SURFICIAL GEOLOGY AND MINERAL RESOURCES OF SIERRA BLANCA PEAK, HUDSPETH COUNTY, TEXAS

by
Jay A. Raney and Edward W. Collins

Final contract report for Texas General Land Office
under GLO contract No. 99-178R and UTA contract no. 98-0542

W. L. Fisher, Director *ad interim*
Bureau of Economic Geology
The University of Texas at Austin

August 1999

CONTENTS

Figures

Table

Plates

INTRODUCTION

The Texas General Land Office (GLO) asked the Bureau of Economic Geology (Bureau) at The University of Texas at Austin to provide information on the geology and potential mineral commodities that may be present in parts of Sections 14, 15, 16, 21, 22, and 23, Block 71, Township 7, T&P Railroad Survey, Hudspeth County, Texas. This area, which is the focus of this study, is referred to in this report as the "lease area." The lease area is covered by a mining lease between Sierra Blanca Ranch Associates, L. P. and Meridian Aggregates Company (dated June 25, 1998). Adjacent areas are described in order to place the lease area in its geologic context. The purpose of the project is to provide general information on the geology of the lease area, which includes a description of the geologic setting, geologic units, and mineral commodities that may be present.

The study is based primarily on a review of available literature and a reconnaissance field investigation. Methods used in this study included compilation of information from published geologic literature, study of available aerial photographs and existing maps, and a brief field investigation of the lease area. On the basis of this work, a geologic map and cross section of the lease study area were prepared. Bureau staff led a geologic tour of the lease area for representatives of the Texas Attorney General's Office and the GLO.

GEOLOGIC SETTING

The lease area lies on the northeast flank of Sierra Blanca Peak (the largest of five peaks called "the Sierra Blanca peaks") that are clustered together west of the town of Sierra Blanca in Hudspeth County, Texas. Round Top, Little Round Top, and Blanca Peak lie northwest and north of Sierra Blanca Peak, and Triple Hill lies to the east of Sierra Blanca Peak. The Sierra Blanca peaks are rhyolite laccoliths that were emplaced in Cretaceous sedimentary strata during the early Oligocene. Sills and dikes of andesite and latite are also present. Henry and others (1986) dated the

Sierra Blanca Peak intrusion at 36.2 Ma (K-Ar on biotite). Erosion has removed the overlying folded and arched sedimentary rocks that once surrounded the rhyolite intrusions. The erosion-resistant rhyolite bodies form prominent topographic features.

Cretaceous sedimentary strata present on the lower flanks of the Sierra Blanca Peaks are covered mostly by alluvial-fan deposits, although some limestone, marl, shale, and sandstone crop out in narrow arroyos that drain from the peaks and in small hills. These strata were deposited on the margin of the Chihuahua Trough in a shallow-marine environment. Cretaceous strata, better exposed along the west flank of Triple Hill, also make up the unnamed narrow mountain southeast of Triple Hill. Throughout the region, Cretaceous sedimentary rocks compose most of the mountain ranges south of the Sierra Blanca peaks and much of the Diablo Plateau north of the peaks.

The geology near and within the lease study area is illustrated on the stratigraphic column, geologic maps, and cross section (plates 1, 2; figs 1, 2; table 1). Rhyolite and alluvial-fan deposits dominate the surface geology of the study area. The alluvial-fan deposits are locally at least as thick as 60 ft. On the geologic map (plate 2), these deposits have been subdivided into older and younger alluvial-fan deposits. Small outcrops of Cretaceous limestone, argillaceous limestone, marl, and shale of the undivided Kiamichi (Benevides), Espy, Del Rio, Buda, and Chispa Summit Formations are also present in the lease area. East of the lease area, flanking nearby Triple Hill, are older Cretaceous limestones, argillaceous limestones, marls, sandstones, and shales of the Finlay, Cox, and Campagrande Formations (Albritton and Smith, 1965).

