of the Smith Creek Bridge site, the Catahoula consists of clay and sandstone and is not a source of knappable stone.

K Lower Cretaceous, chert-bearing limestones, undivided. This complex unit includes all of the chert-bearing limestones, sometimes referred to as the Edwards Group (Barnes 1974a), that are sources of "Edwards Chert" on the Edwards and Stockton plateaus of central and west central Texas. These are the Salmon Peak Limestone, Santa Elena Limestone, Devils River Limestone, and McKnight Formation, as well as the Edwards Formation and its members (that are sometimes mapped as formations), Segovia and Fort Terrett. Most of the chert found as clasts in Quaternary as well as Tertiary gravel on the Gulf Coastal Plain was derived from these Lower Cretaceous limestones on the Edwards and Stockton Plateaus. The area where primary outcrops occur is extensive and covers much of central Texas north and west of the Balcones Escarpment (see Figure 79).

There is considerable variation in the chert in this outcrop. It is often nodular but also occurs in beds. Colors range from almost white to black with innumerable intermediate shades of tan, pink, almost blue, brown, and gray. Colors are often banded or mottled. Edwards chert generally fluoresces under both long- and short-wave ultraviolet radiation (Hofman et al. 1991). Edwards chert ranges from coarse to fine in texture. Because of its quality and the fact that it often occurs in beds or in very large nodules, Edwards chert was used throughout the prehistoric past to make large and sometimes extraordinarily fine chipped stone objects.

CHERT SOURCES IN THE VICINITY OF THE SMITH CREEK BRIDGE SITE

No evidence of a natural chert source was found in the immediate vicinity of the Smith Creek Bridge site (although cherty gravel had been introduced in conjunction with the roads and bridges built and maintained at this crossing). As mapped (Figure 80), gravel with chert clasts should be found at extensive outcrops of the Willis Formation in southeastern and south central De Witt County as well as in a few small, localized exposures in the southwestern part of the county (Barnes 1974b, 1987). Brief field inspection of 25 localities within 40 km of site 41DW270 (Figure 81) verified that, as mapped, Willis gravel crops out primarily to the east of the site, but outcrops in addition to those mapped were located and, more importantly, the nature of these as sources of chert for aboriginal knappers was determined. More thorough and intensive reconnaissance would undoubtedly add more chert localities to the map, but the present study probably allows a fairly accurate characterization of the occurrence of chert. The 25 localities (see Figure 81) can be grouped into 3 categories, those 12 where no chert was found (localities 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, and 14), those 3 where chert occurs but was probably not readily accessible to preindustrial peoples (localities 3, 15, and 16), and those 10 where chert is abundant and would have been readily accessible to prehistoric peoples (localities 10, 17, 18, 19, 20, 21, 22, 23, 24, and 25). For the most part, chert sources suitable for aboriginal exploitation tended to be more than 20 km away from the site (Table 59) These results are described and discussed according to these groups followed by a synopsis of how knappers could have acquired chert in the general area.

The 12 visited localities lacking chert (13, if site 41DW270 is included) all were stream beds and cutbanks where aboriginal exploitation would be possible if chert had been present. These included minor, unnamed creeks and larger streams such as Coleto Creek. As a practical matter, this search was done by automobile on public roads, so all but one of the stream localities are at bridge sites. This posed a potential problem since gravel was often included in the fill used to build bridge approaches, so care was taken to base the evaluation on the creek bed and cuts upstream from the bridge and thereby lessen the risk of introduced chert being mistaken for a natural occurrence. At one locality in this group (Locality 5, on Hoosier Creek just over 10 km southeast of 41DW270) small clasts of chert were noted, but these were not considered large enough to be of any value for knapping. The locality with no bridge, Locality 2 (Figure 82), is a deeply eroded drainage next to an unpaved county road 2 km south of the site that afforded an excellent exposure of Goliad Formation deposits completely lacking in chippable stone.

