

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

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Fluid exchange between surficial waters and groundwater, as well as the processes that control this exchange, are of critical concern to water management districts and planners. Digital high-resolution seismic systems were used to collect geophysical data from more than 40 lakes and rivers of northeastern Florida. Seismic data acquisition in the past has been only partly successful for imaging lake subbottom geology; however, the use of digital seismic technology has greatly enhanced potential applications. Seismic profiles collected from sites in northeastern Florida have demonstrated the potential application of these techniques in understanding the formation of individual lakes. In each case study, geologically controlled solution and/or mechanical processes determined the geomorphology of lakes and evidence of these processes may be seen in seismic profile. Processes that control lake development are twofold: 1) karstification or dissolution of the underlying limestone, and 2) collapse, subsidence, or slumping of overburden to form sinkholes. Initial lake formation is directly related to the karst topography of the underlying host limestone (Fig. 1). Lake size and shape are factors determining the thickness of overburden and size of the collapse or subsidence, and/or the clustering of lake-forming depressions.

Lake evolution follows sequential stages to maturity that creates progression through the following geomorphic types (Kindinger and others, 1999, 2000) (Fig. 2):

- (1) active subsidence or collapse phase (young) - the open to partially filled collapse structures typically associated with sinkholes;
- (2) transitional phase (middle age) - the sinkhole becomes plugged as the voids within the collapse are filled with sediment, periodic reactivation may occur;
- (3) baselevel phase (mature) - active sinkholes are progressively plugged by the continual erosion of material into the basin, and eventually sediment fills the basins;
- (4) polje (drowned prairie) - broad flat-bottom basins located within the epiphreatic zone that are inundated at high stages of the water table and have one or all phases of sinkhole development and many types of karst and karren features.

Most lakes in this study are small (less than 1-km diameter) making stratigraphic correlation from lake to lake difficult. Seismic profiles of subsurface features were used to define the lacustrine geologic history and to locate possible breaches in the confining layer that maintains these lakes (Fig. 3). Six types of acoustic signatures were identified from the seismic profiles to describe the structural history of each lake (Fig. 4). Using these criteria, Florida lakes can be classified by size, sediment fill, subsurface features, and geomorphology. Classification of lakes utilizing digital seismic technology has led to a better understanding of the interaction between the geology and hydrology of central Florida.

REFERENCES

Kindinger, J. L., Davis, J. B., and Flocks, J. G. 1999, *Geology and Evolution of Lakes in North-Central Florida*: Environmental Geology, v. 38:4, p. 301-321.

