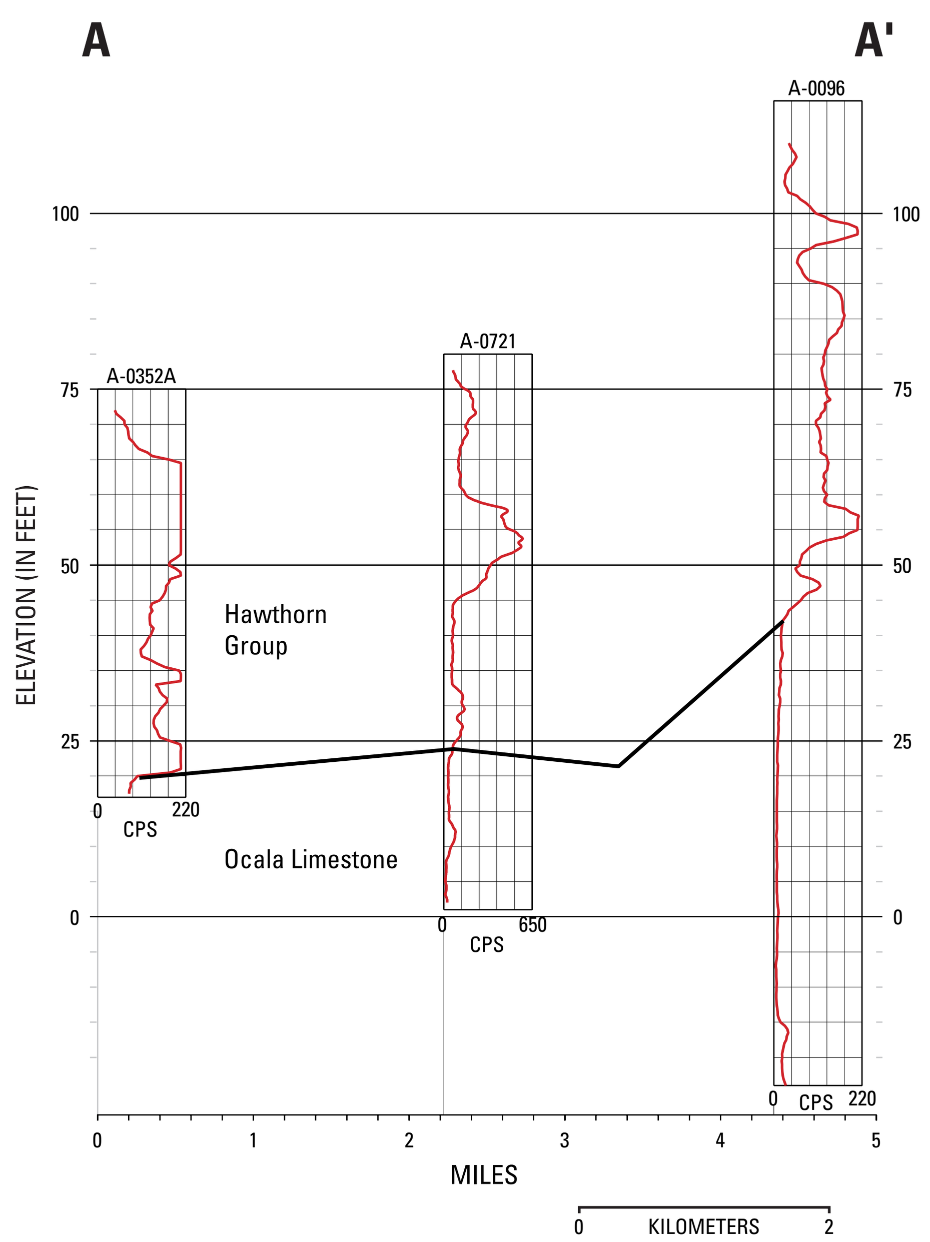
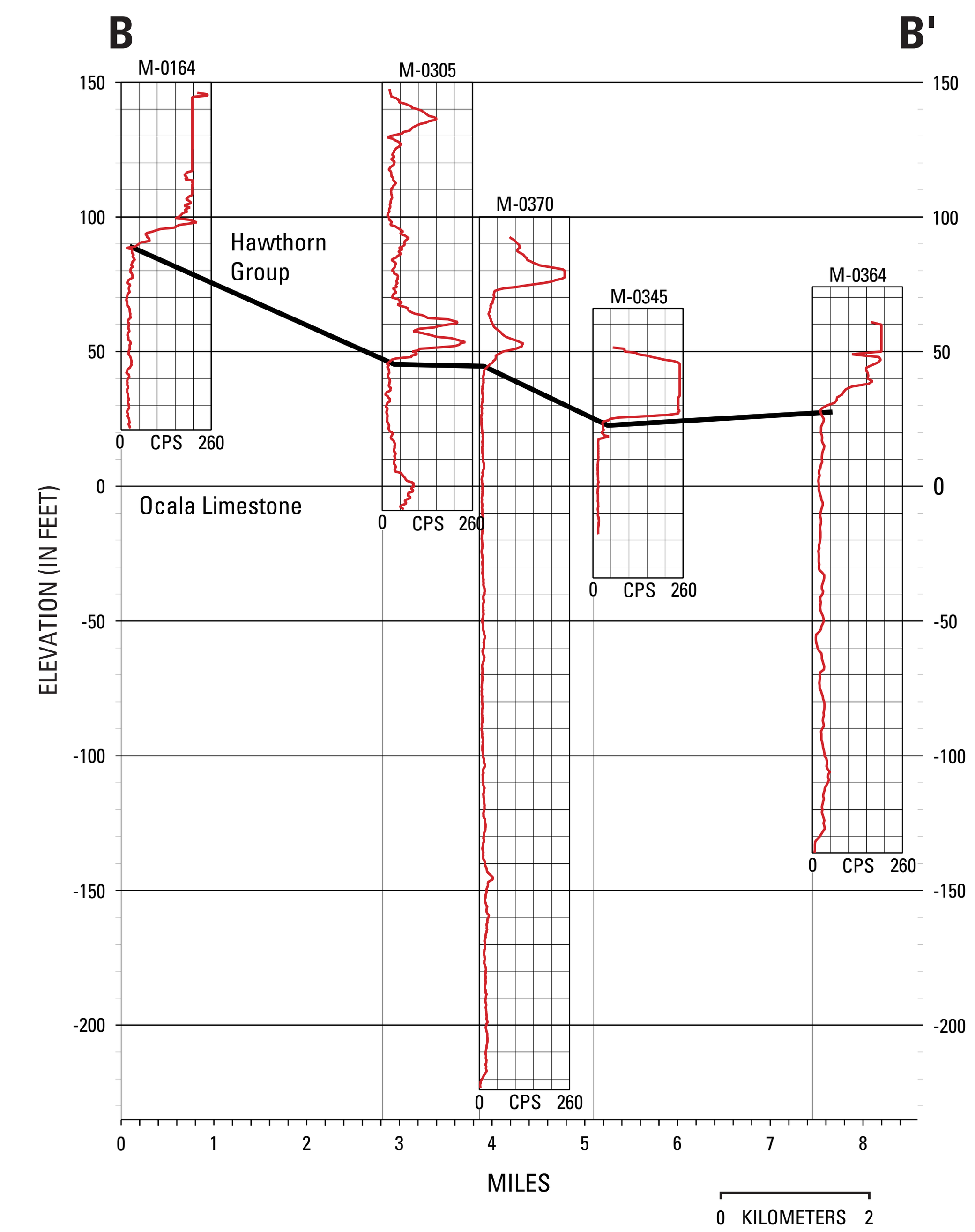
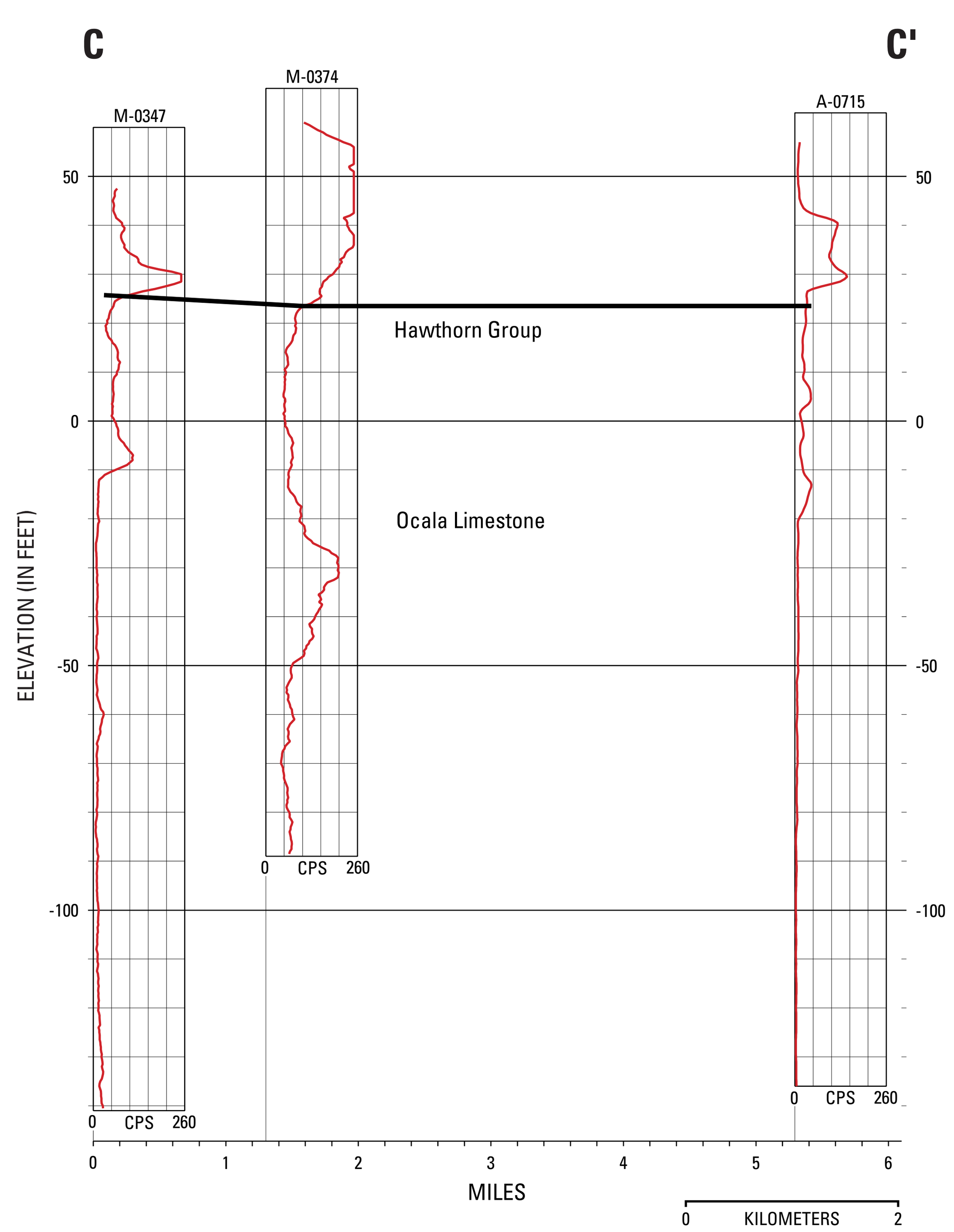
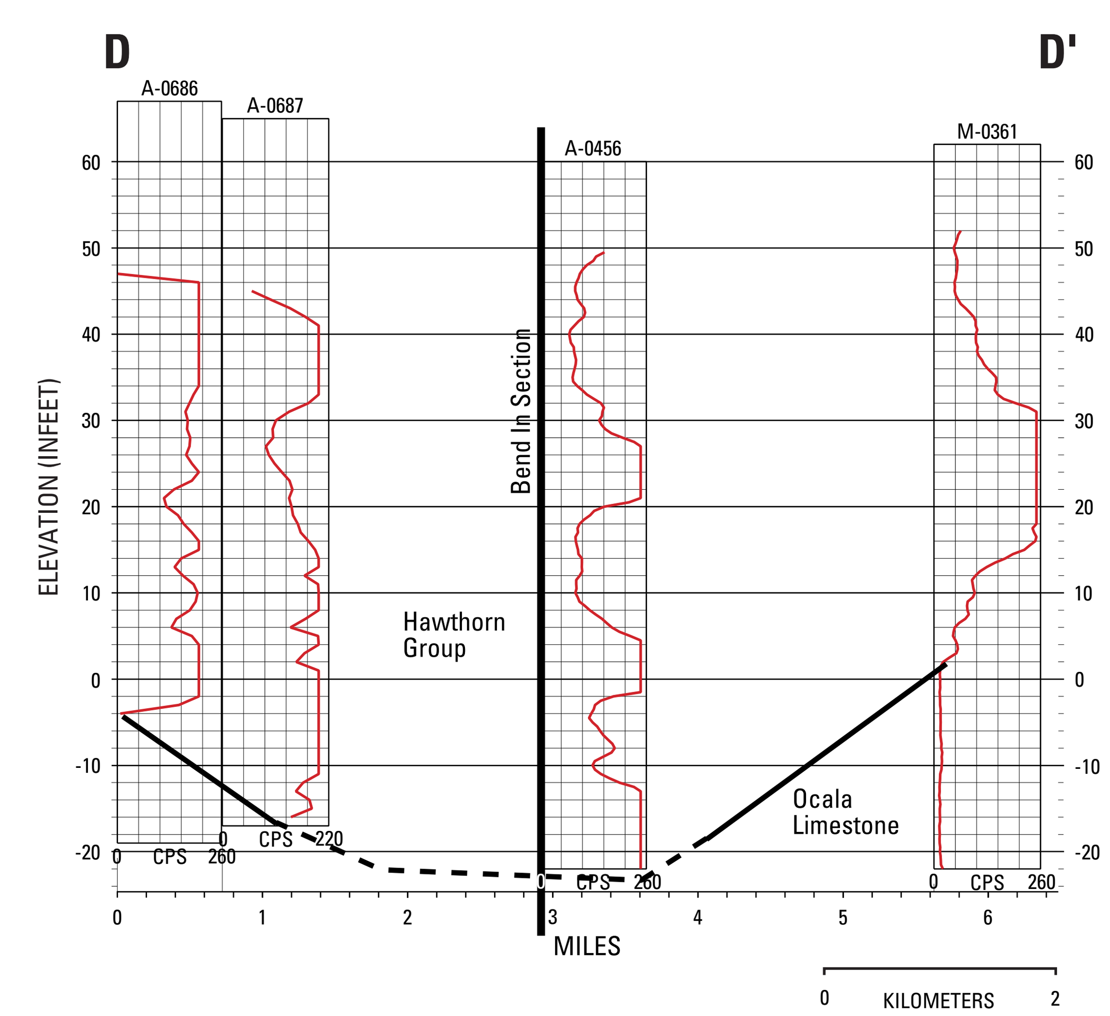
# INDEX MAP AND GAMMA LOG