Modern machinery created the exposures at the three localities where chert was found but not considered accessible

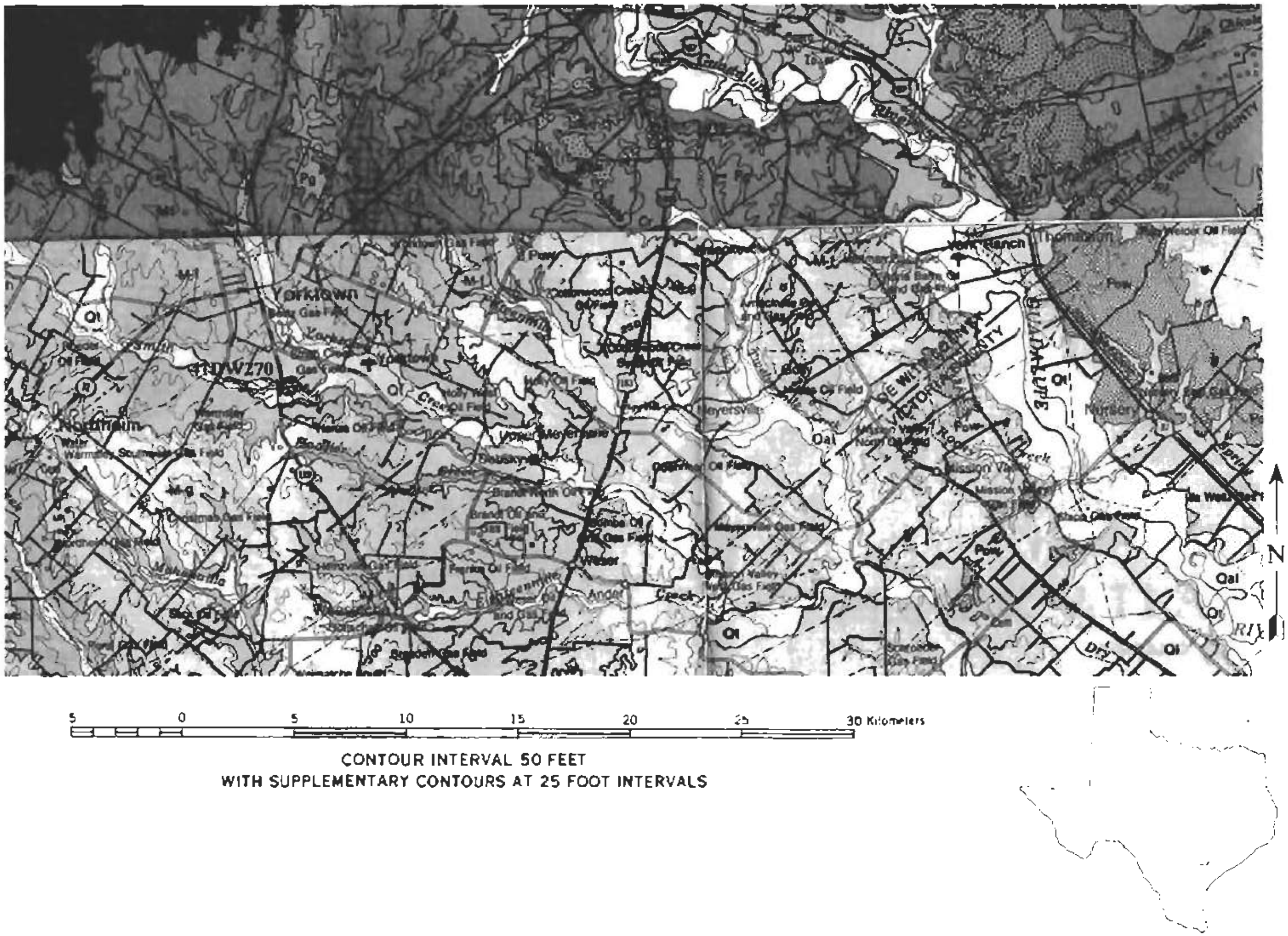


FIGURE 80. Geologic map of Tertiary and Quaternary units in vicinity of the Smith Creek Bridge site as mapped by the Bureau of Economic Geology.

