

The Precambrian Crust

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INTRODUCTION

Little is known of Illinois' oldest rocks, commonly referred to as the "Precambrian basement" or "crystal-line crust." Deposited from 4,500 to 544 million years ago (mya), the Precambrian rocks lie at great depth, where historically there has been little economic incentive to drill. Geological cross sections of the Midwest (e.g., Figure 6-1) typically show the Precambrian as a uniform mass that simply disappears off the bottom of the diagram, a *terra incognita* not greatly different from the outer edges of early medieval maps of the world. The structure, composition, and origins of the deeply buried Precambrian crust of the Midwest have thus remained mostly beyond the geological frontier. This chapter briefly summarizes the general knowledge of the Precambrian in Illinois and then discusses an exceptional area in east-central Illinois where the coincidence of deep drill-hole, seismic reflection, and gravity- and magnetic-field data provides a unique "window" into the deep Earth beneath Illinois.

PRECAMBRIAN BASEMENT OF ILLINOIS

Because the Precambrian strata in Illinois are so deeply buried, knowledge of these rocks is limited to approximately 40 drill holes and a small amount of remote sensing data acquired from seismic surveys and from studying Earth's gravitational and magnetic fields. Most of the Precambrian drill holes have brought up only small fragments of rock. A few precious cores of solid rock have been obtained by oil and utility companies from Precambrian rocks at great expense and have been made available to geologists for study (Sargent 1991) (Figure 6-2). Published descriptions of

the geology of the Precambrian in and around Illinois are available (Bradbury and Atherton 1965, Lidiak 1996, Van Schmus et al. 1996), and the overall shape of the buried surface of the Precambrian rocks can be visualized from a structural contour map (Figure 6-3). The map was constructed using data from deep drill holes and from regional seismic reflection surveys. The depth to the top of the Precambrian ranges from 1,000 feet (about 300 m) below sea level in northernmost Illinois to almost 20,000 feet (6,100 m) below in the extreme southeastern part of the state. The relatively smooth surface shown on such deep structural contour maps is due largely to a lack of data and thus is somewhat misleading. Structural relief is approximately 5,000 feet (1,500 m) at the edge of the Reelfoot Rift and Rough Creek Graben in southern Illinois (Wheeler 1997). Many borings have been drilled by the petroleum industry on elevated basement structures, such as anticlines (convex-upward folds) and buried Precambrian hills; therefore, in many places, the actual depth to basement is probably deeper and more complex than shown (Bradbury and Atherton 1965). For example, actual rock outcrops of the basement rock in the St. Francois Mountains of southeastern Missouri (Figure 6-4) and a small number of closely spaced deep drill holes in Illinois reveal that the Precambrian surface probably has as much as 500 to 1,000 feet (150 to 300 m) of relief in places over distances of a mile or less (Sargent 1991).

Precambrian basement rocks in Illinois, as in other parts of the Midwest, consist primarily of granite plutons, granodiorite, and rhyolite (light-colored [felsic] igneous rocks rich in silica, sodium, aluminum, and potassium) and are assigned to the Eastern Granite-Rhyolite Province (Lidiak 1996), as shown on a simplified reconstruction of

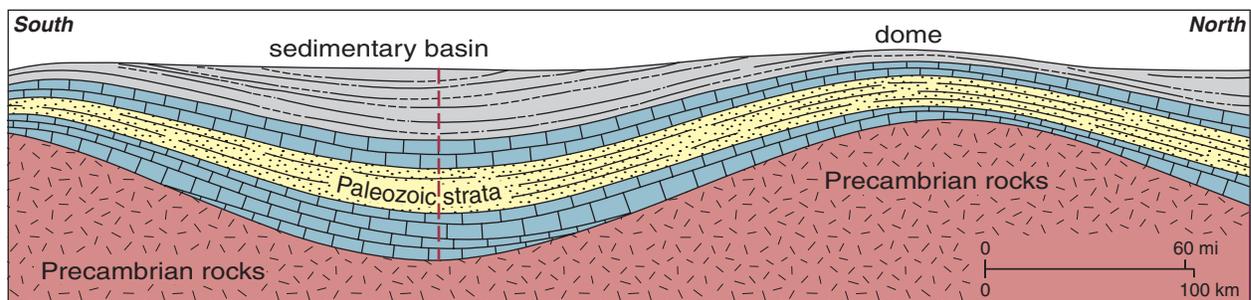


Figure 6-1 Typical diagrammatic geological cross section through a sedimentary basin in the central United States.