DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAPS
OF THE UNITED STATES

GEOLOGIC MAP
OF THE
SPRUCE MOUNTAIN QUADRANGLE
ELKO COUNTY, NEVADA

By
Roger A. Hope

PUBLISHED BY THE U.S. GEOLOGICAL SURVEY
WASHINGTON, D.C.
1972
STRATIGRAPHY

A brief description of each stratigraphic unit is given in the explanation. The units occur in other areas, where they have been extensively described. Peculiarities in the Spruce Mountain stratigraphy are described below.

Undifferentiated dolomite.—The 1,000-foot-thick interval above the Eureka Quartzite and below the Simonson Dolomite contains a heterogeneous assemblage of dolomite beds. To the east, in the Toana and Goshute Ranges, H. J. Bissell (written commun., 1966) was able to differentiate this interval into the Fish Haven Dolomite (Ordovician), Laketown Dolomite (Silurian), and Sevy Dolomite (here Devonian) with a combined thickness of 1,555 feet. The same interval in the central Pequop Range northeast of Spruce Mountain, assigned by Thor­man (1962, p. 28-35) to the Ely Springs (Ordovician) and Lake­town (Silurian) Dolomites, has a thickness of 1,685 feet.

Riepe Spring Limestone of Steele (1960).—The Riepe Spring Limestone was named by Steele (1960, p. 102) for exposures at the north end of Ward Mountain, White Pine County, where it is entirely of middle Wolfcamp (Late Pennsylvanian) age. In the Spruce Mountain quadrangle, rocks of similar lithology range from Missouri and Virgil (Late Pennsylvanian) to Wolf­camp (Early Permian) on the basis of fusulinids. Although the Riepe Spring is about 1,400 feet thick throughout the quadrangle, in three stratigraphic sections the thickness of the Upper Pennsylvanian part of the formation decreases to the southwest from between 690 and 1,140 feet (section 1, fig. 1) to between 80 and 140 feet (section 2). The thickness of Lower Permian

EXPLANATION

Limestone, medium to thick-bedded

Limestone, thin-bedded

Chert-pebble conglomerate

Sandstone and calcarenite

Dolomite

Siltstone

Nodular chert

FIGURE 1. Three stratigraphic sections showing the relation between the Riepe Spring Limestone of Steele (1960) and the Pennsylvania-Permian boundary. See map for location of sections.
clearly truncated at the faults. A 200-foot-thick zone of plates of both faults have nearly parallel eastward dips and are sheared and partially recrystallized Pogonip limestone under-

(see sections A-A' and F -F'). Strata in the upper and lower above and truncates the South Peak fault to the north and west dip about \[45^\circ\] W. and truncates the East fault to \[70^\circ\] E., but steepens farther north. Slip apparently increases southward (see sections E-E', D-D', and C-C'). The reverse separation of the North Peak fault across the East fault in section E-E' indicates either reverse or left-lateral slip. Either way it is likely that there has been rotation along the East fault. The West fault, which dips about \[45^\circ\] W. and truncates the East fault to lies the Spruce Spring fault, but this zone either pinches out or is not exposed where the Spruce Spring fault overrides the South Peak fault. Possibly, some of the curvature of these two faults was caused by upwarping during formation of the Spruce Mountain horst.

The direction of slip on these low-angle faults has not been determined, but for two reasons it is likely that the upper plates moved relatively westward. First, the strata in both upper and lower plates dip rather uniformly eastward (aside from some folding), and there is always a missing stratigraphic interval with younger rocks on older across the faults. If upper plate rocks slipped westward, net slip need not be large. Minimum magnitudes (assuming the slip was approximately perpendicular to the regional strike of bedding) would be 2–3 miles for the North Peak and Spruce Spring faults, and 1–2 miles for the South Peak fault. If upper plate rocks moved eastward, slip would have to be substantially greater. Second, large-scale folds overturned to the west and low-angle faults whose upper plates moved west are exposed east of this quadrangle in the southern Pequop Mountains (G. Fraser, written commun., 1968; Snelson, 1955). The entire southern part of the Pequop Moun-

High-angle faults.—The other faults in this range dip more steeply and have more northerly trends, although faults of all trends and curved traces are common, particularly east of the East fault. None of these faults is noticeably folded. Most show normal separations and indicate crustal elongation.

Some faults, exposed only in upper plate rocks, may have formed at the same time as the low-angle faults and may curve into them at depth. Faults in the upper plate of the Spruce Spring fault east of the East fault do not seem to cross the Spruce Spring fault (see sections A-A' and B-B'). Faults older than the low-angle faults have not been demonstrated.