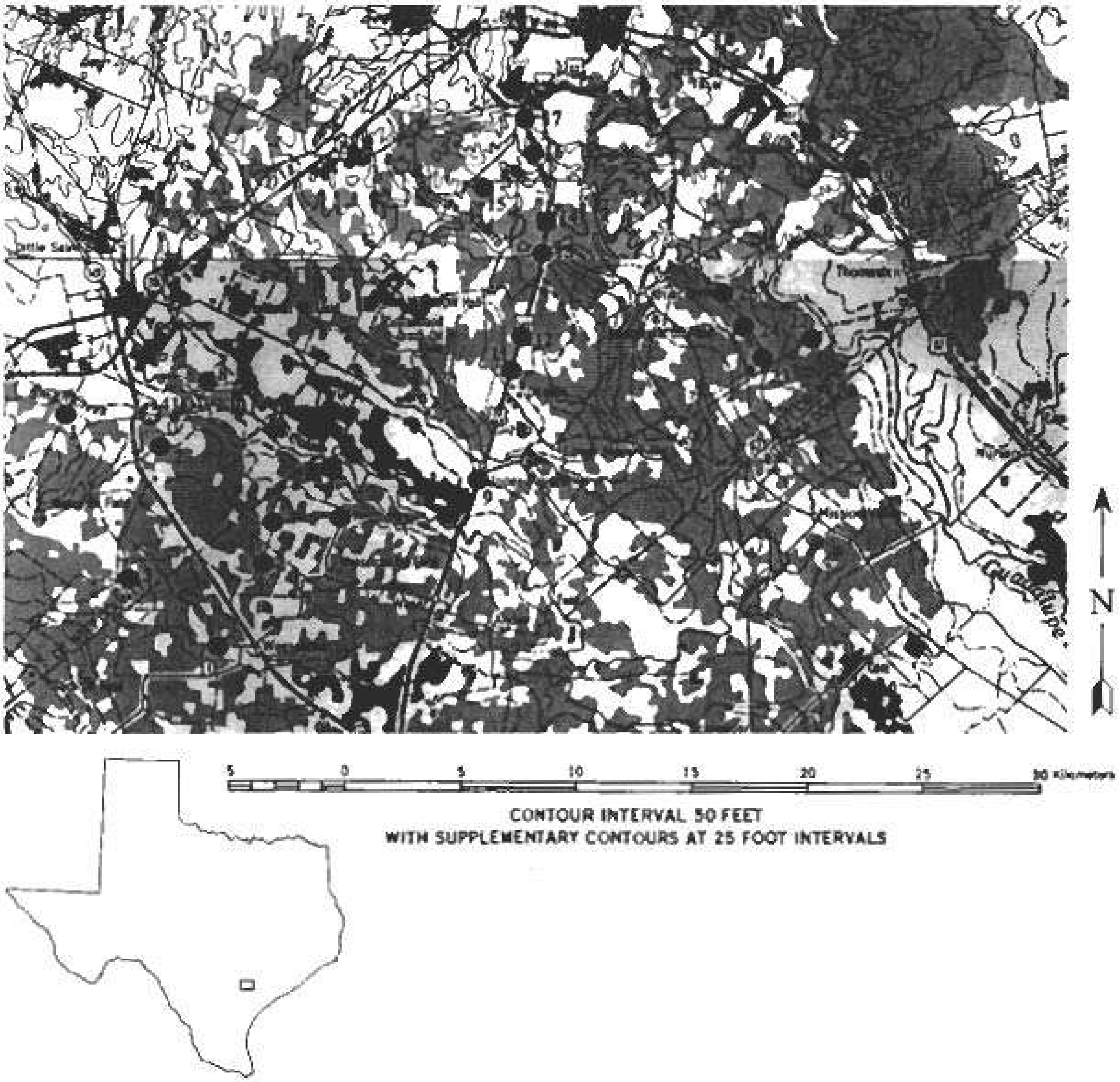


FIGURE 81. Locations of 25 localities visited during field reconnaissance for chert sources.