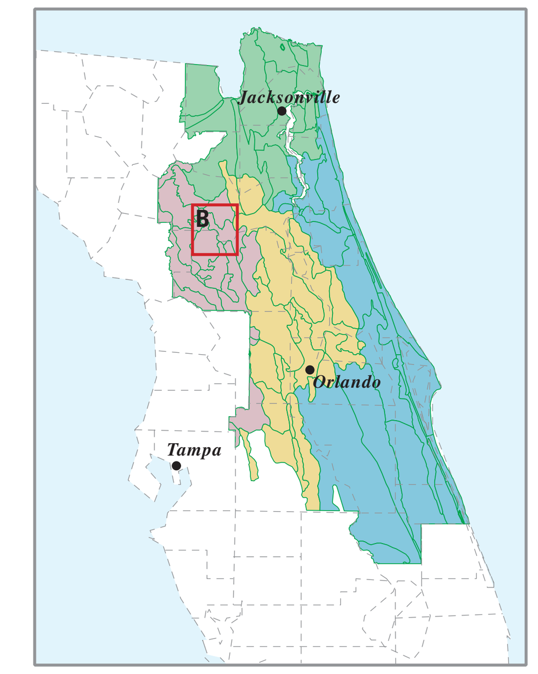
## CROSS-SECTIONS, SECTION B



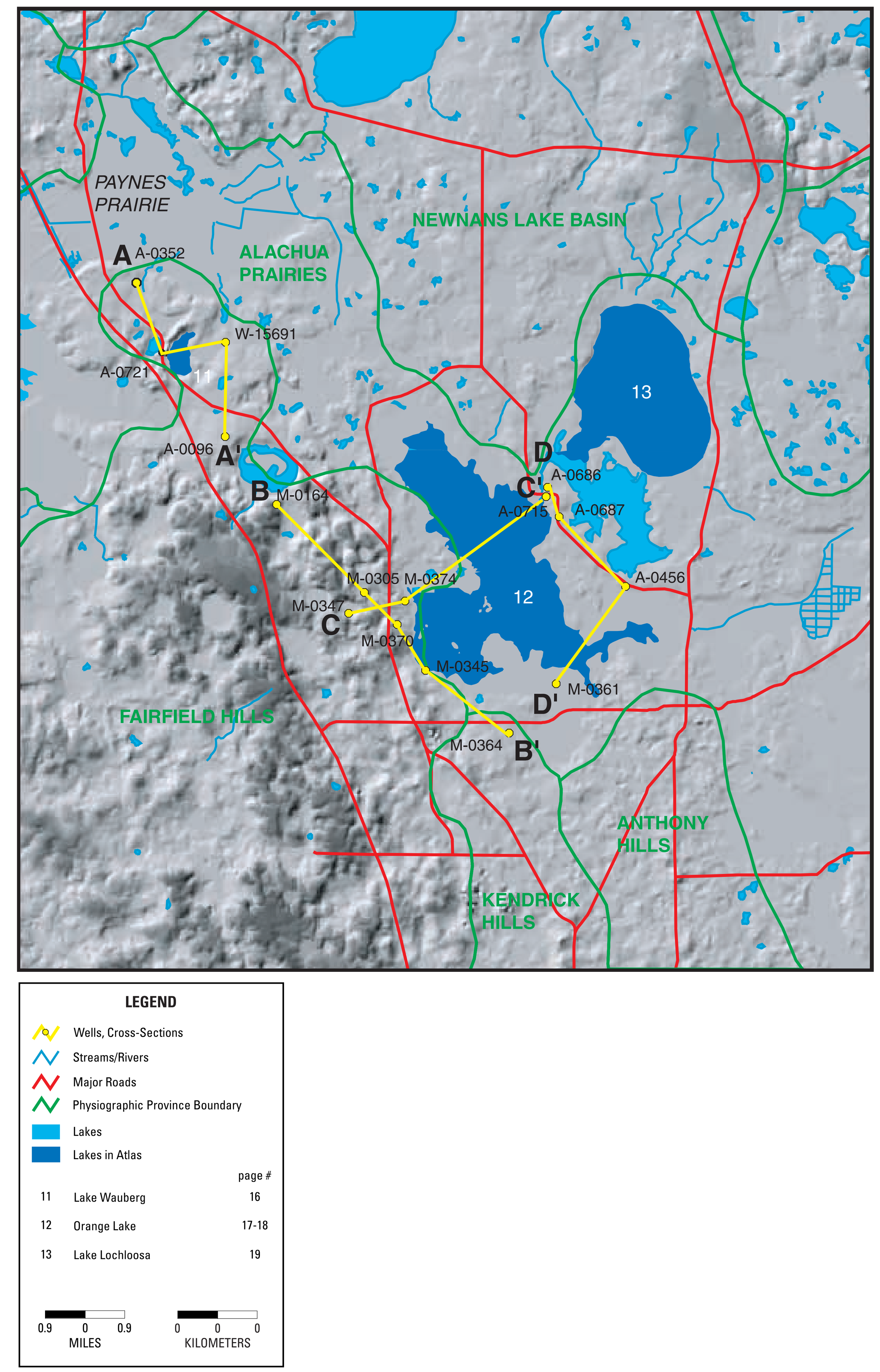



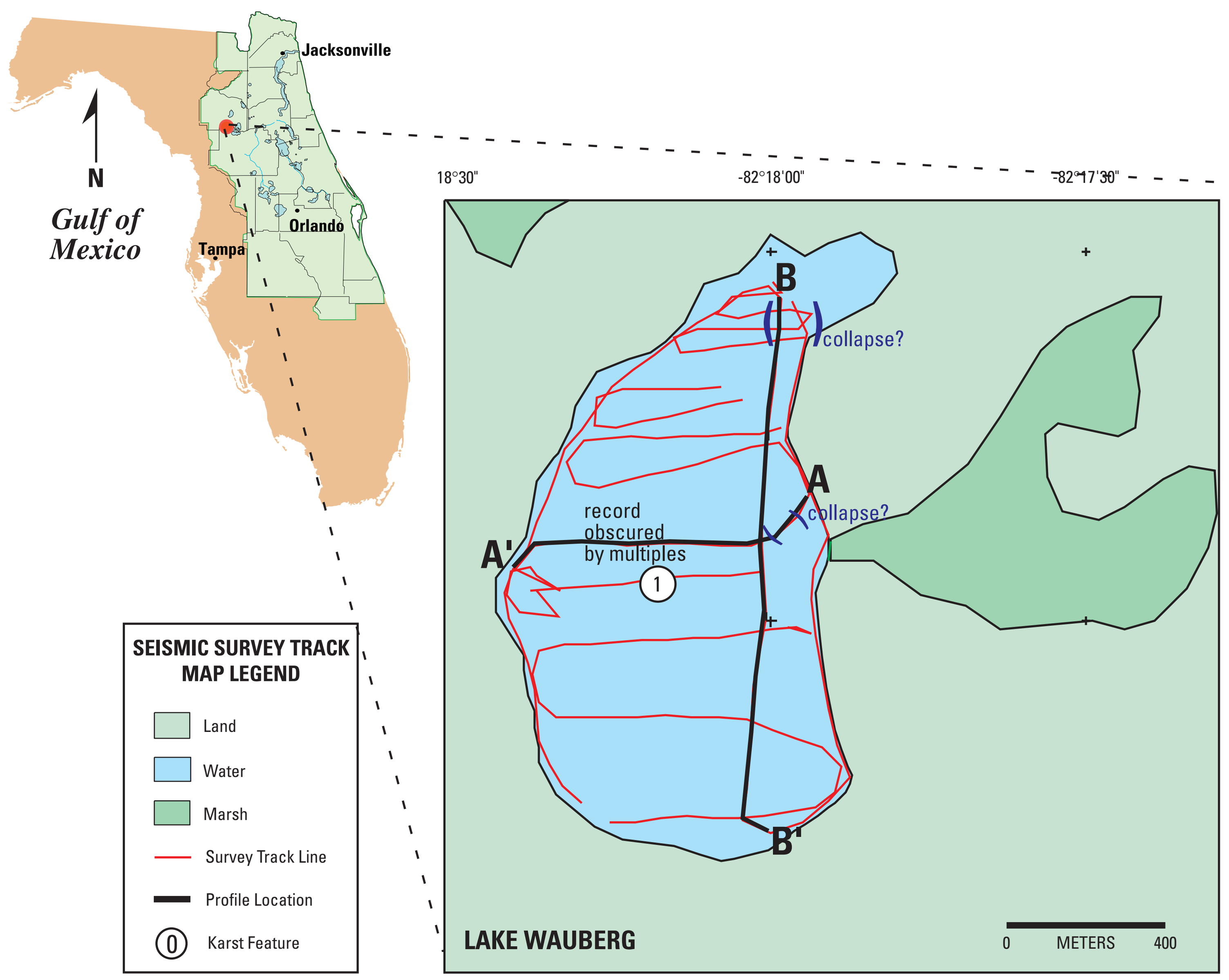




Location of survey area right (red square). Shaded relief map below showing physiographic regions, and location of wells and gamma log cross-section. Gamma Log cross-sections (left) show geologic contacts for correlation to seismic sections.

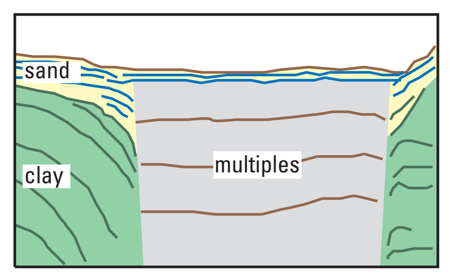


B




EXPLANATION

1. Profile obscured by multiples, noise or signal attenuation.




# LAKE WAUBERG
## ALACHUA COUNTY, FLORIDA

### Introduction

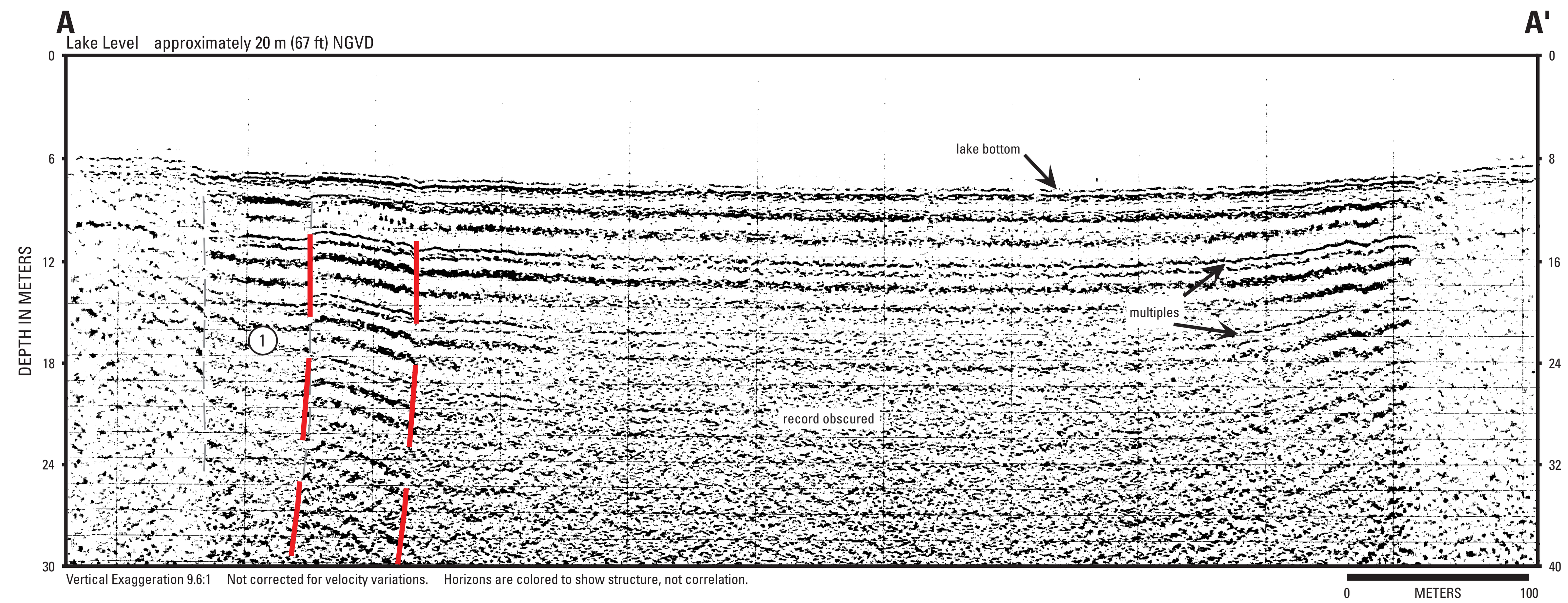
Lake Wauberg is located south of Paynes Prairie in central Alachua County. The lake is in the Ocala Uplift District, situated between the forested highlands of the Fairfield Hills area and the surrounding dissolution valleys of the Alachua Prairies. Lake Wauberg is irregular in shape, covering 1.6 sq km with about 5 km of shoreline. The lake is adjoined to the east by Sawgrass Pond. A marshy area to the northwest is separated from the lake by a topographic high.

### Subsurface Characterization

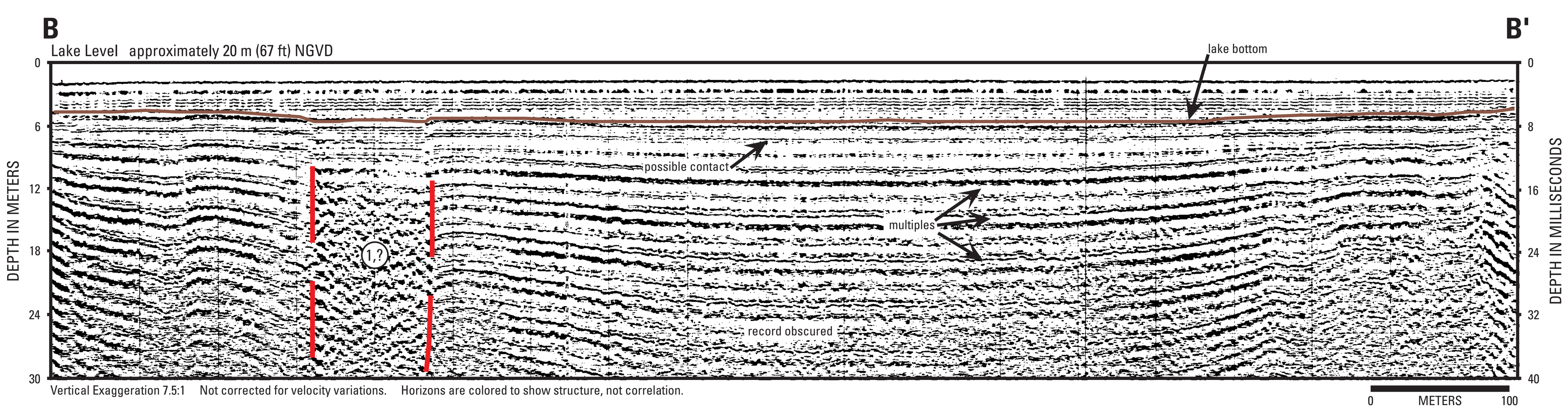
The seismic reflection record acquired from Lake Wauberg is predominantly obscured by strong multiples. In Figure A-A' the multiples appear to be originating from the lake bottom. It is also possible that the multiples may be originating from a hard surface very near the lake bottom as is apparent in Figure B-B'. Typically, strong surface multiples are the result of tightly packed sands or a hard surface near the lake bottom.

A seismic refraction study, completed in the Lake Wauberg area (Wiener, 1982), resulted in a velocity analysis of the sediments and a structural contour map of the top of the Ocala Limestone. A depression in the Ocala surface was identified beneath Lake Wauberg with a minimum elevation of -4.6 m (-15 ft) NGVD. The elevation increased to 22.9 m (75 ft) NGVD below the topographic ridges, with a maximum depth to the Ocala beneath Lake Wauberg of about 82 ft. The elevation contours are further supported by well data in the vicinity of the lake.

Wiener (1982) suggested that the Hawthorn sediments were deposited into the existing depression within the Ocala Limestone and was further thickened as subsidence caused by dissolution of the underlying Ocala Limestone occurred. Subsidence may affect the seismic character of the sediments by disrupting bedding. The seismic record from this site produced very few interpretable features. This is unusual since at lakes where the formation was caused by a central collapse or subsidence there is usually sufficient detail around the perimeter to provide some clues to the underlying structure. It appears that the edges of the subsidence zone extend beyond the surface expression of the lake and cannot be identified by marine seismic methods.




Vertical Exaggeration 9.6:1 Not corrected for velocity variations. Horizons are colored to show structure, not correlation.




Vertical Exaggeration 7.5:1 Not corrected for velocity variations. Horizons are colored to show structure, not correlation.

