Geology of the Balcones Fault Zone along the Growth Corridor of San Antonio, Boerne, Wimberley, and New Braunfels, South-Central Texas

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Extended Abstract

The south-central Texas region that encompasses San Antonio, Boerne, Wimberley, and New Braunfels and adjacent areas west of San Antonio and northeast of New Braunfels is undergoing rapid urban growth. It lies within part of the recharge zone of the Edwards aquifer and includes a complex part of the Balcones Fault Zone (Fig. 1). The geology of this region is important to geologists and other professionals involved in planning land use, designing construction projects, and studying the Edwards aquifer. Recharge of the aquifer may be locally enhanced at karst features, faults, and joints. Faulted aquifer strata partly influence regional ground-water flow, and faults locally juxtapose strata having different physical properties, creating potential construction/foundation problems. Geologic maps are some of the most basic and useful sources of information for this geologically critical area of Central Texas. In this study, maps (scale 1:24,000) were prepared for a >1,250 mi^2 region; additional mapping west of San Antonio and Boerne is ongoing. Maps have been interpreted using standard field mapping techniques and studying aerial photographs. Compilation and field verification of existing geologic maps of various scales aided map interpretation. This study benefited greatly from the many previous stratigraphic, structural, and mapping studies of the region.

The Balcones Fault Zone, one of the main structural features of Central Texas, extends from near Del Rio east-northeastward to San Antonio, where the zone bends northward through New Braunfels, Austin, Georgetown, and Waco and continues toward Dallas. Normal faults composing the zone are either more common or more pronounced between Uvalde and Georgetown, an area that coincides with the Balcones escarpment, a prominent fault-line scarp that is an area of major offset across the fault zone. The fault zone generally follows the strike of the Cretaceous outcrop belt and the structural grain of the buried Paleozoic Ouachita fold and thrust belt. Balcones faults mark the edge of the Texas Coastal Plain and are a manifestation of gulfward tectonic extension, flexure, and tilting along the perimeter of the Gulf of Mexico. Most movement on the Balcones Fault Zone is thought to have occurred during the late Oligocene or early Miocene.

Between San Antonio and New Braunfels the zone is >20 mi wide and is composed of en echelon normal fault strands that mostly strike N40°-70°E and dip southeastward. Fewer faults dip northwestward. Subsidiary faults strike northwestward, northward, and eastward. Rare outcrops containing larger faults indicate fault surfaces are irregular, have dips between 60° and 85°, and display slickenlines parallel to subparallel to the fault dip. Smaller subsidiary faults commonly dip between 45° and 85°. Composite stratigraphic displacement across the fault zone is approximately 1,600 to 1,800 ft. In the study area the fault zone consists of multiple major 2.2- to 7-mi-wide fault blocks bound by long series of southeast-dipping, tight, en echelon large normal faults that have throws ranging between approximately 100 and 850 ft (Fig. 1). Smaller fault blocks occur within the larger fault blocks, and many smaller faults with throws ranging from less than 1 to 100 ft cut strata across the fault zone. Series of tight en echelon large faults that bound the large fault blocks consist of individual fault strands that are commonly between 6 and 16 mi long. Spacing of the large faults increases away from the largest fault that forms the Balcones escarpment. The two largest faults, displaying about 340 and 850 ft of throw, are associated with northwest-dipping antithetic faults that bound narrow graben 3,000 to 4,000 ft wide. Preliminary investigations indicate that along an 18-mi portion of the fault zone located between northeast and northwest San Antonio, the zone is characterized by a composite 4- to 5-mi-wide right step of the largest displacement faults. A southwest-dipping relay ramp associated with complex faulting has formed in this area between the right-stepping large-displacement faults.

Cretaceous limestone, dolomitic limestone, marl, and shale crop out along the fault zone and represent >2,000 ft of shelf deposition on the southeast-trending San Marcos Arch. Northwest of the Balcones escarpment the outcrop belt mostly consists of cyclic, shallow subtidal to tidal-flat limestones and dolomitic limestones of the 650-ft-thick Glen Rose Limestone and the ~550-ft-thick Edwards Group. Nearshore siliciclastic-rich limestones of the 40- to 50-ft-thick Hensel and approximately 75-ft-thick Cow Creek Formations crop out beneath the Glen Rose Limestone locally along the Guadalupe River at the western margin of the fault zone. Open-shelf limestones and shelf/prodelta shale that overlie the

Edwards Group comprise <30 ft of Georgetown limestone (possibly absent locally), 30 to 50 ft of Del Rio clay/shale, 40 to 65 ft of Buda limestone, 15 to 25 ft of Eagle Ford shale, and about 90 to 150 ft of Austin chalk. These relatively thin post-Edwards deposits are preserved within graben west of the escarpment as well as locally along the escarpment. A local packstone to grainstone facies containing abundant altered volcanic material and distinct scour surfaces may indicate shallow-water deposition along the flank of a volcano during upper Austin Group/lower Taylor Group deposition. Southeast of the escarpment, poorly exposed shelf marls, argillaceous limestones, and shale/clay of the >600-ft-thick Taylor Group make up much of the Cretaceous outcrop belt that is commonly covered by Quaternary sand and gravel of the Leona Formation, local older (Pliocene–Pleistocene) gravel, and younger sand and gravel of terraces of main drainageways.