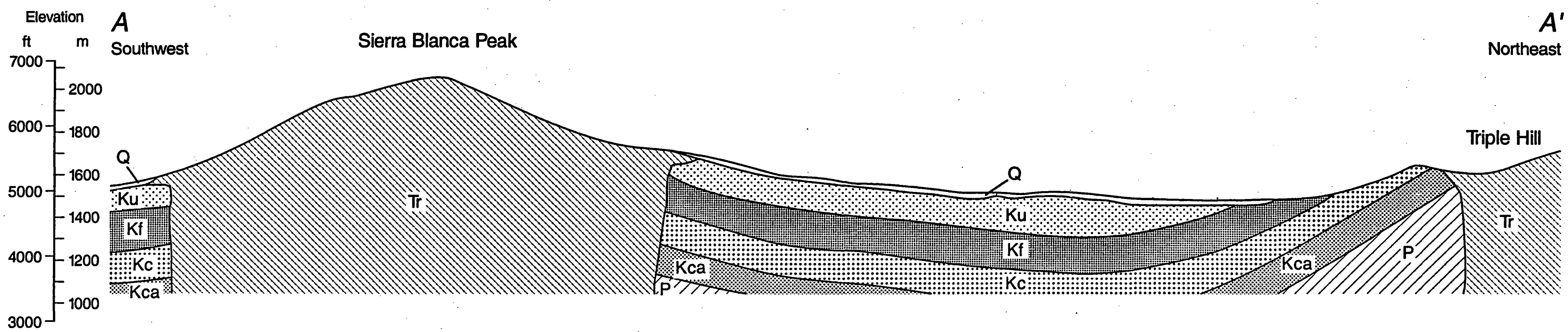
REVIEW OF MINERAL RESOURCES

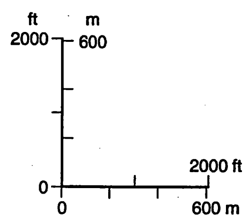
In the general vicinity of the study area there are many mineral prospects, most of which are associated with Tertiary intrusions, especially rhyolite. The major intrusions include the rhyolite laccoliths of the Sierra Blanca peaks and the granitic intrusions (quartz monzonite, granodiorite, monzonite, granite, and syenite) that occur at the north end of the Quitman Mountains, about

Age	Mapped as	Group	Units	Lithology
Quaternary			Alluvium of drainageways	Gravel, sand, mud
Quaternary			Younger alluvial-fan alluvium	Gravel, sand, mud
Quaternary			Older alluvial-fan alluvium	Gravel, sand, mud
Tertiary			Rhyolite laccoliths	Rhyolite
Tertiary			Diorite dikes, sills, and plugs	Diorite (field term)
Cretaceous	Mapped as undivided Cretaceous strata		Chispa Summit Formation	Limestone, shale, and sandstone
Cretaceous	Mapped as undivided Cretaceous strata	Washita Group	Buda Formation	Limestone
Cretaceous	Mapped as undivided Cretaceous strata	Washita Group	Del Rio Formation	Shale
Cretaceous	Mapped as undivided Cretaceous strata	Washita Group	Espy Formation	Limestone, argillaceous limestone, marl, shale
Cretaceous	Mapped as undivided Cretaceous strata		Kiamichi Formation	Shale, sandstone, and limestone
Cretaceous			Finlay Formation	Limestone, argillaceous limestone, and marl
Cretaceous			Cox Formation	Sandstone, siltstone, conglomerate, and some shale and limestone
Cretaceous			Campagrande Formation	Limestone, marl, conglomerate, sandstone, siltstone, and shale

QAc5724c

Figure 1. Stratigraphic column showing rock units and lithologies in Sierra Blanca peaks area. Compiled from Albritton and Smith (1965) and McAnulty (1974, 1980).





Quaternary	Q	Alluvium
Tertiary	Tr	Rhyolite
Cretaceous	Ku	Undivided Kiamichi (Benevides), Espy, Del Rio, Buda, and Chispa Summit Formations
	Kf	Finlay Formation
	Kc	Cox Formation
	Kca	Campagrande Formation
Permian	P	Undivided Permian rocks

QAc5725(a)c

Figure 2. Geologic cross section of study area.

