Archeological Evidence for Pimple (Prairie) Mound Genesis

Abstract. *Archeological deposits have been discovered in three pimple mounds on the upper Texas coast. Such incorporation indicates that (i) these particular mounds are aggradational rather than erosional in origin; (ii) mound formation continued until at least A.D. 1100 to 1200; (iii) each mound took 300 to 500 years to form; (iv) mounds within the same mound field did not form simultaneously; (v) certain Gulf Coast pimple mounds have archeological research potential; and (vi) archeological data also offer a means for investigating mound formation.*

Pimple mounds, also known as prairie mounds and sand mounds, are ubiquitous geomorphic features of the outer coastal plain of Texas and Louisiana. Although their origin has been debated since the mid-19th century, the major conclusion has been that they usually result from erosional deterioration of Pleistocene meander and barrier island ridges. Along the northwestern coast of the Gulf of Mexico, pimple mounds occur primarily on the Beaumont and Prairie formations. Typically, they are situated on low-relief slopes of silts and sands comprising relict meander ridges and barrier islands (*1*). The mounds range in height from 15 cm to over 1.5 m, are circular to elliptical in plan, and vary in diameter from 2 to over 60 m. They are present in at least the tens of thousands.

Scientific literature on the origin of pimple mounds has included mention of about 30 different mechanisms, such as gas vents, differential compaction of sediments, uprooted trees, anthills, Indian house platforms and burial sites, gopher mounds, rill erosion, and entrapment of windblown sand. Critical reviews of this literature and recent field studies (*2*) led to the conclusion that rill or stream erosion and entrapment of windblown sediment account for most Gulf Coast mound occurrences. Because examination of mound interiors yielded little evidence for their origin through accumulation, explanations have focused on erosional processes, with mounds viewed as residual elements. Although there are limited instances of modern pimple mound formation on active barriers and deltas, it has been assumed that the mounds on Pleistocene surfaces were principally formed in the late Pleistocene and early Recent epochs (*1, 3*). While this may often have been the case, evidence described below indicates important exceptions to such a generalization.

Early reports of artifacts in Gulf Coast mounds were unclear about whether the artifacts were associated with pimple mounds (*4*), and thus rejected an anthropogenic origin for the mounds (*5*). Recently, pimple mounds containing artifacts have been reported on Bayou Lacassine, Bayou Chene, and the Mermentau River in southwest Louisiana (*6*). While their form is similar to that of Prairie Formation pimple mounds, the resemblance may be superficial. These localities are situated on active floodplains and consist of sandy clay pimple mound terrains on which are draped clayey silts and sands (overbank deposits) varying in depth from 15 to 75 cm. Artifacts (primarily ceramic fragments) found in the overbank deposits indicate that they were sites of cultural activity after formation of the mounds. These sites do not appear to shed light on mound formation processes, except to establish a terminal date. Similar instances of apparent relict topography formed by artifact-bearing flood deposits draped over pimple mounds or gilgai microrelief terrain have been reported from the Houston area (*7*). In both regions the more recent sediment mantle covers mound and intermound areas alike.

We conducted test excavations at archeological sites 41 JF 26, 41 JF 31(A), and 41 JF 31(B) near Big Hill salt dome in the Pipkin Marsh area of southwest Jefferson County, Texas. These sites are within a classic pimple mound field formed on relict natural levees associated with the Big Hill ridge system (*8*) of the Pleistocene Trinity River delta. The mounds known to contain archeological middens are identical in form to hundreds nearby which remain uninvestigated. These excavations uncovered the refuse of human habitation, stratified well within the mound structure. None of the middens contain mollusk shells, which are common at archeological sites in the coastal zone. Although gophers may have displaced some artifacts, nearly 90 percent of them were found in a clayey silt containing dark organically stained midden (Fig. 1).

If, as at Pipkin Marsh, no shells are accumulated in middens, the surface of an archeological campsite may not be raised much higher than that of the surrounding ground surface. Although organic enrichment of the soil may have had a local effect on plant growth, the existence in the mound of coarser sediments with better drainage than in the intermound areas encourages differential plant growth to serve as a trap for sediment mobilized by wind or water. Consequently, the conclusion of previous studies that anthropogenic processes did not cause pimple mound formation probably is correct.

The incorporated archeological strata label certain features of mound formation processes. Datable artifact assemblages indicate that mound 26 formed between A.D. 700 and 1300; formation of mounds 31(A) and 31(B) occurred between 100 B.C. and about A.D. 300 (*9*). The morphology and structure of site 31(B) (Fig. 1) prompt further observations:

1) The top of the Beaumont Formation under the mound (unit II) is 15 to 20 cm higher than in the adjacent intermound area.

2) The stratigraphy of the mound (units III and IV) is not represented in the intermound area; there, the Beaumont Formation either is exposed at the surface or is covered with a thin veneer of black, peaty marsh sediment.

3) The shape of the mound is that of a truncated cone, with basal nick points evident on the top of the Beaumont Formation and on the present mound surface.

