GEOLOGY OF THE EASTERN PART OF THE SAFFORD BASIN, GRAHAM COUNTY, ARIZONA

(A Preliminary Report)

By

Edward S. Davidson

U. S. Geological Survey, Tucson, Arizona

INTRODUCTION

A comprehensive geohydrologic study of the Safford basin is being made by the Ground Water Branch of the U. S. Geological Survey in cooperation with the University of Arizona. Work undertaken by the Survey includes geologic mapping of the various sedimentary and geomorphic units occurring in the basin. To date, the eastern end of the basin has been mapped. The most significant results of this work are outlined below.

Several sedimentary geologic units occur in the basin: The stratigraphically lowest sediment is the basin fill; overlying the basin fill are gravels which cap the terraces that extend in steps from the Gila River to the mountain edges; and alluvium beneath the present flood plain of the Gila River. The alluvium is the youngest sediment within the map area. The generalized distribution of 1)several facies of basin fill, 2) terraces, and 3) alluvium is shown on figure 1.

BASIN FILL

The rocks of the basin fill in the map area comprise three sedimentary facies. These are fanglomerate, sand and silt, and shoestring deposits of conglomerate enclosed at several stratigraphic levels in the sand and silt. At least two fanglomerates crop out at the mouth of Bonita Creek and a third fanglomerate occurs in the northwestern part of the map area. The two fanglomerates exposed at the mouth of Bonita Creek total more than 1, 000 feet in thickness (L. A. Heindl, 1958, Cenozoic alluvial deposits of the upper Gila River area, New Mexico and Arizona: Arizona Univ., Tucson, unpublished doctoral thesis). The other two principal facies of the basin fill extend out from the area of fanglomerate outcrop at the mouth of Bonita Creek.

The older fanglomerate at the mouth of Bonita Creek is indurated and composed of boulders and cobbles of basalt, andesite, and rhyolite set in a carbonate-cemented sandstone matrix having the same composition. Andesite and basalt flows are intercalated near the base of the older fanglomerate along the Gila River and Bonita Creek. Some of these lava flows are contiguous along their strike with widespread tuff beds up to 100 feet in thickness. The fanglomerate is crossbedded and imbricated, and the trend of these structures indicates that the source area lies to the northwest. Several normal faults having up to 80 feet of displacement occur in this fanglomerate, but they do not displace rocks of the overlying fanglomerate. The older fanglomerate is in fault contact with andesite and basalt flows cropping out in the extreme northeast corner of the map area (Heindl, op. cit., p. 64).

The younger fanglomerate unconformably overlies the older fanglomerate. It is moderately friable and contains boulders of andesite, basalt, rhyolite, quartzite, and red granite. This fanglomerate crops out mainly on the east side of the Gila River in the fanglomerate area, and intertongues with both of the finer grained basin-fill sediments seen in the Safford basin proper (W. L. Van Horn, 1957, Late Cenozoic beds in the upper Safford Valley, Graham County, Arizona: Arizona Univ., Tucson, unpublished master's thesis). Crossbeds, imbricate structures, and composition indicate that the source of this fanglomerate lies to the north.