**Subsurface Characterizations of Selected Water Bodies in the St. Johns River Water Management District, Northeast Florida**

Jack L. Kindinger[1], Jeffrey B. Davis[2], and James G. Flocks[1]
2000

[1] Center for Coastal Geology and Regional Marine Studies
U.S. Geological Survey
St.. Petersburg, Florida 33701

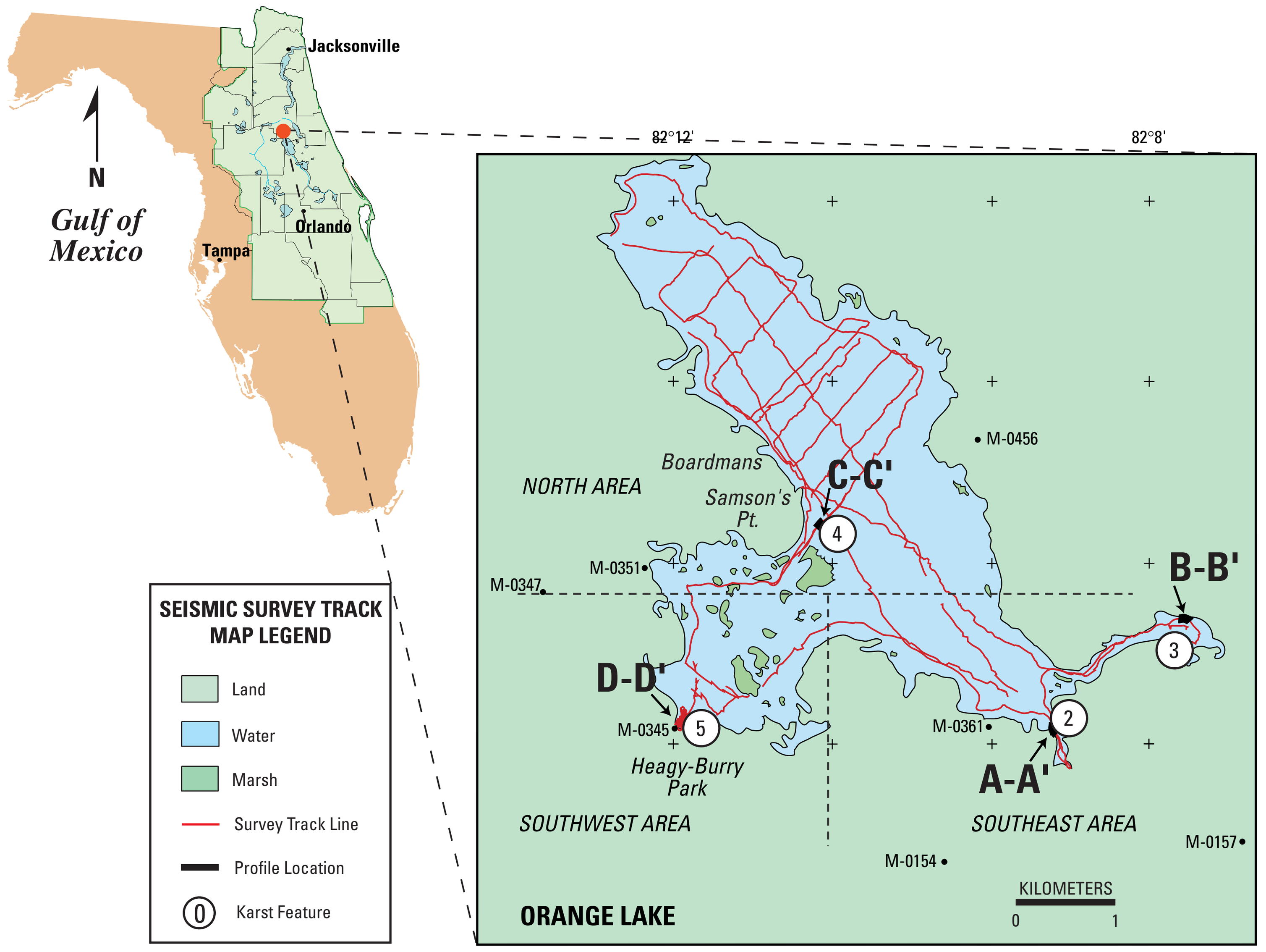
[2] St. Johns River Water Management District
Palatka, Florida 32178



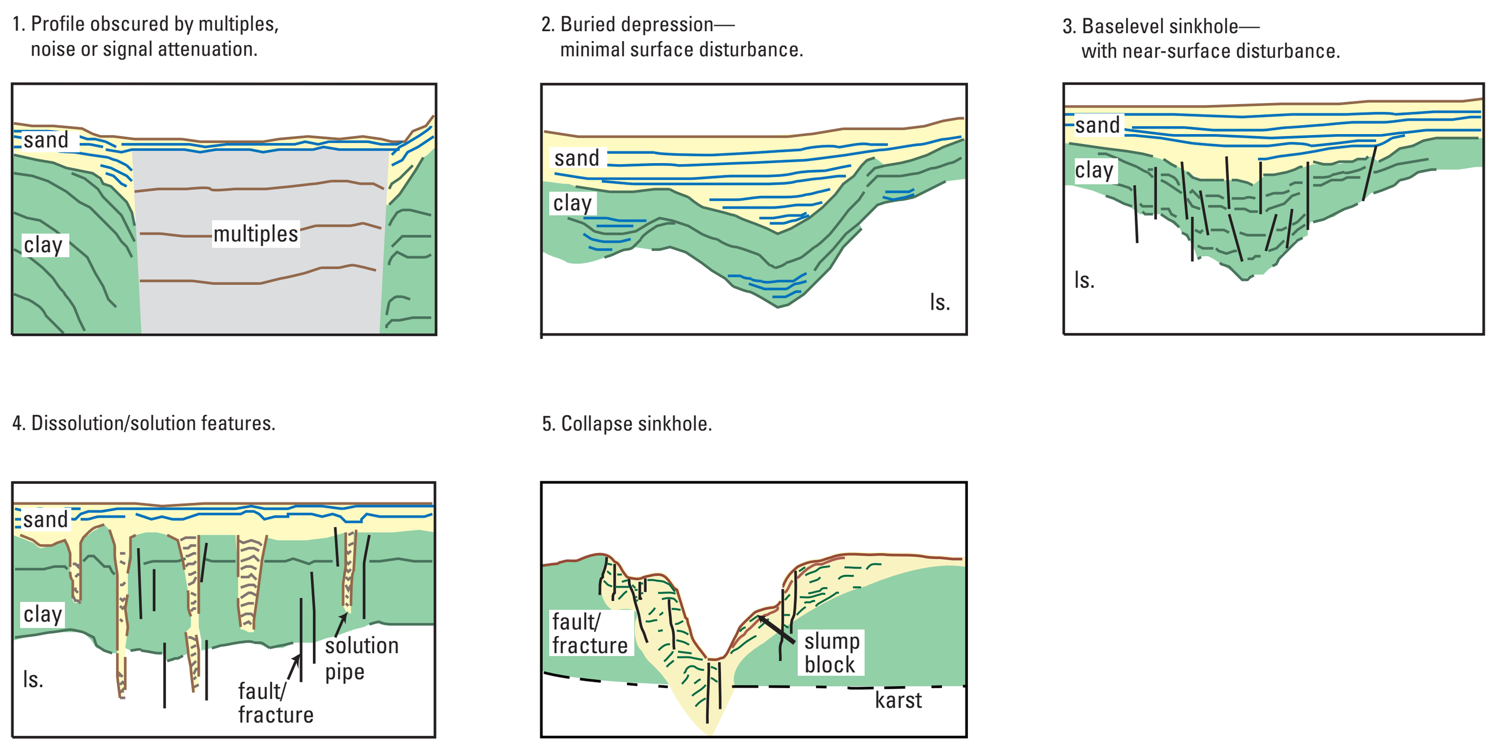
This sheet is Section B page 16 of Open-File Report #00-180 prepared by the U.S. Geological Survey Center for Coastal Geology and the St. Johns River Water Management District. For a detailed description of methods, site locations, explanation of regional geology, physiography, karst development and karst features identified by seismic profiling, refer to pages 1 through 7.

B

# ORANGE LAKE
## ALACHUA COUNTY, FLORIDA




EXPLANATION




### Introduction

Orange Lake is located in Alachua County, north-central Florida. The lake occupies the physiographic division known as the Alachua Prairies (Brooks and Merritt, 1981). Advanced karst development in the subsurface created solution valleys that are characterized by flat-floored depressions with numerous dissolution features. A geologic term for these environments is polje. These broad, drowned prairies occupy the epiphreatic zone and are strongly influenced by fluctuations in the water table. An extreme example is Paynes Prairie to the north which commonly fluctuates from grassland to marsh to completely inundated and was at one time known as Alachua Lake.

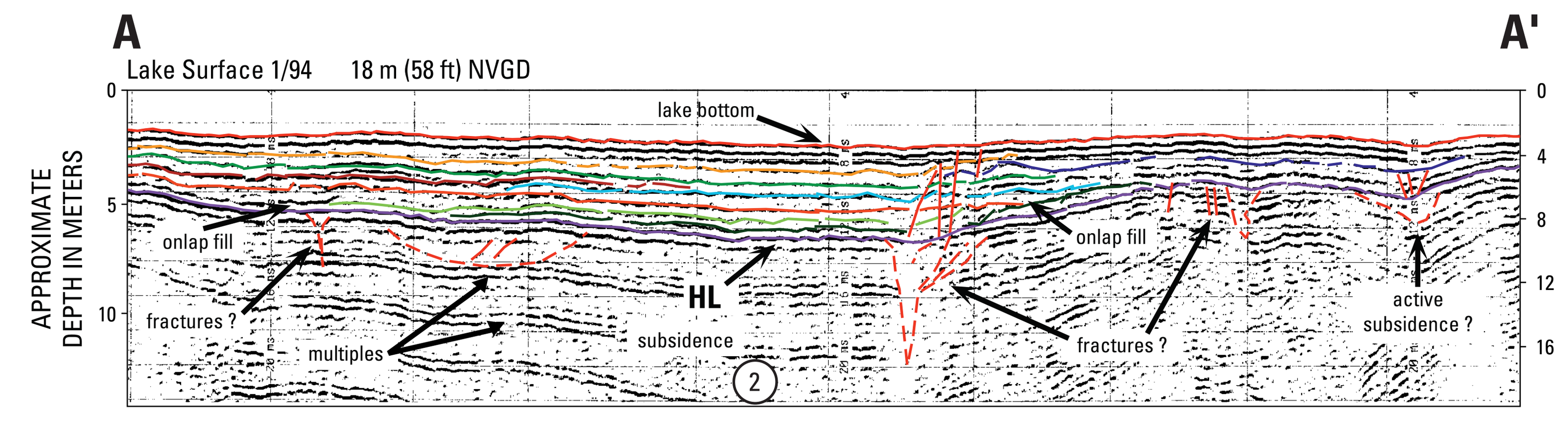
Orange Lake is a relatively shallow, irregularly shaped lake with approximately 44 km (144 ft) of shoreline covering 30 km$^2$, with much of the shore grading into freshwater marsh. The surficial sediments of the lake bottom are organic and/or organics mixed with sand and clay, transported into the lake by storm runoff and streams (Rowland, 1957).

The west side of the lake is flanked by the Fairfield Hills, a Pleistocene sand ridge which may supply some of the sediments to the lake bottom. The ridge overlies the less permeable, Miocene sediments of the Hawthorn Group. In the southwestern corner of the lake, the shallow bottom gives way to a cluster of dolines (sinkhole complex) that penetrate the semi-confining layer into the karst limestone beneath. Pirkle and Brooks (1959a) suggest that the sands and clays of the Hawthorn Group are typically impermeable. When the water table drops, under sufficient hydrostatic pressure from the surface water, this material will fail and be flushed into solution channels in the limestone. Once the outlets are opened, the lake water will adjust to the level of the water table in the limestone unless the sinks again become plugged.

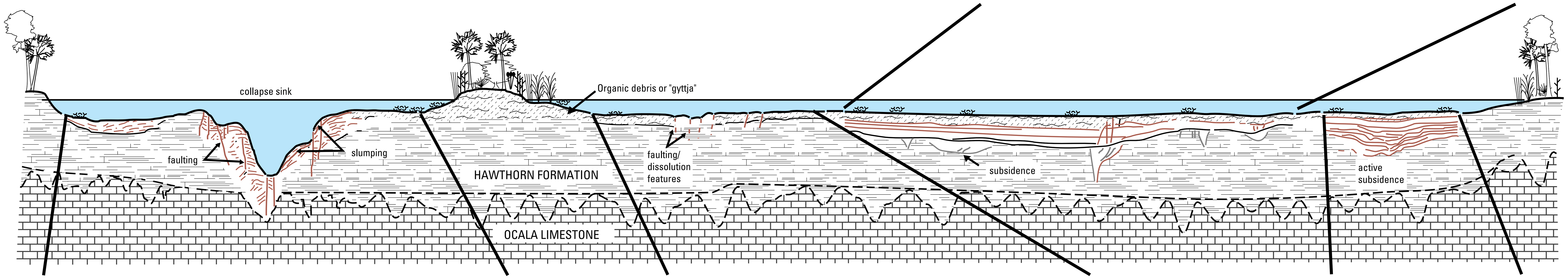
### Subsurface Characterization

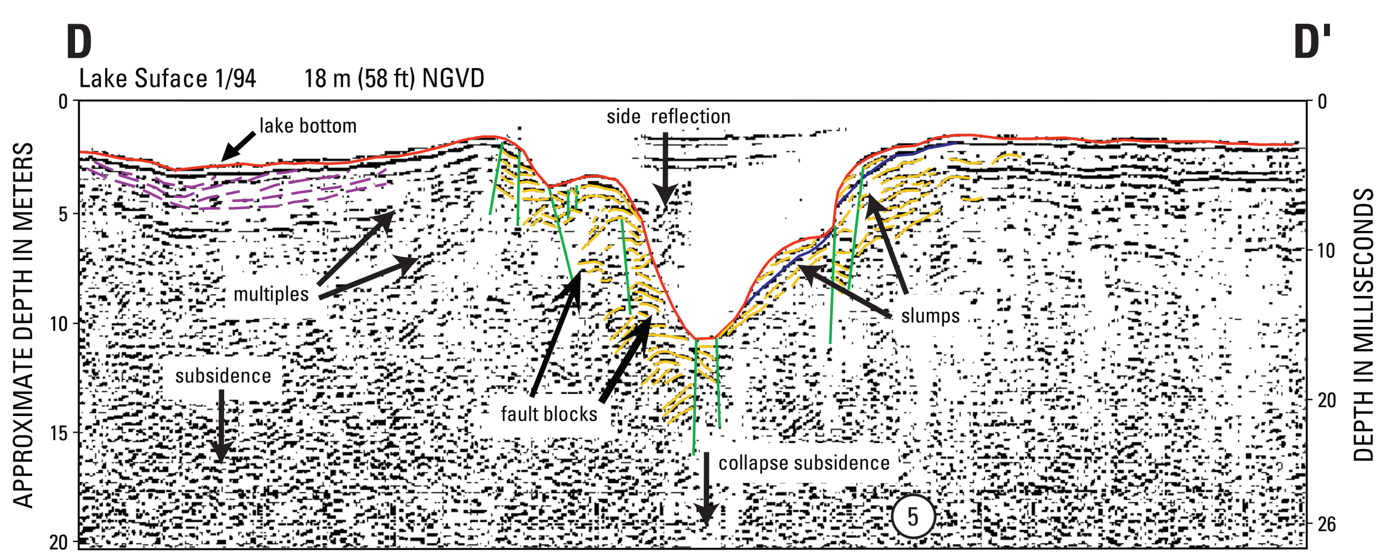
The geologic structure of Orange Lake in general is a semi-confining unit overlying limestone karst. The Plio-Pleistocene surficial sediments include sands and clays that range in thickness from ~1 m (~3 ft), over most of the area, to about 20 m (67 ft) in the Fairfield Hills. These sediments are underlain by clays, sandy clays and carbonates of the Miocene Hawthorn Group. Natural gamma logs from boreholes adjacent to Orange Lake indicate that the clays range in thickness from about 5 m south and southwest of the lake, to more than 25 m (82 ft) on the east side. Horizon HL in profile A-A' below may represent the top of the Hawthorn Group. The Ocala Limestone carbonates are the oldest units exposed in this area and can be seen in roadcuts and numerous quarries. The contact between units exhibits highly irregular surfaces typical of karst. The top of the Ocala Limestone range from about 6 m to > -6 m (20 to > -20 ft) NGVD, with an overall trend dipping to the northeast. Dissolution of the carbonate is active and can be seen at the Heagy-Burry Park. For years, dirt fill has been periodically brought to an actively subsiding sinkhole on the east side of the park's boat ramp and is representative of cover subsidence sinks in Orange Lake. Land-based ground penetrating radar profiles from the park adjacent to the collapse sinkhole indicate numerous buried sinkholes and cavities (Davis, 1996).

