U.S. DEPARTMENT OF THE INTERIOR
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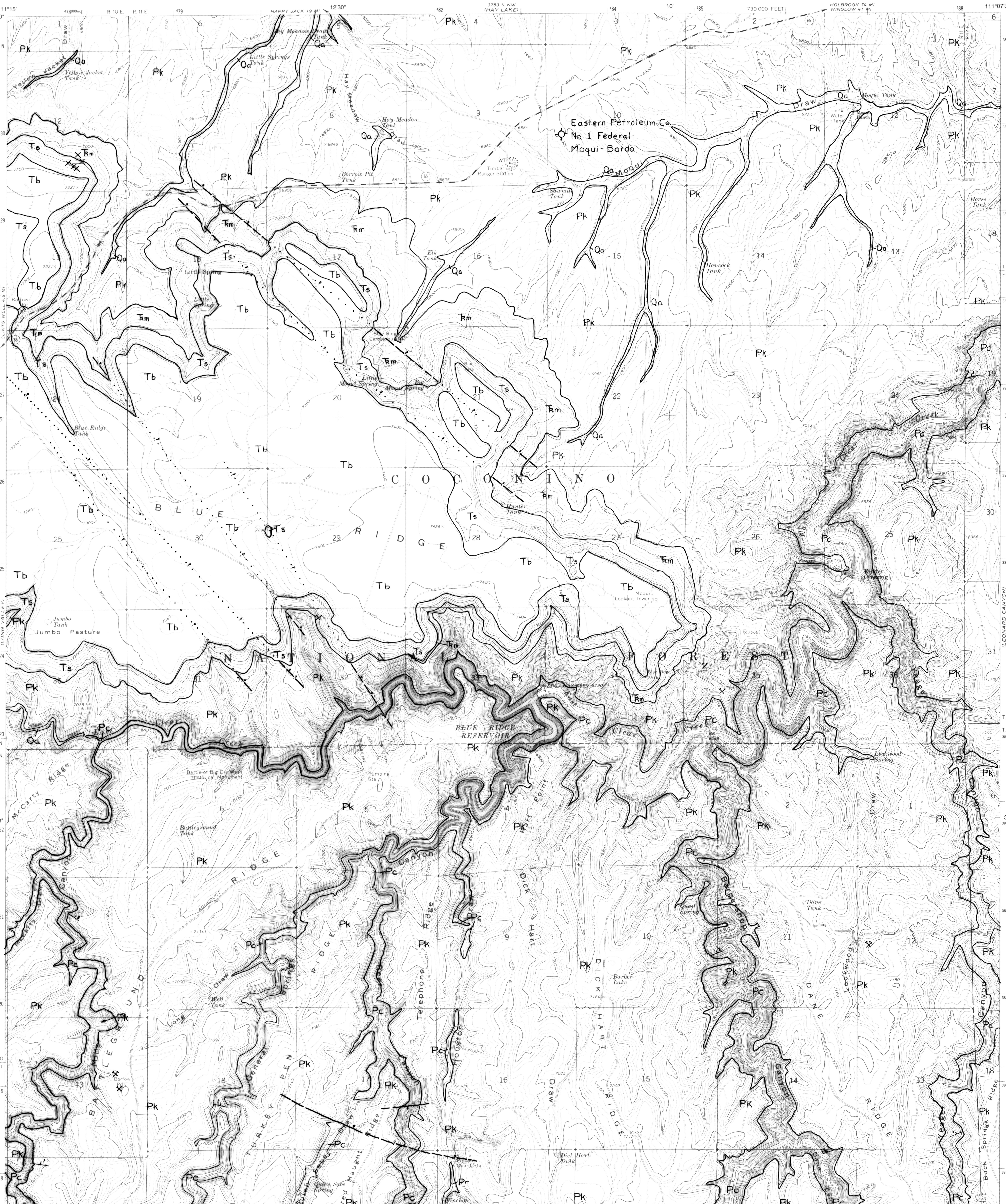

Base from U.S. Geological Survey, 1965
Polyconic projection

APPROXIMATE MEAN DECLINATION, 1994

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

Geology mapped 1984, 1992-1993

CORRELATION OF MAP UNITS

Unit		
Qa	Holocene	QUATERNARY
Unconformity		
Tb	Miocene	TERTIARY
Unconformity		
Ts	Eocene? and Paleocene?	TERTIARY
Unconformity		
TRm	Middle? and Lower Triassic	TRIASSIC
Unconformity		
Pk	Lower Permian	PERMIAN
Unconformity		
Pc	Lower Permian	PERMIAN