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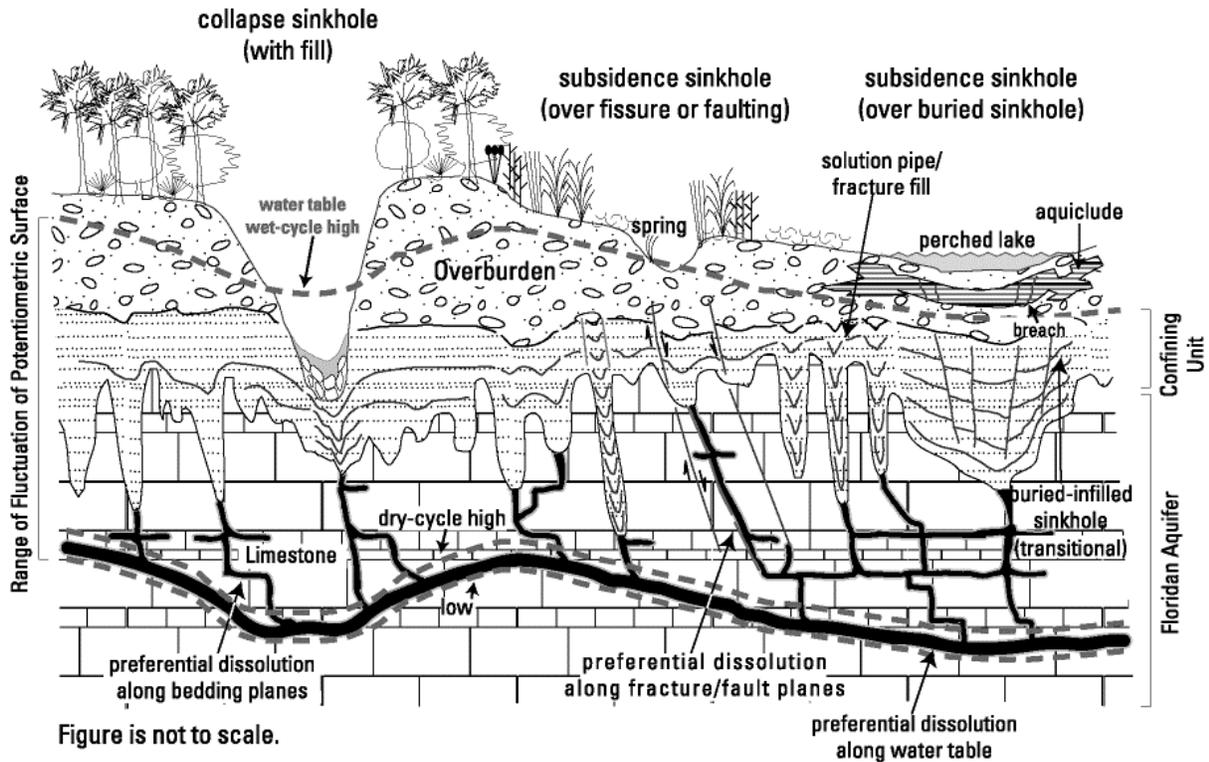


Figure 1. Diagnostic solution and collapse features of karst and karren topography from northeastern Florida. Individual sinkholes range from less than 1 m to more 100 m.