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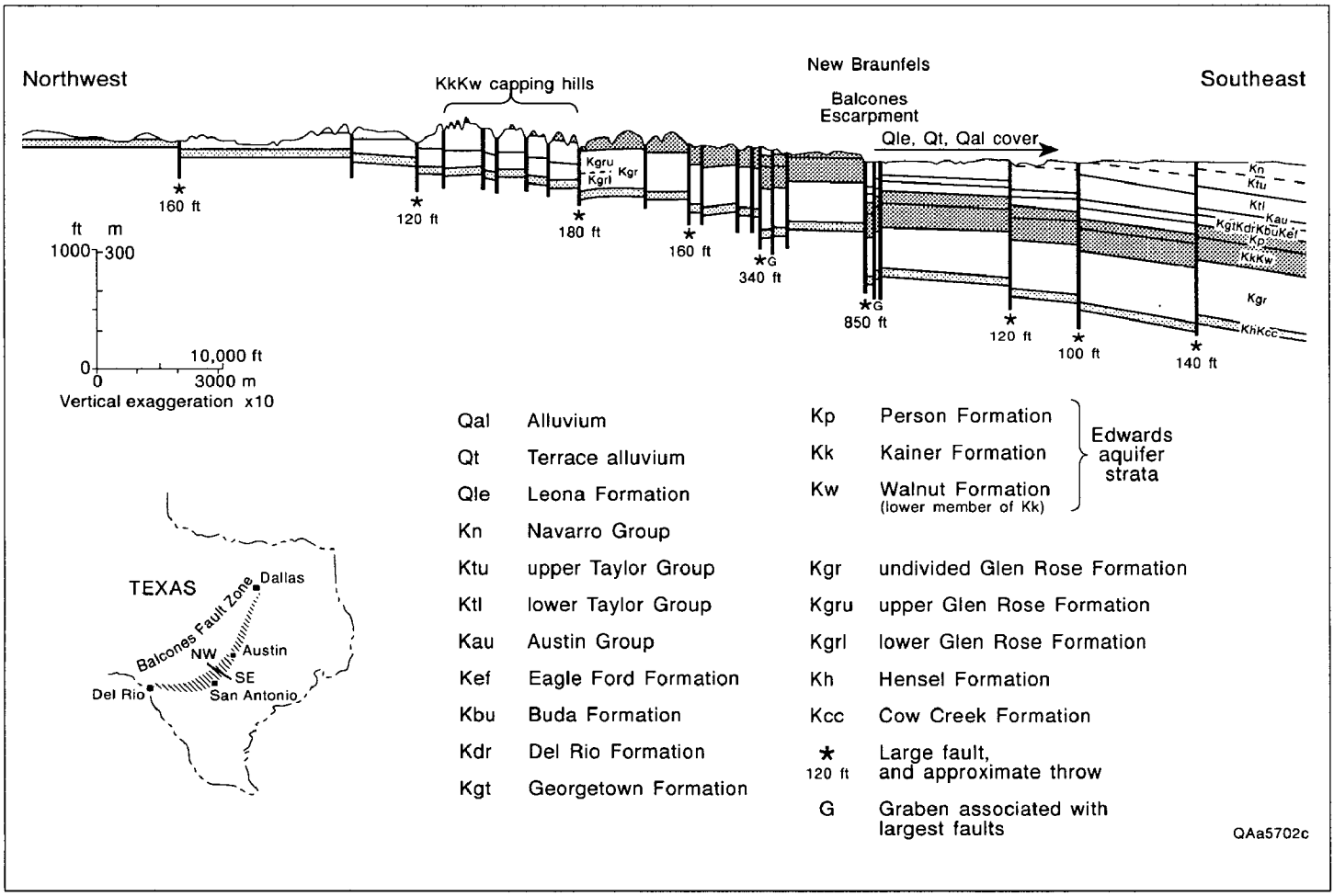

Figure 1. Structural cross section of the Balcones Fault Zone at New Braunfels, Texas.