to preindustrial people. Locality 3 is a small gravel quarry on a ridge top near a paved county road 7 km south southwest of 41DW270. Clasts of chert, quartzite, and silicified wood up to about 12 cm in maximum dimension are present in this deposit, however, the locality is not considered to have any potential value as a source of chert to preindustrial knappers. A veneer of sandy soil completely covered the ridge top and the only siliceous stones at the surface were small pebbles and a few cobbles that almost certainly were scattered there by the modern quarrying activities. There is a good possibility that there are natural exposures of this gravel bed nearby since chert cobbles were noted in the bed of Cow Creek about 5 km to the southeast (see discussion of Locality 10, below), but none was found in this brief reconnaissance.

Locality 15 ("Alvarez Quarry") is a large, active gravel quarry on the interfluve between Fivemile Creek and Threemile Creek. It is near the crest of a ridge, and the gravel deposit is at least 2 m in thickness. Clasts of chert, quartzite, chalcedony, and silicified wood are present (see Figure 77b-e), with some of the chert pieces being as large as 28 to 30 cm in maximum dimension. There is considerable variation in the colors and textures of the cherts from this locality, although most of them have all of the characteristics (including fluorescence) of "Edwards" chert. A few pebble-sized chert pieces of red and black color and very fine texture are not familiar Edwards varieties, but they fluoresce in the same way as Edwards cherts. The quartzites range in color from white to tan to deep purple with the purple varieties being very hard and ideally suited for use as hammerstones. Gravel at this locality is minimally exposed at the surface and no good outcrops were observed, but it is likely that native peoples could have

TABLE 59
Visited Localities by Distance from Site and Status as Possible Sources of Chert

	Distance from Smith Creek Bridge Site					
	0-5 km	5-10 km	10-20 km	20-30 km	30-40 km	Totals
No chert	1, 2, 8	4, 6, 7	5, 9, 11, 12	13, 14		12
Inaccessible chert		3,	15,	16,		3
Accessible chert			10,	17, 23, 24, 25	18, 19, 20, 21, 22	10
Totals:	3	4	6	7	5	25

FIGURE 82. View to the north across Locality 2 showing extensive, chert-free section exposed by erosion.

acquired chert at places in the small drainages flanking this ridge.

