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A FOSSIL HUNTER'S GUIDE TO THE GEOLOGY OF SOUTHERN FLORIDA

By

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A Fossil Hunter's Guide to the Geology of Southern Florida

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The Florida peninsula is the exposed portion of the much broader feature known as the Florida Platform. The exposed portion lies almost all to the east of the axis of the platform. The axis of the Florida Platform occurs approximately along the present-day western coast of the peninsula.

The southern Florida peninsula, for the purposes of this discussion, extends southward from the southern boundaries of Pasco, Sumter, Lake, and Orange Counties. In general, the southern peninsula is characterized by flat plains and coastal lowlands. Hilly uplands occur only in the central northern area in portions of Polk and Highlands Counties. Figure 1 illustrates a geomorphic map of southern Florida.

Puri and Vernon (1964) recognized two broad physiographic regions in the southern peninsula, the Central Highlands and the Coastal Lowlands. The rolling hills of the Central Highlands extend into the southern region from the north and occupy only a small portion of the area. The highlands include the Lake Wales Ridge, the Polk Uplands and several lesser ridges (Figure 1; White, 1970). The highest elevations in southern Florida occur in the Central Highlands (along the Lake Wales Ridge) where elevations of more than 300 feet above mean sea level (MSL) are present. The Coastal Lowlands cover most of the southern portion of the state with elevations generally below 100 feet above MSL. Within the Coastal Lowlands, White (1970) recognized a number of smaller geomorphic features including the Gulf Coastal Lowlands, Eastern Valley, Osceola Plain, De Soto Plain and the Everglades (Figure 1).

The Central Highlands exhibits a rolling topography characterized by numerous sinkhole lakes. Paleo-sand dunes are present along the flanks of the Lake Wales Ridge in many areas. The higher portions of this zone are characterized by thick sand deposits lying on Eocene or Oligocene limestones or the Hawthorn Group sands and clays. On the Polk Uplands, a thin sand cover blankets the phosphate-bearing, very fossiliferous sediments of the upper Hawthorn Group. The phosphate-rich sediments are mined in Polk, Hillsborough and Hardee Counties exposing a plethora of vertebrate fossils. A variable thickness of sand also covers the Hawthorn Group on the Desoto Plain.

The Gulf Coastal Lowlands are underlain by Oligocene to Miocene carbonate sediments. Varying thicknesses of Neogene and Quaternary sediments blanket the older rocks. The contact between the carbonate rocks and the younger sediments is often marked by a lag deposit of phosphate gravel containing water-worn fossil fragments. Large quartz pebbles are occasionally found in this lag deposit. These unusually large clasts are thought to have been transported southward from the piedmont trapped in root clusters of trees. The often fossiliferous sediments that overlie the rubble zone contain a diversity of mollusk species.

Bounding the Central Highlands on the east and south are the Osceola Plain, the Okeechobee Plain and the De Soto Plain. The Osceola Plain is a beach ridge plain formed during a previous sea level highstand. The paleo-beach ridges exert strong control on the drainage on the eastern half of the plain. This is readily evident on the 7.5 minute topographic quadrangles covering the area. The beach ridges are not as evident on the western, higher portion of the Osceola Plain. Elevations on the Osceola Plain range from approximately 30 feet to 80 feet above MSL. A thick sequence of sands with some shell underlies the Osceola Plain. These Pleistocene deposits include a lithified coquina representing an ancient beach deposit.

The De Soto Plain lies to the west of the Osceola Plain and the southern tip of the Central Highlands. The elevations on the De Soto Plain are similar to those of the Osceola Plain. However, the De Soto Plain does not appear to be an ancient beach ridge plain. A variably thick sequence of sands with some shell lies on the Hawthorn Group with the Hawthorn at or near the surface in some areas.

The Okeechobee Plain occurs between the Osceola and De Soto Plains at lower elevations. The elevations of the Okeechobee Plain range from 20 to 30 feet above MSL. The plain is very flat and was considered by White (1970) to be a northern extension of the Everglades. It is underlain by sands with some very fossiliferous zones. Shell pits near Lake Okeechobee yield abundant late Pleistocene mollusk shells.

To the east of the Osceola Plain lies the Eastern Valley. This valley is low lying and swampy with shell beds near the surface. The Eastern Valley is a paleo-lagoon that extended far to the north. The St. Johns River headwaters occur in the Eastern Valley in Indian