DESCRIPTION OF MAP UNITS

Qa **Alluvium (Holocene)**--Dark-gray to dark-brown, thin-bedded silt, mixed with minor sand and gravel. Forms floor of Moqui Draw and embankments along lesser streams. A modern alluvium, composed mostly of clasts of chert and dolomite derived from Kaibab Formation, is commonly entrenched in the dark silt. Boundaries of alluvium are generally indefinite; only larger areas are shown. Probably as much as 6 m thick near Moqui Ranch.

Tb **Basaltic rocks (Miocene)**--Medium- to dark-gray, weathers dark grayish brown, aphanitic to medium grained. Groundmass is micrograined to very fine grained, composed of acicular plagioclase, clinopyroxene, olivine, and opaque oxides. Olivine phenocrysts are mostly 1 to 4 mm in diameter; clinopyroxene and plagioclase phenocrysts average 1 to 2 mm in diameter. Basalt, commonly vesicular, is in flow units 6 to 12 m thick; yields large colluvial blocks that obscure basal contact. At base of basalt is unconformity that irregularly truncates Tertiary sedimentary rocks. Thickness uncertain because of relief along unconformity; unit probably as much as 25 m thick on hills east of Jumbo Pasture on southern part of Blue Ridge. Samples from basalt flows in Pine quadrangle, about 13 km to the southwest, yielded K-Ar ages of 11.4 +/- 0.27 Ma (Pierce and others, 1979, p. 7) and 14.25 +/- 0.74 Ma (Muhammad Shafiqullah, University of Arizona, and H.W Peirce, Arizona Geological Survey, oral and written communs., 1988).

Basalt lies on a northwesterly sloping erosional surface that has relief of about 80 m in this quadrangle. Age of surface is poorly constrained but is probably result of erosion during late Eocene and Oligocene (Elston and Young, 1991, p. 12,392, 12,398-12,399). Regional studies suggest that this surface may be part of a late Paleogene erosional surface that extends from Canada through western United States into Mexico (Epis and Chapin, 1975, p. 63-69; Gresens, 1981, p. 146-151). Locally, the surface has been traced from this quadrangle about 20 km southwestward to near Fossil Springs (Weir and Beard, 1984). There the surface slopes downward more than 400 m in less than 1.2 km, marking an ancient edge of the Colorado Plateau (Twenter, 1962; Peirce, 1987).

Ts **Sedimentary rocks (Eocene? and Paleocene?)**--Conglomerate, in places interstratified with or grading upward to beds of sandstone and mudstone; locally includes beds of limestone. Conglomerate is mostly yellowish gray, commonly reddish gray near top of outcrops. Matrix is fine and medium grains of quartz and chert. Stones are chiefly subangular to rounded pebbles of chert and dolomite derived from Kaibab Formation. Boulders of dolomite are common near base. Pebbles and cobbles of Coconino Sandstone are rare but conspicuous. Rounded pebbles to boulders of Precambrian rocks are locally common near base in northwestern part of the quadrangle. They are abundant in outcrops along highway in the SW 1/4 sec. 13, T. 14 N., R. 10 E. Distinctive clasts of black rhyolite and rhyodacite porphyry in Tertiary sedimentary rocks in adjacent Long Valley quadrangle (Weir and others, in press) are identical to rocks exposed in New River Mountains about 80 km south-southwest of this area (C.M. Conway, U.S. Geological Survey, oral commun., 1985).

Stratification of conglomerate is generally indistinct; some conglomerate is in uneven horizontal beds about 0.3 to 1 m thick. Imbrication of stones in conglomerate is uncommon but locally suggests easterly transport. Conglomerate is poorly indurated and yields abundant pebbles to colluvium, which locally obscures base.

Sandstone and mudstone are mostly reddish brown to grayish red. Sandstone is composed of subangular to subrounded, very fine to fine grains of quartz and chert and is in uneven beds generally less than 30 cm thick. Mudstone is very silty, in part gypsiferous, and locally tuffaceous; it is in thin even beds, whose outcrops weather to hackly or fluffy surfaces. Sandstone and mudstone are largely restricted to the upper part of sections more than 30 m thick.