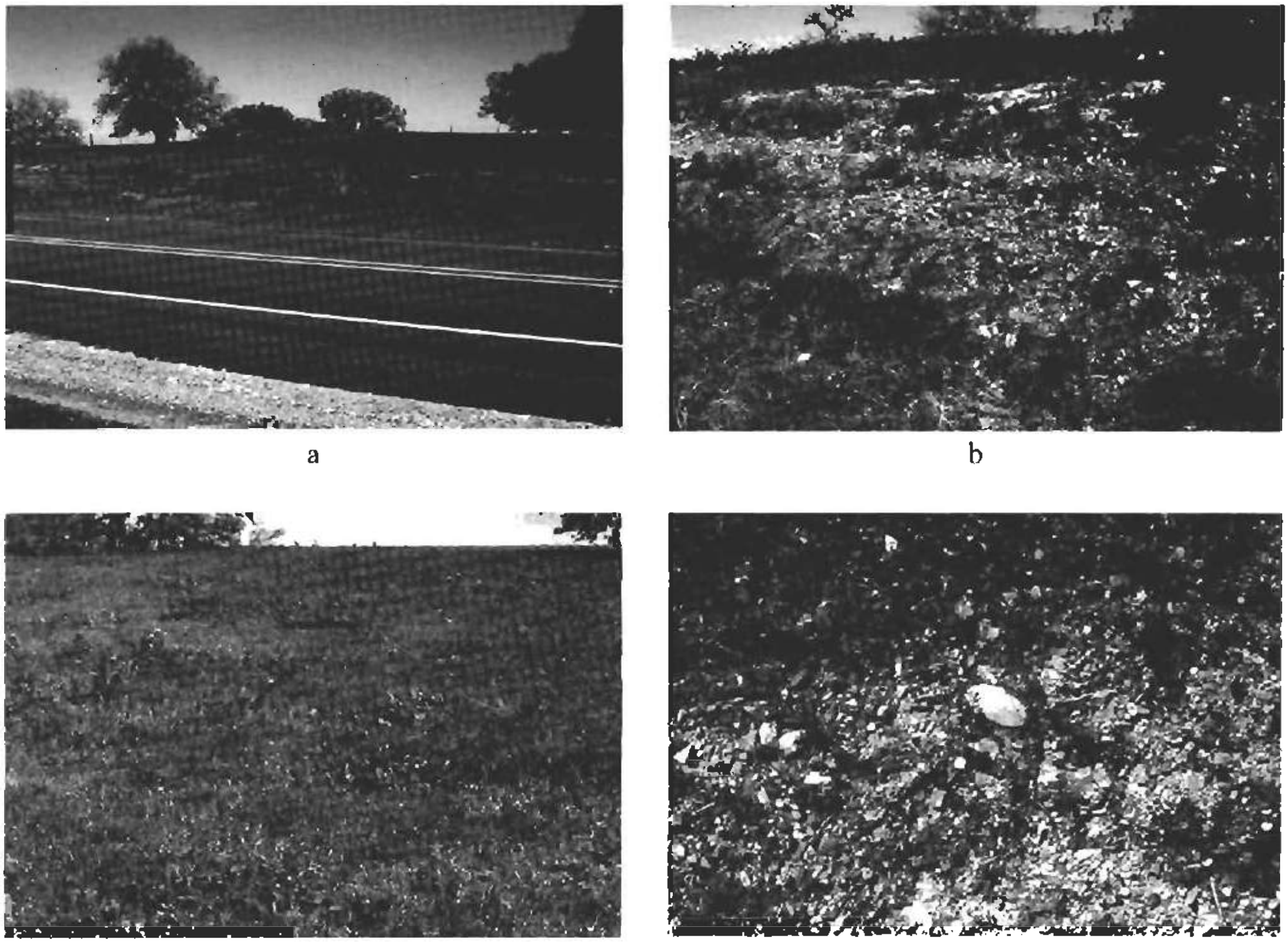
Locality 16, a ridgetop, proved to be one of the more informative, especially when viewed in conjunction with nearby Locality 17, a creek bed. Locality 16 is an excellent exposure (Figure 83) in a roadcut along Highway 77 Alternate near Clinton, roughly 22 km from site 41DW270. Gravel in a deposit close to 3 m in thickness is exposed on both sides of the highway for a distance of more than 100 m (see Figure 83a, b). There is a half-meter-thick deposit of carbonate-cemented sand on top of the gravel (see Figure 83a,b) in turn overlain by unconsolidated sand up to a meter in thickness; there is no chert exposed in the pasture land outside of the roadcut (see Figure 83c). Although large clasts of good quality chert (see Figure 83b, d) are present in abundance in this deposit, they were neither visible nor accessible prior to the artificial cut, so this locality cannot be considered an aboriginal chert source. However, in the next drainage to the north is Locality 17 (see below), which is an extensive natural exposure of chert-rich gravel.

Locality 10 is in the bed of Cow Creek 1 km west of Weesatche and only 11 km (a 2-hour walk) south southeast of the Smith Creek Bridge site (see Figure 81). In the gravelly bed of the creek are a few chert clasts up to 20 or 25 cm in maximum dimension and numerous pieces in the 5 to 10 cm range. As some of the small tributaries of this drainage head in the vicinity of the gravel ridge described above (Locality 3), it is likely that chert could have been obtained for some distance up and down the creek from this locality. This exposure was only observed from the bridge and no specimens were collected, but the materials seem to be similar to those represented in the site. It is possible that both chert clasts for knapping and quartzite stones for hammering were collected from this area by the former inhabitants of site 41DW270.

