GEOLOGIC SETTING

The Ardmore basin is an elongate northwest–southeast-trending structure located in south-central Oklahoma (Fig. 1). It lies between the Criner Hills uplift to the southwest and the Arbuckle Mountains and Pauls Valley uplift to the north. To the southeast, the Ardmore basin extends below the overriding Ouachita thrust belt, and both are buried, in part, by overlapping Cretaceous sediments. To the northwest, the Ardmore basin is separated from the Anadarko basin by a major fault with a displacement of as much as several thousand feet, downthrown to the north.

Curtis and Ham (1979) show the Ardmore basin as a geomorphic province characterized by lowlands of folded Mississippian and Pennsylvanian shales and sandstones lying between the Arbuckle Mountains to the north and the Dissected Coastal Plain to the south. The City of Ardmore is located in the south-central part of the area, and Lake Murray lies a few miles to the southeast of Ardmore (inside front cover).

Sandstones form resistant ridges on the flanks of folds, adjacent to broad, flat valleys underlain by shale. Caddo Creek (inside front cover) flows across the area from northwest to southeast to join the Washita River. Elevations within the Ardmore basin range in general from just under 700 ft (along Caddo Creek) to ~1,000 ft above sea level.

STRUCTURAL GEOLOGY

The structural geology of the Ardmore basin is complex and detailed analyses or interpretations are beyond the scope of this guidebook. However, a brief introduction to the evolutionary history of the basin is important to an understanding of the depositional processes that affected the Springer and Golf Course Formations. The rate of basinal subsidence, the length of time involved, and the provenance of the sediments determined the thickness, geometry, and lithology of the units.

According to Ham (1963, p. 15; Ham and others, 1964, p. 9), the southern Oklahoma geosyncline was initiated by a great intra-cratonic sag that developed upon a deeply eroded continental craton during the late Precambrian. The explanation of Hoffman and others (1974) for these processes involves modern plate tectonic theory, and they use the term "aulacogen" to describe the southern Oklahoma structural feature. (Aulacogens are structural troughs that extend at a high angle from a continental margin onto the craton. An aulacogen first develops as a rift valley; later, it subsides more rapidly than the adjoining continental platform and forms a deep trough that dies out onto the craton [Hoffman and others, 1974].) According to Ham (1963, p. 15; Ham and others, 1964, p. 9, 150), the development of the southern Oklahoma geosyncline took place in three stages. In its earliest stage (basement-rock stage), which was eugeosynclinal, it was bounded by faults and filled with graywacke, bedded chert, spilitic basalt, and rhyolite (Early and Middle Cambrian in age) to a probable thickness of 20,000 ft. At this stage, the trough was ~100 mi wide and, in what is now Oklahoma, nearly 300 mi long. It extended southeastward into an area subsequently overridden by the Paleozoic Ouachita thrust belt (Fig. 1). Before this first stage ended with the outpouring of thick rhyolites and with general emergence, major faults originated along opposite margins of the newly modified basin. The basin was downthrown at least one mile as a graben (Ham, 1963, p. 18; Ham and others, 1964, p. 9).

The second stage was dominated by the deposition of carbonate rocks from Late Cambrian through Devonian time, and the third stage was marked by the deposition of clastic sediments, Mississippian, Pennsylvanian, and Permian in age (Ham and others, 1964, p. 150–151). Sedimentary strata above the basement rocks range in thickness from 30,000 to 40,000 ft (Ham and others, 1964, p. 10). In the Permian, the southern Oklahoma geosyncline collapsed by strong folding accompanied by thrust faulting (Ham and others, 1964, p. 10).

More recent works by Gilbert and Donovan (1982), Coffman and others (1986), Gilbert (1986, 1992), Granath (1989), McConnell and Gilbert (1990), and Hogan and Gilbert (1995) support Ham's earlier interpretations of the evolution of the southern Oklahoma aulacogen (SOA). Hogan and Gilbert (1995, p. 41) state that:

> The SOA (Hoffman et al., 1974) is one of several aulacogens that developed during rifting of the Laurentian Supercontinent in Late Proterozoic to Cambrian time. . . . Subsequent to Cambrian rifting, a large interior basin developed over the SOA and igneous rocks of the rifting event were buried by up to 4–5 km of Cambrian to Mississippian sediments (Gilbert, 1992). During late Mississippian to early Pennsylvanian time, igneous rocks of the SOA were uplifted as large fault-bounded blocks as a result of plate collisions associated with the Ouachita Orogeny.

Included within the region of maximum subsidence of the southern Oklahoma aulacogen are the Ardmore basin, the Anadarko basin, the Marietta basin, and, at the western edge of the Arbuckle uplift, the closely folded Arbuckle Mountains (Fig. 1). In the Ardmore basin, the west–northwest alignment of folds and faults is a pervasive structural trend that developed during the Late Paleozoic orogeny (Pruatt, 1975, p. 3). Ham and others (1964, p. 10) say that "the basement rocks of the Wichita Province influenced the magnitude and intensity of folding that occurred during the several stages of Pennsylvanian orogeny." Where it is covered by sediments of the Ouachita frontal thrust (Fig. 1), the Ardmore basin contains a thickness of 5.8 mi of Paleozoic strata (Pruatt, 1975, p. 4).

Local structural features of importance in, and adjacent to, the Ardmore basin include the Arbuckle Mountains, Berwyn syncline, Caddo anticline, Criner Hills uplift, Glenn syncline, Overbrook anticline, and Woodford anticline (Fig. 2). Dionisio (1975) and Ghazal (1975), respectively, mapped the eastern and western parts of the Caddo anticline and produced geologic maps showing the outcrop areas of the strata that are the focus of this field trip. In general, dips on rocks on the flanks of the structures in the field-trip area are steep; most are 50°–85°. In places where the beds are nearly vertical and erosion has removed the less resistant shales from around the sandstones, it is possible to study not only the tops and soles of the beds but also the layered sequences within each unit.