Map showing the orientation of layering and faults in the San Carlos-Safford-Duncan Nonpoint-Source Management Zone, east-central Arizona

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INTRODUCTION

Plate 1 of this report shows the orientation of layering in rocks exposed in the San Carlos-Safford-Duncan nonpoint-source management area. The map is a compilation of geologic data from a variety of published sources (see Harris, 1996), and unpublished maps on file at the Arizona Geological Survey. Figure 1 shows the location of the San Carlos-Safford-Duncan nonpoint-source management area. The geologic base map for Plate 1 is compiled from Reynolds [1988], Drewes [1996b,c,d], and Drewes [1980].

Rock units shown on the compilation are simplified lithologic units. The units have been generalized to group rock types that are grossly similar in their lithologic character with respect to hydrologic characteristics. Basin fill units have been divided into a younger unit (Qs) of generally non-consolidated sand, gravel and clay that form the near surface deposits, and an older unit (Ts) of generally more consolidated (less permeable) sand, gravel and clay that form most of the deep basin fill. Strata of the older unit have been exposed by erosion due to base-level drop associated with the integration of the regional drainage system. Abundant Cretaceous through late Tertiary volcanic rocks in the area have been divided into two units. The younger (QTb) consists of relatively thin basalt lavas associated with the San Bernardino and San Carlos volcanic fields. These lavas are interbedded with units Ts and Qs. The older volcanic unit (TKv) includes a wide variety of volcanic rocks. These rocks tend to be highly fractured from the time of their formation (except the thick welded tuffs of the Chiricahua Mountains), with rapid lateral variations in lithology. Their fine grain size and degree of fracturing make these rocks quite susceptible to chemical alteration by meteoric or hydrothermal water. The bedded sedimentary rock unit (MzpCs) includes rocks deposited in marine and marginal marine environments during Precambrian and Paleozoic time, as well as fluvial and marine sediments of the Cretaceous Bisbee Group. These units are all characterized by relatively continuous lithology and originally planar, horizontal bedding. In many areas, particularly along the western part of the map area, this originally horizontal bedding has been strongly tilted and disrupted by Mesozoic and Tertiary faulting. Map-scale folds in bedding of these units are delineated by the strike and dip symbols on the accompanying plate. All massive, non-foliated to weakly foliated intrusive igneous rocks have been included in one unit (TpCi). These rocks tend to have very low permeability except along fracture zones, the orientation of which is dictated by the external stresses imposed on the rock body. Bodies of granitic igneous rocks have unpredictable size and geometry, with irregular contacts. Diabase intrusions in the Apache Group (Precambrian sedimentary rocks included in unit MzpCs) were emplaced as sheets parallel to bedding in their host sediments. Metamorphic rocks in the map area are also included in one unit (pCm) because of their heterogeneous character. Foliation in these rocks may be strongly developed and planar over 100's of meters, and control the orientation of fractures and permeable zones. The mylonite zone along the northeastern side of the Pinaleño Mountains is one such zone.

The pattern of faults and bedding shown on this map is highly generalized. If more detailed information is required for a particular area, the geologic map index for the San Carlos-Safford-Duncan nonpoint source management area [Harris, 1996] should be consulted to locate detailed geologic maps.

FAULTING AND TILTING OF STRATA

In general the structural complexity of rocks increases from northeast to southwest across the map area. Tertiary volcanic rocks in the northeastern part of the study area form the southern margin of the Colorado Plateau [Spencer and Reynolds, 1989] (Figure 2). The dip of the volcanic rocks is generally less than 15°, and the dip direction varies regionally. Faults that cut the volcanic rocks have separations of 10's to 100's of feet. Fault separation and tilting of strata is small enough that it is difficult to distinguish dip due to original depositional slopes from tectonic tilting, and many of the faults may be related to volcanic processes. Most of this area has not been mapped in detail. Along the northeastern side of the

San Simon Valley is a transitional zone in which rocks are gently but consistently tilted 10 to 15° to the northeast, separated by down-to-the-southwest, northwest-trending normal faults.

