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PRECAMBRIAN ROCKS OF SOUTHWESTERN NEW MEXICO

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INTRODUCTION

The Precambrian rocks of southwestern New Mexico are currently of little economic interest; however, the possibility of their containing ore should not be ignored. One needs only to recall the United Verde and United Verde Extension ore bodies in the Precambrian of Arizona (Anderson, 1968) to visualize the possible rewards. Also, to fully understand the geologic framework of the region it is necessary to have at least a rudimentary knowledge of the basement rocks.

Most of the Precambrian rocks that are exposed in southwestern New Mexico (Fig. 1) are granitic, although locally metamorphic rocks may be very abundant. At a number of localities these rocks are unconformably overlain by sedimentary strata of Cambrian age and assignment of the crystalline rocks to the Precambrian is not questioned. At a few other localities, though, the stratigraphic relations are not conclusive and the Precambrian age of the crystalline locks is tentative, particularly with the general lack of radiometric data.

The only published radiometric ages that I am aware of were reported by Zeller (1965) for granite at Hatchet Gap north of the Big Hatchet Mountains (loc. 17, Fig. 1) . Zeller (1965, p. 8) cited a written communication from Jaffe and Schlecht (1957) reporting ages of 605 m.y. and 640 m.y. obtained from zircons. The analytical techniques were not stated, but presumably these were lead-alpha dates. In view of the apparent absence of any known granite-forming event of this general age in adjacent regions, including southeastern Arizona (Livingston and Damon, 1968; Erickson, 1968) and southcentral New Mexico (Muehlberger and others, 1967; Denison and Hetherington, 1969) the dates reported by Zeller are considered tentative. Bickford and Wetherill (1965) have noted that no major occurrence of igneous or metamorphic rock in North America is known for the period 900-500 m.y. ago.

Engel (1963) considered the Precambrian rocks of southwestern New Mexico to belong to the Central Precambrian province of North America which ranges from 1.4 b.y. to 1.8 b.y. in age. This assignment appears to be compatible with radiometric ages that are reported for adjacent regions (Livingston and Damon, 1968; Denison and Hetherington, 1969) . However, with the absence of well documented absolute ages for most of southwestern New Mexico, assignment to any particular province is tentative.

Precambrian outcrops shown on Figure 1 are modified from a preliminary map by Foster and Stipp (1961) . Other general references include geologic folios by Paige (1916) and Darton (1917). Localities shown by number on Figure 1 are referred to with specific references in the following section.

OCCURRENCES AND LITHOLOGIES

In the northern Big Burro Mountains (loc. 1, Fig. 1) Hewitt (1959) described a Precambrian sequence of rocks consisting of two metamorphic series that were both intruded by the Burro Mountains batholith. Gillerman (1964) extended the usage of these units recognized by Hewitt throughout western Grant County, New Mexico (loc. 2, Fig. I) .

The oldest metamorphic rocks described by Hewitt (1959) belong to the Bullard Peak series and consist of roof pendants and xenoliths of quartz-feldspar gneiss, biotite gneiss, muscovite schist, biotite schist, sillimanite gneiss, hornblende gneiss, amphibolite, and granite gneiss. These rocks formed by amphibolite facies regional metamorphism of argillaceous feldspathic sandstone, calcareous argillaceous siltstone, shale, dolomitic shale, diabase, and granite.

Another group of metamorphic rocks in the Burro Mountains was named the Ash Creek series by Hewitt (1959) and is interpreted as being younger than the Bullard Peak series because of a lower grade of regional metamorphism (greenschist facies) in the Ash Creek rocks. Following the low-grade regional metamorphism there were three episodes of contact metamorphism related to intrusion of anorthosite, diabase, and the Burro Mountains granitic rocks. The Ash Creek series includes sericite phyllite, andalusite-sericite schist, cordierite hornfels, spotted andalusite hornfels, biotite hornfels, diopside quartzite, serpentine marble-ophicalcite rocks, calcite-serpentine-chlorite rocks, talc serpentinite, massive serpentinite, and magnetite serpentinite. These rocks are the result of both regional and contact metamorphism of quartz sandstone, silty dolomite, feldspathic and argillaceous sandstone or siltstone, shale, quartzose shale, siliceous dolomite, and argillaceous limestone.

Anorthosite xenoliths occur in the granite and in diabase near Ash Creek in the northern Big Burro Mountains. Diabasic rocks are found cutting the Ash Creek and Bullard Peak metamorphic series and are in turn truncated by granite. Thus, there appears to have been intrusion of anorthosite, then diabase, and finally the granitic rocks of the Burro Mountains batholith.