Additional work regarding Orange Lake not included in this summary can be found in Kindinger and others (1994, 1998).

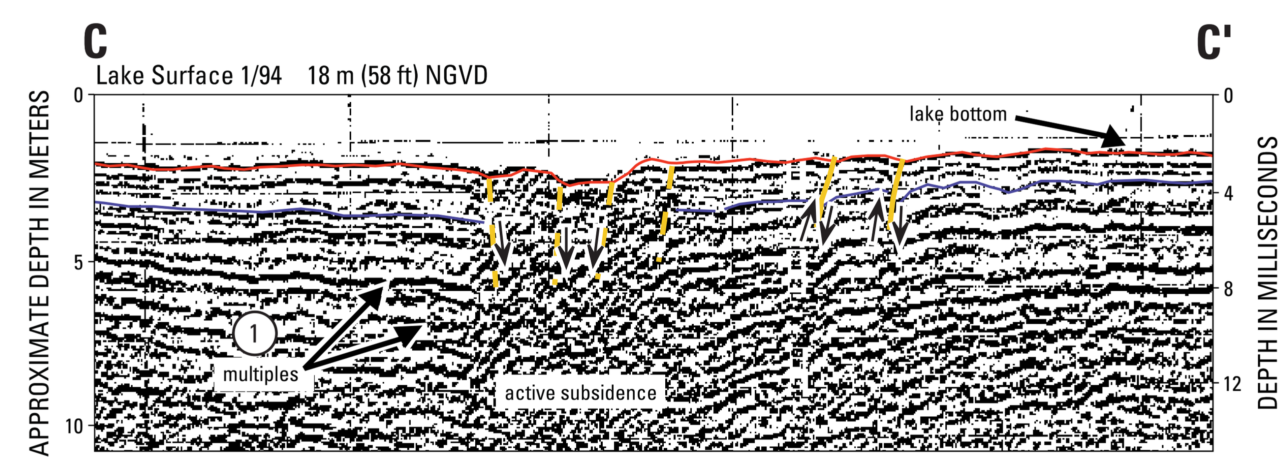



Vertical Exaggeration 5:1 Not corrected for velocity variations.
Horizons are colored to show structure, not correlation.

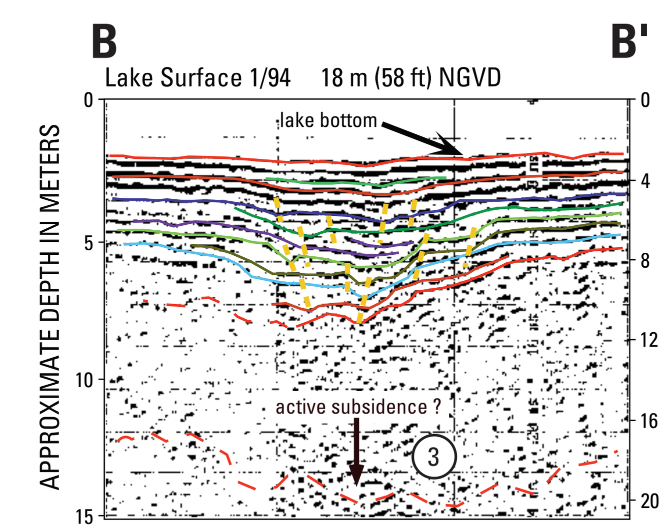



Vertical Exaggeration 3:1 Not corrected for velocity variations.
Horizons are colored to show structure, not correlation.



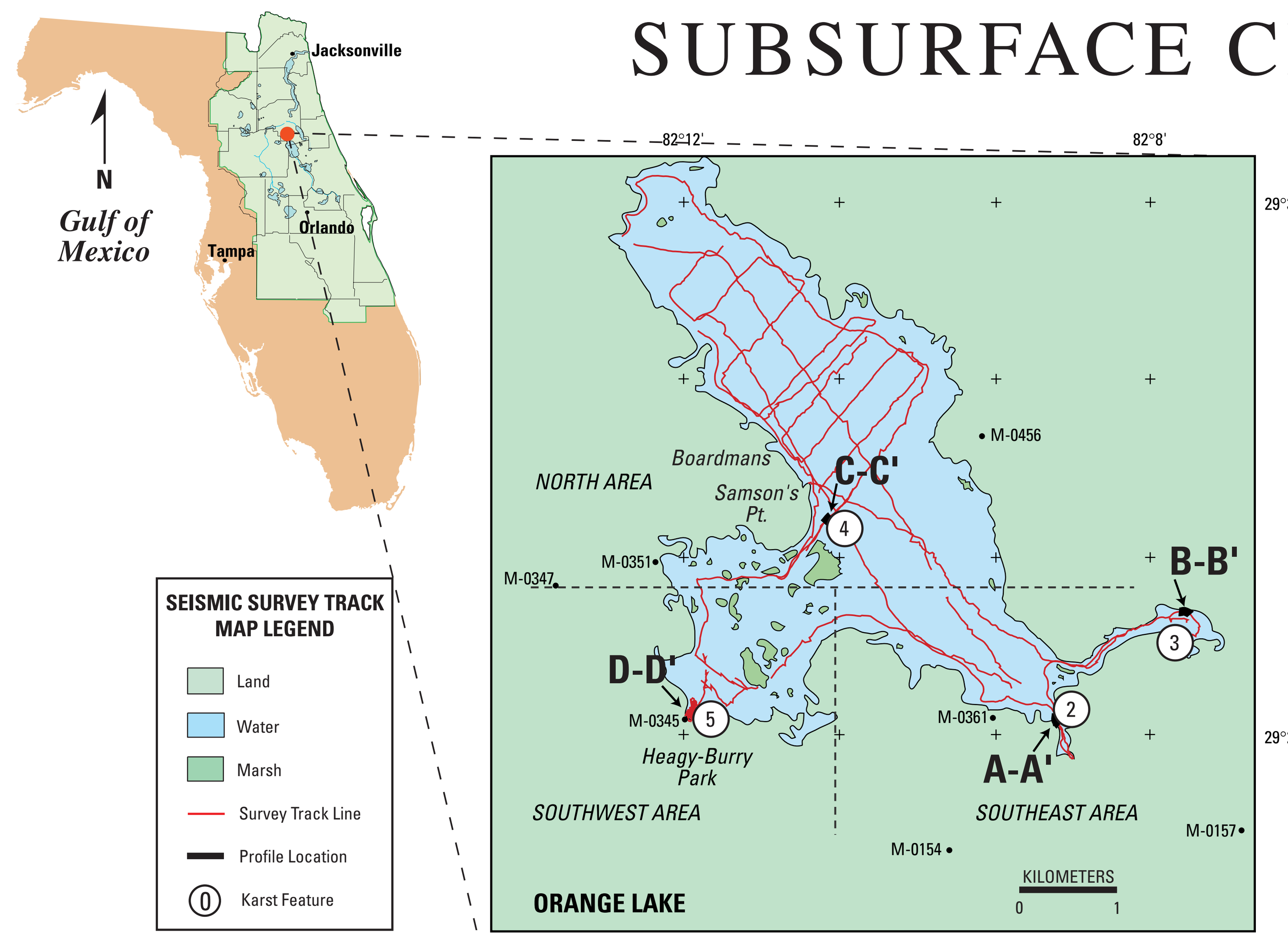

Vertical Exaggeration 5:1 Not corrected for velocity variations.
Horizons are colored to show structure, not correlation.



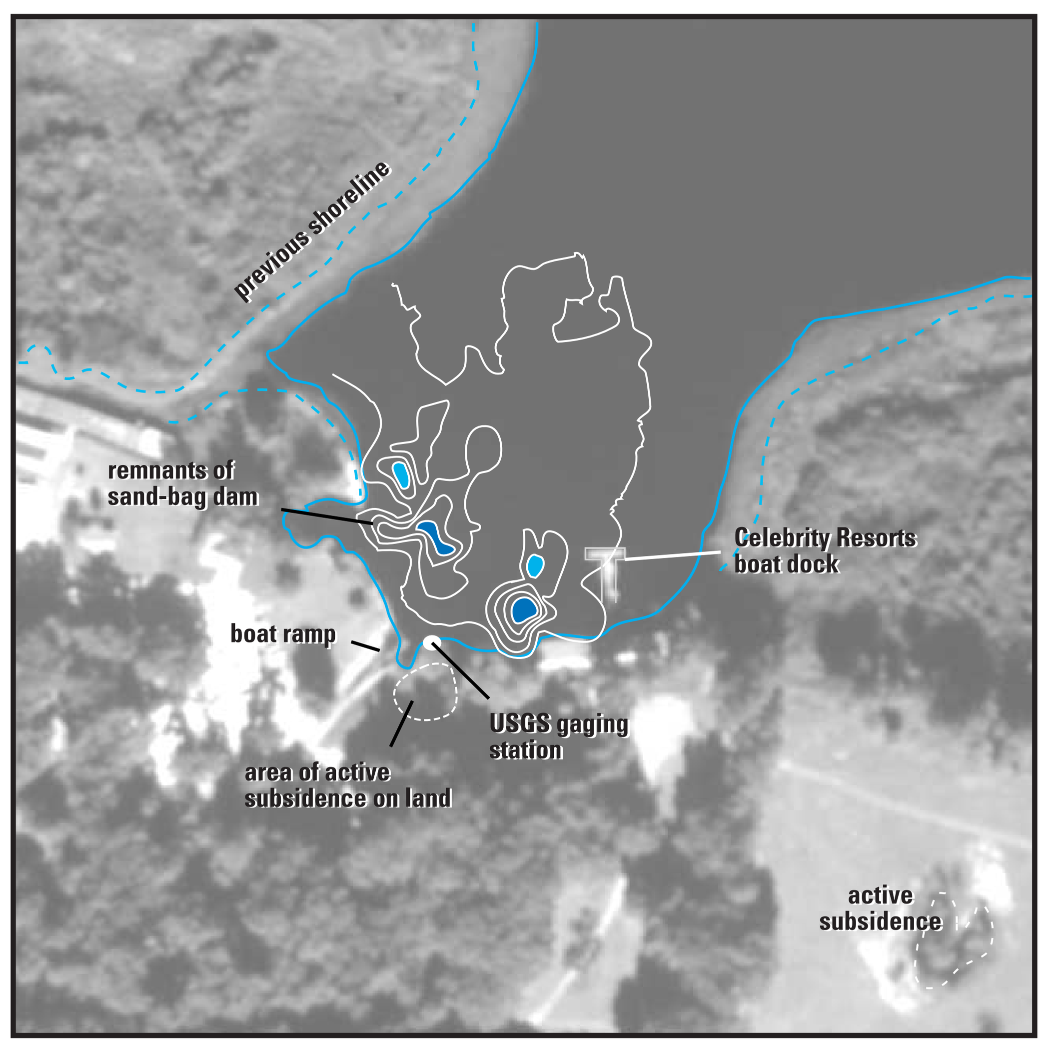

Vertical exaggeration 6:1.
Not corrected for velocity variations.
Horizons are colored to show structure, not correlations.

# SUBSURFACE CHARACTERIZATION OF ORANGE LAKE

## ALACHUA COUNTY, FLORIDA




Aerial photograph and contour overlay of the sinkhole complex in Orange Lake.




In the following discussion Orange Lake is divided into three areas (see index map at left) based on distinct geomorphic features identified from HRSP profiles. The primary karst features found within the lake are in various stages of maturity and include cover subsidence, cover collapse and buried sinkholes.

### Southeast Area

The southeastern area of Orange Lake has a water depth of 1 to 3 m (3 to 9.8 ft). The primary karst features within this area are cover subsidence sinkholes and associated fissures (A-A', B-B', previous page). These features have type 2 and 3 characteristics (features legend, previous page), where the overburden has subsided to accommodate loss due to solution in the underlying limestone. Less common karst features have also been identified, such as buried sinkholes, faults and dissolution pipes.

The large subsidence along the southern shore measured approximately 400 m (1312 ft) in diameter (A-A'). The surface expression is apparent on the lake bottom as a slight subsidence. Horizon HL (A-A', type 2, HL) forms a depression filled by onlapping cover sediments. Several high-angle faults are present, with little vertical displacement. These features may also represent dissolution pipes. Leakage of lake waters to the aquifer in these and similar areas is controlled by the permeability of the cover sediments or proximity of the faults to the lake floor. Of the features identified in the southeast area, very few appear to breach the lake bottom.

A small number of depressions found in the southeastern area may be linked to more active sinkhole development (B-B', type 3). The type 3 feature is smaller than the type 2 (~ 50m, 164 ft). The pattern of disturbed horizons implies active subsidence with intervening periods of deposition. As the sinkhole subsides, it is subsequently filled by sediment, seen as onlapping reflections within the depressions, followed by differential subsidence. Buried by <1 m (3.3 ft) of sediment, this sinkhole is an example of the composite mature subsidence sinkhole. A proposed model for subsidence sinkhole development is outlined in the figure below (B-B' this page).

### North Area

The north and central areas of Orange Lake are geologically similar and will be combined and discussed as one area. The lake bottom and subsurface are relatively flat and intact with small subsidence features throughout. The unconsolidated surficial sediment is a sandy clay that, along with the shallow water depth, produces strong multiple reflections that mask much of the geologic data (type 1 feature, profile C-C' previous page). The vertical features in the cross section may indicate the early stages of a subsidence sinkhole, with the central area actively subsiding and/or collapsing. The high angle reflectors throughout the profile may represent stress fractures created by slumping as the overburden accommodates dissolution at depth. The features may also represent dissolution pipes through the overburden, indicating a breach in the confining layer.

Features in the northern portion of the lake are generally small (1 to 10 m across, 3 to 33 ft) and tend to be isolated. Distribution and size of features in this area are different than the features in the southeast that tend to cluster together to form larger (>100 m, 328 ft) structures. Surface features and shallow horizons (< 2 m, 66 ft) were seen in the HRSP data that indicated a number of subsidence sinkholes in this area (type 3) and type 4 karst features that have clustered to form disturbed areas in the subsurface, up to 40 m (131 ft) across. Most of the area between Samsons Point and Boardman show some form of subsidence.

