TERTIARY DEPOSITS IN SOUTHERN ARIZONA

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INTRODUCTION

Southern Arizona is characterized by north to northwest trending chains of mountain ranges separated by large, more or less isolated valleys which are partly filled with terrestrial deposits. The broad sweep of the valleys between the flanking mountain ranges suggests a uniformity of underlying materials that is belied by exposures revealed by more than a few feet of dissection. Recent work has shown that the alluvial deposits underlying the valley floors may consist of several units and that these units may be differentiated and mapped on the basis of composition, sedimentary characteristics, continuity of sedimentation, and structural relationships. Detailed studies of these deposits will provide an increasing understanding of the Tertiary history of the region.

At the present time, Tertiary deposits may be divided into three broad groups. The topmost and most widespread deposits are of probable late Tertiary to early Pleistocene age. They show a common sedimentary and environmental pattern reflecting deposition more or less contemporaneously with the development of the late stages of basin-and-range structure. The middle group of sedimentary units is generally considered to be middle Tertiary in age. Units of this period underlie or are in fault contact with the late Tertiary deposits and have been derived from what may be pictured as a basin-and-range topography differing in extent and source areas from those exposed today. The oldest group of possible Tertiary deposits is not confined to basin-and-range types of sedimentary deposits. In part, these deposits may represent a continuation of Cretaceous sedimentation into Tertiary time, and in part they may represent units set off from Cretaceous and middle Tertiary strata by unconformities.

EARLY TERTIARY ROCKS

Tucson Mountains

In the Tucson Mountains, part of the Amole arkose, which has been considered wholly of Cretaceous age (Brown, 1939; McKee, 1951), may be as young as Tertiary (Kinnison, 1958). In addition, several areas of volcanic rock outcrop, mapped by Brown as part of a pre-Amole volcanic sequence, are shown by Kinnison (1958; Trip IV; 24) to overlie the Amole arkose as a megabreccia of possible Cretaceous-Tertiary age. The megabreccia is overlain by rhyolitic and andesitic flows and tuffs and interbedded siltstone and arkose containing plant remains of Tertiary age.

Silver Bell Mountains

In the vicinity of the Silver Bell mine, 25 miles northeast of the Tucson Mountains, the Silver Bell formation (Courtright, 1958) lies with angular discordance on Cretaceous (?) sedimentary strata and porphyritic rocks intruding them. The Silver Bell formation consists of up to about 500 feet of volcanic conglomerate and clastic breccia composed predominantly of porphyritic rocks. The Cretaceous-Tertiary boundary may lie between the Silver Bell formation and the underlying rocks (Richard and Courtright, 1954). Courtright (1958) considers the Silver Bell formation to be possibly younger than the megabreccia in the Tucson Mountains described by Kinnison (1958). Overlying the Silver Bell formation is a sequence of pyroclastic and volcanic flow rocks which Courtright tentatively correlates with the volcanic sequence above the megabreccia.

Central Cochise County

The Bronco volcanics (Gilluly, 1956) crop out south of Tombstone and consist of a dominantly andesitic lower part and an upper part composed principally of quartz latite tuff. A local basal conglomerate contains many rounded boulders of Paleozoic and Cretaceous rocks. The Bronco volcanics may range in maximum thickness from about 5,000 to 6,000 feet. The Bronco volcanics unconformably overlie the Cretaceous Bisbee formation and are older than local thrust faults. Gilluly (1956) suggests that the Bronco volcanics are probably early Tertiary in age.

MIDDLE TERTIARY DEPOSITS

Mineta Ridge area

On the northeast side of the Rincon Mountains, Chew (1952a, 1952b) described the Mineta beds, a sequence of strata consisting of conglomerate, limestone, mudstone, and siltstone. These strata are exposed in a complexly faulted block that is thrust over older metamorphosed rocks to the west and is in normal fault contact with younger deposits to the east. The Mineta beds consist of three members; a lower, conglomerate member, composed of about 1,300 feet of thin-bedded arkosic conglomerate; a middle, limestone member, consisting of about 50 feet of alternating marly algal limestone and shale; and an upper detrital member, consisting of about 1,400 feet of thin-bedded siltstone, mudstone, and limestone. The Mineta beds are cut by dikes and sills and overlain by flows of andesite porphyry containing large feldspar phenocrysts. Superficially the deposits are similar to strata of Cretaceous age in the Santa Rita and Empire Mountains. However, fossil rhinoceros teeth from a limestone bed in the upper part of the detrital member of the Mineta beds were identified as Diceratherium sp., of probable lower Miocene age (Lance, personal communication).

Cienega Gap area

The Cienega Gap area forms the broad pass between the Rincon and Empire Mountains about 25 miles east of Tucson. From this area, Brennan (1957) described the Pantano formation which consists of about 13,500 feet of conglomerate, sandstone, mudstone, and argillaceous limestone, with, locally, flows of andesite porphyry. The Pantano formation has been overthrust by Paleozoic sedimentary rocks and by metamorphic and sedimentary rocks of probable Cretaceous age. Brennan considers the Pantano formation to be probably equivalent to the Mineta beds, which are in part of lower Miocene age.