The Burro Mountains composite batholith consists principally of granite. Hewitt (1959), Gillerman (1951, 1964), Ballman (1960), and Gillerman and Whitebread (1956) have noted that hornblende granite, hornblende-biotite granite, and biotite granite are the most abundant rock types although minor alaskite, porphyritic granite, and granodiorite are also present. Pegmatite and aplite dikes are mapped as part of the Burro Mountains batholith.

Migmatization of hornblende gneiss, amphibolite, biotite schist, and quartz-feldspar gneiss adjacent to the batholith

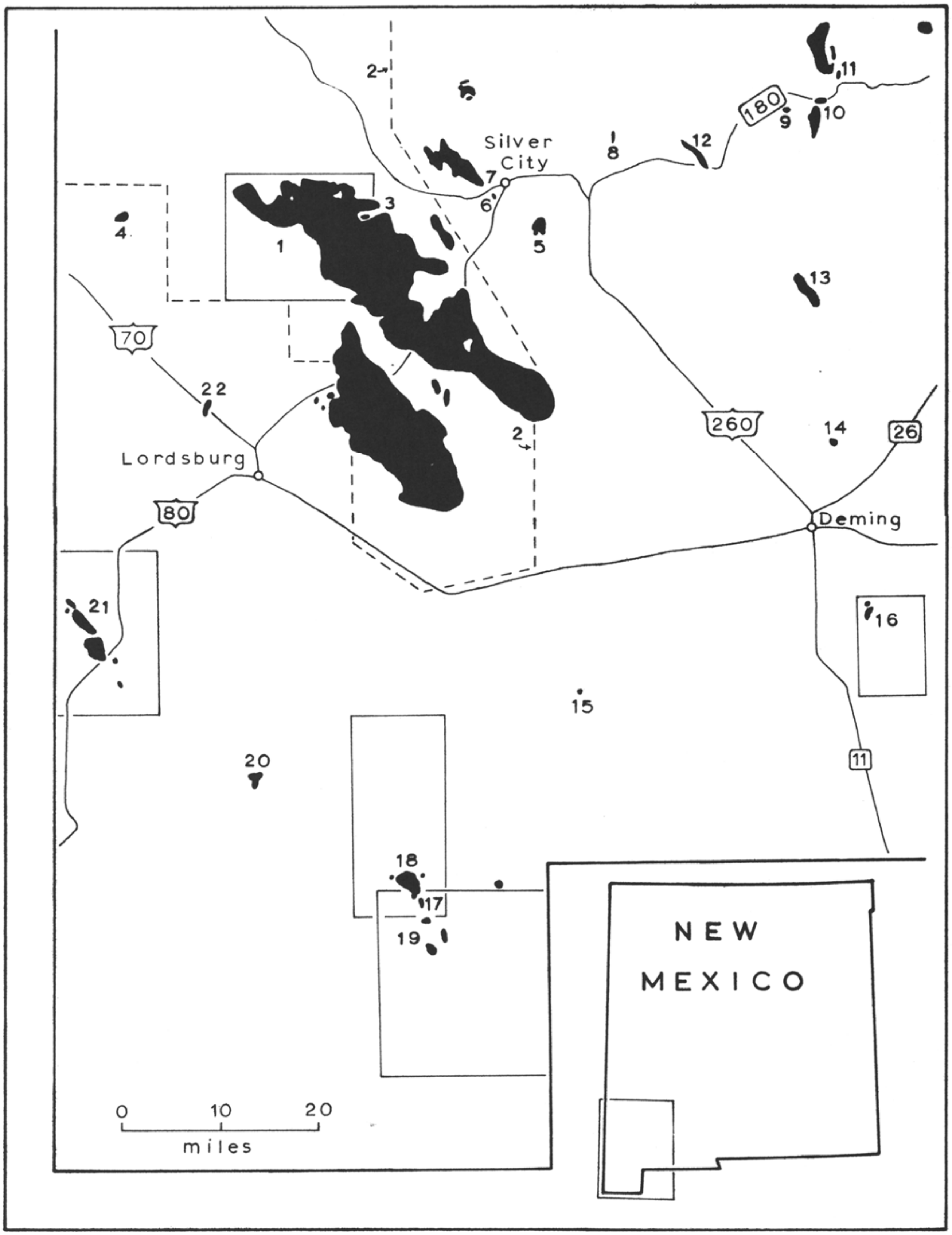

FIGURE 1.
Index map showing Precambrian outcrops and numbered localities referred to in text.

was reported by Hewitt (1959) . He also described orbicular rock in a small xenolith of migmatite.