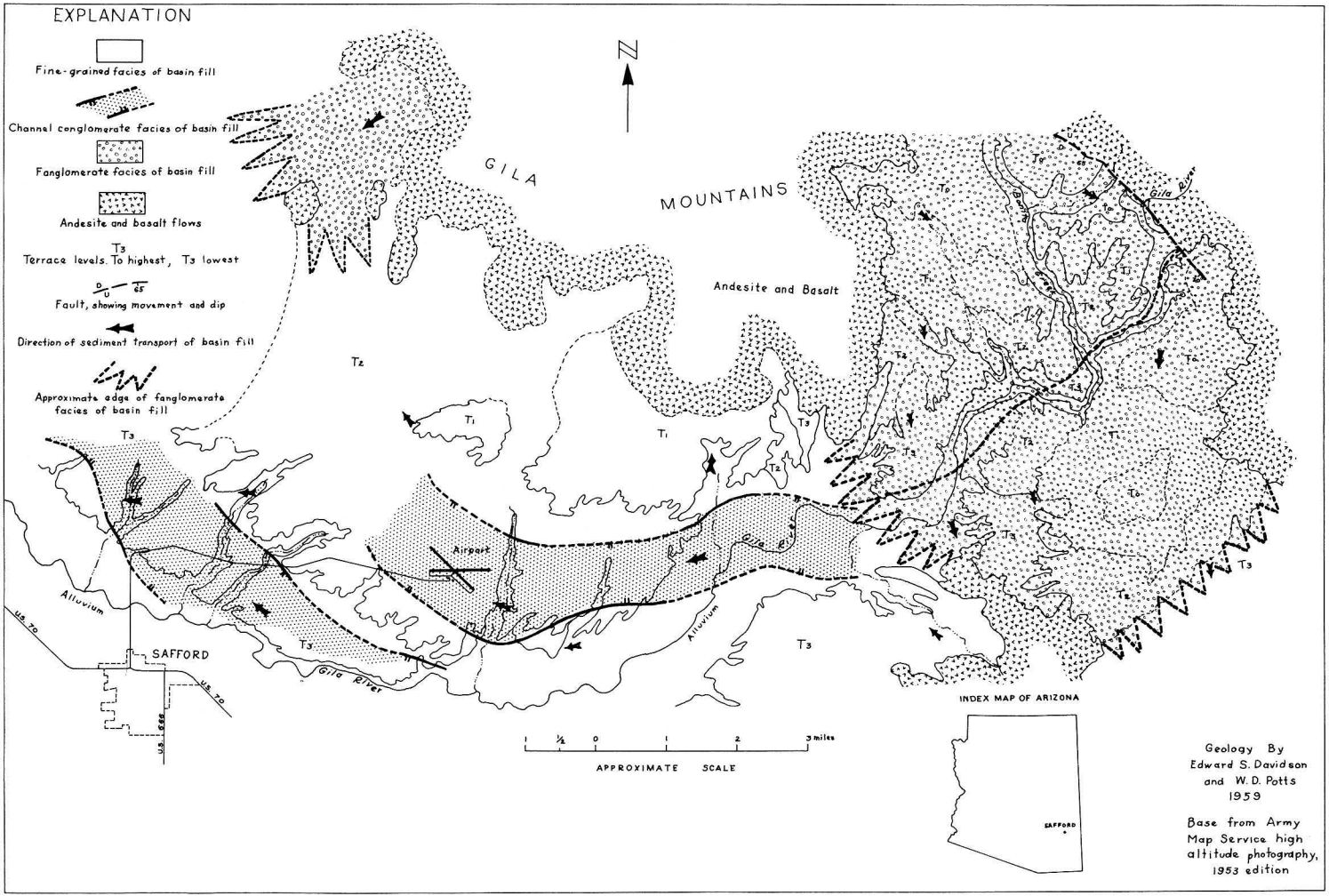

Figure 1.--Generalized geologic map of the eastern part of the Safford basin.

The small fanglomerate in the northwestern part of the map area is at the mouth of a fairly large drainage area. The volume of sediment contributed to the Safford basin from this fanglomerate area is not large in comparison to the amount contributed from the northeastern end of the basin.

The sand and silt beds apparently can be divided into two stratigraphic units. The lower unit grades from brown crossbedded sand having conglomerate interbeds, west of the airport (fig. 1), to light-brown silt and green silt and mudstone southwest of the airport. The upper unit consists of brown sand and silt and numerous pebble-conglomerate beds. This unit is interbedded with the northern shoestring channel conglomerate described below. It crops out only in the map area east of the airport. The grain size of the sediments in this unit grades from medium and coarse near the channel conglomerate to very fine near the Gila Mountains. The sand and silt consist of grains of quartz, mica, and feldspar; the conglomerate beds contain pebbles of basalt, andesite, rhyolite, and red granite.

The shoestring conglomerate beds, up to 1-1/2 miles in width and about 50 feet in thickness, trend westward in the central part of the basin. They have the same composition as the younger fanglomerate. Bedding structures and composition indicate that the conglomerates were deposited by a stream that flowed from the fanglomerate area. Two channel deposits are shown in figure 1; the northern deposit is stratigraphically about 50 feet higher than the southern, and interfingers laterally with buff-colored sand and silt. The central and western exposures of this deposit show about 10 to 15 feet of scouring into underlying beds. The southern deposit lies with erosional unconformity on the lowermost sand and silt unit. This conglomerate may be equivalent in age and stratigraphic assignment to the northern shoestring conglomerate, or it may be equivalent to the much later terrace gravels in level T3 (fig. 1). More fieldwork may clarify this problem.

The pattern of sedimentation in the eastern part of the Safford basin suggests that the exposed basin fill was deposited largely by an ancestral river entering the basin from the northeast. However, the exposed sediments represent only a small part of the sediments in the basin. It is not yet known whether these same conditions can be postulated for the entire thickness of fill in the Safford basin. The large areas of mud and fine-grained sediments encountered by drill holes indicate that lake and swamp deposits may be widespread in the unexposed part of the section. The presumption is that a considerable part of these sediments was derived from the surrounding mountain blocks. Therefore, any extrapolation of the surface geology to depth should be done with caution.

The hydrologic implications gained from the sediment distribution are of importance, especially if the distribution of sediments at depth is similar to that seen in the exposed outcrops. The classical view holds that the basin sediments are derived from the adjacent mountains and are coarse near the mountain edges, grading outward to fine-grained sizes in the central part of the basin. The sediments near the mountain edges, being coarser, would be highly permeable and maximum recharge to the basin reservoir could be expected along the mountain fronts. In the eastern part of the Safford basin, at least in part, the finer sediments lie against the rock shelves of the basin, and coarser, more permeable sediments extend out only from places where ancient major tributaries entered the basin. The areas of possible large and significant natural recharge to the basin sediments along the mountain fronts may be limited to the relatively small areas of fanglomerate outcrop near the mouths of ancient tributaries (Lance, 1959), and to those places in the central part of the basin where the channel conglomerates and coarser sand occur and are in contact with similar deposits which are possible avenues of recharge.

TERRACE GRAVELS

Terrace gravels overlie the basin fill with erosional and angular unconformity. The several terrace levels (fig. 1) are separated by vertical intervals of 40 to 100 feet. The gravel deposits are composed of cobbles of andesite, basalt, rhyolite, and red granite, and range from 10 to 40 feet in thickness. Some of this

material is derived locally, but much of it has a more distant, upstream source. These terraces may represent ancient base levels of the Gila River and its tributaries in the Safford basin. It follows that the bed of the ancient Gila River was hundreds of feet above its present elevation. As pointed out above, the southern mapped channel deposit may correlate with terrace gravels in level T3 (fig. 1), and therefore may represent an ancient bed of the Gila River.

ALLUVIUM

The large areas of alluvium are confined to the present flood plain of the Gila River. The sediments are poorly consolidated mixtures of sand, gravel, and silt. This material probably is up to 150 feet in thickness in the Gila River valley and is the main source of ground water in the Safford area at this time.

REFERENCE

Lance, J. F., 1959, Geologic framework of arid basins in Arizona (abs.): Geol. Soc. America Bull., vol. 70, no. 12, p