Light-gray micrograined limestone crops out locally in northwestern part of the quadrangle, as along highway in the SW1/4 sec. 13, T. 14 N., R. 10 E. Limestone is in wavy laminae in lenses about 1 to 3 m thick and 10 to 30 m long. Limestone exposed along highway contains abundant molds of aquatic plants, some in growth position (Peirce and Nations, 1986, p. 113-114).

Tertiary sedimentary rocks crop out poorly on forested slopes below basalt cap of Blue Ridge. They are well exposed only along highway and in quarry in the SW1/4 sec. 13, T. 14 N., R. 10 E. Unit ranges irregularly in thickness from about 35 m northwest of Little Spring to about 65 m near Hunter Tank.

Tertiary sedimentary rocks lie unconformably on Moenkopi and Kaibab Formations. The unconformity is an irregular, northwesterly sloping surface that in the Blue Ridge area has a relief of about 150 m (Weir and others, in press; Weir and Nealey, 1993). It is part of a regional erosion surface formed in Late Cretaceous and Eocene (Elston and Young, 1991, p. 12,392).

Sediments are mostly fluvial deposits derived from erosion of local bedrock and from highlands in south-central Arizona. Limestone indicates that fluvial deposition was interrupted by local ponding. Some fine-grained tuffaceous layers may be airfall deposits.

Tertiary sedimentary rocks of this quadrangle are part of an isolated patch of Tertiary sedimentary rocks centered roughly on Blue Ridge (fig. 1) near edge of Colorado Plateau in Arizona. The nearest similar Tertiary deposits, which may be of more than one generation, are on rim of West Clear Creek about 30 km east of this quadrangle (Ulrich and Bielski, 1983), near Fossil Creek about 35 km southwest (Weir and Beard, 1984), on Buckhead Mesa about 33 km south-southwest (Peirce and Nations, 1986, p. 115), and near Young about 52 km southeast (Young and others, 1987, p. 192).

Because Tertiary sedimentary rocks of Blue Ridge area lack fossils and dated igneous clasts, their age is inferred from regional studies of stratigraphy and paleomagnetism. They are correlated with similar rocks that occupy a similar stratigraphic position near the Mogollon Rim, which forms the south edge of Colorado Plateau in Arizona. Tertiary sedimentary rocks near the Plateau are commonly referred to as "Rim gravels" (Cooley and Davidson, 1963, fig. 10). Similar deposits in east-central Arizona have been referred to informally as the "Mogollon Rim formation" (Potochnik, 1989, p. 110). Rim gravels of the region have been dated as late Paleocene to late Eocene on the basis of K-Ar ages of volcanic clasts, gastropods, magnetic polarity, pollen, and dated volcanic ash beds (Elston and Young, 1991). Paleomagnetism of samples collected from Tertiary sedimentary rocks in the SW1/4 sec. 13, T. 14 N., R. 10 E. is consonant with the inferred Paleocene-Eocene age (Elston and others, 1989, p. 161-162).

TRm **Moenkopi Formation (Middle? and Lower Triassic)**--Reddish-brown siltstone and sandstone, and locally a basal grayish-yellow conglomerate. Siltstone is micaceous and forms thick sets of laminae and thin beds. Sandstone is very fine to medium grained and locally finely micaceous. It is in thin, lenticular beds, a few centimeters to about a meter thick, interstratified irregularly in siltstone. Conglomerate is composed chiefly of coarse grains to small boulders of chert and dolomite derived from the Kaibab Formation. In northwestern part of quadrangle the conglomerate contains pebbles and cobbles of Precambrian gray quartzite. Quartzite clasts indicate an Early Triassic source area to the south or west, similar to Mogollon Highlands of Cooley and Davidson (1963). Conglomerate is in lenses, as much as 1 m thick, resting on an irregular unconformity. The Moenkopi is cut out about 1.5 km west-northwest of the dam of Blue Ridge Reservoir by the unconformity at base of Tertiary sedimentary rocks. Formation probably reaches a maximum thickness of about 80 m on covered slopes on east flank of Blue Ridge.

