Origin of the "Cup and Saucer,"

Mitchell County, Texas

by

Robert W. Baumgardner, Jr.
Bureau of Economic Geology
The University of Texas at Austin

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The "Cup and Saucer" feature, so named because of its similarity to those utensils (W. J. Brown, 1980, personal communication) is located in southern Mitchell County, Texas. It is on private property, but can be easily seen about 400 ft (122 m) east of State Highway 163 between Sterling City and Colorado City, 3.4 mi (5.4 km) north of the intersection of that highway with FM2183. It is located on the eastern edge of the Hyman NE quadrangle (scale 1:24,000, 7.5 minute series, U.S. Geological Survey, topographic maps), 0.75 mi (1.2 km) south of Beals Mountain.

The feature will be described according to the following conventions. The "saucer" portion, which dips concentrically toward the center, will be called the "lower ring." The "cup" portion, in the center of the saucer, will be called the "core." The outcrops south of the lower ring, which also are capped by rocks dipping toward the core, will be referred to as the "outer ring."

This feature, long assumed to be a meteorite crater, exhibits characteristics that argue for another explanation. First, the lower ring is capped with massive sandstone rocks that dip only gently ($3^{o}30'$-$14^{o}10'$) toward the core. This would not likely be the result of a violent meteorite impact. Second, abundant black stones scattered on the upper surface of the saucer are cemented with iron oxide, but are neither fragments of a meteorite nor fused by the heat of an impact. Rather, they appear to be concretions formed in the vadose zone when the ring was still buried by younger sediments and the local water table was higher. Third, if this feature were an ancient impact structure the core would be composed of breccia, created by the meteorite impact. However, the core is composed of friable fine-grained sandstone, volcanic ash, and fluvial gravels, none of which are brecciated.

It is more likely that the Cup and Saucer originally formed as a shallow sinkhole. Consolidated sandstone beds of the Triassic Dockum Group cap the lower ring. Thus, collapse of these beds to form a shallow bowl occurred after deposition and lithification of the massive sandstone. The original sink was probably larger than the present-day feature, but erosion has reduced the saucer to its present diameter of about 1500 ft (457 m). The sinkhole probably acted as a local sediment trap, receiving overbank flows from nearby streams. It may have been a small, wet-weather lake in the floodplain of a stream.

The volcanic ash exposed around the core has small-scale cross-bedding. Gravels overlying the ash are well-rounded and up to 1.0 in (2.5 cm) in diameter. This abrupt change in particle size signals a rapid, localized change in the depositional environment. The ash may have been the last unit deposited within the shallow sinkhole, filling it to the rim before the stream migrated laterally and deposited the coarse gravel as channel fill above the ash.

The ash beds at the south end of the core appear to be in their original depositional position. However, on the north side of the core, the contact between the ash and an overlying sandstone bed slopes toward the center of the core at between 16° and 32°. It appears that these ash beds collapsed subsequent to their deposition. Thus, part of the feature has subsided at least once since it formed.

The ash deposit at this location resembles that seen in association with the Seymour Formation near Seymour, Texas (Hibbard and Dalquest, 1966). That ash has not been dated but is thought to be Type "O" Pearl~~o~~ette Ash of Kansan age, about 600,000 years old. If that date is accurate, then

The collapse that formed the sinkhole occurred prior to 600,000 years BP, and the collapse that displaced the ash beds on the north side of the sink is more recent than that.

The iron oxide-cemented concretions found on the upper surface of the lower ring formed in situ. Evidence for this is seen in their shapes which include botryoidal and elongated forms that show no signs of transport. In addition, some concretions contain gravel with lithologies like those in which the concretions are found. The concretions formed by precipitation of iron from ground water moving through the permeable sediments deposited in the shallow sinkhole. The consolidated sandstone which caps the lower ring may have acted as an aquitard, producing a perched ground-water table and preventing the rapid downward movement of water. This would have created a favorable environment for precipitation of pore-fillings, by increasing the length of time the ground water was in contact with the permeable sediments (Davies and others, 1979). This could explain why the concretions are abundant inside the lower ring and rare at the same elevation along the hillslopes just 2100 ft (640 m) to the northwest.

The sinkhole probably formed as a result of dissolution of Permian age salts. This feature is in a position relative to the Caprock Escarpment that is similar to that of known dissolution/collapse features farther north in the Texas Panhandle (Gustavson, 1980). Those features are attributed to dissolution of salt in the Salado and San Andres Formations, at depths of up to 600 ft (180 m).

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