In the Black Hawk mining district of the northern Big Burro Mountains (loc. 3, Fig. 1) Gillerman and Whitebread (1956) suggested the following sequence of Precambrian igneous rocks, in order of decreasing age: (1) monzonite and quartz monzonite, (2) quartz diorite gneiss, (3) biotite quartz diorite, (4) diorite, (5) syenite, and (6) granite. They reported that the granite, similar to that which forms the main mass of the Burro Mountains batholith, intrudes all the other rock types noted above. Quartz diorite gneiss has also been mapped by Hewitt (1959) along the western side of the Big Burro Mountains.

The following sequence of Precambrian events in the Burro Mountains region seems likely:

(1) Amphibolite facies regional metamorphism of sedimentary and igneous rocks to form the Bullard Peak series.

(2) Deposition of sediments that were parent rocks of the Ash Creek series.

(3) Greenschist facies regional metamorphism.

(4) Intrusion of anorthosite, diabase, monzonite, quartz monzonite, quartz diorite gneiss, biotite quartz diorite, diorite, and syenite.

(5) Intrusion of granitic rocks of the Burro Mountains batholith, including several textural and mineralogical varieties.

(6) Intrusion of pegmatite and aplite dikes.

Near Virden (loc. 4, Fig. 1) there is a small exposure of coarse-grained, biotite granite that is locally porphyritic (Morrison, 1965; Elston, 1960). Pegmatite, aplite, and diorite dikes are also present. The granite resembles the Burro Mountains granite, but there is no assurance that the two occurrences are parts of the same batholith. It is probable, however, that the granites formed during the same general igneous episode.

At Lone Mountain (loc. 5, Fig. 1) near Silver City, Pratt (1967) reported two main varieties of granite, one being a porphyritic biotite granite and the other a porphyritic granite containing no mafic minerals but a trace of muscovite. There also are dikes of pegmatite and fine-grained granite. Pratt suggested that the biotite granite may be younger than the other main granite.

Pink, medium-grained, muscovite granite that is rich in sodic plagioclase is exposed near Boston Hill (Entwistle, 1944; loc. 6, Fig.1) . Entwistle also noted the presence of porphyritic biotite granite two miles to the northwest (loc. 7, Fig.1) .

A narrow, lenticular outcrop of fine-grained, granitic biotite gneiss occurs on the east side of the Hanover-Fierro pluton (Jones and others, 1967; loc. 8, Fig. 1). They also reported Precambrian granite encountered in a drill hole one mile north of Santa Rita.

In the Black Range, Kuellmer (1954) reported outcrops of Precambrian graywacke (loc. 9 and 10, Fig. 1) that appear to have undergone only very low-grade metamorphism. Biotite granite is exposed north and northwest of Kingston (loc. 11, Fig. 1); age relations between the graywacke and granite are not known, although both are cut by metadiabase dikes.

West of the Mimbres River (loc. 12, Fig. 1) are outcrops of uralitized diabase having relict ophitic texture. East of the Mimbres River and north of Cooks Peak (loc. 13, Fig. 1) Jicha (1954) and Elston (1957) noted coarse-grained, biotite granite and granite gneiss that grade into hornblende-chlorite schist.

Griswold (1961) described pink, coarse-grained granite, diorite, and amphibolite at Fluorite Ridge (loc. 14, Fig. 1) and pink granite in the Klondike Hills (loc. 15, Fig. 1) . He suggested that the diorite and amphibolite may be older than the granite.

Rocks in the Florida Mountains that are definitely Precambrian occur only to the west and northwest of Capitol Dome (loc. 16, Fig. 1) where they are unconformably overlain by the Bliss Sandstone. Previous workers (Darton, 1917; Griswold, 1961) considered the crystalline rocks south of Capitol Dome to be Precambrian also, but recent work by Corbitt (Univ. New Mexico Ph.D. dissertation in progress) indicates that those crystalline rocks are, at least in part, intrusive into the Paleozoic strata. The Lobo Formation, although of uncertain age, is commonly considered to be Cretaceous (?) —Tertiary (?) (Dane and Bachman, 1965) and locally rests unconformably on the crystalline rocks in question. This bracketing suggests a Mesozoic age for the intrusion.

The Mesozoic (?) intrusive rocks are largely medium- to coarse-grained syenite, but rocks transitional to quartz syenite or granite are also present. A hornblende gabbro sheet and mafic dikes appear to be intrusive into the syenite and therefore are younger.