Four localities (17, 23, 24, and 25) are possible aboriginal chert sources between 20 and 30 km northeast and east of the Smith Creek Bridge site. All but Locality 25 are gravel bars in creek beds. Locality 17 is in an unnamed creek just west of Clinton. The bed of the creek is littered with large chert clasts and individual clasts between 10 and 20 cm in length are common (Figure 84; note fence posts for scale in b). A few clasts approach 30 cm in maximum dimension. Similar gravel deposits were observed at Localities 23 (Figure 85) and 24, although the largest clasts at these two localities are generally under 25 cm. If gravel bars like those seen at localities 23 and 24 existed at the time 41DW270 was occupied, they allowed the knapper to select cobbles from extensive and prolific exposures. These would seem to be ideal chert sources within a half day walk of 41DW270.

Locality 25 ("Koenig-McCrab"), a ridge top locality, was chosen for sampling because of ready accessibility. This locality (Figure 86) consists of a cut along unpaved Koenig-McCrab road in southeastern De Witt County, near the Victoria County line. Gravel is exposed in a deposit slightly over a meter in thickness (see Figure 86a). The clasts making up this gravel are almost exclusively of chert and they range in maximum dimension from 1 to greater than 25 cm; cortex is heavily battered and there is a wide array of colors and textures (see Figure 77f-i). Colors vary from light tan to very dark brown and textures from medium to very fine grained. Since this gravel is not overlain by younger material (see Figure 86a), clasts are exposed at the surface in the pastureland adjacent to the road (see Figure 86b). This chert would have been accessible for selective collecting and it would have been possible to dig up buried clasts with primitive tools, although with the nearby stream exposures (e.g., Localities 21, 22, 23, and 24), there would probably be little incentive to do so.

Localities 18, 19, 20, and 21 lie between 30 and 40 km from site 41DW270 along Highway 87, each at a crossing of



a b c d

FIGURE 83. Chert gravel exposed below the surface in a road cut at Locality 7. (a) view toward the west across US 77-ALT showing coarse gravel overlain by sandy unit; (b) section as exposed in cut on west side of road showing gravel with endurated cap overlain by sandy unit; (c) pasture west of roadcut where no chert clasts are visible at the surface; (d) closeup of chert clasts exposed by roadcut (knife is 11 cm long).

a westerly flowing stream that drains a portion of an extensive upland lying east of the highway. This upland area is mapped as an outcrop of the Willis Formation (Barnes 1974b, 1987) that, undoubtedly, is the source of the abundant cherty gravel seen in the beds of each of these streams. At Locality 21 (Price Creek at Highway 87), the exposed gravel bar is quite large and clasts approaching 40 cm in maximum length were observed. This is the most prolific single chert locality observed during this project (Figure 87). Locality 22 (Figure 88) is part of this same group of exposures but is on a tributary of Price Creek a short distance west of Highway 87. It, too, would be an extremely prolific source of chippable stone just over 30 km from the Smith Creek Bridge site.

SUMMARY AND CONCLUSIONS

Stone tool manufacture begins with the acquisition of raw material, and the nature of that raw material influences the knapping strategies that can be used and limits the size and form of objects that can be produced (Collins 1975). Archeologists have long recognized that the Gulf Coastal Plain of Texas has its own chert resources (e.g., Banks 1990; Brown 1989; Lynn et al. 1977), but most have interpreted **large** artifacts made of "Edwards" chert as necessarily originating on or very near the Edwards Plateau (e.g., Hester and Barber 1990; Hester and Brown 1985; Miller 1993). In fact, a significant number of those pieces, even the largest, **could** have originated in chert gravel of the Willis Formation and, with the cortex removed, might not be visually distinguishable from pieces that came from the primary outcrop. Some examples are instructive.

