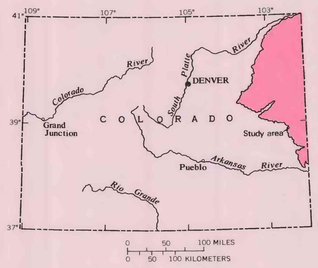
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-669



LOCATION OF STUDY AREA

INTRODUCTION

The northern High Plains of Colorado, an area of about 9,500 square miles in the eastern part of the State (index map), is underlain by the Ogallala Formation of late Tertiary age. The northern High Plains of Colorado extend from the Colorado State line on the east to the edge of the Ogallala Formation on the north, west, and south. The Ogallala Formation is an unconsolidated or partly consolidated deposit of sand, gravel, clay, silt, and caliche that contains sufficient saturated thickness of sand and gravel to be an important source of irrigation water in much of the study area. The Ogallala aquifer, as described in this report, consists of the Ogallala Formation and overlying sediments.

The bedrock underlying the Ogallala Formation is relatively impermeable and restricts vertical ground-water flow. The bedrock surface, therefore, is the bottom of the Ogallala aquifer. A thorough knowledge of this surface will contribute to an understanding of the Ogallala aquifer.

The maps showing the altitude of the top of the bedrock surface and the depth to bedrock were compiled using logs from the wells, test holes, and seismic shot holes plotted on the accompanying map. The majority of the logs were prepared by drillers, but some of the test holes had logs prepared by geologists. The difference in altitude between the land and bedrock surface was also used in preparing the map showing the depth to bedrock. Most data used to construct the map of the bedrock surface were collected in cooperation with the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer.

BEDROCK GEOLOGY

The uppermost bedrock in the northern High Plains of Colorado consists of rocks of Tertiary and Cretaceous age. The White River Formation or Group of Tertiary age primarily is composed of claystone and is the uppermost bedrock in parts of Logan, Phillips, and Washington Counties. The Laramie Formation and Fox Hills Sandstone (sandstone and shale) of Cretaceous age is the uppermost bedrock in the westernmost part of the northern High Plains. The Cretaceous Niobrara Formation primarily is composed of shale and is the uppermost bedrock in northeastern Prowers and eastern Kiowa County. The Pierre Shale, also of Cretaceous age, is the uppermost bedrock in Kit Carson County and in parts of Cheyenne, Kiowa, Lincoln, Logan, Phillips, Washington, and Yuma Counties. The White River Formation, Niobrara Formation and the Pierre Shale are relatively impermeable and yield negligible water to wells. However, the White River Formation or Group, in contrast to the Niobrara Formation and Pierre Shale, locally may contain fractures and channel deposits of sand and gravel which may yield water to wells.

ALTITUDE OF THE BEDROCK SURFACE

The bedrock surface is an erosional surface on Cretaceous and Tertiary rocks that was developed before deposition of the Ogallala Formation. This surface forms the base of the Ogallala aquifer and generally slopes from west to east and ranges from a high of about 5,900 feet in the most western part of the study area to a low of about 3,200 feet at the Colorado State line in two small areas in northeastern Yuma County. Several deep bedrock valleys, such as those in eastern Cheyenne County and south and southwest of Wray, were eroded into the bedrock surface. These valleys were formed by streams flowing on the erosional surface and are shown by upgradient bends in the bedrock contours. Valleys in the bedrock surface do not appear to effect present drainage in most instances. The North Fork Republican River occupies the bedrock valley southwest of Wray. However, the bedrock valley south of Wray, as well as deep bedrock valleys in eastern Washington County, do not contain present stream courses. The Arikaree River valley near Cope overlies a bedrock high. The configuration of the bedrock surface affects ground-water flow. The contours of the water table generally parallel the bedrock surface (Borman, 1979), indicating that ground water generally flows in the direction of the slope of the bedrock surface.

DEPTH TO BEDROCK

The depth to bedrock in the northern High Plains of Colorado ranges from less than 50 feet in several places in Cheyenne, Kiowa, Kit Carson, Lincoln, Logan, Washington, and Yuma Counties to more than 500 feet in east-central Washington County. The depth to bedrock in much of the northern High Plains is between 100 and 350 feet.

The land surface has been lowered by stream erosion so the depth to bedrock generally is less in present stream valleys, such as those of the South Fork Republican River and the Arikaree River, than in upland areas between drainages.

The depth to bedrock generally is greater in areas underlain by bedrock valleys. The bedrock valley in east-central Washington County has relief of about 250 feet. The depth to bedrock in this valley is more than 500 feet, whereas the depth to bedrock in nearby areas outside the valley is less than 350 feet.