The southwestern part of the map area is in the Basin and Range extensional province and has been affected by Mesozoic faulting of all sorts and by Tertiary normal faulting associated with crustal extension. Major faults and fault zones include, from south to north, the Apache Pass fault complex, Stockton Pass fault zone, Oak Draw fault zone, the Pinaleño-Black Rock detachment fault system, and the Hawk Canyon Fault system (Figure 3). The Apache Pass fault complex and Stockton Pass fault zones are steep west-northwest-trending fault zones with several phases of movement and a number of separate fault strands [Drewes, 1996a, 1996c, 1981]. The Oak Draw fault zone and Pinaleño-Black Rock detachment system are major low-angle normal faults that bound the Pinaleño-Santa Teresa Mountains block on the south and northeast respectively [Spencer and Reynolds, 1989]. Between the Stockton Pass fault zone and the Black Rock Detachment fault, granitic and metamorphic rocks of the Pinaleño and Santa Teresa Mountains are relatively unfaulted [Drewes, 1996a, 1996b]. The Hawk Canyon fault is one of a group of normal faults that bound southwest-tilted mountain blocks of the Mescal Mountains and Hog Mountain area northeast of the Santa Teresa Mountains [Spencer and Reynolds, 1989]. Numerous smaller faults are present, especially in Paleozoic and Mesozoic rocks of the Basin and Range province (unit MzpCs).

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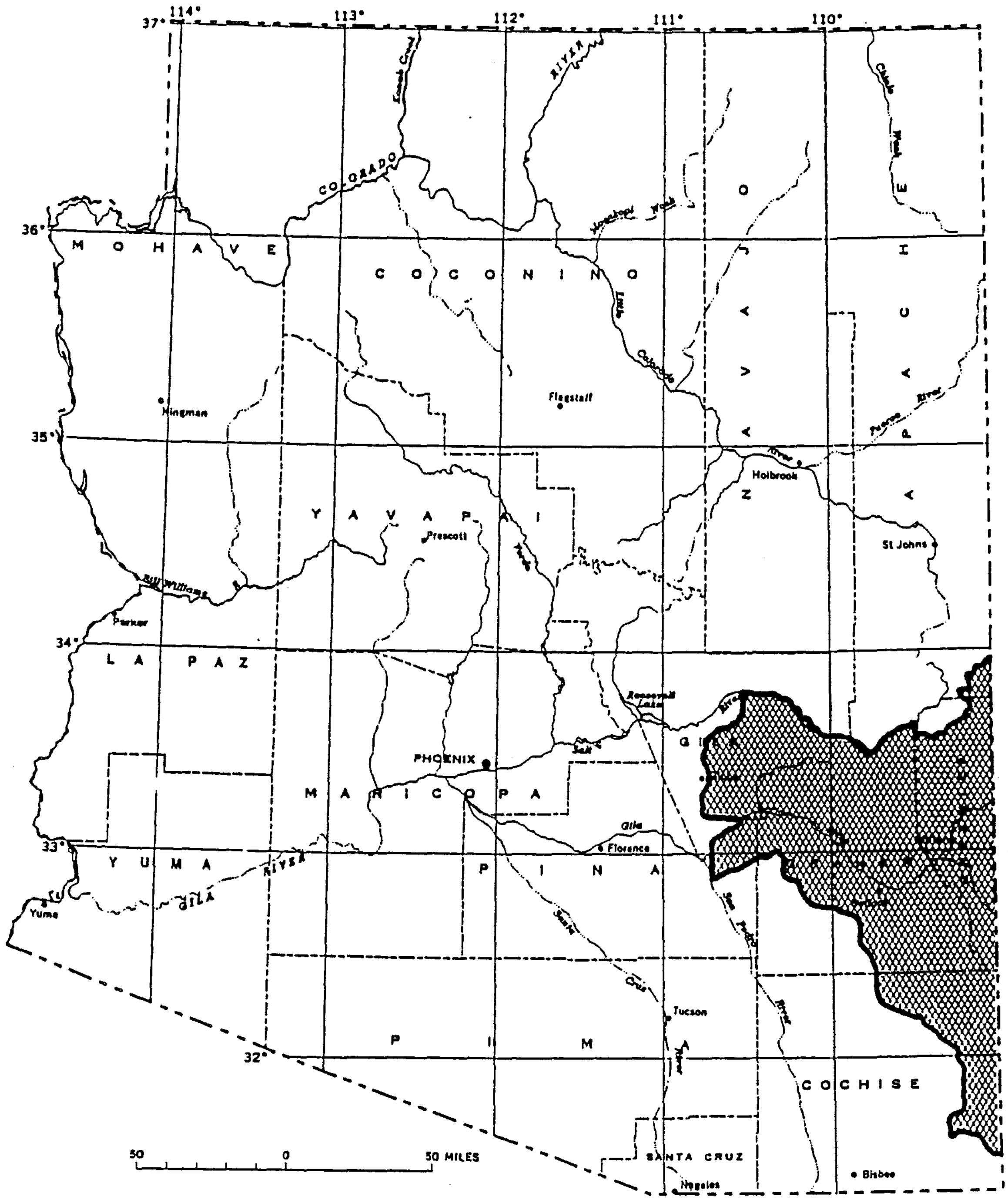

Figure 1. Location of the San Carlos-Safford-Duncan Nonpoint-Source Management Zone.