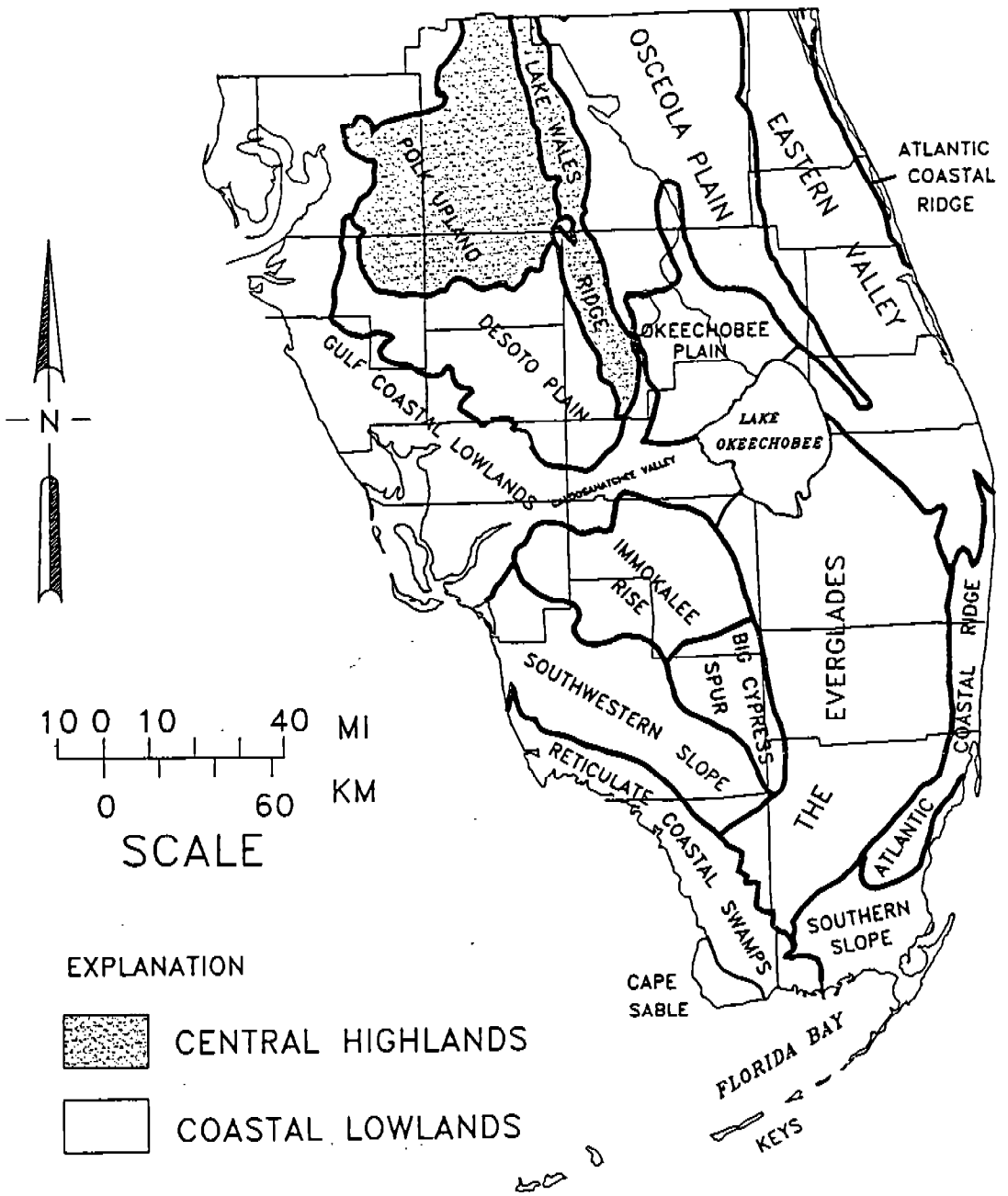

Figure 1. Generalized geomorphic map of southern Florida
[from Scott et al. (1991) as modified from White (1970)]

River County. The Atlantic Coastal Ridge borders the valley on the east. The persistent coastal ridge feature is composed of sands and lithified coquina.

The southern portion of the state, south of a line trending east-west through Lake Okeechobee, is quite flat exhibiting very little relief. The Immokalee Rise and its southern extension, the Big Cypress Spur, formed as submarine sand shoals during the Pleistocene covering older limestones. The Southwestern Slope lies to the west of the Rise. On the slope, the limestones are covered by only a thin veneer of sand.

The Everglades occur between the Immokalee Rise, Big Cypress Spur, and Southwestern Slope on the west and the Atlantic Coastal Ridge on the east. The Everglades is a unique and interesting geomorphic feature. It has been called the "river of grass" formed as water sheet-flowed south from Lake Okeechobee to Florida Bay. Peat and organic sediments overlie Pleistocene limestones throughout much of the region. In some areas, such as at Rock Reef Pass in the Everglades National Park, highly karstified limestones are exposed at the surface. Peat and organic sediments fill the dissolutional depressions. White (1970) felt that the Everglades formed in a trough developed by dissolutional lowering of the limestone surface of southern Florida.

The Atlantic Coastal Ridge of southeastern Florida is composed of sands and coquina north of the Palm Beach-Broward County line and predominantly limestone in Broward and Dade Counties. The northern portion formed as a barrier island or shoal while the southern portion formed as an oolite shoal. This persistent topographic feature provided the high ground upon which the cities of southeastern Florida developed.

Geology

The surficial geology and geomorphology of southern Florida is, in general, not strongly affected by subsurface structural features (Figure 2). This is direct contrast with northern Florida where the structural features strongly affect the outcrop pattern of the Eocene through Miocene sediments. The northern portion of the area under consideration exhibits the effects of the structures that influence the geology of northern peninsular Florida. The most prominent of these is the Ocala Platform which can be seen in the northwestern portion of Figure 2. Here the Oligocene Suwannee Limestone and the Hawthorn Group sediments are exposed on the southeastward plunging nose of the Ocala Platform. Younger formations lap onto the flanks of the structure. Cross section A-A' in Figure 3 illustrates how the younger Suwannee Limestone and Hawthorn Group lap onto the structurally high Ocala Limestone. Where the carbonate rocks are near the surface, karst features are common.

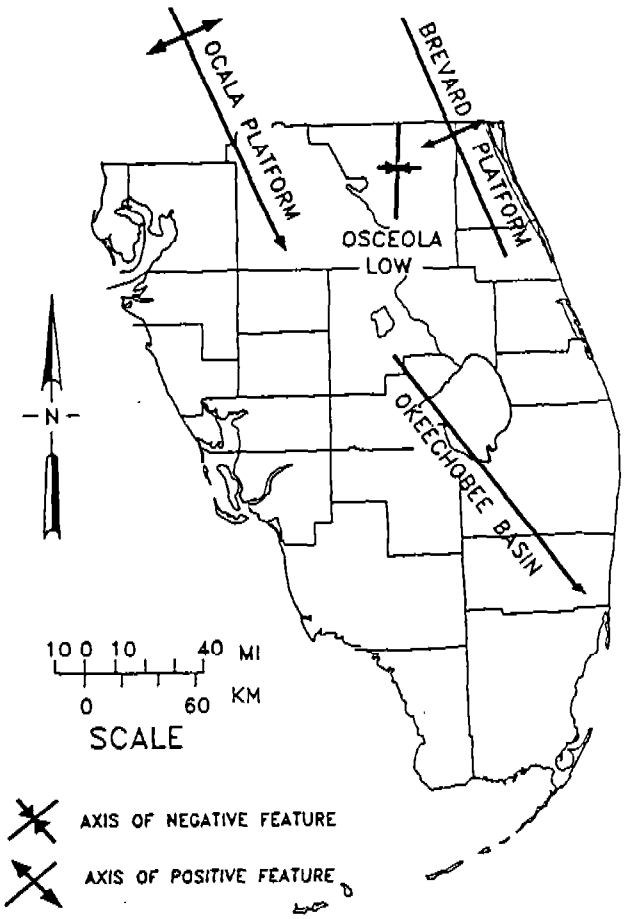

Figure 2: Geologic structures in southern Florida (from Scott et al., 1991)

Other structural features affecting the sediments in southern Florida include the Brevard Platform, the Osceola Low, and the Okeechobee Basin. The Brevard Platform occurs in the northeastern portion of this area. This structure brings the Eocene limestones within a hundred feet of the surface and the Hawthorn Group sediments are thinned to absent over its crest. The Brevard Platform plunges to the south-southeast and affects the formations as far south as Martin County.