The rocks of undoubted Precambrian age are present beneath the Bliss Sandstone west of Capitol Dome where they consist mainly of medium- to coarse-grained, reddish granite. A few outcrops of fine-grained granitic gneiss, biotite schist, retrogressively metamorphosed amphibolite, and hornblende gneiss are seen near the northern end of the Florida Mountains. These metamorphic rocks appear to have been derived from igneous and sedimentary rocks and are probably older than the granite.

A small downfaulted block containing nonmetamorphosed diamictite is unconformably overlain by the Bliss Formation. The diamictite consists mostly of granitic clasts up to 5 feet long and pellets of shale up to 2 cm in diameter enclosed in a fissile shale matrix. A few sandy layers are also present. The diamictite is unconformable on a deeply weathered Precambrian mafic gneiss and is also in fault contact with Precambrian granite. Thus, the diamictite is younger than the granite and older than the Bliss; it seems likely that the diamictite is younger Precambrian, but it may be as young as Cambrian as the Bliss appears to be no older than Late Cambrian.

In the southern part of the Florida Mountains there are a few exposures of phyllite and fine-grained, quartz monzonitic gneiss that may be Precambrian remnants that were engulfed by the syenite, but the evidence of their age is not conclusive. Some of the granitic rocks south of Capitol Dome may also be Precambrian.

Extensive radiometric dating of these rocks will be needed before all the critical questions can be answered.

Near Hatchet Gap (loc. 17, Fig. 1) between the Big Hatchet and Little Hatchet Mountains, Zeller (1965) reported a small outcrop of quartzite that was intruded by Precambrian granite. Lasky (1947) considered these rocks and a similar granite exposed in the Little Hatchet Mountains (loc. 18, Fig. 1) to be Cretaceous or Tertiary. Because of the anomalous radiometric date of about 600 m.y. reported by Zeller (1965) the possibility of resetting of the zircons during a younger thermal event seems likely. The granite near Hatchet Gap was described by Lasky (1947) as being porphyritic biotite granite with a rapakivi-like texture.

At other places in the Big Hatchet Mountains (loc. 19, Fig. 1) Zeller (1965) noted that the Precambrian age of the rocks is conclusive, as they are unconformably overlain by the Bliss Formation.

In the northern Animas Mountains (loc. 20, Fig. 1) pink, very coarse-grained, porphyritic granite is present (Zeller, 1958). Preliminary mapping by Zeller indicates that this granite occurs in a thrust slice; its precise structural setting has an important bearing on regional tectonic interpretations and needs additional study.

The central Peloncillo Mountains (loc. 21, Fig. 1) have medium-grained, pink, biotite granite overlain unconformably by Bolsa Quartzite (Gillerman, 1958; Cargo, 1959) and the granite therefore is Precambrian.

Along Highway 70 several miles northwest of Lordsburg (loc. 22, Fig. 1) there is granite gneiss exposed (Elston, 1970, personal commun.). The stratigraphic relation of this gneiss to the Paleozoic rocks is not seen, but presumably it is Precambrian.

CONCLUSIONS

1. Paucity of radiometric data and lateral discontinuity of Precambrian outcrops makes a regional synthesis of the Precambrian tentative.

2. Much of the so-called Precambrian of southwestern New Mexico must be thoroughly studied, preferably isotopically, before the ages and sequences of events can be firmly established.

3. At least two episodes of regional metamorphism occurred prior to emplacement of granitic and related rocks.

4. Most of the Precambrian rocks of southwestern New Mexico are granite that has intruded the older metamorphic rocks.

5. The graywacke terrain of the Black Range may represent a separate Precambrian subprovince that has had a different geologic development than the rest of southwestern New Mexico.

6. Anorthosite xenoliths in the granitic rocks of the Burro Mountains batholith suggest that a more extensive anorthositic terrain may be present somewhere beneath the unconformably overlying rocks. There is a possibility of associated ore, including copper, ilmenite, and titaniferous magnetite.

7. Extensive geochemical study of the unconformity at the top of the Precambrian might provide directional indicators of dispersal patterns of sediment derived from ore bodies cut by the unconformity.

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Air view southwestward from vicinity of Hachita Peak in Little Hatchet Mountains, across Playas Valley to Animas Mountains. Playas Lake in middle ground. Prominent peak in extreme distance near center of photograph is Animas Peak, with the smaller peak on this side being Gillespie Peak.