Pk **Kaibab Formation (Lower Permian)**--Dolomite, limestone, and sandstone. Dolomite and limestone are yellowish gray to light gray, very fine to fine grained, in part finely sandy. Locally contain abundant irregular nodules, mostly about 2 to 10 cm in diameter, of reddish-brown and light- to medium-gray chert. Carbonate beds, generally about 0.3 to 1.3 m thick, have uneven surfaces owing in part to interstratal solution. Fossils, in a few beds near base of formation, include silicified brachiopods, gastropods, crinoid colunals, and fragments of sponges. Sandstone is light brown to pinkish gray, composed of fine to medium, subrounded to rounded grains of quartz and minor amounts of feldspar and mica; irregularly interstratified with dolomite and limestone in lenses commonly 0.3 to 1 m thick. In areas of low relief formation commonly weathers to a chert-fragment residuum that resembles weathered outcrops of Tertiary sedimentary rocks.

Upper surface of Kaibab is irregular and may be in part an ancient karst preserved beneath Moenkopi and Tertiary sedimentary rocks. Base of the formation is an unconformity that has local relief of as much as 6 m in a distance of 30 m. Kaibab is irregular in thickness because of unconformities at base and top; it probably ranges from about 115 to 200 m in thickness.

Pc **Coconino Sandstone (Lower Permian)**--Sandstone, very light grayish orange to pale orange. Composed of very fine to fine, subrounded to rounded grains of quartz and trace amounts of feldspar, chert, and mica; moderately well cemented by silica. In planar and trough sets, commonly about 1 m thick, of low- to high-angle crossbeds. Forms steep canyon walls along streams in southern part of quadrangle. About 75 m of the formation is exposed along East Clear Creek near east edge of quadrangle. Where Coconino is fully exposed in Pine quadrangle, about 22 km west-southwest, formation ranges from about 245 to 305 m in thickness (Weisman and Weir, 1990).

DESCRIPTION OF MAP SYMBOLS

- Contact
- Fault - dashed where approximately located; dotted where concealed; queried where conjectural. Bar and ball on downthrown side.
- Strike and dip of inclined beds
- Prospect pit (manganese)
- Quarry
- Oil and gas well (dry hole)

GEOLOGIC SUMMARY

INTRODUCTION

The Blue Ridge Reservoir quadrangle lies in the southwestern part of the Colorado Plateau in the western part of the Mogollon Slope, which inclines gently to the northeast. The south edge of the quadrangle is about 8 km north of the Mogollon Rim, which marks the physiographic edge of the Plateau. Elevations range from about 6,370 to 7,435 ft (1,942-2,268 m). Total relief in the quadrangle is about 1,060 ft (325 m), but away from the canyons of East Clear Creek and its tributaries and the rim of Blue Ridge local relief is commonly less than 100 ft (30 m).

Only a few families live in the area all year. However, from late spring to early autumn the population increases to several hundred as people move to the cool highlands to occupy cabins, recreational vehicles, and campsites. The area lies within a Ponderosa pine forest that extends hundreds of kilometers east and west along the margin of the Colorado Plateau. Logging and tourism are the principal economic activities.

Sedimentary formations exposed in the quadrangle have an aggregate thickness of more than 400 m and range in age from Permian to Tertiary. Miocene basalt caps Blue Ridge. The structure is simple, complicated chiefly by unconformities that have large relief. Faults are few and have small displacements. The prevailing dips are very low to the north.

STRUCTURE

The quadrangle lies about 18 km east of the axis of the Mormon Mountain Anticline, a broad regional structure whose east flank is characterized by low northeasterly dips (Weir and others, 1989). Details of structure within this quadrangle are obscured by relief on unconformities and by interstratal solution of carbonate beds. Contours drawn on the unconformity at the base of the Kaibab Formation (fig. 1) indicate a general northerly dip of about 1 to 2 degrees. Some irregularities in the contours result from uneven paleorelief on the underlying Coconino Sandstone.

Northwest-trending linear narrow valleys in basalt and Tertiary sedimentary rocks on Blue Ridge probably indicate minor faults of pre-Tertiary age. Topographic differences across the valleys are as much as 6 m, but the differences may be magnified by solution of carbonate rocks in the underlying Kaibab Formation. Displacements cannot be accurately determined because of poor exposures, and the probable faults can be projected only short distances in the Kaibab.

Minor faults on Fred Haught Ridge near the south edge of the quadrangle have displacements of about 1 to 6 m.

ECONOMIC GEOLOGY

The chief economic asset of this quadrangle is its scenic woodland. Small deposits of manganese are in the western part of the quadrangle. Several formations have been quarried for local use. The petroleum potential of the area is uncertain. Ground water has been little exploited.