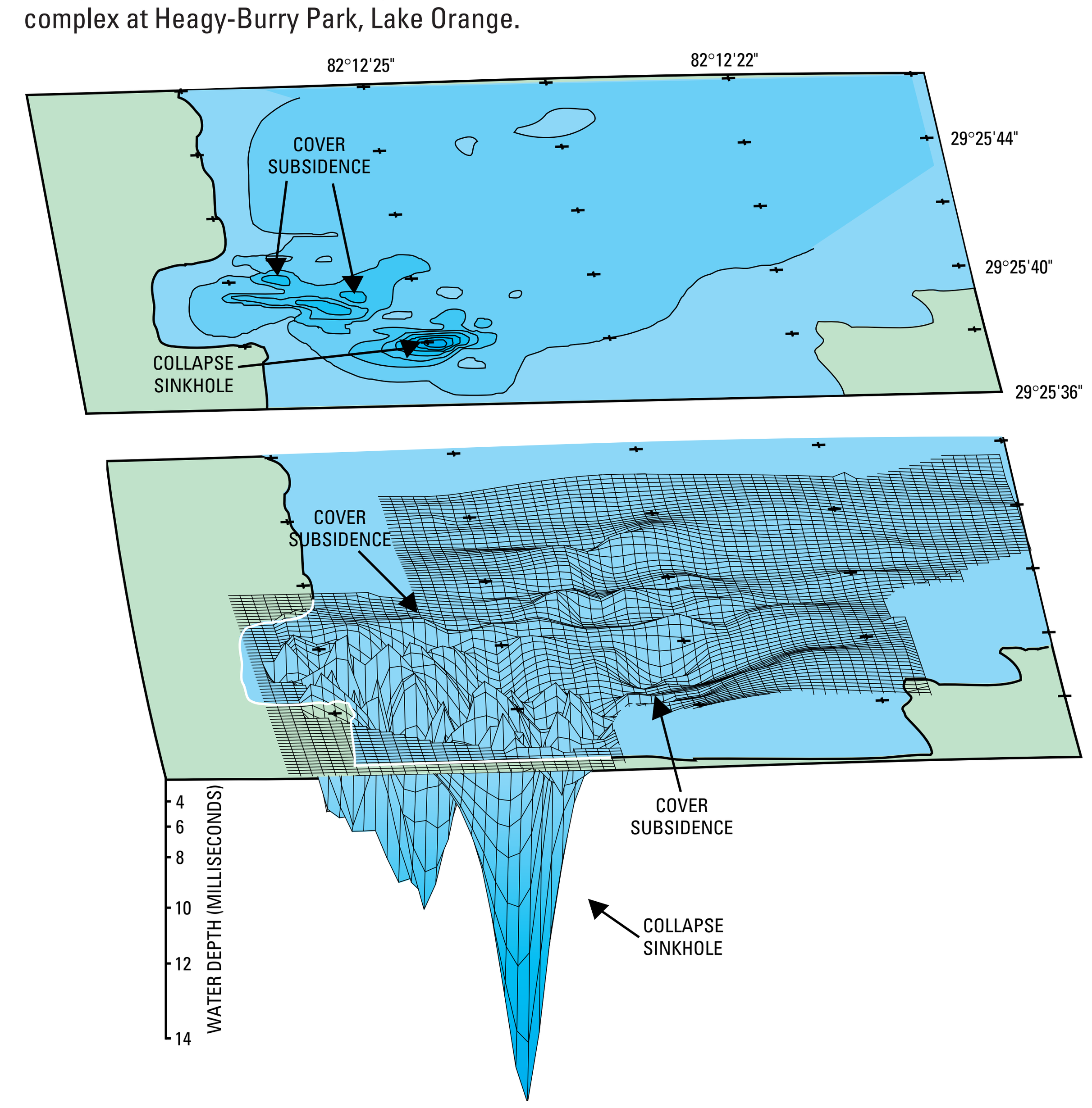
### Southwest Area

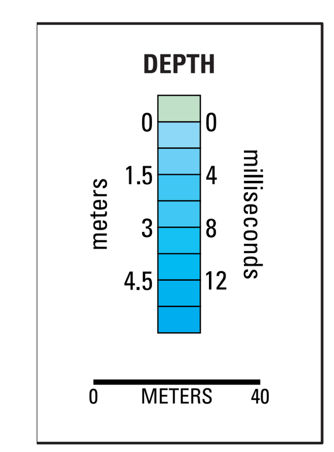
The southwest area consists of a broad flat bottom with a bathymetry very similar to that in the southeast and north areas, except for the collapse sinkhole (type 5 feature, profile D-D', previous page) near the southwestern shore. The sinkhole has completely breached the confining unit. It is possible that other features are present but access was limited by aquatic weeds and the southwest area could not be completely surveyed.

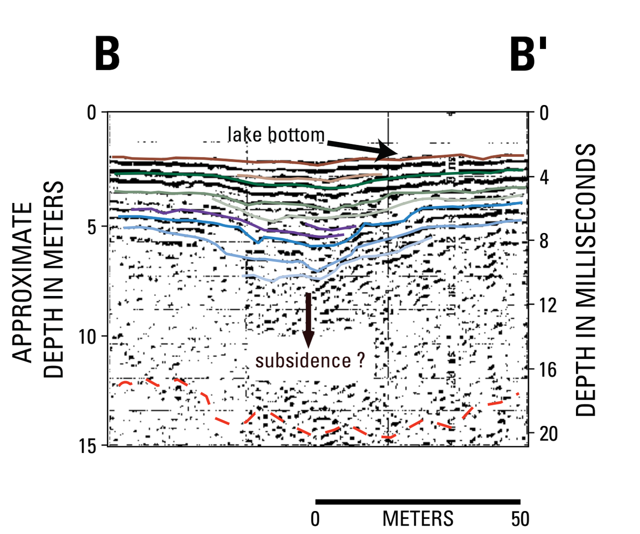
The clustered collapse sinkholes are near the southwestern shoreline adjacent to Heagy-Burry Park and boat ramp. Observations by scuba divers indicate that there is a downward flow of water from the lake into one of the sinks (Spechler and Wilson, 1992). Reports by Pirkle and Brooks (1959b) and Spechler and Wilson (1992) indicate a direct hydraulic connection with the aquifer. During the 1956 drought, water from Orange Lake could be seen draining into the collapse sinkhole of Heagy-Burry Park. Profile D-D' shows the steep slope and fault blocks of the sinkhole. The mass movement of limestone blocks would open pathways for water to migrate along the fractures. Sediment slumping along the steep flanks of the sinkhole also are visible and are part of the natural process that plugs the doline. Adjacent to the collapse are evidence of adjacent cover subsidence sinkholes that ultimately may coalesce in the sinkhole complex.

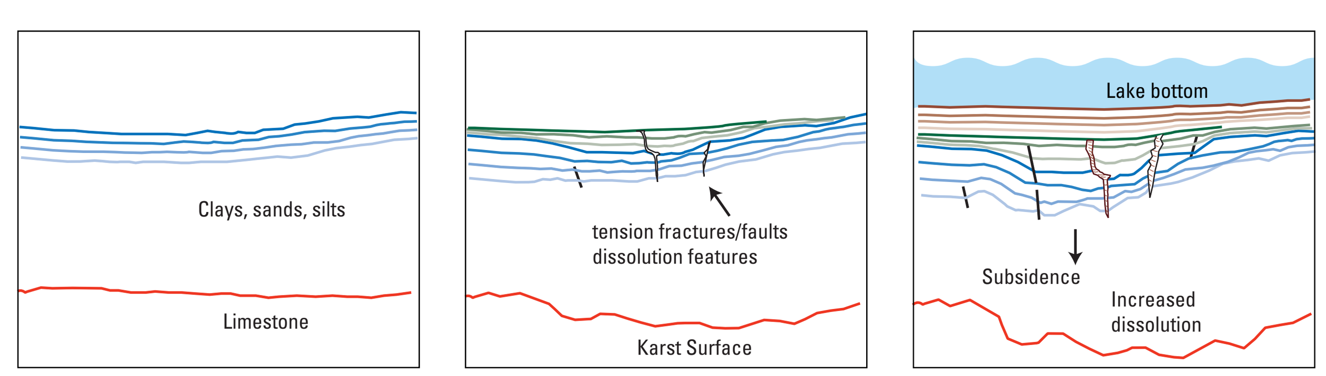
A three-dimensional bathymetric grid of the clustered sinkholes near Heagy-Burry Park is shown below. The grid model was constructed using the two-way travel time for the lake-bottom reflection (HRSP). Two collapse sinkholes and two adjacent subsidence features are evident from this model. It is not clear if the features are remnants from the sinkhole that was observed in 1956 or are sinks that have formed since. Past reports (Rowland 1957, Jessen 1972) indicate that a single hole approximately 63 m (20 ft) in diameter was exposed. A temporary sandbag and earthen dam emplaced around the hole subsequently collapsed into the hole. Large quantity of fill, a storage tank, and junked vehicles were also placed into the hole. Remnants of the dam, and hence the most northern boundary of the 1956 sink, can presently be seen about 10 m offshore from the park. The figure to the left shows the contours of the sinkhole superimposed on an enlarged aerial photograph of the Heagy-Burry Park area. The photo and overlay show the extent of the collapse and subsidence features, including a sinkhole on land in the southeastern portion of the photograph. An area east of the boat ramp is continually subsiding and fill material is periodically emplaced in the depression. Though the limits of the sinkhole observed in 1956 are not known, it is clear that this area represents a sinkhole complex that is still quite active and expanding.

Bathymetric contour and mesh plot of the sinkhole complex at Heagy-Burry Park, Lake Orange.




**A.** Model for cover subsidence sinkhole development. Undisturbed, impermeable bedded clays, sands and silts (Hawthorn) overlie Limestone (Ocala).

**B.** Dissolution of limestone creates loss of material in subsurface. Overburden subsides to accomodate loss. Tension faults develop as bedding is disturbed, creating dissolution pathways (pipes) and breaches in impermeable layer. Continued deposition onlaps onto original sediment surface.

**C.** Fluctuations in water table or other factors may slow dissolution rates, subsidence decreases or terminates, continued deposition, perhaps fluvial, fills any surface depression and dissolution pipes.

**Subsurface Characterizations of Selected Water Bodies in the St. Johns River Water Management District, Northeast Florida**

Jack L. Kindinger[1], Jeffrey B. Davis[2], and James G. Flocks[1]
2000

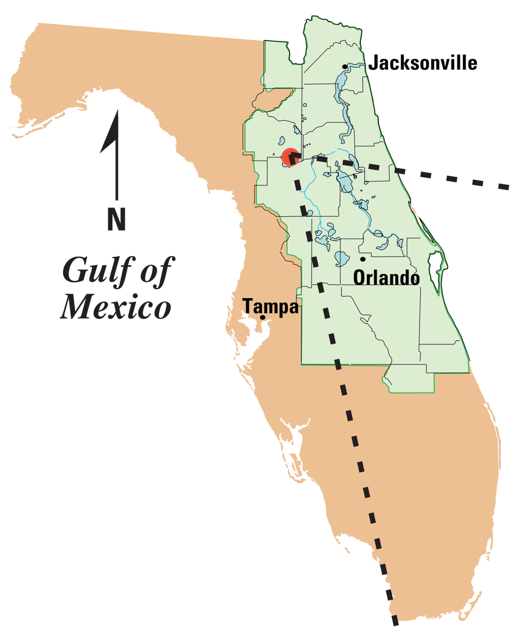
[1] Center for Coastal Geology and Regional Marine Studies
U.S. Geological Survey
St.. Petersburg, Florida 33701

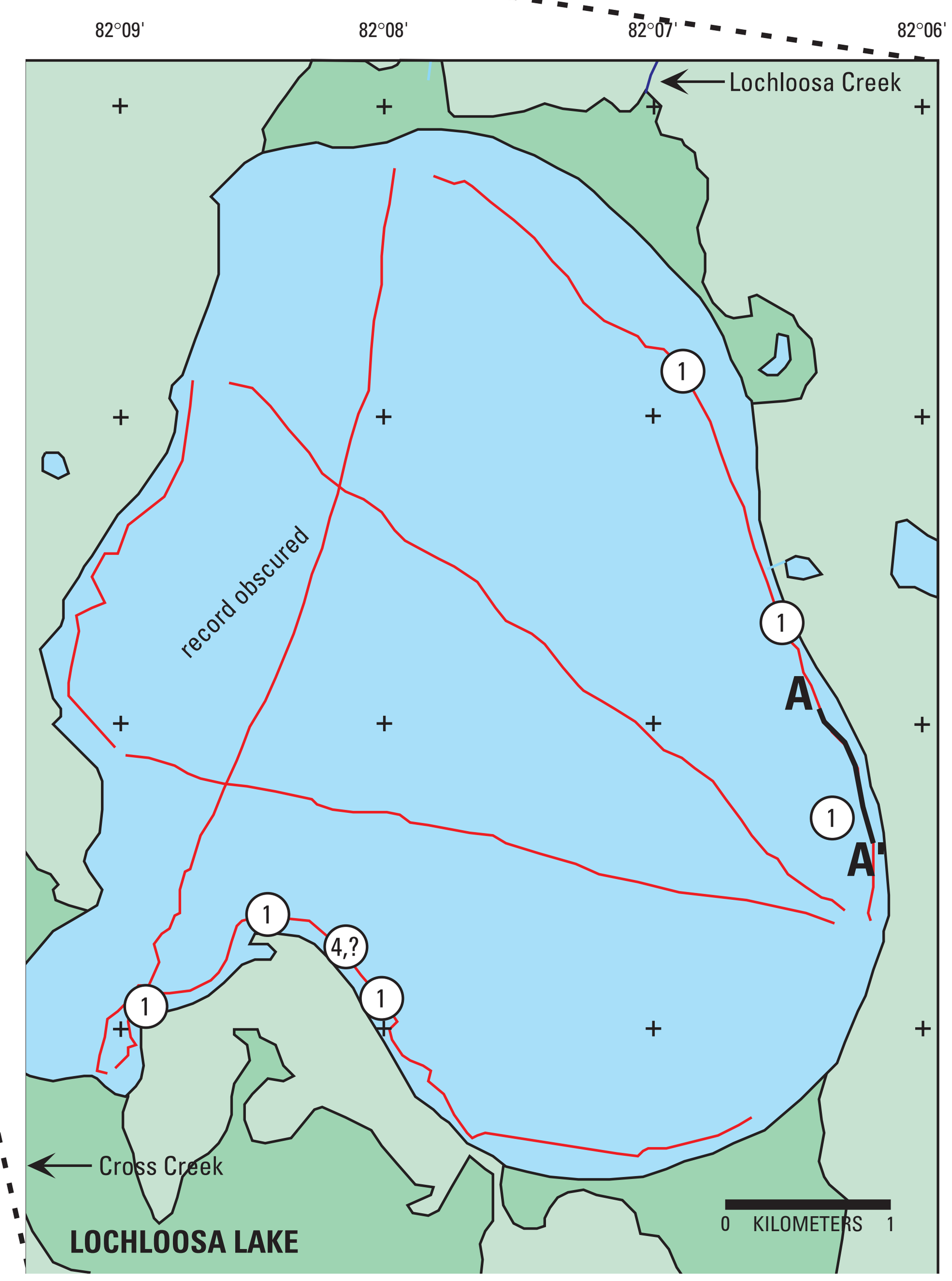
[2] St. Johns River Water Management District
Palatka, Florida 32178

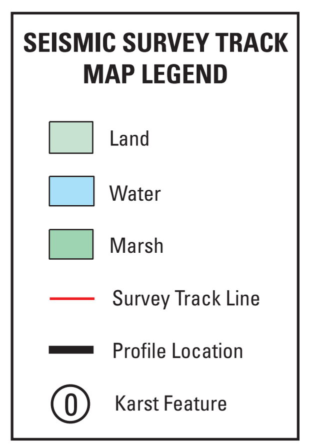


This sheet is Section B page 18 of Open-File Report #00-180 prepared by the U.S. Geological Survey Center for Coastal Geology and the St. Johns River Water Management District. For a detailed description of methods, site locations, explanation of regional geology, physiography, karst development and karst features identified by seismic profiling, refer to pages 1 through 7.