The distance from the land surface to the bottom of the Ogallala Formation or aquifer is shown on the map showing the depth to bedrock. This information may be used to estimate the depth of a well which fully penetrates the aquifer. This distance includes the unsaturated part of the aquifer, so the saturated thickness of the aquifer cannot be determined from the map.

The study area is limited to the area underlain by the Ogallala Formation. However, the Ogallala Formation may be overlain by alluvium, colluvium, or eolian deposits, therefore the depth to bedrock at the boundary of the study area may be shown as more than 50 feet.

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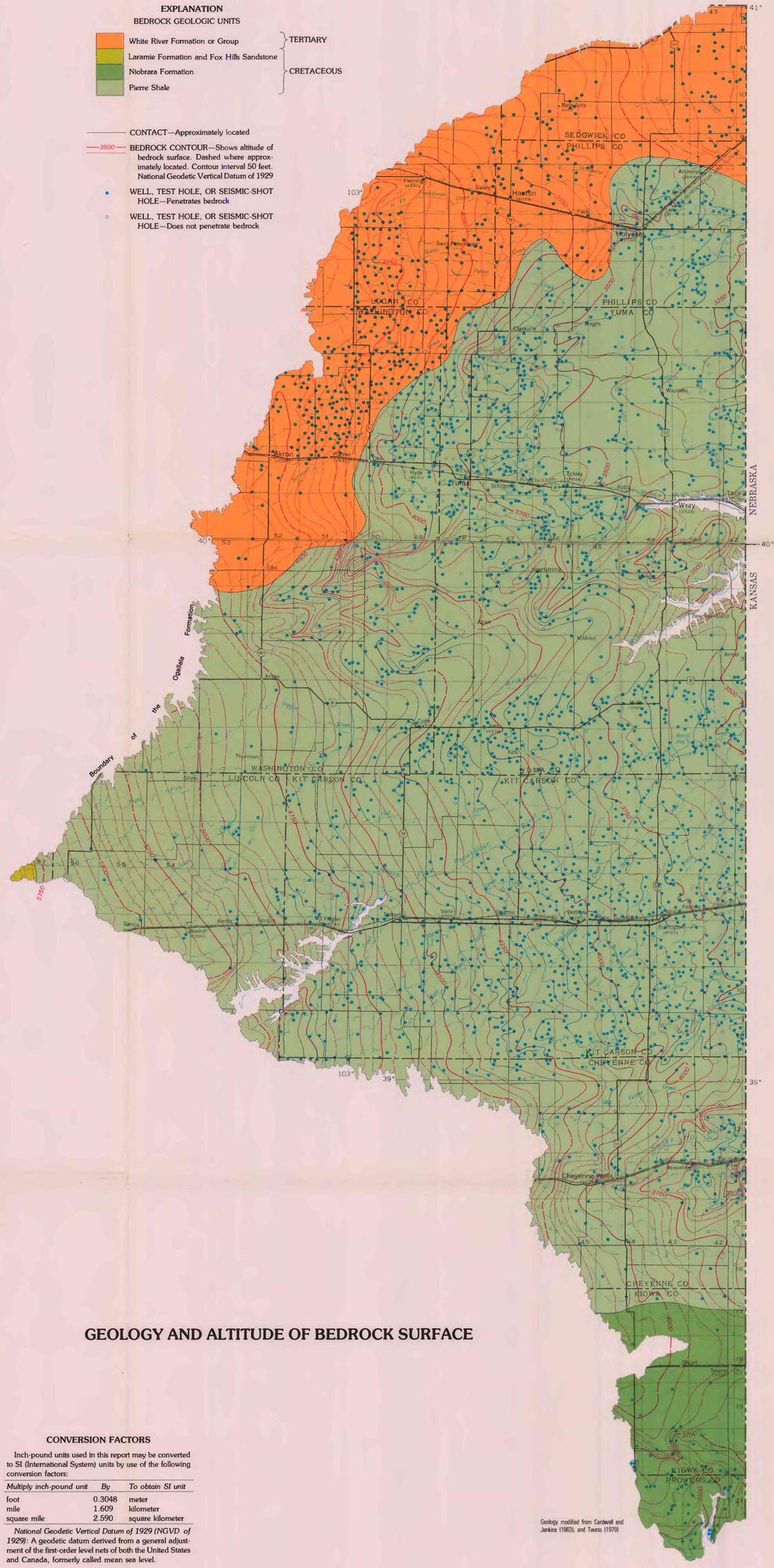
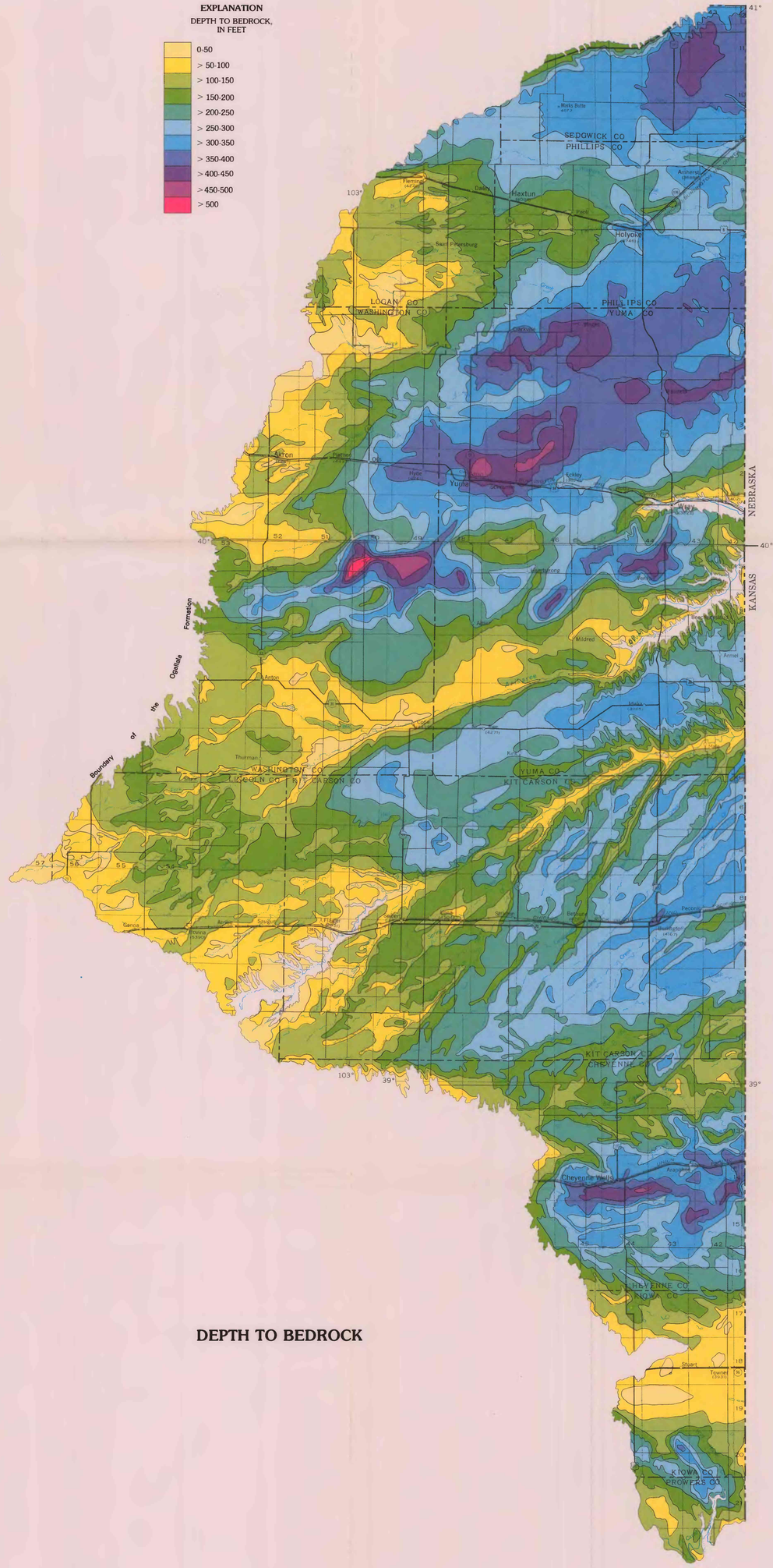


GEOLOGY AND ALTITUDE OF BEDROCK SURFACE

Geology modified from Cardwell and Jenkins (1963), and Tweto (1979)



DEPTH TO BEDROCK

CONVERSION FACTORS

Inch-pound units used in this report may be converted to SI (International System) units by use of the following conversion factors:

Multiply inch-pound unit	*By*	*To obtain SI unit*
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

Base from U.S. Geological Survey
State base map, 1969

SCALE 1:500 000
10 0 10 20 MILES
10 0 10 20 KILOMETERS

GEOLOGY, ALTITUDE, AND DEPTH OF THE BEDROCK SURFACE BENEATH THE OGALLALA FORMATION IN THE NORTHERN HIGH PLAINS OF COLORADO

By
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1983

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