A RECONNAISSANCE OF EARTH FISSURES NEAR APACHE JUNCTION, CHANDLER HEIGHTS, AND SOUTHWESTERN PICACHO BASIN

by

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INTRODUCTION

Earth fissures are tension cracks that form in response to land subsidence caused by groundwater pumping. Land subsidence is common in Arizona's alluvial basins, where extensive groundwater withdrawal has lowered water tables by as much as several hundred feet. Subsidence and earth fissures are important because they can cause significant damage to structures such as roads and irrigation canals. Fissures are a serious geologic hazard and their impact will increase as Arizona's population grows.

PURPOSE

Several areas of central and southern Arizona were surveyed by helicopter in 1986. The air survey was mainly a reconnaissance of areas with known fissures to determine if existing fissures had lengthened or new fissures had developed since the areas were last field-checked in about 1977. Fissures seen from the air were plotted on maps, but were not confirmed by field checking. This project was initiated to test the accuracy and efficiency of searching for fissures by air versus using aerial photo interpretation. Three sites were chosen for this study based on indications of earth fissures in and near residential and agricultural areas, and time constraints. The location of the areas covered by this study are shown by bold boxes in Figure 1; two previous Arizona Geological Survey projects in Picacho basin (OFR 89-10 and OFR 91-1) are also shown.

GEOGRAPHIC SETTING

Apache Junction and Chandler Heights are rapidly growing areas known to have earth fissures. Apache Junction straddles the Pinal-Maricopa County line about 25 miles east of Phoenix and is at the northern edge of an area known as Higley basin. Chandler Heights is 25 miles southeast of Phoenix, at the southwest edge of Higley basin and at the northern edge of the Santan Mountains.

Picacho basin is a large area bounded on the east by the Picacho Mountains and Picacho Peak and on the west by the Casa Grande and Sawtooth mountains. The basin lies north of the Silverbell and West Silverbell mountains. Fissures in the north half of Picacho basin have been the subject of numerous investigations. This investigation focused on the southwestern part of the basin, which has received relatively little attention.

PREVIOUS STUDIES

Land subsidence and earth fissure have been intensely studied in Arizona. Pertinent to Picacho Basin are investigations by Peterson (1962), Christie (1978), Slaff and others (1989), Jackson (1990), and Slaff (1991). Data on water-level declines and land subsidence as well as locations of earth fissures in central and southern Arizona are presented in Schumann (1974), Laney and others (1978), and Schumann and Genualdi (1986a; 1986b). The most comprehensive summary of subsidence and earth fissures in Arizona is that of Slaff (1993).