# LOCHLOOSA LAKE
## ALACHUA COUNTY, FLORIDA

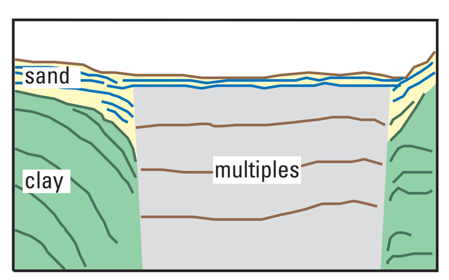


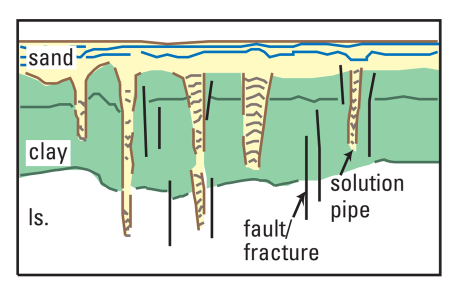




EXPLANATION

1. Profile obscured by multiples, noise or signal attenuation.




4. Dissolution/solution features.

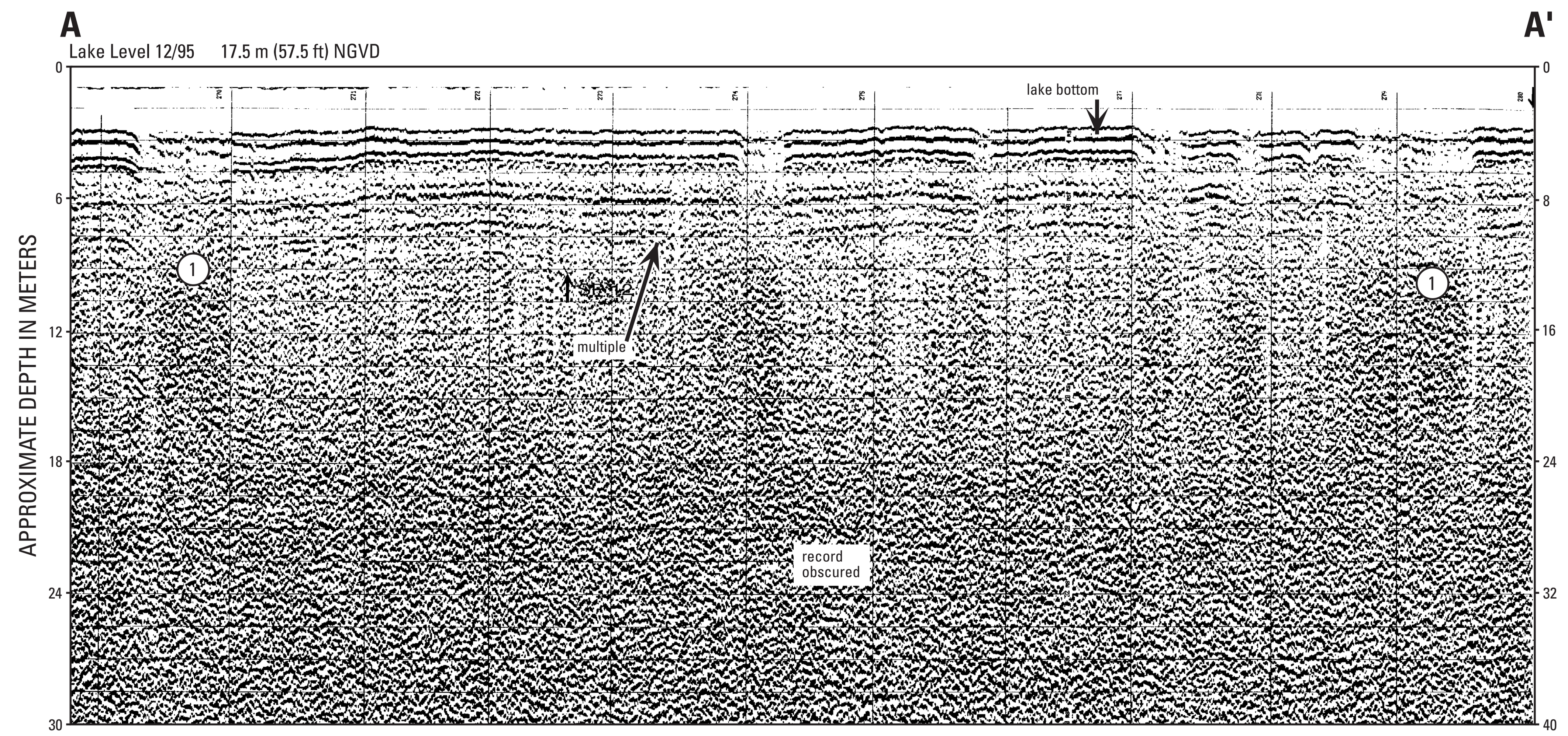



### Introduction

Lochloosa Lake is located in the Alachua Prairies, southern Alachua county. Part of the Ocala Uplift, this area of highly mature karst terrain has been dissolved virtually to the water table (Brooks, 1981), creating loosely connected marshlands and lakes. Lochloosa is connected via Cross Creek to Lake Orange, which ultimately connects via canal to Paynes Prairie to the north. The shoreline is predominantly marshland, with Lochloosa creek to the north and Little Lochloosa and Right Arm Lochloosa Lake to the south and west. Lochloosa Lake is irregular in shape, with a perimeter of 21 km (13 mi) and an area of about 22 sq km. Lake elevation at the time of the seismic survey was 17.5 m (57.5 ft) NGVD.

### Subsurface Characterization

The quality of the seismic profiles obtained from Lochloosa Lake is generally poor. This is primarily due to both a pervasive bottom multiple throughout the lake and abundant acoustic noise in the subsurface. The latter is probably due to the high organic content in the bottom sediments seen in the marsh lakes of this area. Scott (1988) describes the top of the Hawthorn Group (Coosawhatchie Fm.) to be very near the surface in this area (<6 m, 19.7 ft). Although this is not readily apparent in the seismic profiles acquired in Lochloosa, it does correlate with some of the data obtained in neighboring Lake Orange. In some areas of Lochloosa Lake, there does appear to be a reflector visible at about 8 ms (6 m) although it is not readily mappable due to the noise and bottom multiple. The most characteristic feature visible in the seismic profiles from Lochloosa are similar to the type 1 feature shown in the explanation (profile A-A'). This is a typical return in this type of lake and is probably not related to subsurface structure. In several places it is possible that numerous, high angle reflectors may indicate a type 4 feature (see Survey Track map).




Vertical Exaggeration 9:1 Not corrected for velocity variations. Horizons are colored to show structure, not correlation.

**Subsurface Characterizations of Selected Water Bodies in the St. Johns River Water Management District, Northeast Florida**

Jack L. Kindinger[1], Jeffrey B. Davis[2], and James G. Flocks[1]
2000

[1] Center for Coastal Geology and Regional Marine Studies
U.S. Geological Survey
St.. Petersburg, Florida 33701

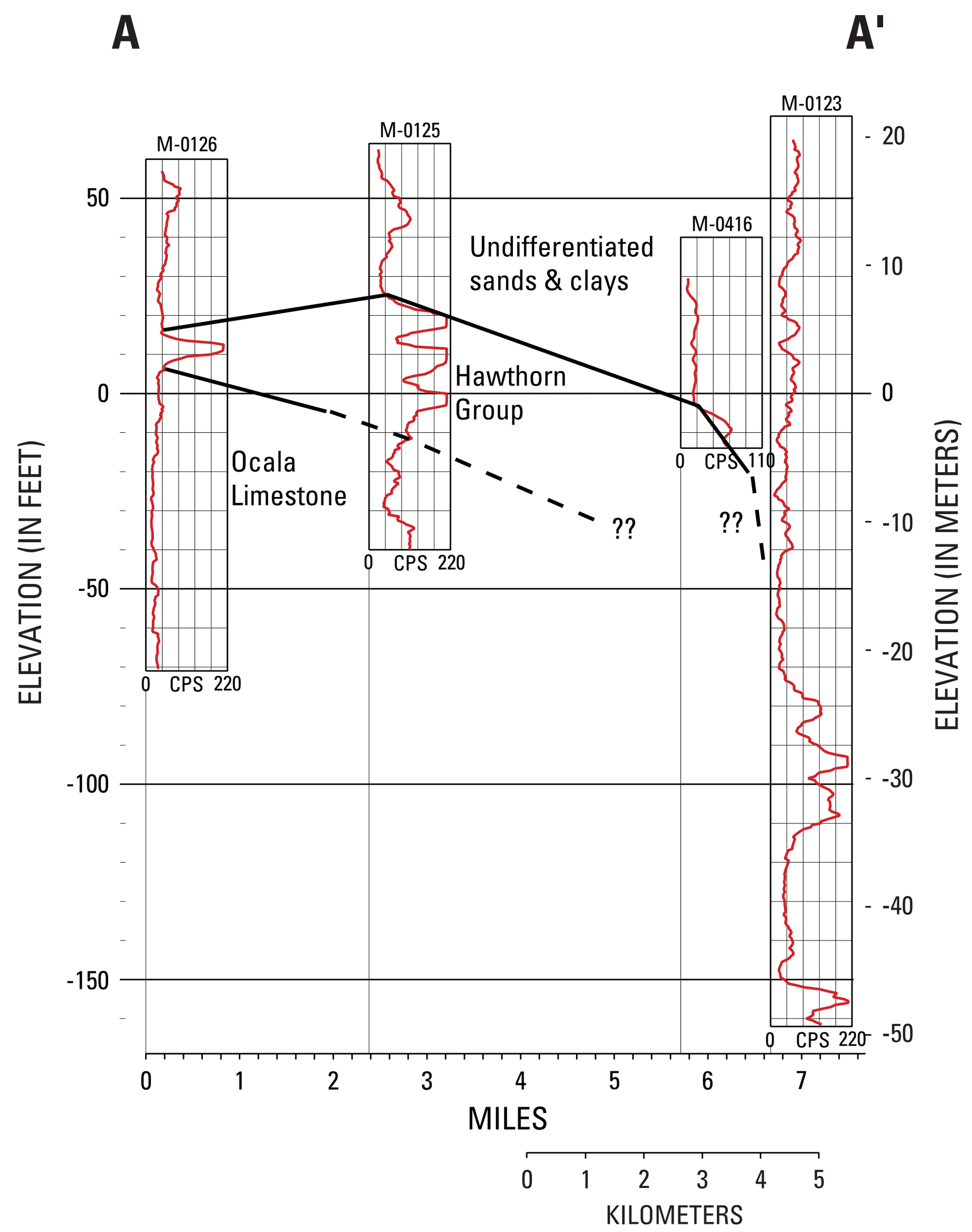
[2] St. Johns River Water Management District
Palatka, Florida 32178

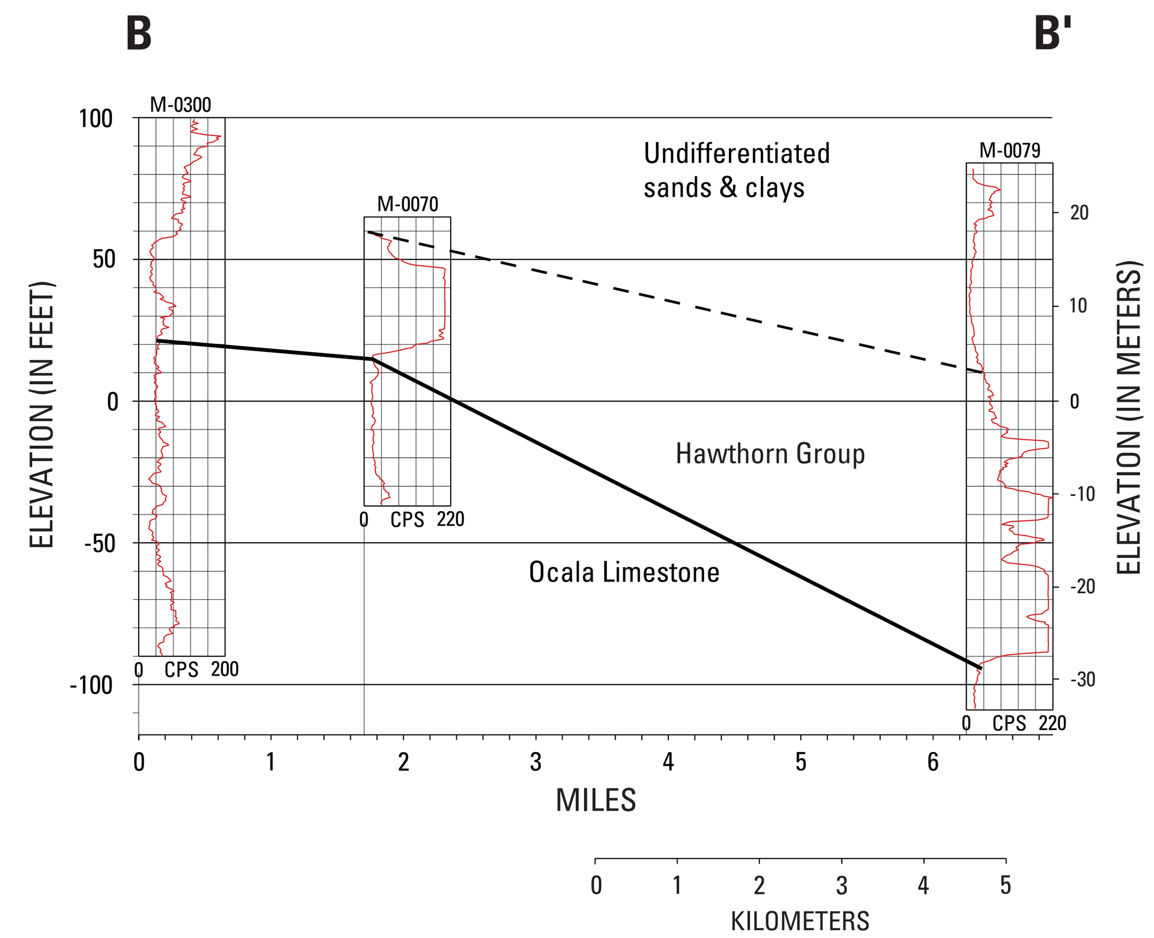


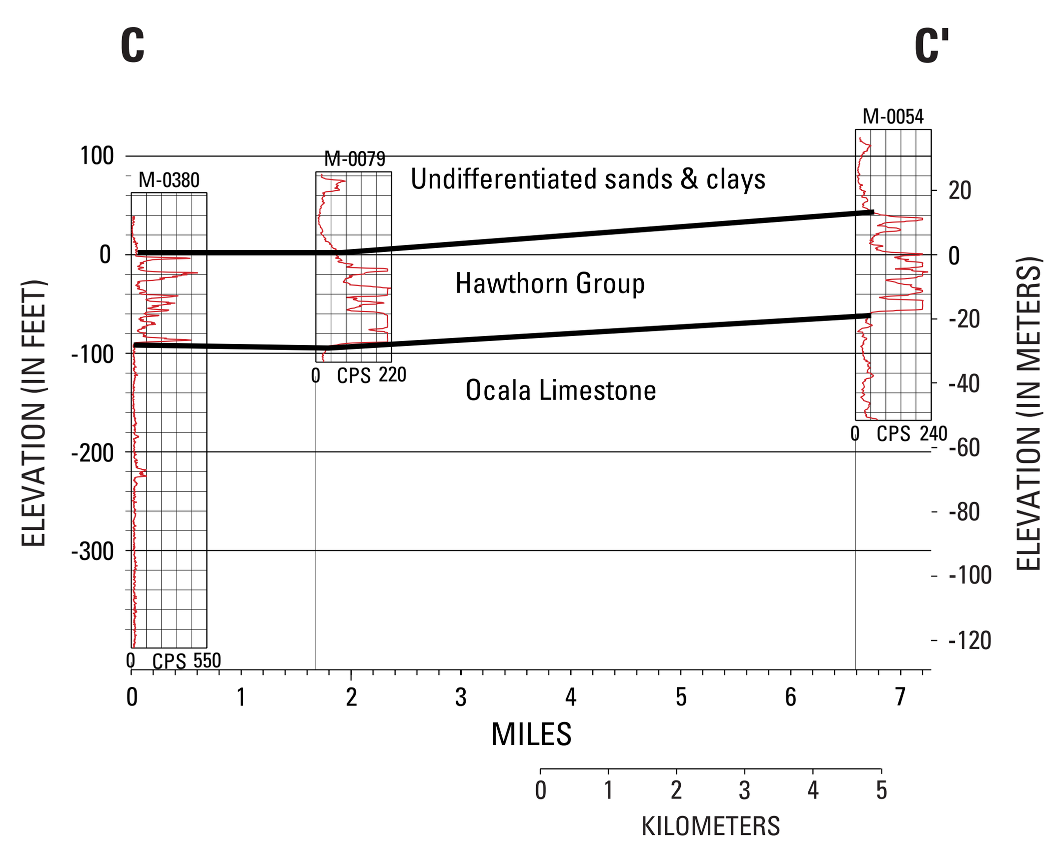
This sheet is Section B page 19 of Open-File Report #00-180 prepared by the U.S. Geological Survey Center for Coastal Geology and the St. Johns River Water Management District. For a detailed description of methods, site locations, explanation of regional geology, physiography, karst development and karst features identified by seismic profiling, refer to pages 1 through 7.