The remaining two structural features are basins where the sediments are thicker. The Osceola Low is a relatively small basin in Osceola County and part of Brevard County. The post-Ocala Limestone sediments thicken in the basin to a maximum of more than 350 feet. The Okeechobee Basin is a broad south and south-southeast dipping structure. Within the basin, the post-Ocala sediments thicken to the south to more than 1300 feet (Figure 3, Section C-C').

Our discussion of the lithostratigraphy of the southern Florida peninsula will begin with the Ocala Limestone, the oldest unit shown on the geologic

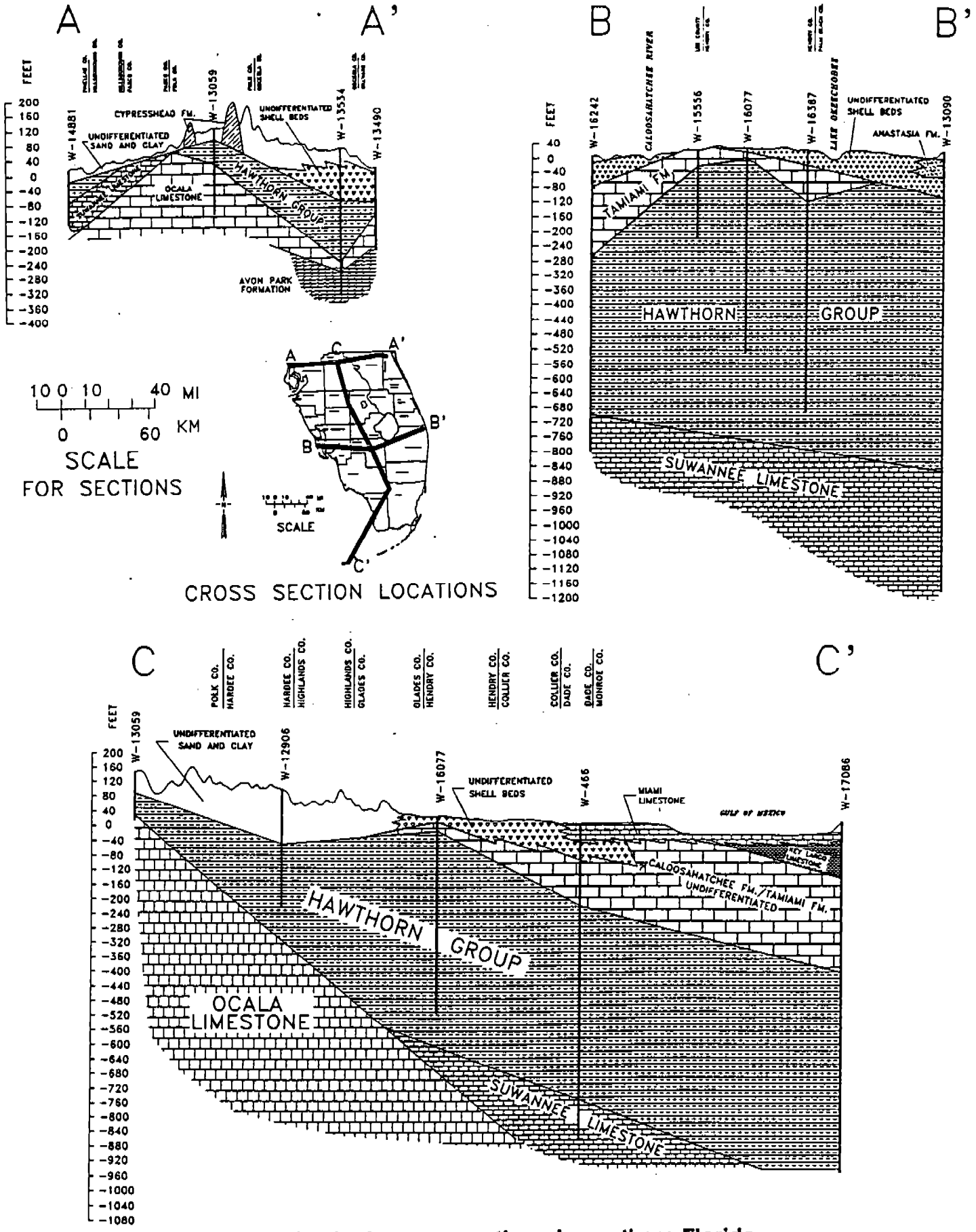

Figure 3. Geologic cross sections in southern Florida

map of the area (Figure 4). The map in Figure 4 is constructed to show the extent of the formations as they occur within 20 feet of land surface. Each formation may be more extensive in the subsurface, but because each eventually dips below the arbitrary 20 feet depth or pinches out, their entire extent is hidden by shallower units shown on the map. Areas underlain by more than 20 feet of undifferentiated Pleistocene and Holocene sands are shown as white areas on the map.

The Late Eocene (approximately 38 to 35 million years ago [mya] Ocala Limestone is a very fossiliferous limestone containing mollusks, echinoids and foraminifers. It forms an important portion of the major water-bearing unit, the Floridan aquifer system, in Florida and parts of Alabama, Georgia and South Carolina. Where the Suwannee Limestone is present, the Ocala underlies it. The Suwannee is missing due to erosion or nondeposition in the northeastern portion of the southern Florida peninsula. As a result, the Hawthorn Group immediately overlies the Ocala Limestone. The Ocala Limestone is absent under portions of Broward, Dade and Monroe Counties. Presumably, it was removed by the erosive forces of the Gulf Stream when it impinged upon the Florida Platform during sea level fluctuations.