Table 1. Rock type/lithology and resource data for geologic units at the surface of Block 71, Township 7, T&P Railroad Survey, and the lease study area within Sections 14, 15, 16, 21, 22, and 23, Block 71, Township 7, T&P Railroad Survey

Unit: **Alluvium of drainageways. Includes some undivided slope-wash alluvium and colluvium (Quaternary).**

Rock type/lithology: Sand, gravel, and mud.

Resource data: Unit common throughout region. Flooding commonly sudden and severe, although infrequent. Located within lease area.

Unit: **Younger alluvial fan deposits. Includes some undivided colluvium (Quaternary).**

Rock type/lithology: Gravel, sand, and mud. Gravel is boulder to pebble size and derived from nearby rhyolite intrusions and limestone, argillaceous limestone, and sandstone bedrock outcrops.

Resource data: Some potential as sand and gravel resource, depending on demand and transportation costs. Size variability of gravel is great. Unit common throughout region.

Unit: **Older alluvial fan deposits. Includes some undivided colluvium (Quaternary).**

Rock type/lithology: Gravel, sand, and mud. Gravel is boulder to pebble size and derived from nearby rhyolite intrusions and limestone, argillaceous limestone, and sandstone bedrock outcrops. Appears to lack thick near-surface caliche associated with older alluvial fan deposits in other parts of region.

Resource data: Some potential as sand and gravel resource depending on demand and transportation costs. Size variability of gravel is great. Unit common throughout region.

Unit: **Rhyolite (Tertiary).**

Rock type/lithology: Rhyolite. Porphyritic with quartz and K-feldspar phenocrysts in aphanitic groundmass; minor biotite phenocrysts.

Resource data: Quarried as aggregate resource in lease study area. Appears to be too fractured to be considered for dimension stone. Excavation requires blasting. Associated with fluorite and beryllium prospects outside of lease area. Rhyolite–country rock contact (common area for mineralization) is mostly covered by alluvium. Fluorite/beryllium prospects are at northwest and south parts of Sierra Blanca Peak. Fluorite/beryllium prospects are also at other nearby rhyolite laccolith intrusions, Round Top, Little Round Top, and Little Blanca Mountain (northwest of Sierra Blanca Peak). No prospects are reported at the Triple Hill intrusion (east of Sierra Blanca Peak).

Table 1. continued.

Unit: **Diorite (Teritary dikes, sills, plugs)**

Rock type/lithology: Diorite (field terminology). Andesite and other lithologies.

Resource data: Mineralization potential associated with small intrusives in lease study area is unknown because of the lack of surface exposures. Outcrops near lease area on west side of Sierra Blanca Peak indicate that diorite is partly replaced and veined with fluorite at many places where it is in contact with overlying rhyolite.

Unit: **Undivided Cretaceous rocks of the Kiamichi (Benevides), Espy, Del Rio, Buda, and Chispa Summit (Eagle Ford) Formations**

Rock type/lithology: Limestone, argillaceous limestone, marl, shale, and sandstone.

Resource data: Only small outcrops in lease study. Relatively more common outside of lease area. Possibly very local use as fill material or low-grade aggregate. Contact with rhyolite (common area for fluorite/beryllium mineralization) is mostly covered, so mineralization potential is untested.

Unit: **Finlay Formation (Cretaceous)**

Rock type/lithology: Limestone, argillaceous limestone, and lesser marl and sandstone.

Resource data: Large outcrops within lease study area do not exist. Unit is common outside of lease study area. Some potential as local source of crushed stone, road base, or fill material.

Unit: **Cox Formation (Cretaceous)**

Rock type/lithology: Sandstone, siltstone, conglomerate, and some shale and limestone.

Resource data: Large outcrops within lease study area do not exist. Unit is common outside of lease study area. The Cox is commonly a water-bearing unit in the subsurface and recharge unit in outcrop. Some potential as local source of fill material.

Unit: **Campagrande Formation (Cretaceous)**

Rock type/lithology: Limestone, marl, conglomerate, sandstone, siltstone and shale.

Resource data: Large outcrops within lease study area do not exist. Unit is common outside of lease study area. Some potential as local source of crushed stone, road base, or fill material.