The East and West faults, which bound the Spruce Mountain horst, as well as a parallel fault about a mile east of the East fault are clearly younger than both the low-angle faults and most of the other high-angle faults. This can be seen by their cross-cutting relationships, as well as their more pronounced topographic expression. South of the canyon containing the Black Forest mine, the East fault dips about \[45^\circ\] E., but steepens to about \[70^\circ\] farther north. Slip apparently increases southward (see sections E-E', D-D', and C-C'). The reverse separation of the North Peak fault across the East fault in section E-E' indicates either reverse or left-lateral slip. Either way it is likely that there has been rotation along the East fault. The West fault, which dips about \[45^\circ\] W. and truncates the East fault to

---

**FIGURE 2.** Hypothetical cross section of Spruce Mountain area after development of low-angle faults, but before high-angle faulting and eastward tilting. Lithologic symbols same as on map.
the north, has a greater net slip than the East fault and prob-
ably formed as rocks of the range were tilted eastward.
If, as is postulated, the eastward tilting occurred simulta-
neously with the younger high-angle faulting, then the low-angle
faults existed prior to tilting. Figure 2 shows what an east-
west cross section through Spruce Mountain would have looked
like just prior to high-angle faulting and tilting. The low-angle
faults would be south- to east-dipping normal faults. Folding
in the upper plate of the North Peak fault could be attributed to
a flattening of the dip as the fault followed the incompetent
Chainman-Diamond Peak interval before cutting more steeply
through the strata above and below.

Later Tertiary or Quaternary landslide.—The low bluff just
east of U.S. Highway 93 is capped by a nearly flat resistant
50-foot layer of limestone breccia overlying folded Tertiary
tuffaceous sandstone, ash, and earthy limestone. The Tertiary
strata are not deformed in contact with the breccia. Their folding
appears to have preceded emplacement of the breccia. The
breccia fragments are generally angular. Most clasts are 2-3
inches across, but blocks over a foot in diameter are fairly com-
mon. Many fragments have not moved far relative to one an-
other, because details of their internal structure as well as their
outlines can be matched. A band of limestone fragments con-
taining rounded quartz sand grains can be traced along the face
of the bluff near the base of the breccia. The band is undula-
tory, varies in thickness up to a maximum of about 3 feet, and
contains admixed fragments of other lithologies—particularly
ward the margins. About 99 percent of the breccia frag-
ments probably represent the Guilmette Formation. Fossil
fragments of spaghettilike Cladopora or Amphipora occur in a
few clasts. The Guilmette fragments contain abundant calcite
veins and are brecciated from an earlier cataclastic event. Oth-
er minor lithologies are fusulinid-bearing limestone (probably
derived from the lower part of the Pequop Formation of Steele,
1959, 1960) and quartzite.

Other outcrops of brecciated and veined Guilmette Formation
occur only on the summit and surrounding parts of Spruce
Mountain where brecciation is spatially and probably genetically
related to the overlying North Peak fault. Therefore, the pre-
viously brecciated limestone mass near the highway apparently
slid from Spruce Mountain. It was partly disaggregated during
transport, because its areal outcrop is considerably larger than
the source area and because there is a small admixture of exot-
ic fragments. This mass, interpreted here as a landslide, has
been previously called the upper plate of a thrust (Wheeler and
McNair, 1950) and the basal part of a dissected and faulted al-
luvial fan (Hazzard and Moran, 1952, p. 845-848).

REFERENCES
Hazzard, J. C., and Moran, W. R., 1952, Reported late Tertiary
thrusting in northeastern Nevada: Am. Assoc. Petroleum
Geologists Bull., v. 36, no. 5, p. 844-856.
Snelson, Sigmund, 1955, Geology of the southern Pequop Moun-
Steele, Grant, 1959, Basin-and-range structure reflects Paleo-
zoic tectonics and sedimentation [abs.]: Am. Assoc. Petrole-
um Geologists, v. 43, no. 5, p. 1105.
Thorman, C. H., 1962, Structure and stratigraphy of the Wood
Hills and a portion of the northern Pequop Mountains, Elko
Wheeler, H. E., and McNair, A. H., 1950, Late Tertiary thrust-
ing in northeastern Nevada [abs.]: Geol. Soc. America Bull.,
v. 61, no. 12, pt. 2, p. 1518.