The Lower Oligocene (approximately 35 to 30 mya) Suwannee Limestone is exposed in a very limited area in Hillsborough and Polk Counties (Figure 4). The Suwannee is a very fossiliferous limestone containing foraminifers, mollusks and echinoids. One characteristic fossil of the Suwannee Limestone is the echinoid *Rynchol*ampus *gouldii* which occurs in abundance in some locations. This limestone formation constitutes an important part of the Floridan aquifer system in southern Florida. In general, the Hawthorn Group overlies the Suwannee throughout southern Florida.

Prior to the mid-Oligocene, the Florida Platform was a broad carbonate depositional environment with only a minor influx of siliciclastics (quartz sands, silts, and clays). The siliciclastic sediment source, the Appalachian Mountains, had been subjected to erosion for millions of years and had been reduced considerably in elevation. As a result, little sediment was being shed and entering the carbonate-depositing environment of the Platform. A broad, regional uplift of the southern Appalachians occurred during the mid-Oligocene (some 30 mya), rejuvenating the erosional cycle. The renewed erosion supplied siliciclastic sediments to the marine depositional environment. These sediments were transported onto the Florida Platform, first mixing with the carbonates then, subsequently, replacing carbonate deposition. This dramatic transformation occurred during the deposition of the Hawthorn Group and represents the first major sedimentation change on the Florida Platform in millions of years.

While this shift in sedimentation was taking place, another unique and interesting geologic event was occurring. Phosphate was forming (phosphogenesis). The deposition of abundant phosphate is a geologically infrequent event requiring a very specific set of circumstances. Cold, phosphorous-laden ocean waters upwelled onto the shallow continental shelf allowing many organisms to flourish. The organic-rich sediments that resulted allowed the precipitation of phosphatic minerals. Subsequent sea level fluctuations concentrated the phosphate grains and created the phosphate deposits of the Hawthorn Group.

The Hawthorn Group in southern Florida consists of two formations, in ascending order, the Arcadia Formation and the Peace River Formation. The Upper Oligocene to Middle Miocene (approximately 30 mya to 16 mya) Arcadia Formation is predominantly a carbonate unit comprised of dolostone/limestone with highly variable percentages of quartz sand, clay and phosphate. Based on the variable lithologies, the Arcadia has two named members, the Nocatee and Tampa Members. The Nocatee Member is a sand and clay unit with variable phosphate. The Tampa Member is a sandy limestone with only minor phosphate. The Arcadia Formation, in general, is fossiliferous containing abundant mollusks and other marine fossils with the rare inclusion of vertebrates. The Arcadia Formation occurs at or near the surface in portions of Hillsborough, Pinellas, Manatee Sarasota and Charlotte Counties (Figure 4). Late Pleistocene shell beds overlie the Arcadia in part of this area. A well developed rubble zone containing phosphate gravel, vertebrate fossils and quartz cobbles and pebbles occurs between the units.

The Middle Miocene to Lower Pliocene (16 mya to 4 mya) Peace River Formation is predominantly a siliciclastic unit with only scattered carbonate beds. The phosphate content is highly variable with some beds containing economically valuable concentrations. The most phosphatic beds within the Peace River Formation occur within the Bone Valley Member. The Bone Valley Member, previously referred to as the Bone Valley gravel or the Bone Valley Formation, occurs in a restricted area that includes portions of Polk, Hillsborough, Manatee and Hardee Counties. This area comprises the main portion of the Central Florida Phosphate District and has been the site of phosphate mining activities since the turn of the century. The name is derived from the common occurrence of terrestrial and marine vertebrate fossils within the deposit. A wide variety of vertebrate fossils are found in this deposit ranging