6 mi west of the town of Sierra Blanca. There are also mineral prospects associated with smaller, commonly porphyritic dikes and sills of various igneous lithologies (rhyolite, latite, and andesite). Rhyolite is being excavated and processed for aggregate. Sand and gravel deposits, which are numerous, have also been locally exploited. No commercial development of the Cretaceous units has occurred. The location of known mineral prospects near the Sierra Blanca Peaks and adjacent areas is shown in figure 3.

Base- and Precious-Metal Occurrences

Although some operators of the base- and precious-metal (Pb, Zn, Cu, Fe, Au, Ag) prospects may have shipped small quantities of mineralized rock for testing and analysis (less than 50 tons), the only significant past producer is the Bonanza Mine, which is located in the southwest corner of figure 3 (Price and others, 1983). Mineralization at the Bonanza Mine and related prospects occurs in a zone of veins and fractures adjacent to a rhyolite dike. The zone is as wide as 300 ft, although individual veins are generally less that 2 ft wide. The mine was developed at four levels and three shafts. The Bonanza Mine is reported (Murry, 1980) to have produced 1,488,479 pounds of zinc and 50,000 to 75,000 ounces of silver. The ore also contains significant lead and minor to trace amounts of copper and other metals. The Bonanza Mine, the only significant producer of zinc in the state of Texas, is currently inactive. Other precious- and base-metal occurrences, some of which have trace amounts of nickel and uranium, have been prospected but no significant developments have occurred. Murry (1980) also suggested a potential for mineralization associated with skarns (contact metamorphic zones) at the margins of the intrusive rocks. No base- or precious-metal minerals are known to occur on the lease area.

Fluorite and Beryllium Occurrences

Numerous fluorite and beryllium occurrences are associated with the Sierra Blanca peaks, and other occurrences are present in the region adjacent to the study area (McAnulty, 1974; 1980). This