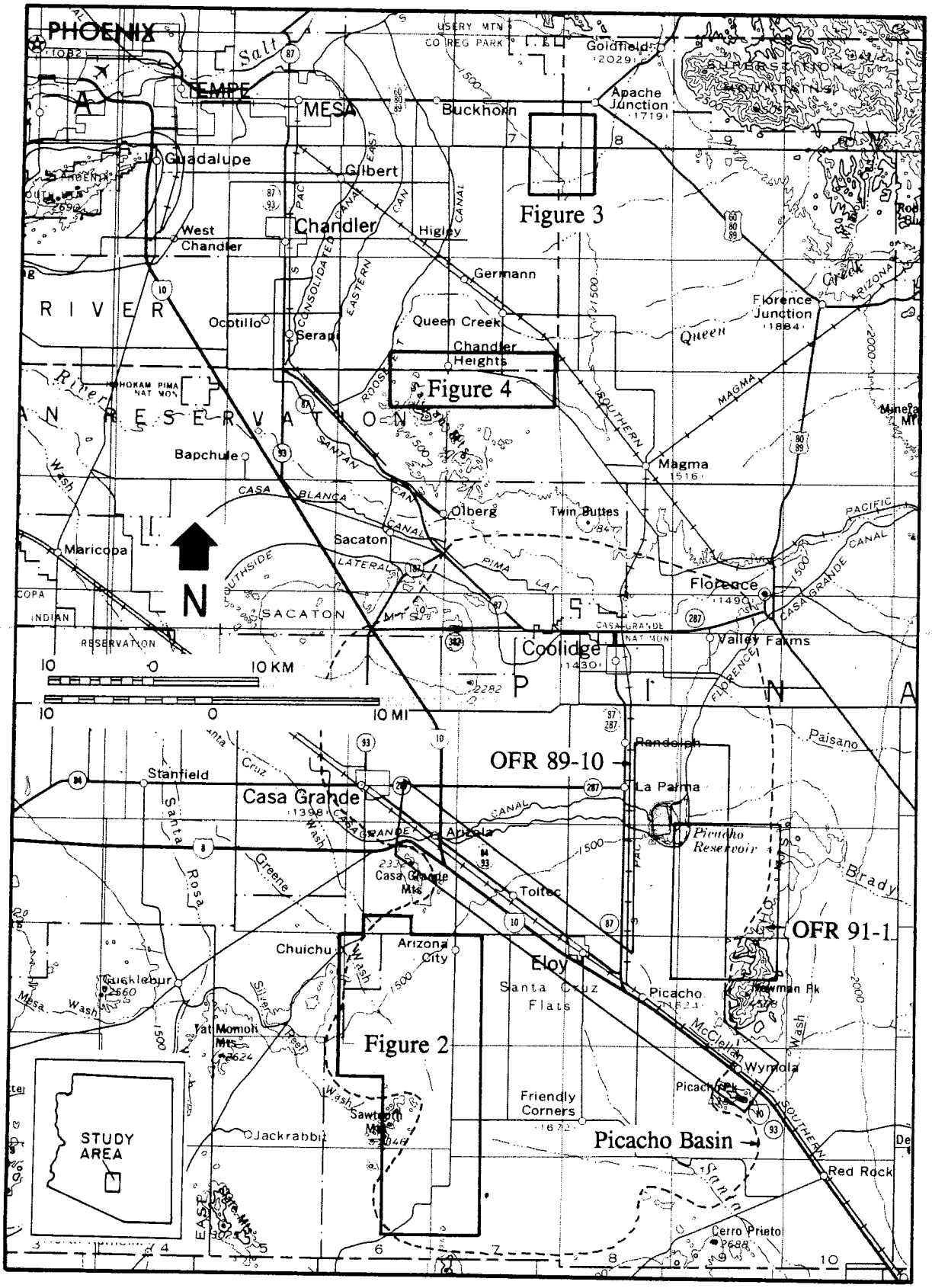

Figure 1. Location of areas surveyed for earth fissures.

METHODS

The first step in this investigation was to compare the unpublished aerial survey maps with detailed air photos. Possible fissures indicated on the maps and photos were visited in the field during April through June 1994. Where possible, intervening areas were also field-checked to determine if fissures were present that were not recognized from the air or were not discernible on photos.

RESULTS

Field work confirmed that most of the features identified by the helicopter reconnaissance were, in fact, earth fissures. In the years since the air survey was performed, several of the fissures have grown. New fissures have developed in Apache Junction near Hawk Rock (Figure 3), and east of Chandler Heights (Figure 4). The new Chandler Heights fissures have formed so recently that they do not appear on detailed air photos taken in 1987. This fissure system damaged an abandoned irrigation canal and rendered a road impassable. A large fissure near a residential area at the southwest margin of Picacho basin was not recorded by the helicopter survey, but is distinct on the 1987 photos.

Collapse pits and depressions found in the western portion of the Picacho basin (Figure 2) have not been described before. These collapse features range from barely recognizable depressions a few inches deep to large pits up to fifteen feet wide and eight feet deep. With the exception of the area of small pits and depressions south of the Sawtooth Mountains, all of the areas with depressions are associated with abandoned wells. One possible explanation for the origin of the collapsed areas is that the well casings are damaged at depth. If alluvium were to move into the well through a flaw in the casing, a void could form around the well. The void could then propagate up to the surface. This scenario might explain why collapse features that are apparently young or active have formed around wells that have been abandoned perhaps for decades. Damage to the well casings could result from regional compaction or from local compaction within steep cones of depression around individual wells.

CONCLUSIONS

As groundwater levels in Arizona's deep alluvial basins continue to decline, land subsidence and development of earth fissures will also continue. Monitoring of earth fissure activity is important for land use planning and reduction of geologic hazards. Helicopter surveys are a rapid way to track the growth and spread of fissures, but cost is a limiting factor in their use. Conventional aerial photo interpretation is less expensive, but detailed photo coverage may be difficult to find and is not available for most parts of the state. Many features, such as old roads, canals, berms, fences, and cattle trails, can interfere with the recognition of fissures on photos. Fissures that are very young may not be obvious from a fly-over or on a photo. Helicopter surveys and aerial photo interpretation can only be confirmed by field-checking.

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