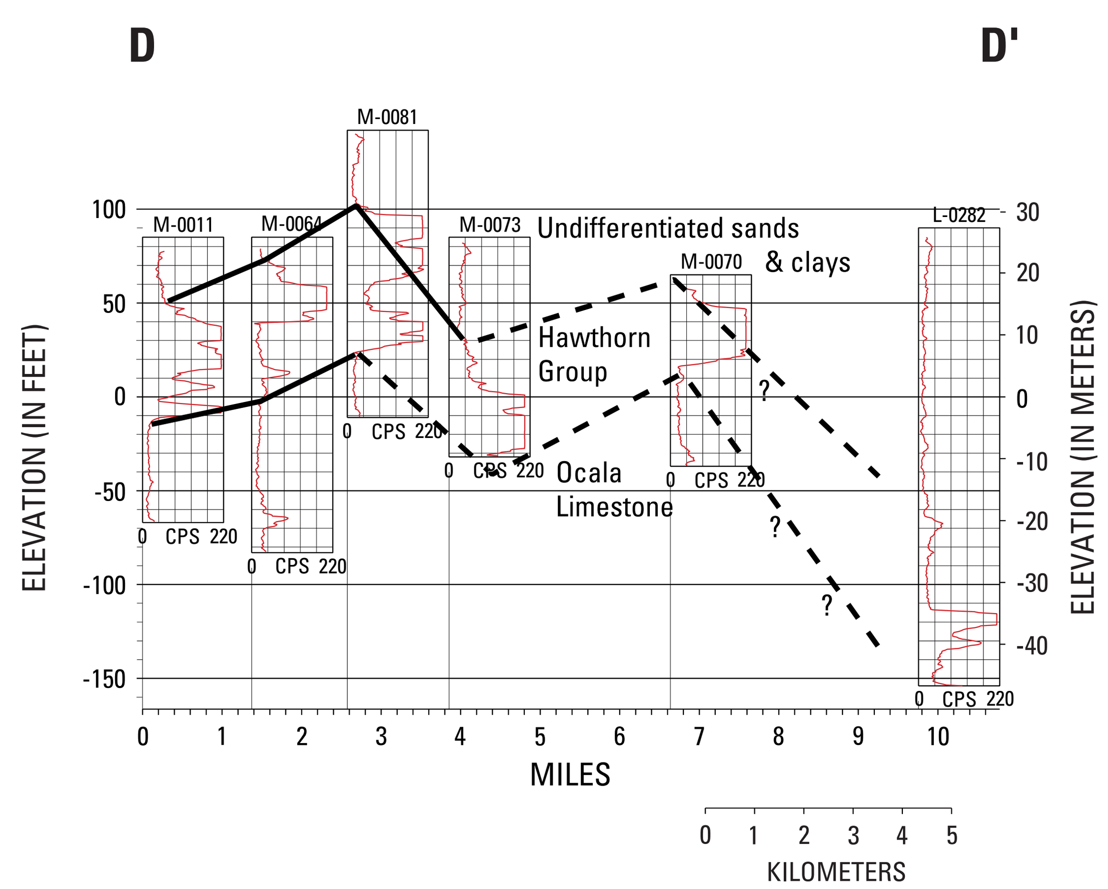
# INDEX MAP AND GAMMA LOG

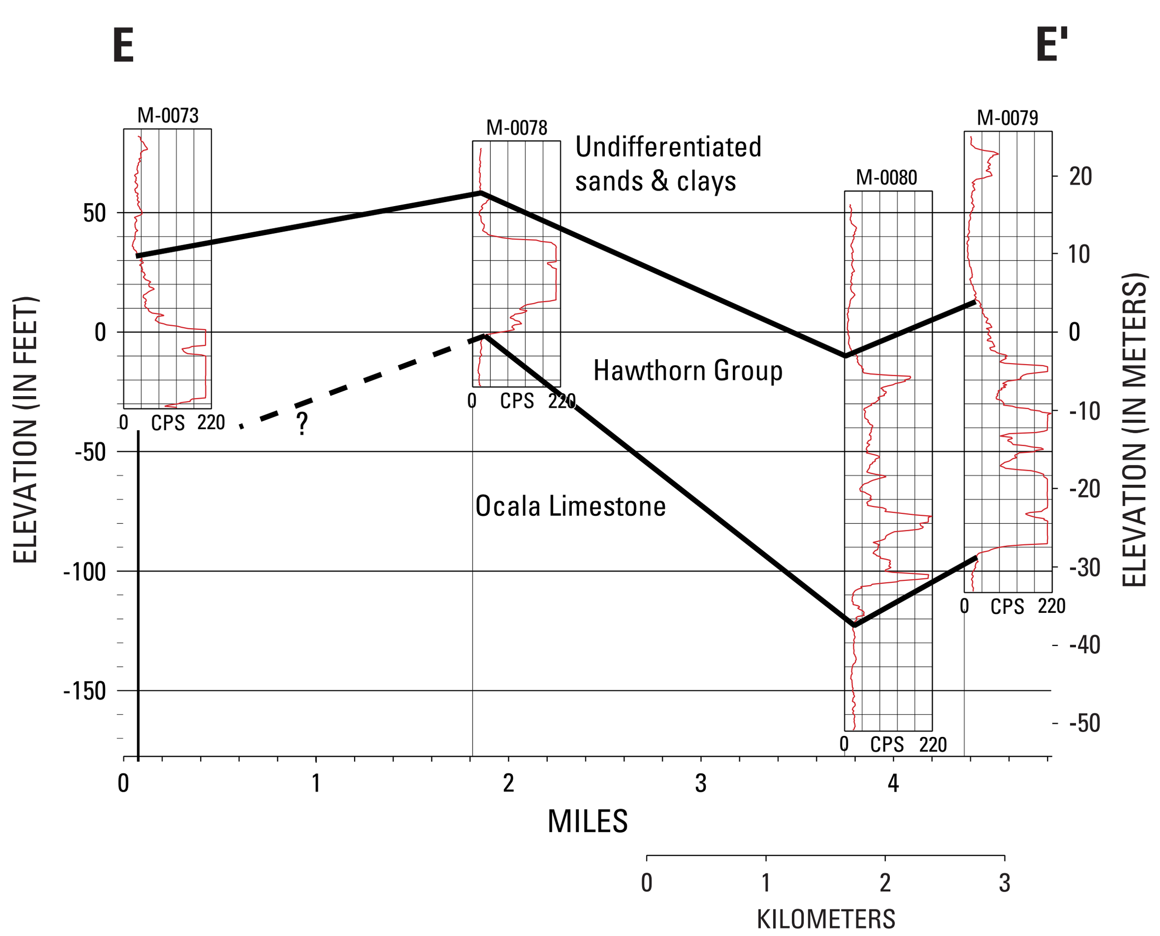
## CROSS-SECTIONS, SECTION C

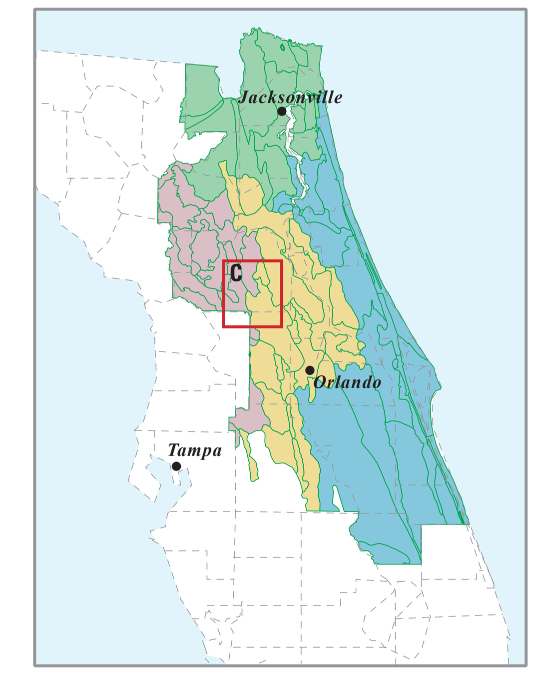


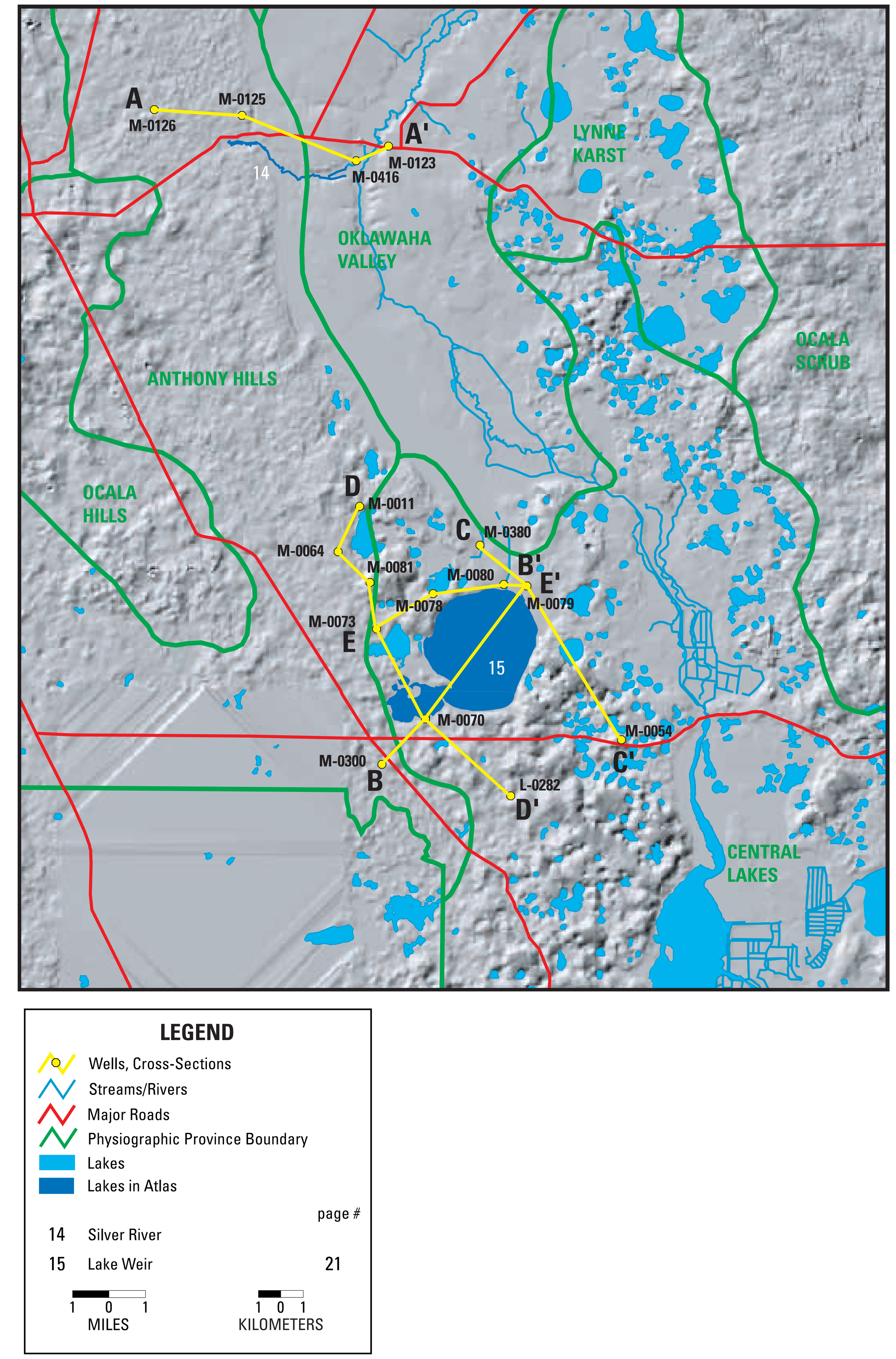



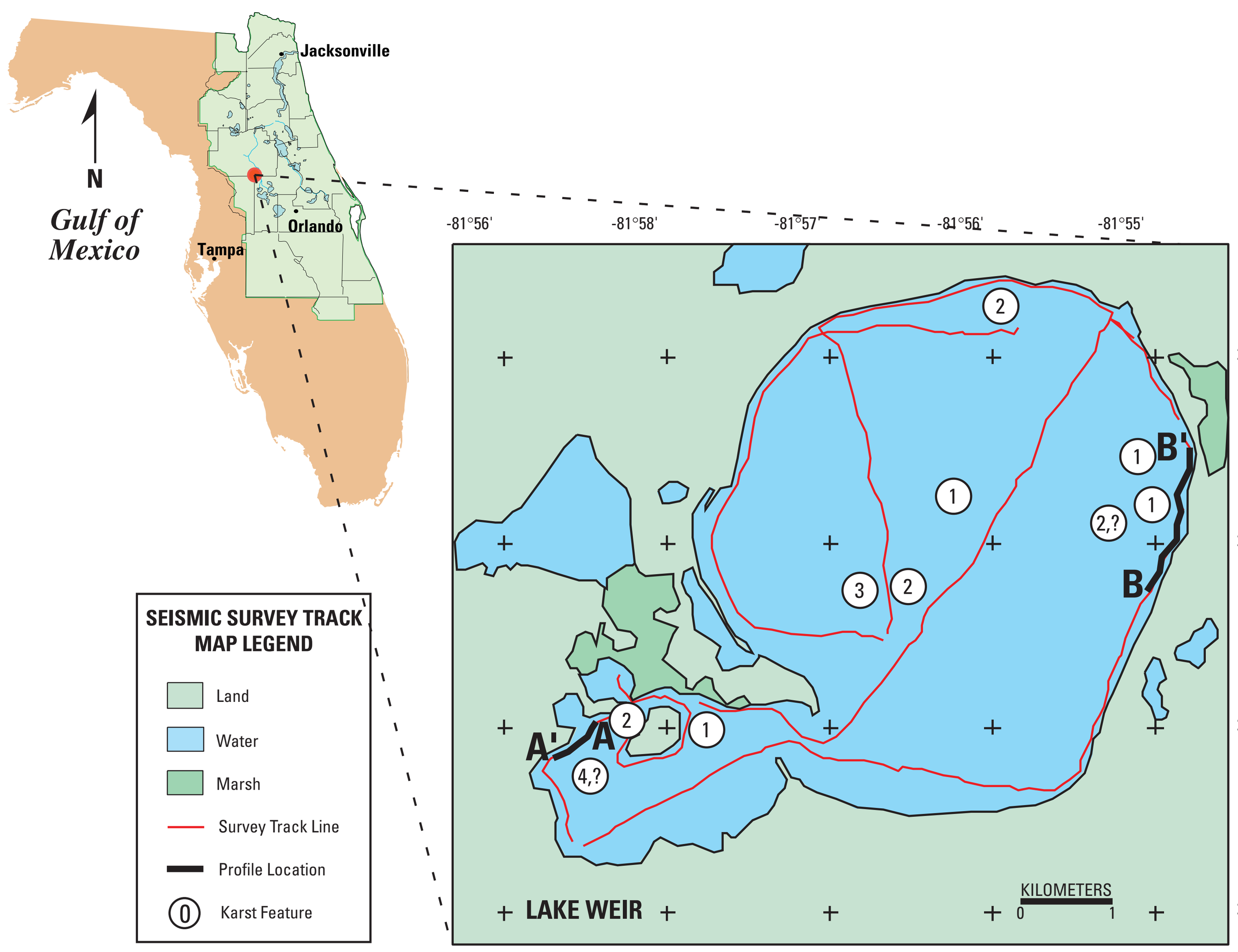




Location of survey area right (red square). Shaded relief map below showing physiographic regions, and location of wells and gamma log cross-section. Gamma Log cross-sections (left) show geologic contacts for correlation to seismic sections.