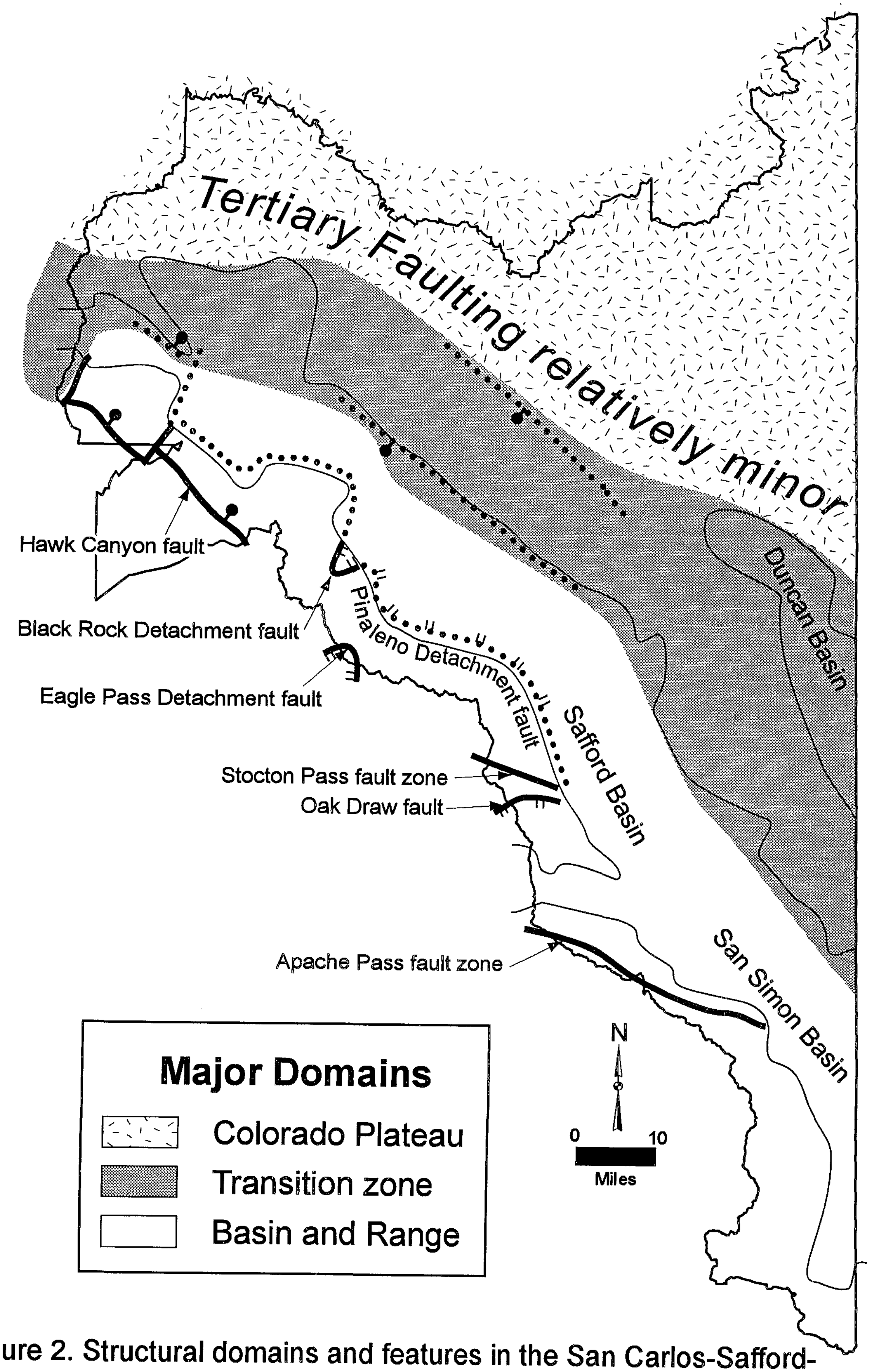

Figure 2. Structural domains and features in the San Carlos-Safford-Duncan nonpoint source management area