Muggins Mountains

The Muggins Mountains, about 25 miles east of Yuma and 200 miles west of Tucson, include a thick sequence of conglomerate, sandstone, mudstone, and volcanic ash overlain by a thick sequence of volcanic flows and tuffs (Reyner and Ashwell, 1958). The sedimentary rocks have been folded and thrust, and are locally intruded by basaltic and andesitic masses. A fossil camel from lake bed deposits exposed on the south flank of the Muggins Mountains was identified as a new species of Stenomylus of probable lower Miocene age (Wood, 1958; Lance and Wood, 1958).

Globe-Ray area

The Whitetail conglomerate (Ransome, 1903; 1923) crops out in the Globe-Ray area. It consists of conglomerate up to about 1,000 feet thick that rests unconformably on eroded surfaces of older rocks and is conformably overlain by a dacite flow. Near Ray, the dacite above the Whitetail conglomerate is overlain by about 125 feet of conglomerate, referred to by Ransome (1923) as the Gila conglomerate. Ransome considered the Whitetail to be early Tertiary and the Gila to be Pleistocene. Heindl (1958), however, argues that there is essentially no time gap between the deposition of the upper part of the Whitetail and the Gila conglomerate in the vicinity of Ray. Heindl also points out that the Gila conglomerate in the Ray area is not necessarily contemporaneous with dated deposits more than 75 miles away in the vicinities of Benson and Safford. Although the Whitetail conglomerate has been extensively faulted, it is not involved in thrusting, and Heindl (1958) tentatively considers it to be younger than middle Tertiary.

LATE TERTIARY-QUATERNARY DEPOSITS

The large basins in southeastern Arizona are for the most part floored by alluvial deposits that have not been extensively deformed or have been deformed predominantly by normal faulting along their contacts with the mountain ranges. In effect, these deposits are deformed by a continuation of the general differential uplift that initially caused their deposition. These deposits are exposed to depths of several hundred feet in the San Pedro and Safford Valleys and their maximum subsurface thickness in the central parts of the valleys has been reported as about 3,000 feet from water-well drillers' logs. Some of the subsurface thicknesses reported may include unrecognized deposits of middle Tertiary or older sediments. Most of these deposits have been collectively called the Gila conglomerate (Gilbert, 1875) but the continued use of this term fails to provide stratigraphic tools with which to analyze the deposits (Heindl, 1958).

As an example of late Tertiary valley fill, the deposits in the eastern part of the Safford Valley are briefly described. Van Horn (1957) and Heindl (1958) have distinguished two units within the Gila conglomerate described from the area by Gilbert (1875) and a third unit in the Gila conglomerate, as used by Knechtel (1936). The three units are the lower Bonita beds, the middle Solomonsville beds, and the upper Frye Mesa beds. The Bonita beds consist of a massive conglomerate characterized by basaltic and rhyolitic fragments and range in thickness from about 400 to 800 feet. The Solomonsville beds lie disconformably on a locally eroded surface of the Bonita beds. The Solomonsville beds are also a massive conglomerate where they overlie the Bonita beds but can be distinguished by a different lithology. The conglomerate of the Solomonsville beds intertongues with and grades into sandy to silty beds toward the center of the valley. The total thickness of the Solomonsville beds, including subsurface deposits, may be about 2,000 feet. The Frye Mesa beds lie conformably on the Solomonsville beds and consist of a conglomerate containing large boulders set in a brown silty matrix. The maximum thickness of the Frye Mesa beds adjoining the Graham Mountains is about 700 feet, but the unit thins rapidly toward the center of the Safford Valley.

The Solomonsville beds, exposed through a thickness of about 300 feet, range in age from Pliocene to Pleistocene, possibly into Kansan (Lance, 1958). The Bonita beds are at least pre-Blancan, probably Pliocene and the Frye Mesa beds are Pleistocene.

CLASSIFICATION OF TERTIARY DEPOSITS

Datable fossils are rare in the Tertiary deposits and reliable stratigraphic correlations are difficult. Heindl (1958) proposed that the Tertiary deposits can be classified on the basis of their structural relationships until their stratigraphic relationships and ages are determined. Heindl emphasized that deposits classified in one category in one area may be the equivalent of or closely related to deposits of other categories in other areas and that deposits of the same age may be locally classified in different categories. Heindl's classification is as follows:

Upper Set - Deposits consisting principally of valley fill sediments (1) that are undeformed or in normal fault contact with older rocks; (2) whose lithology reflects rocks in adjacent mountains; (3) that lack mineralization; and (4) that are overlain by only thin surficial deposits.

Lower Set - Includes deposits (1) that generally underlie the upper set and are not related to the structural troughs of the existing topography; (2) are locally deformed by thrust or normal faulting; and (3) may be intruded and mineralized.

Category I - Older than volcanic rocks exposed at crests of adjacent mountain blocks; locally conformable with or grading into deposits of the upper set.

Gold Gulch type - Essentially undeformed except by normal faulting and essentially conformable with the upper set.

Hackberry Wash type - Tilted deposits deformed by normal and probably thrust faulting; locally appear to grade upward into deposits of the upper set.

Category II - Whitetail type - Interbedded with upper parts of the Tertiary volcanic rock sequence; exposed within uplifted blocks; essentially undeformed except by normal faulting.

Category III - Pantano type - Underlying or interbedded with lower parts of the Tertiary volcanic sequence; exposed within mountain and depressed blocks; deformed by both thrust and normal faulting.

It may be now advisable to add a "Lowest set" of deposits to include those of possible early Tertiary age.