In reference to bifaces from a cache found in Dimmit County, Hester and Brown (1985:5) comment that, "although it is conceivable that they could have been fashioned locally, their size (larger than most local Uvalde and Rio Grande gravels) and the fine-grained nature of the chert suggests that they were made in central Texas (i.e., within the Edwards Plateau) and represent pieces traded into southern Texas in

a

b

c

FIGURE 84. Chert gravel exposed in bed of unnamed creek west of Clinton, Locality 17. (a) view of creek bed west of US 77-ALT; (b) gravel bar east of US 77-ALT with fence posts for scale; (c) close up view of gravel bar east of US 77-ALT showing clasts up to 30 cm in maximum dimension.

FIGURE 85. Chert gravel exposed as a bar in bed of creek at Locality 23.

prehistoric times." The length and width measurements of the four pieces (in centimeters) are: 12.5-x-7.0, 10.0-x-5.8, 12.5-x-6.4, and 13.4-x-6.8. These are within the range of sizes of stream cobbles of Edwards chert of the Willis Formation in and near De Witt County. In this case, it is farther from the cache site to the De Witt County sources than it is to the closest Edwards Formation outcrops on the plateau (north of Uvalde), and the authors' intepretation is probably correct. However, the alternative that people moved stone from west to east rather than from north to south cannot be disregarded.

Another large biface, this one from Atascosa County (Hester and Barber 1990), measures 17.6-x-8.8 cm and has visual as well as ultraviolet fluorescent attributes of Edwards chert. In this case, the piece is large enough to lessen the likelihood of its having been made of most Willis Formation cobbles, but it does fit within the larger size-ranges of pieces seen near the Victoria-De Witt County line. This piece was found at a locality roughly equal distances from Edwards outcrops in the San Antonio vicinity and the large gravel outcrops in De Witt County. Once again, the implication is that alternative interpretations for the origin of this chert must be considered.

a

b

FIGURE 86. Chert gravel exposure in roadcut along Koenig-McCrab road, Locality 25. (a) section as exposed on east side of road showing lack of overlying deposits; (b) pasture east of road showing numerous chert clasts exposed on the surface.

FIGURE 87. Large gravel bar in bed of Price Creek immediately downstream from US 87 bridge, Locality 21.

It would be especially interesting to know the origin of the chert represented in the F. N. Fosatti cache of 10 large, thin bifaces reportedly found in a gravel quarry near Victoria (Jackson and Woolsey n.d.; Miller 1993). It is entirely possible that these pieces were made of chert cobbles obtained locally.

To summarize, there are significant deposits of chert occurring as gravel in the Willis Formation in and near De Witt County that need to be considered when interpreting possible sources of "Edwards" chert artifacts found anywhere on the coastal plains. In the case of the Smith Creek Bridge site, it seems highly probable that virtually all of the chert, quartzite, and silicified wood found at the site was acquired as cobbles from Willis gravel deposits within less than a one-day walk of the site.

Localities 16, 17, and 18-25 are along the southwestern margin of the main Willis Formation outcrop belt (Barnes 1974b, 1987) and lie between 20 and 40 km from the Smith Creek Bridge site. Evidence from this small sample of exposures as well as observations made at other times along the Guadalupe River in Victoria County show this to be a major chert source area. Chert is abundant, it commonly occurs in pieces up to 25 cm in length, and it is of medium to excellent quality. Both upland and streambed exposures occur. It would

FIGURE 88. Gravel bar in bed of tributary to Price Creek, Locality 22.

benefit archeological interpretation to have more complete information on the nature and extent of this source area, but even at this preliminary state of knowledge, it is incumbent upon archeologists to recognize this part of the Central Gulf Coastal Plain as a significant chert source area when interpreting regional patterns of chipped stone technology. These interpretations will be greatly facilitated if means can be devised to distinguish these secondary deposits of chert from their counterparts in the primary source areas on the Edwards and Stockton Plateaus.

This limited study also suggests that more detailed mapping would reveal numerous chert sources west and southwest of the main Willis outcrop. Examples discovered in this project are Localities 3 and 10.