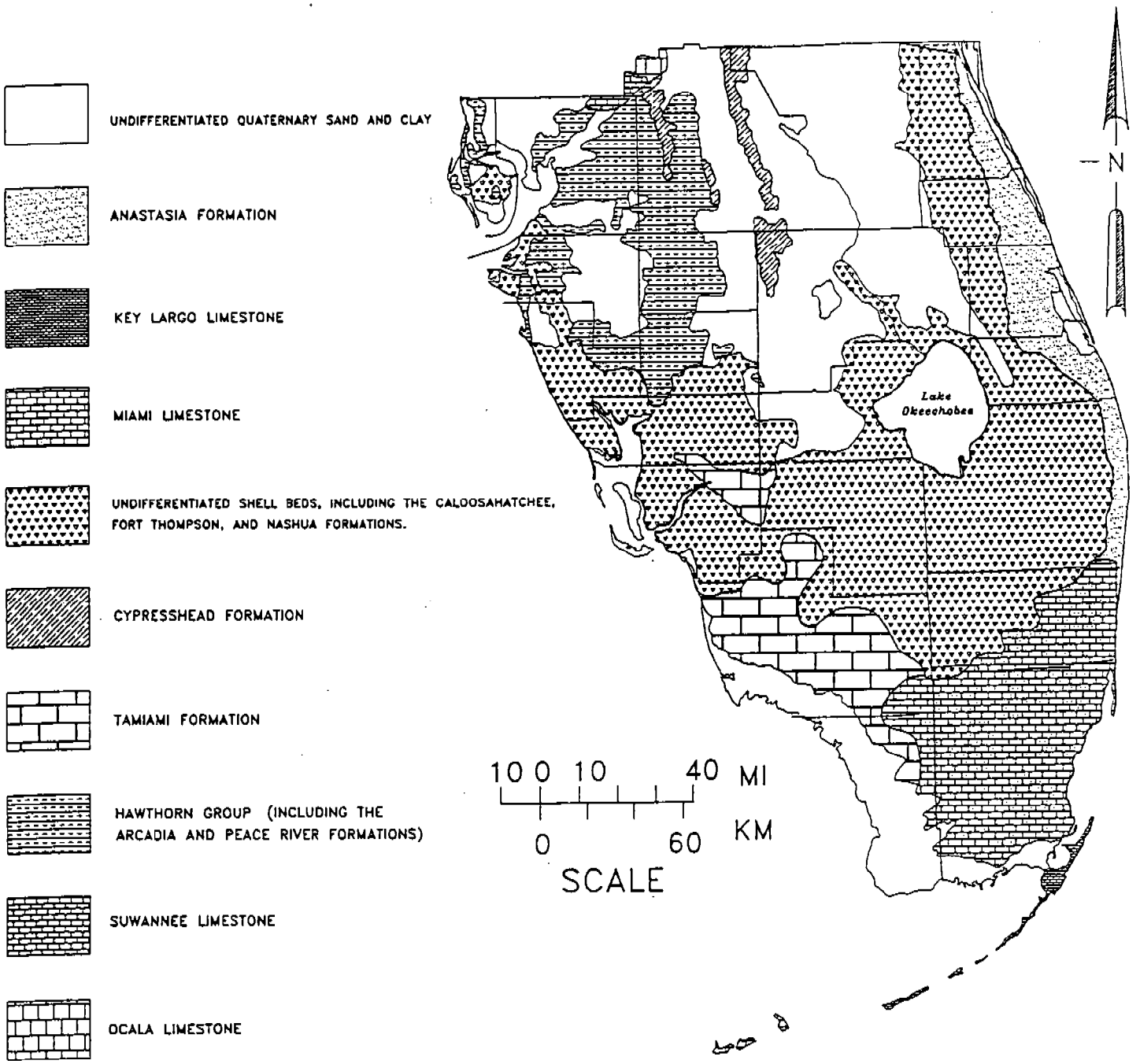

Figure 4. Geologic map of southern Florida

(compiled from county geologic maps by various authors as listed in references)

from shark's teeth to dugong, whale, horse, and many others.

The Bone Valley Member consists of quartz sand, clay and phosphate. The phosphate occurs as silt- to gravel-sized clasts of the mineral francolite, a carbonate fluorapatite. Phosphatic gravel beds are interbedded with finer grained, sand-sized phosphate beds. The phosphatic sediments contain highly variable admixtures of quartz sand and clay.

Overlying the Hawthorn Group in the central portion of the peninsula is the Upper Pliocene (approximately 3 mya) Cypresshead Formation (Figure 4). This unfossiliferous unit is composed of clayey, occasionally gravelly quartz sands and forms the higher ridges of the Central Highlands. Reworked Cypresshead sands and younger undifferentiated sands make up the remainder of the highlands.

Overlying the Hawthorn Group sediments in much of southern Florida is the Tamiami Formation. The Upper Pliocene Tamiami Formation consists of limestones, sands and clays. Some portions of the Tamiami, for example the Pinecrest beds, are extremely fossiliferous containing a very diverse molluskan fauna that attracts both professional and amateur paleontologists. The Tamiami Formation is exposed or occurs in the shallow subsurface in southwestern peninsular Florida.

Plio-Pleistocene sediments overlie the Tamiami Formation and the Hawthorn Group (where the Tamiami is absent) and consist of limestones and sands with variable fossil content. These units have been recognized as the Caloosahatchee "formation", Bermont "formation" and the Fort Thompson Formation (Figure 4) by many paleontologists. Although a particular lithology may occur in a formation, problems arise from the practice of identifying the units based on the incorporated molluskan faunas. Currently, a particular fauna with its guide fossils is used to determine whether a unit is the Caloosahatchee "formation" or the Bermont "formation". This practice does not conform with the North American Stratigraphic Code. The Code is a set of guidelines adopted by geologists that specify how to identify various types of stratigraphic units. Under the Code, formations are lithostratigraphic units which should be identified based on the sediment types, not on the recognition of the incorporated fossils. In an attempt to rectify the situation, Scott (1992) suggested placing the Caloosahatchee, Bermont and Fort Thompson formations in the Okeechobee formation (informally). Lithologically, the Okeechobee formation consists of limestone, sands and clays with varying shell content. Currently, drilling is being conducted in southern Florida to determine the validity of this approach.

The Atlantic Coastal Ridge in southern Florida is constructed of the Anastasia Formation north of the Palm Beach/Broward County line and the Miami Limestone to the south. The Anastasia Formation is a coquina composed of variably lithified shell and sand. The Miami Limestone consists of oolitic limestone and bryozoan-rich limestone that is variably lithified. Excellent exposures of the Anastasia occur along the coast at numerous locations including The Refuge in Martin County and Blowing Rocks in Palm Beach County. The Miami Limestone is well exposed at Silver Bluff and along canals transecting the coastal ridge.

The Florida Keys are constructed of upper Pleistocene limestones. The upper keys are composed of Key Largo Limestone, essentially a fossil coral reef. Fossil corals of many species and sizes are enclosed in a carbonate matrix. The Key Largo Limestone is well exposed along some of the canals in the upper keys. The State of Florida has purchased the old Windley Key Quarry site where the Key Largo Limestone was quarried for building and decorative facing stone. The site is being preserved as a State Geological Site and will be open to the public in the near future. The lower keys are composed of Miami Limestone oolite facies similar to the southern portion of the Atlantic Coastal Ridge in Dade County.

Fossil Hunting Localities

Southern Florida offers the fossil enthusiast some of the finest Miocene to Recent collecting opportunities in the state. Vertebrate fossils may be found in abundance in the Hawthorn Group sediments, and this area of Florida is also noted for its Pliocene and Pleistocene shell bed deposits, as well as the outstanding Recent shell collecting opportunities at Sanibel Island, near Ft. Myers.

Figure 5 is a generalized location map for the geographic areas mentioned in this article. Some of the classic geologic localities are also illustrated in Figure 6. The latter figure is some 30 years old, so bear in mind that the land ownership and access information is likely obsolete.