Pipkin Marsh is about 8 km inland from the Gulf of Mexico at an elevation less than 3 m above mean sea level. It is inundated periodically by storm surges. This mechanism, plus the nick points and the absence of significant sediment accumulation in the intermound area, supports a conclusion that the difference

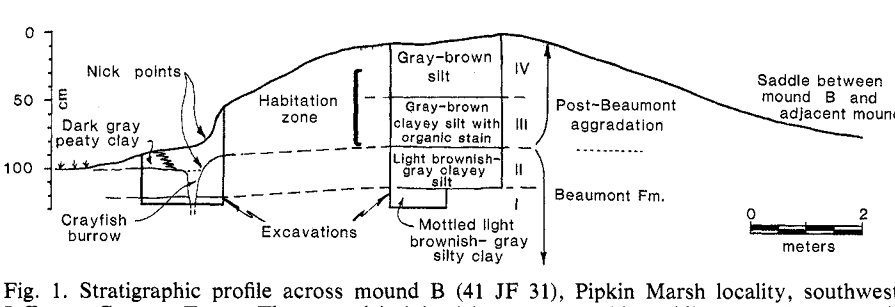

Fig. 1. Stratigraphic profile across mound B (41 JF 31), Pipkin Marsh locality, southwest Jefferson County, Texas. The mound is joined by a topographic saddle to another mound. Consequently, the profile in this particular direction does not reflect a symmetrical pattern of nick points and intermound marsh sedimentation.

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in Beaumont Formation elevation under the mound and between mounds is a function of mound formation. We suggest that these particular pimple mounds are aggradational features formed from the coarser fraction (sands and silts) reworked out of Beaumont Formation sediments eroded from the intermound areas. Such a process of erosion and redeposition is substantially consistent with previous explanations of pimple mound formation, except that at Pipkin Marsh there is direct evidence for redeposition of eroded materials, evidence lacking or equivocal in previous soil and sediment analyses (*2*). The differential ages of artifacts from sites 26 and 31(B) suggest that these mounds each took about 300 to 500 years to form.

Pimple mounds seem to accumulate by one or more processes until an equilibrium profile is approached, after which net accumulation slows or stops (*10*). Indeed, if most of mound 31(B) accumulated during a 400-year period ending some 1600 years ago, the truncated cone morphology must be an equilibrium form. Storm surges may enhance this local relief and inhibit lateral spreading of mounds by maintaining nick points at their bases.

The diachronic nature of mound initiation in a pimple mound field also implies spatial processes and a mound density equilibrium. Although it is unknown whether this equilibrium has been reached in the Pipkin Marsh area, mound formation there continued at least to the early second millennium A.D. Examination of the geometry of mounds within a field and a search for "juvenile" mounds would aid in understanding the processes by which they form. The incorporated archeological remains may also assist in reconstructing the environmental conditions, such as climate, under which pimple mounds formed.

The Pipkin Marsh sites indicate that pimple mound terrains should be considered as having archeological potential. In view of the thousands of Gulf Coast mounds, it is necessary to have means to weight the probability of associated archeological deposits.

A 1767 Spanish colonial report (*11*) describes the usefulness of pimple mounds in areas with poor drainage: "Extraordinary features of this plain are flat-topped mounds, from four to six varas in diameter and from one to two in height, which nature has scattered about in great number making it passable. Rising above the surface of the water they serve as a resting-place for the people who often have to carry their goods on their shoulders because the beasts become worn out, or lack food. On these mounds they can keep their feet dry while packing the loads which otherwise would be almost impossible."

Presumably, pimple mound areas likely to have been sites of prehistoric cultural activity would be those adjacent to aquatic habitats whose resources were being intensively exploited, as in Pipkin Marsh. The most probable location for such mounds is along the contact of Beaumont and Prairie formations with Recent marsh near the coast. Conversely, pimple mounds on high bluffs around estuaries or on segments of the Ingleside barrier would be unlikely areas for archeological deposits of the kind described here. Mound fields on upland surfaces of the Beaumont Formation also would have a low probability of associated archeological remains, except perhaps for fields close to small streams or to chains of small lakes in degraded Pleistocene river channels, since such streams and lakes may have helped to determine aboriginal routes of access across the coastal upland prairies.

The Pipkin Marsh data indicate that the genesis of pimple mounds may be much more recent than was previously supported by field evidence. This process continued until at least 700 years ago and may be continuing today as a concomitant of drainage network development on late Pleistocene meander and barrier island ridges. Individual mounds may form rapidly in relation to the overall period of mound field development. This suggests a need to focus less on individual mounds and more on the development of mound fields as an integrated system of physical and biological processes for creating and modifying landforms.

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Acetylcholine and Bradykinin Relax Intrapulmonary Arteries by Acting on Endothelial Cells: Role in Lung Vascular Diseases

Abstract. *Acetylcholine and bradykinin produced potent relaxation of isolated canine intrapulmonary arteries contracted by serotonin, norepinephrine, or phenylephrine—provided the endothelium was left intact. Selective mechanical destruction of the endothelium transformed the activity of these substances from vasodilatation to vasoconstriction. Acetylcholine-induced relaxations, in the presence of intact endothelium, could be selectively inhibited competitively by atropine, but could not be inhibited by cyclooxygenase inhibitors, a lipoxygenase inhibitor, adrenergic blocking drugs, or histaminergic antagonists. Relaxations produced by prostacyclin, prostaglandin E_1, isoproterenol, papaverine, or histamine H_2-receptor agonists were not modified, or attenuated, by selective destruction of pulmonary endothelial cells. These observations might provide insight into the etiology of the increased pulmonary resistance observed in pulmonary hypertension and shock lung.*

Rabbit aortic rings contracted with various stimulants will relax when acetylcholine is added if the aortic rings are prepared with their endothelial cells left intact (*1*). We wondered whether selective removal of the endothelium from intrapulmonary arteries would result in a loss of ability of these vessels to relax in response to certain neurohumoral vasodilators and whether the vessels would contract, rather than relax, in response to these agents.

There is at present no agreement on the etiology of pulmonary hypertension, although various mechanisms have been proposed (*2*). During the past 10 years,

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