One cautionary note, however, must be made. The abundant exposures seen today are of two principal kinds—upland areas where Willis gravel is exposed at the surface and deeply incised drainages where cherty gravel bars are exposed in and alongside the streams. Present-day conditions may differ from those that existed at times in the culturally relevant past. At times of greater soil or vegetation cover, or both, upland deposits like that seen at Locality 25 might not have been visible or accessible. Similarly, at times when the regional fluvial systems were operating under different climatic conditions or greater vegetational cover, streams may have been less deeply incised and muddy, silty, or sandy beds may have been more prevalent in the areas where gravel beds are seen today. These would have lessened access to chert by native peoples, but gravel deposits are so widespread and abundant, that some areas of exposure could be expected even during times of extensive upland cover and alluviated stream valleys. People on the coastal plain may have had to dig for chert under these circumstances, but as an alternative to traveling 100 km to the primary outcrop or engaging in long-distance exchange, quarrying might have been the preferred means of acquiring stone.

As Hester and Barber (1990:3) have noted, "while the evidence is far from complete, there is an indication that the large thin bifaces, often made of Edwards Plateau chert, were being traded onto the coastal plain as objects of some considerable value" to be used as grave goods, possible status objects, and also as blanks for the manufacture of projectile points, corner tang knives, and other items. The assessment of "value" in these cases rests in part upon the inference that these pieces moved long distances across the coastal plain from the Edwards Plateau (whether by trade or direct acquisition). If these pieces were found to derive from sources in the central part of the coastal plain, this assessment might need to be reconsidered.

Subjectively, it appears that many of the large bifaces from the coastal plain are from the darker, finer-grained varieties of Edwards chert. These varieties are present in the Willis deposits, but not in pieces as large as those of tan-colored, medium-grained chert. This could imply that only large bifaces of tan, medium-grained chert could have derived from Willis gravel deposits whereas bifaces of the darker, fine-grained material still might be best interpreted as having originated in the Edwards outcrop area. It is obvious that this issue requires considerable further investigation.

It would appear from patterns of chert utilization at the Smith Creek Bridge site either that the site was occupied at a time when access to chert was optimal or at least that access was not greatly hampered. How that set of conditions compared and contrasted with earlier or later intervals in the local prehistoric record is yet to be determined. That substantial changes occurred is almost a certainty and some very generalized possibilities can be suggested from the work of Quaternary specialists in nearby regions.

The closest detailed Quaternary paleoclimatic reconstruction is that for central Texas synthesized by Collins (1995) from various geological, palynological, and paleontological studies. That sequence begins with a relatively xeric interval ending around 11,500 B.P. (all dates in this discussion are in radiocarbon years before present; mesic or xeric intervals are relative to present conditions). That was followed by a mesic period (11,500-9000 B.P.) and then by the major and widespread middle Holocene xeric interval that lasted from 8500 to 3500 B.P. with a brief amelioration at around 6000 B.P. Another mesic (3500-1000 B.P.) and xeric (1000-800 B.P.) cycle followed. Data are ambiguous for the most recent 800 or so years of the Holocene with some data suggesting continuing relative aridity and others indicating somewhat more mesic conditions over the last 800 radiocarbon years.

In central, northeastern, and high plains regions of the state, erosion and stream incision tend to occur in the more xeric intervals and landscape aggradation and valley filling tend to characterize the more mesic intervals (cf. Collins 1995; Hall 1990; Holliday 1997). If similar responses prevailed during the Holocene in coastal plain streams and if a similar paleoclimatic sequence transpired, one might expect chert access to be more favorable in the xeric intervals (ca. 8500-3500, 1000-800 B.P.) and less favorable during the mesic ones (ca. 6000-5500, 3500-1000 B.P.). Dating of the Morhiss component at the Smith Creek Bridge site falls within this latter postulated mesic interval, although an interval of aridity may be inferred from the snails recovered at the site. What the prevailing paleoenvironmental evidence will turn out to be for the region and whether or not it correlates significantly with prehistoric use of, and by extension access to, chert will only be known when considerably more paleoenvironmental data as well as patterns of chert exploitation for multiple localities and ages can be arrayed for the region.

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