With southern Florida's burgeoning population, many potential fossil sites are becoming developed or otherwise off limits. Other popular sites such as the Newburn or APAC pit near Sarasota are closed. Many private mines and quarries are no longer willing to bear the liability in allowing the public into their pits. In at least one instance, a shell pit was closed to all collectors due to unauthorized entry by a group of thoughtless fossil hunters. It has therefore become even more imperative to conduct all collecting in a responsible manner, no matter where one hunts. Respect the private property rights of others, and

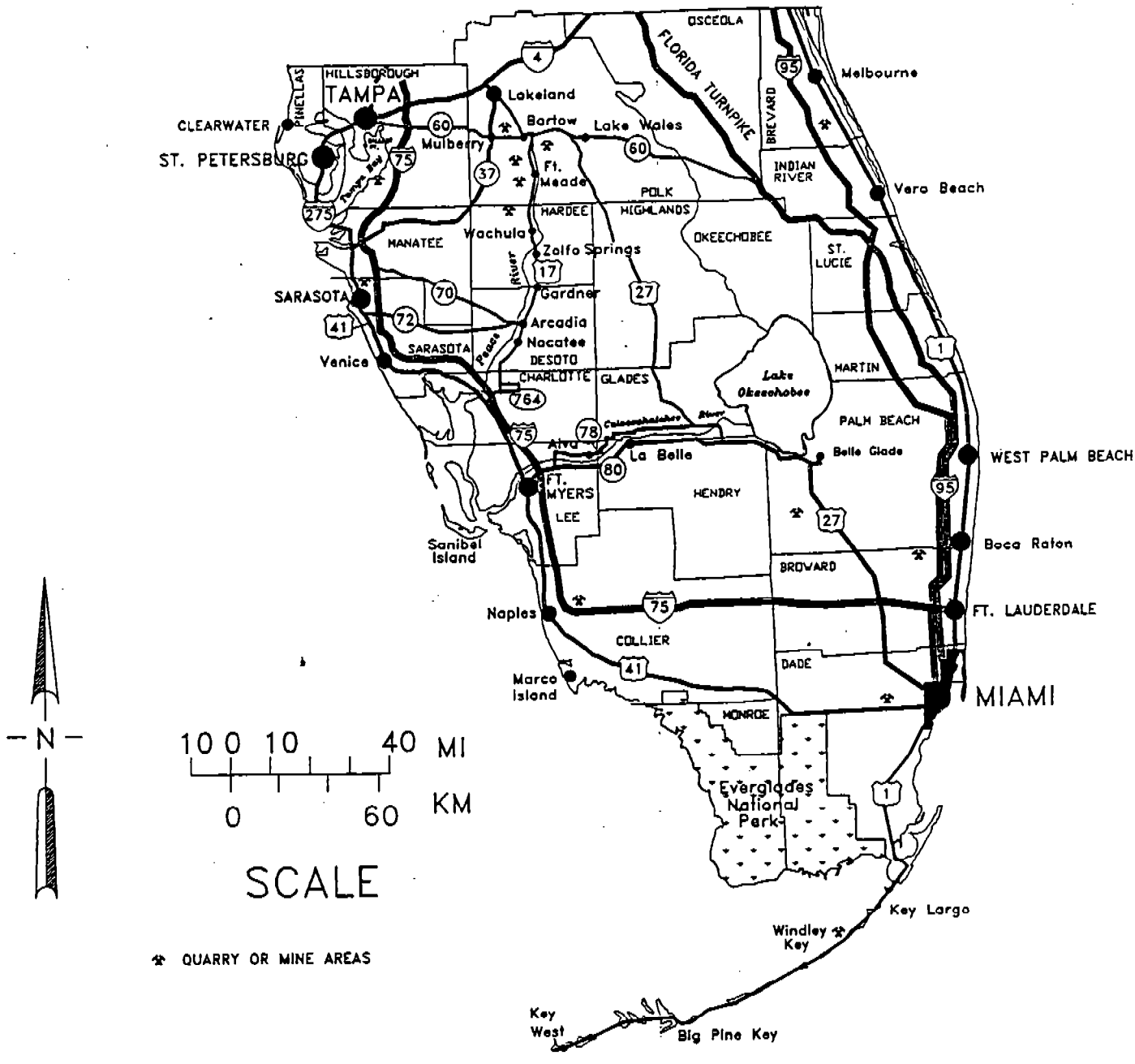

Figure 5. Generalized location map for southern Florida

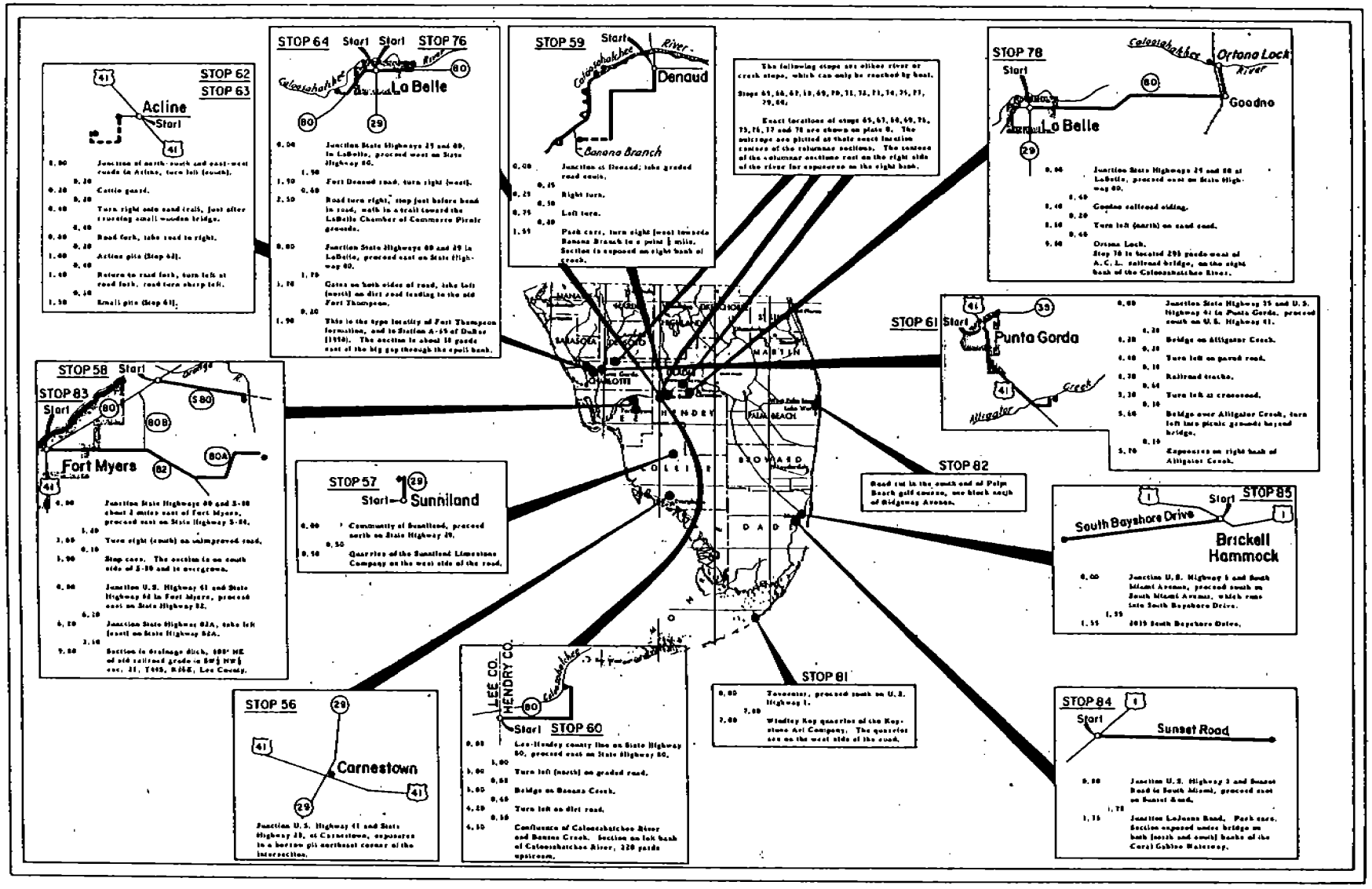

Figure 6. Classic geologic sites in southern Florida

(from Purl and Vernon, 1964)

always seek permission before entering anyone's land. To ensure your being allowed to return, avoid littering or destructive digging, and leave it as you found it.

The mines of the Central Florida Phosphate District, nearby and south of Bartow, have yielded some of the richest Miocene and Pliocene vertebrate fossils found in Florida. This region is world famous for its fossils, and has been dubbed the "Bone Valley". Shark teeth and bones from a variety of both terrestrial and marine vertebrates are common finds. Unfortunately, access to the few remaining mines is difficult to come by. Most are closed to the public and many have regular security patrols. At last checking two mining companies still allowed escorted groups (primarily fossil clubs) in to collect: Cargill Fertilizer, Inc., P.O. Box 1035, Ft. Meade, FL, 33841, (813) 285-8125, and IMC Agrico, P.O. Box 867, Bartow, FL 33830. (813) 533-1121. Most collecting is done on the large mine spoil piles, in certain designated inactive areas of the mines.

Individuals may collect fossil material similar to that found in the phosphate mines at numerous sites along the Peace River. This stream is incised into Miocene Hawthorn Group sediments, and yields Miocene to Pleistocene fossils. It flows in a leisurely southwestward course from Bartow to Charlotte Harbor on the west coast. The best fossils occur in the stretch from Zolfo Springs to Nocatee. Here stream bottom sediments are composed of fossiliferous sands and gravels, and screenwashing is the preferred method of recovering the fossils. The Peace River is shallow enough to wade over much of its course, and a canoe or boat allows travel to collecting sites away from popular access points. Public boat ramps are available at Arcadia, Gardener and Zolfo Springs. Canoes may be rented at the Canoe Outpost in Arcadia.