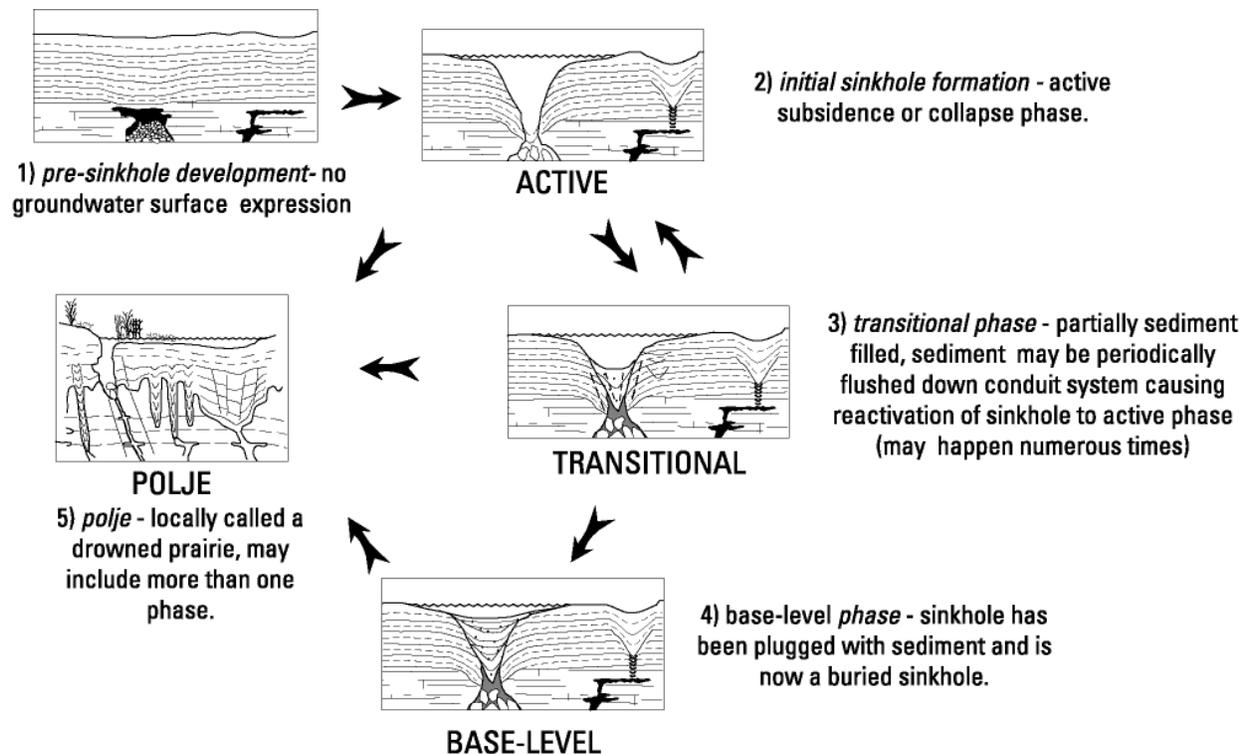


Figure 2. Predicted sinkhole sequential evolution in Florida. Modified from Kindinger and others, 1999.