A few prospect pits for manganese are in Tertiary sedimentary rocks and the Moenkopi Formation on the northeast-facing slopes of Blue Ridge in the S1/2 sec. 12, T. 14 N., R. 10 E. Black and purplish-black manganese oxides impregnate and coat clasts in these formations. Farnham and Stewart (1958, p. 11) mentioned deposits, which yielded small amounts of ore in the 1940's, in sec. 35, T. 14 N., R. 11 E. and in sec. 7, T. 13 E., R. 11 E. Lane (1992, p. 33, 67-68) reported analyses of samples of maganese-impregnated rock collected from or near these deposits ranging from about 41 to 47 percent manganese.

Conglomerate and fine-grained rocks were quarried from Tertiary sedimentary rocks near the highway in the SW1/4 sec. 13, T. 14 N., R. 10 E. The fine-grained rocks were probably used as road fill. The crushed conglomerate was used to surface dirt roads in the Coconino National Forest. Dolomite from the Kaibab Formation has been excavated from small quarries in the east-central and southwestern parts of the quadrangle. The dolomite was used as fill and surfacing material.

The oil and gas potential of the quadrangle is difficult to assess because little is known about the details of subsurface structure and stratigraphy. Among the few wells drilled in the southwestern part of the Colorado Plateau are the Eastern Petroleum Co. No. 1 Federal-Moqui-Bardo in the SW1/4 sec. 10, T. 14 N., R. 11 E. and the Pease No. 1 Federal in the Turkey Mountain quadrangle (Weir and Nealey, 1993) about 14 km to the northwest (Conley, 1975a, b). The Eastern Petroleum well penetrated 3,691 ft (1,125 m) of Paleozoic sedimentary rocks and bottomed in Devonian strata. The Pease well penetrated 3,595 ft (1,096 m) of Paleozoic sedimentary rocks and bottomed in Precambrian rocks (Peirce and Scurlock, 1972, p. 161, 162). No shows of oil were reported in either well. Both wells are on relative highs as shown by contours on the unconformity on the top of the Coconino Sandstone (Conley and Scurlock, 1976), though contours on a key bed lower in Permian strata show a regional northeasterly slope (Conley, 1977).

Peirce and Wilt (1970, p. 51-72) observed that in this region Cambrian, Devonian, and Mississippian formations are potential host rocks for oil and gas and that the Pennsylvanian and Permian section may also contain host rocks. The effect of Tertiary eruptions of basalt in this region on petroliferous units is uncertain. However, inasmuch as oil is produced from a Tertiary sill in Paleozoic strata in northeastern Arizona (Peirce and Wilt, 1970, p. 46, 48-49), the volcanic activity probably did not preclude accumulations of oil and gas.

Surface water provides most local needs. Several wells have been drilled to tap ground water in the Coconino Sandstone (Conley, 1975a,b). The wells into the Coconino, the principal aquifer of the region, range in depth from about 145 to 300 m.

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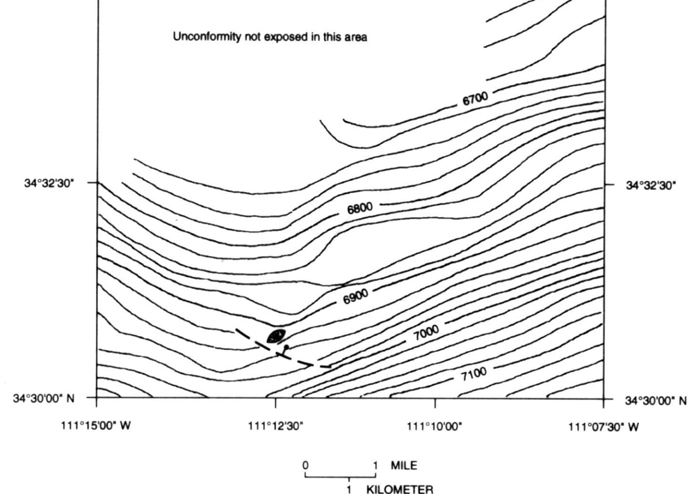

Figure 1. Contours drawn on unconformity at base of Kaibab Formation in the southern part of the quadrangle. Contour interval 20 ft. (6.1 m). Surface slopes generally northward about 1 to 2 degrees. Some irregularities shown by contours probably reflect uneven paleotopography at top of underlying Coconino Sandstone.

PRELIMINARY GEOLOGIC MAP OF THE BLUE RIDGE RESERVOIR QUADRANGLE, COCONINO COUNTY, ARIZONA

By

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1997

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