For collectors who are landlubbers, several bridges and public parks provide pedestrian access to the river. The following land access sites are suggested by the Fossil Club of Miami in their June, 1994 newsletter. Fossils may be sifted with a hardware cloth screen from the streambed of Joshua Creek, a tributary to the Peace River which passes under State Road 17 a few miles south of Arcadia. Park on the east side of 17 and wade the shallows 100 yards downstream of the bridge. Just west of Arcadia, car parking is available on the north side of the highway 70 bridge over the Peace River. Locals collect shark teeth, vertebrate bones, Indian beads, and old bottles in a gravel bar under the sand in the river bottom near the bridge. A similar collecting opportunity occurs about 100 yards downstream from Crews Riverside Park, at the Wachula bridge over the Peace River (County Road 636, just west of Wachula). Shark teeth and other small fossils are found by digging and sifting in the gravel streambed. Another possibility is Brownville Park, located on a dirt road just south of Brownville Road (take highway 17 north from Arcadia 4.5 miles, then west on Brownville road to the dirt road on the left just before the river). Fossils have been found in the stream bed 100-150 yards north and south of the park.

Many other local creeks and streams in and west of the phosphate district may yield similar finds. Brown (1988) recommends Horse Creek in De Soto County (10 miles west of Arcadia on State Road 72) for fossils similar to those in the Peace River. Hunt in shallow water south of the bridge. A mask and snorkel will help locate fossils in the bottom sediments.

Shallow sediments of the Hawthorn Group extend westward from the phosphate district to coastal portions of Pinellas and Manatee Counties (see Figure 4). This unit lies at shallow depth in portions of the Tampa Bay area. Many of the stream banks which once exposed this unit have long since been encased in concrete during Tampa's urban expansion. One site in Tampa, near the eastern terminus of Gandy Boulevard on Hillsborough Bay, is Ballast Point. It is famous in mineralogical circles for its prized agatized coral geodes which erode out of Hawthorn Group sediments near the shore. These geodes represent silicified Oligocene-Miocene coral heads whose hollow interiors have become lined with variously-colored agate or chalcedony, a finely-crystalline form of quartz. Now a park, the site was effectively picked clean over the years by collectors. The city performed the coup de grace when they constructed a concrete seawall along the shore, covering the remaining outcrop. Today small pieces of agatized coral and small agatized mollusk shells may still be found with diligent searching among the rock rubble covering the beach and offshore area. Similar agatized corals have been found in dredge material along the causeways to the coastal barrier islands in northern Pinellas County and in some of the streams along the eastern shore of Tampa Bay. Future finds of similar material could occur during dredging or excavation work in the Tampa area, and the interested collector should make it a routine to check such sites.