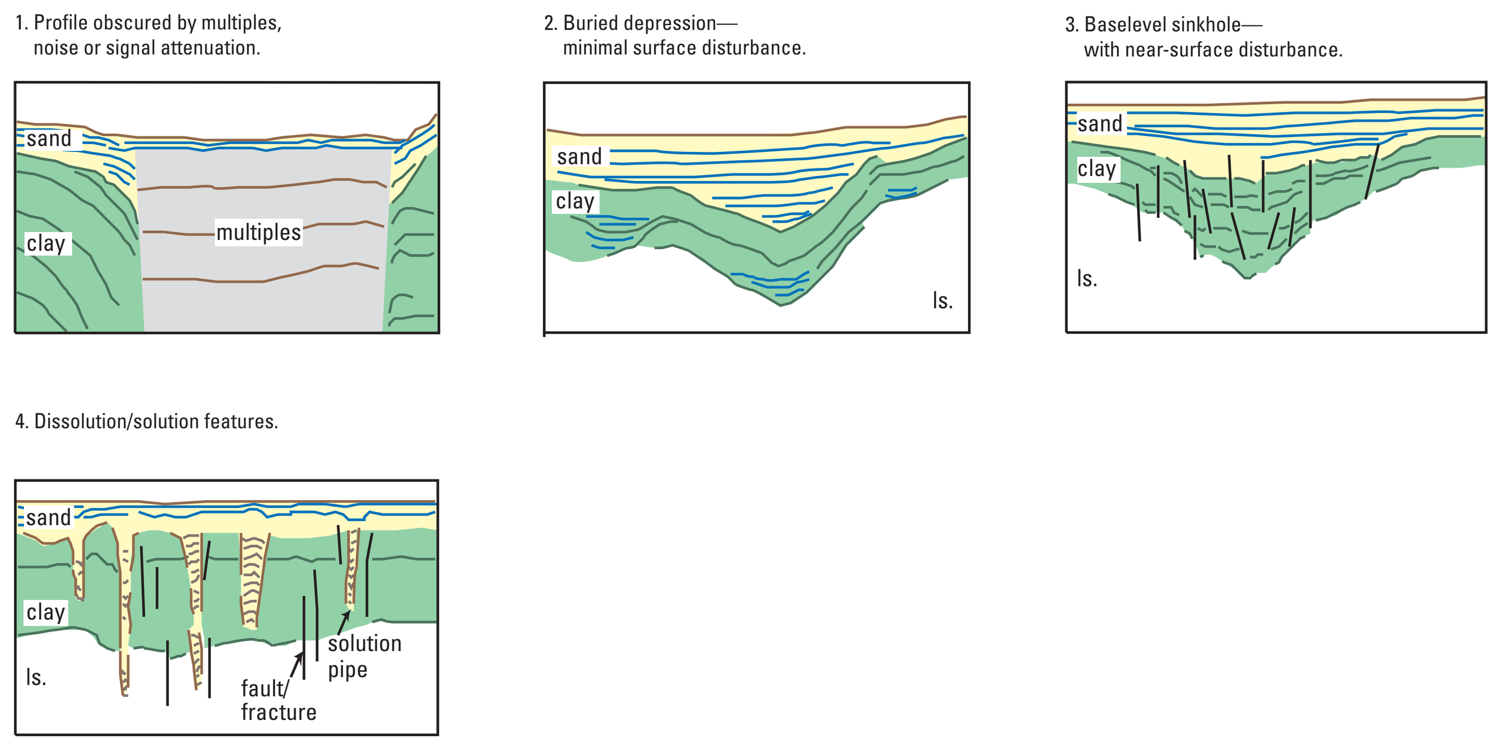


# LAKE WEIR

## MARION COUNTY, FLORIDA




EXPLANATION




### Introduction

Lake Weir, in southcentral Marion county, is situated along the edge of the Ocala Uplift in the Central Lakes District. This area is comprised of sand hills with water table lakes filling their interstices (Brooks and Merritt, 1981). These sand hills comprise part of the thick, undifferentiated sediments that overlie the Hawthorn Group, which occurs at about sea level in this area (Scott, 1988). The lake wraps around the southern extent of one of these hills to form Little Lake Weir to the west. Lake elevation at the time of the seismic survey was ~16.7 m (55 ft) NGVD. Lake Weir is roughly circular in shape with a perimeter of approximately 35 km and an area of 31 sq km. To the north, the lake is connected via drainage canal to Marshall Swamp which occupies the large Oklawaha valley and river system.

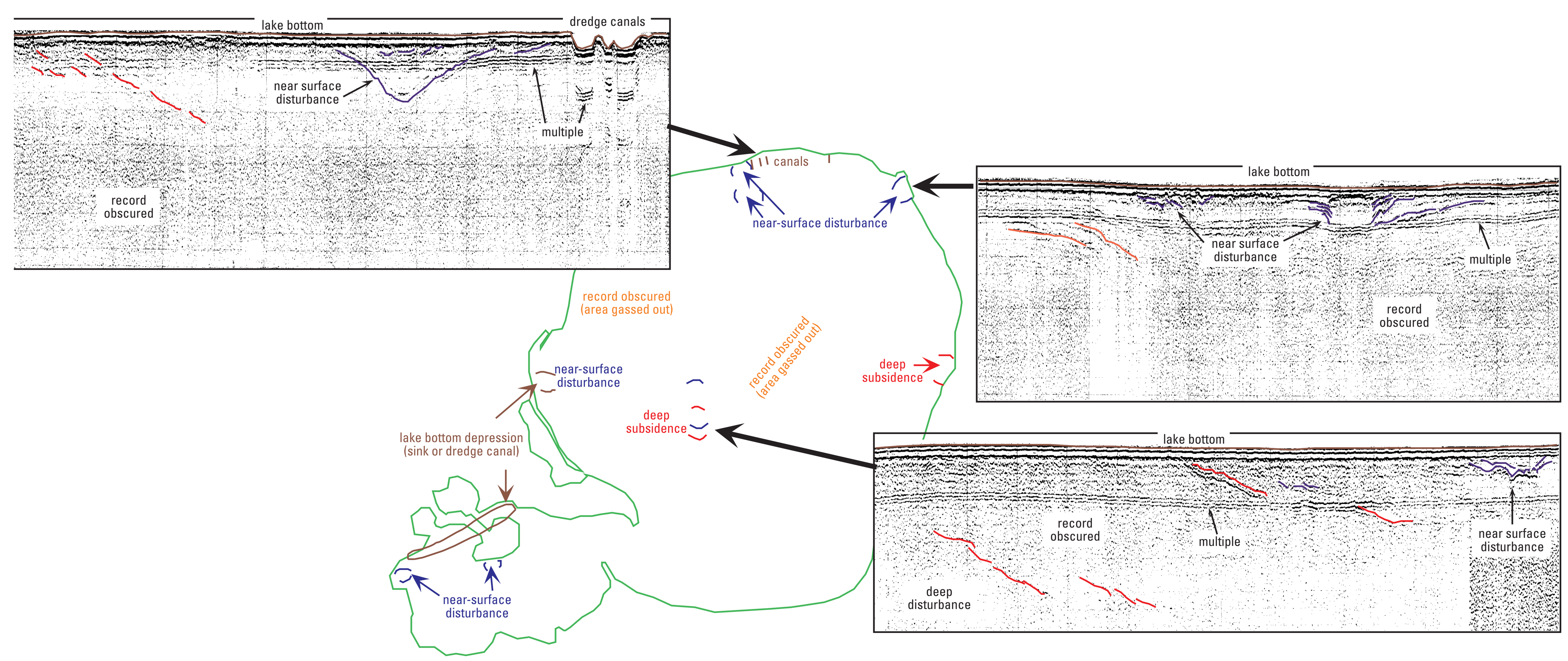
### Subsurface Characterization

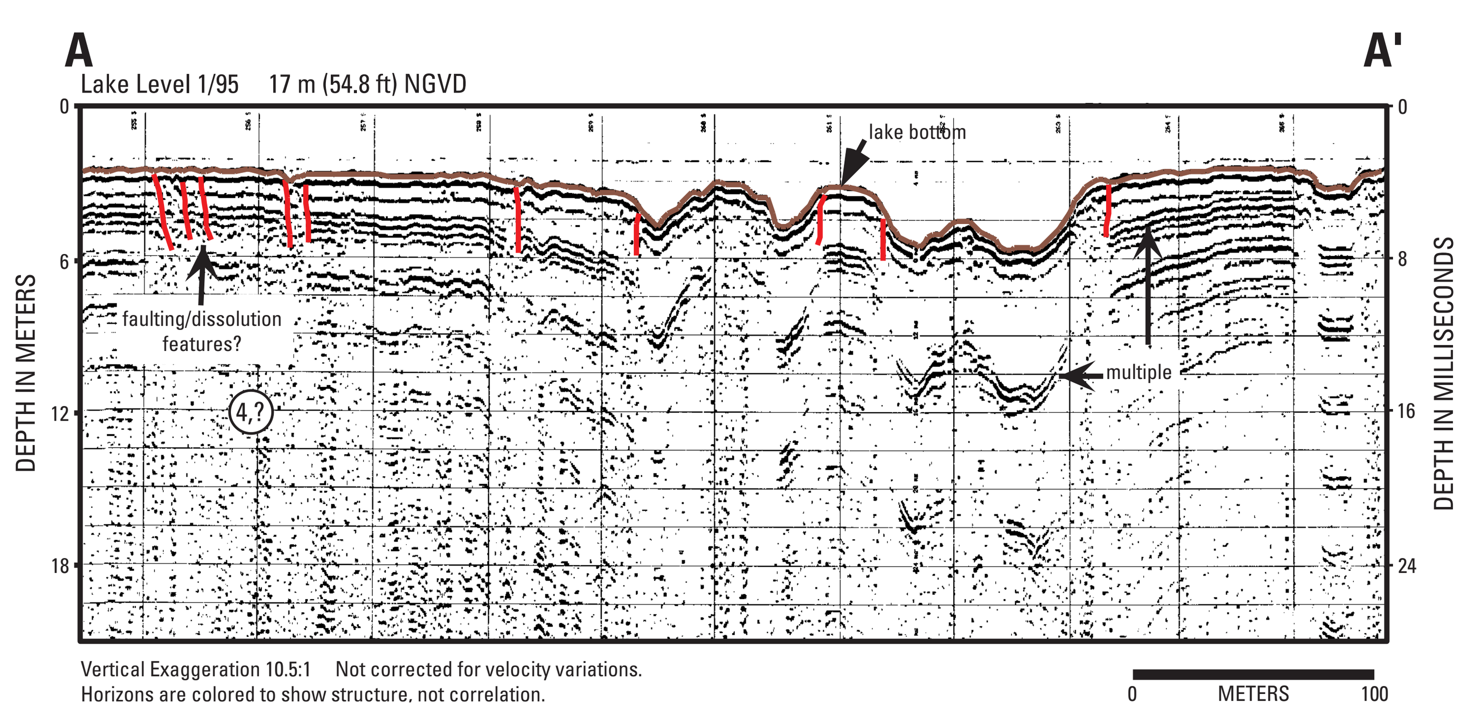
The subsurface disturbance features visible in seismic profiles acquired from Lake Weir generally fall into subsidence type categories (2 and 3) at two different depth levels (see subsidence location map, below). The deeper structures could possibly correspond to subsidence within the Hawthorn Group (Profile B-B'), but detail is obscured by noise in the overlying record. Near-surface features show low-angle reflectors that exhibit disturbed bedding (blue lines in profiles). Relationships between the upper and lower features are seldom apparent due to the generally poor acoustic return. Large areas in the central portion of the lake show a gassed out appearance. This could be due to a hard, sandy lake bottom or high organic content in the surficial sediments. The seismic records to the west show strong multiples, which also obscure the underlying record. This could also be due to a hard sandy lake bottom. Surface features include obvious dredge canals along the northern shore and a very large, long dredge-like structure across Little Lake Weir (Profile A-A', see location map left). This feature is up to 300 m (984 ft) wide and 3 m (9.8 ft) deep (6 m, 19.7 ft water depth). It cannot be determined from the record whether this is a dredge canal or collapse structure.

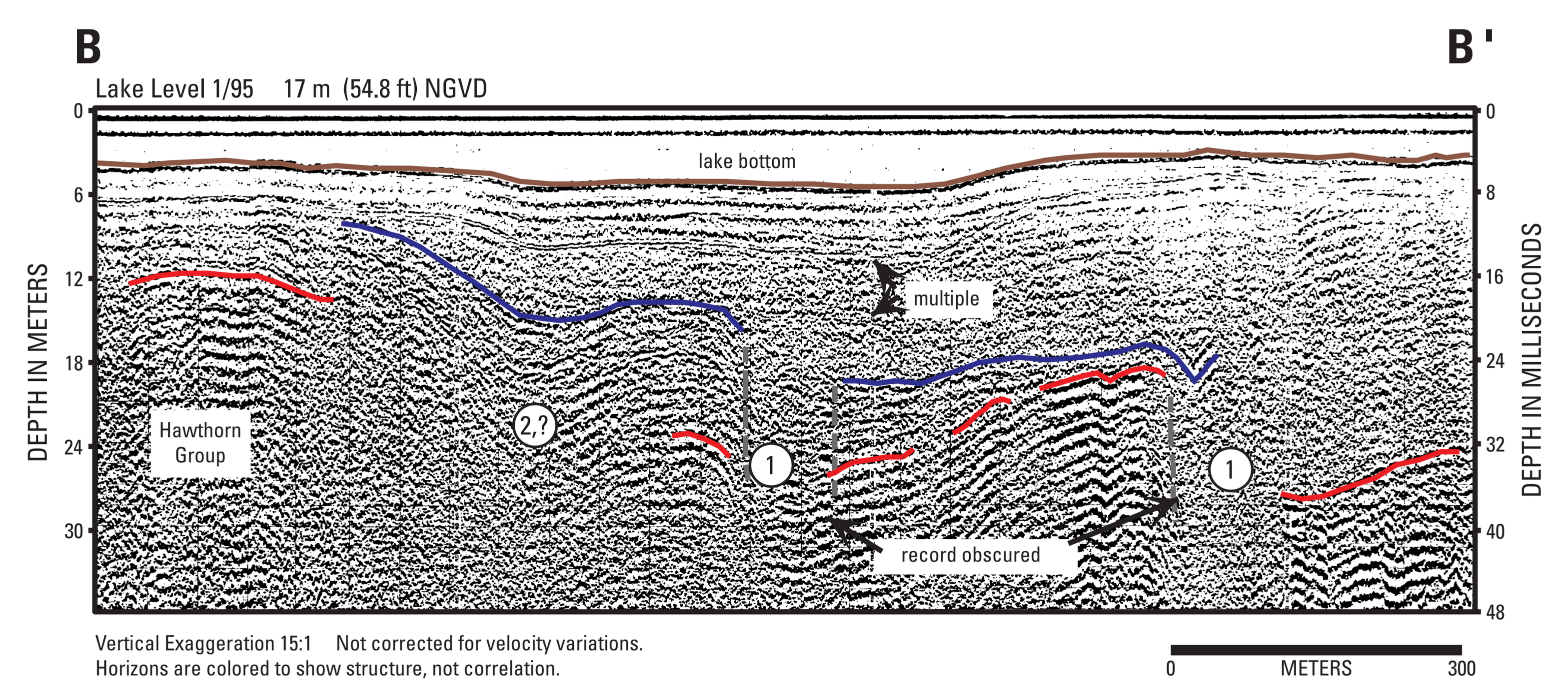
Possible near-surface faulting (red dashed lines) and what could be a real reflector dipping beneath the multiple could indicate subsidence in the area.

The top of the Ocala Limestone plunges to the east beneath Lake Weir, as indicated from interpretations of gamma-log profiles obtained from wells around the lake. The Ocala surface is at 4.6 m (15 ft) NGVD on the southwest side of the lake (well M-0070, see Gamma-log sheet) and decreases to about 30.5 m (-100 ft) NVGD on the east side (M-0079, M-0080). A well north of the lake (M-0078) shows the contact to be at -5 feet NGVD. This irregular surface may indicate mature karst development beneath Lake Weir and the disturbed nature of the reflective horizons shown in seismic profile B-B' (blue and red lines) could be a result of more recent subsidence in the overburden. Well logs indicate that the Hawthorn Group crop out on the west side of the lake and dip to around zero feet NGVD to the east. This corresponds to approximately 16 m depth in seismic profile B-B' and would suggest the reflective horizons represented by the red and blue lines in the profile to correlate with the top of the Hawthorn Group.

LOCATION OF POSSIBLE SUBSIDENCE & RELATED FEATURES INTERPRETED FROM SEISMIC PROFILES




**Subsurface Characterizations of Selected Water Bodies in the St. Johns River Water Management District, Northeast Florida**

Jack L. Kindinger[1], Jeffrey B. Davis[2], and James G. Flocks[1]
2000

[1] Center for Coastal Geology and Regional Marine Studies
U.S. Geological Survey
St.. Petersburg, Florida 33701

[2] St. Johns River Water Management District
Palatka, Florida 32178



This sheet is Section C page 21 of Open-File Report #00-180 prepared by the U.S. Geological Survey Center for Coastal Geology and the St. Johns River Water Management District. For a detailed description of methods, site locations, explanation of regional geology, physiography, karst development and karst features identified by seismic profiling, refer to pages 1 through 7.