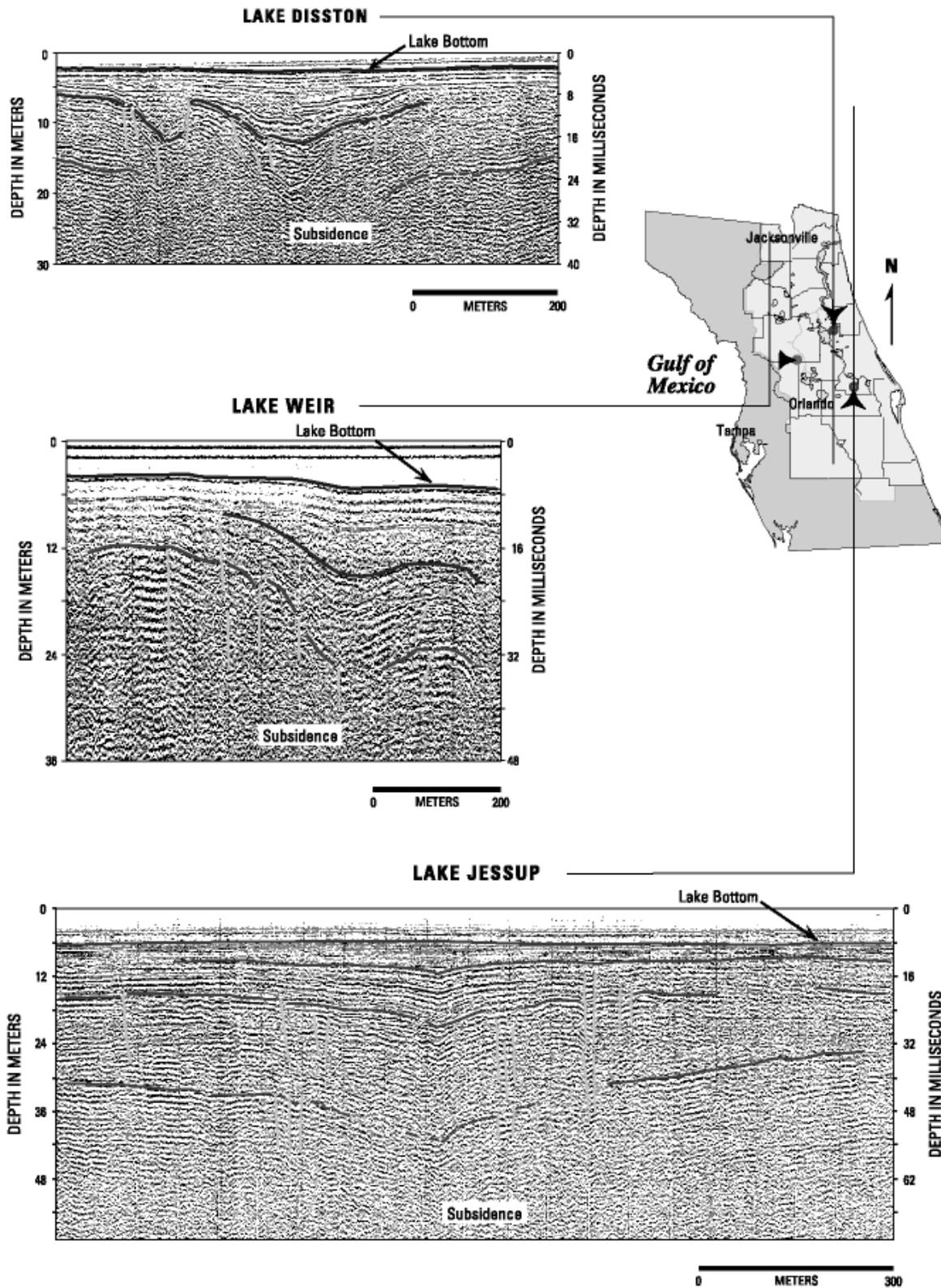


Figure 3. High-resolution seismic profile examples from three lakes located in separate geomorphologic regions of northeastern Florida. Drawn lines are for interpretive purposes and do not indicate correlation between profiles.

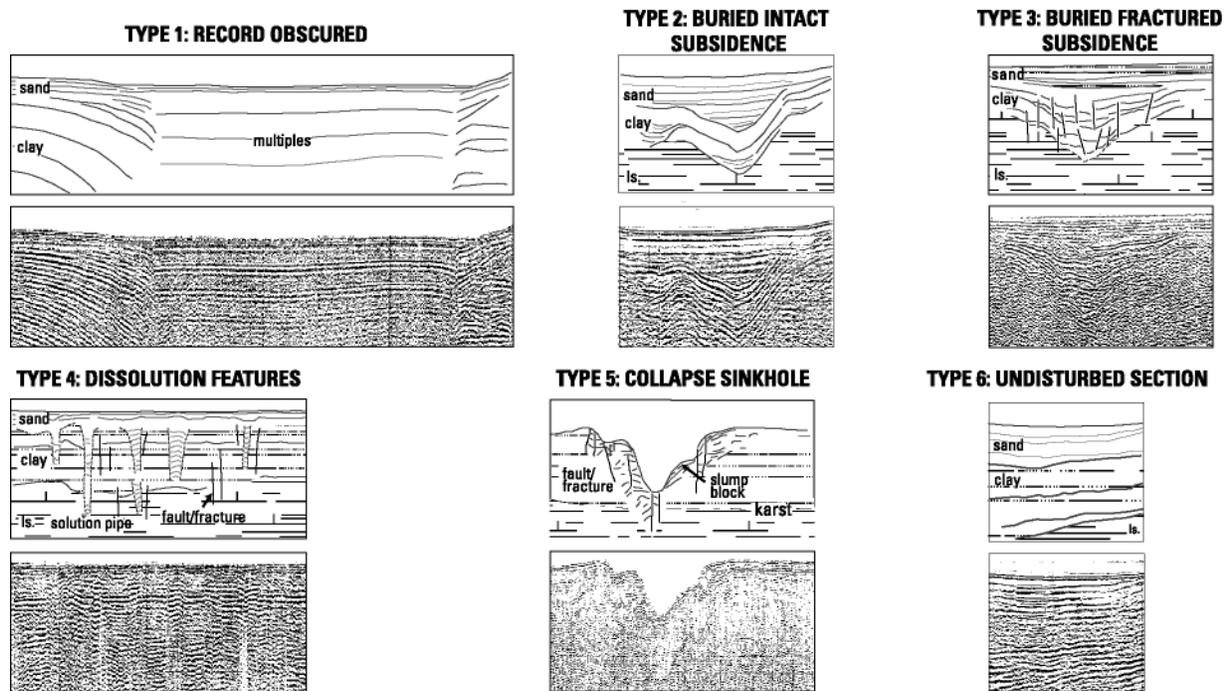


Figure 4. Seismic profiles with line drawing interpretations of six types of features described from the lakes of northeastern Florida.