The Hawthorn Group extends offshore on Florida's Gulf Coast onto the broad continental shelf. Shark teeth and fossils from submarine outcrops of the Hawthorn and younger units wash ashore on beaches from Clearwater south to Venice. Venice Beach and nearby Caspensen Beach are famous for their extremely abundant shark teeth. These may be

picked up in the strand line and swash zone of the beach, or dredged in the shallows with a hand held screen mesh. Local convenience stores market long-handled screened scoops for just this purpose. Most of the teeth found on the beach are small. Larger teeth are sometimes found by scuba divers in the bottom sediments offshore. This is one site worth visiting as it is hard to avoid finding fossils here.

Florida's southwest coastal and south-central peninsula areas are truly the realm of the invertebrate fossil enthusiast. Molluskan fossiliferous units of the Caloosahatchee, Bermont, Ft. Thompson, and Pinecrest formations occur near or at the surface over broad areas of the southern peninsula (see Figure 4). These shallow units extend from St. Petersburg southward through Lee County, then eastward in a broad swath near Lake Okeechobee. They continue up the east coast, eventually grading to the north into the fossiliferous sediments of the Nashua Formation. Their distribution reflects the extent of encroaching Plio-Pleistocene seas, and the shelly units form a u-shaped areal pattern around the generally unfossiliferous undifferentiated Quaternary and Cypresshead Formation sediments of the central highlands (see Figure 4).

The Plio-Pleistocene shell units commonly contain abundant well-preserved Pliocene and Pleistocene mollusks, corals, and barnacles as well as some freshwater forms. They occur at variable, generally shallow depths along Florida's southwest coast and portions of the east coast, and are best observed in excavations. Abundant well-preserved mollusks occur in the walls of a drainage ditch around Fossil Park, at 9th Avenue and 71st Street in St. Petersburg.

Shell beds are commonly mined as roadbase material from pits in coastal counties. Prior to their recent closings, such commercial pits provided collectors with access to excellent fossil shells. Shell pits are commonly in a state of flux, and changing ownerships may one day bring more relaxed policies on admitting avocational fossil hunters.

Invertebrate fossil hunters have a number of collecting options open to them. Some general ideas and suggestions are presented here. Manmade canals, excavations and natural creeks which have cut down into fossiliferous strata are likely places to look. Brown (1988) describes a fossil mollusk site at Shell Creek in Charlotte County (four miles west of I-75 on S.R. 17 to County Road 764, then 4.4 miles east to Shell Creek Park. Best collecting is from a canoe launched at the park. Search the high banks for shell-laden beds of the Plio-Pleistocene Caloosahatchee formation. Other deeply-incised streams in the area covered by shelly sediments (Figure 4) are worth scouting out.

Shelly sediments are also exposed in abundance along the Caloosahatchee River and its tributaries, particularly in the 4 mile segment just east of La Belle in Hendry County. The high banks are best explored and collected from a boat or canoe. Boat access is available at the Franklin Lock in Lee County, near the State Road 78 - State Road 31 junction, and at the public ramp on S.R. 78 just west of La Belle.

The Plio-Pleistocene shelly units may contain both land and marine vertebrate fossils. It is not unusual to find fossil bird or horse material in the shell-bearing strata. The famous Leisey shell pit, located on the eastern shore of Tampa Bay near Apollo Beach, gained national attention with the discovery of a fantastically abundant and diverse assemblage of Pleistocene vertebrate fossils in the shell strata. These finds are described in Hulbert et al., (1994).

Other Pleistocene vertebrate bearing strata are present throughout southern Florida. The famous canal bank site at Vero Beach and the similar "Melbourne Bone Bed", both discovered early in the century in Pleistocene sands along the east coast, attest to this fact. Abundant fossil sea bird fossils were also recently discovered in a shell pit in southwest Florida (Emslie, 1992).

Hunting for vertebrate material entails searching in the same kinds of areas as fossil mollusks occur. Check any areas where excavation or dredging is in progress. Many collectors walk the sediment spoil piles created by the dredging of canals. Similar material is commonly pumped up as fill in construction and beach renourishment projects. The smaller vertebrate teeth and bones easily survive the dredging process, and diligent searching may yield good finds.

As with the Miocene fossils of the Peace River, Pleistocene vertebrate material commonly occurs in streambed deposits. Vertebrate fossil deposits may be concentrated in holes or other natural impediments on the streambed. Depending on which part of the area one searches, a variety of fossil ages may also be present, due to the stream having cut downward through different ages of strata. Renz (1993) describes his discovery of a nearly complete Pleistocene sloth skeleton simply by wading a shallow stream in southwest Florida.

Collecting opportunities generally decline in the southernmost counties of this area, but fossils are still available. Quarries and drainage ditches cut in the Pliocene Tamiami Formation in Collier County may contain mollusks and echinoids, including the characteristic sand dollar *Encope tamiamiensis*. Limestone portions of this formation are typically more lithified than younger units, and many of the

fossils occur as molds and casts or are well-cemented in the rock matrix.

Most of eastern Broward and all of Dade County, as well as the lower Florida keys, are underlain by shallow, generally unfossiliferous oolitic Miami Limestone. The Miami Limestone has some molluskan fossiliferous portions, and Pleistocene vertebrate fossils have been found in sinkholes in the unit. However, the area is sparse in fossils as a general rule.

The upper Florida keys, from Key Largo to Big Pine Key, are comprised of Key Largo Limestone. This unit contains abundant and well-preserved Pleistocene corals, which may be observed in channel cuts on Key Largo. Most corals are cemented in the rock matrix, but collectors have been able to recover individual corals from areas where new canals are being blasted and dredged.

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