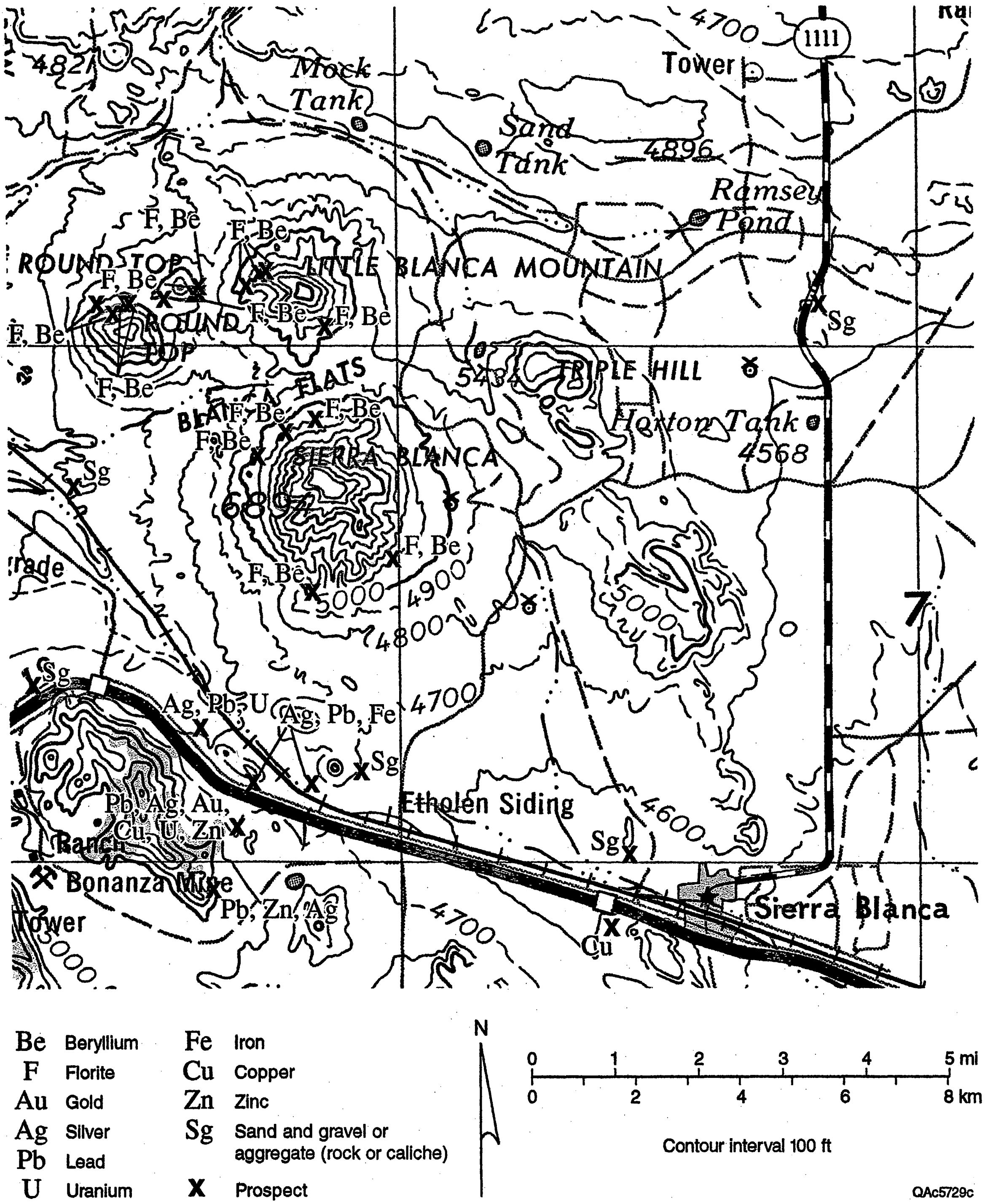


Figure 3. Location of known mineral prospects near the Sierra Blanca peaks. Data from McAnulty (1974, 1980) and Price and others (1983).

summary discussion is restricted to those associated with the Sierra Blanca peaks. No deposits of fluorite or beryllium that are economic in today's markets have been discovered, although significant deposits have been delineated such that changes in commodity prices, commodity markets, or beneficiation technologies could in the future make the occurrences economic and stimulate mineral production and additional exploration.

Fluorite mineralization has been identified at many locations in the contact zone between the intrusive rocks and the enclosing Cretaceous sedimentary rocks. McAnulty (1974) reported "45 outcrops of fluorspar on Sierra Blanca Peak, Little Sierra Blanca Mountain, Round Top and Little Round Top" (p. 27). Mineralized zones reach 15 ft in width. Samples taken by McAnulty (1974) contained about 50 to 73 percent calcium fluoride, and he reported that samples analyzed by the U.S. Geological Survey contained trace to significant amounts of beryllium and that there was a direct correlation between beryllium content and calcium fluoride content. Minor amounts of tin and uranium (McAnulty, 1980) are also present. The fluorite is commonly fine grained and occurs as replacement deposits or as fracture fillings and coatings. Various rare fluorine-bearing minerals are present. Most of the rhyolites are also highly anomalous in fluorine.

Beryllium mineralization, which is associated with the occurrences of anomalous fluorine, is also widespread and abundant in the Sierra Blanca peaks (McAnulty, 1980). The most definitive, recently published study of the Sierra Blanca beryllium deposits is that by Rubin and others (1988). They reported that the major beryllium-bearing minerals are behoite, bertrandite, and phenakite. Most of the mineralization is very fine grained. Although anomalous beryllium occurs in the rhyolite and is locally concentrated in fracture zones in the rhyolite, it is most common in the contact zones between the rhyolite laccoliths and the adjacent Cretaceous sedimentary rocks. Such contact zones have been the focus of many of the exploration activities, mostly by Cypress Minerals Company/Cypress Beryllium Corporation. Even apparently unmineralized rhyolite contains 10 ppm to 200 ppm Be and anomalous uranium, tin, and zinc (McAnulty, 1980). Trace-element geochemistry is well illustrated in table I of Rubin and others (1988), and major elements analyses are shown in table 1 of Barker (1980).

Previous exploration activities clearly demonstrated that the contact between the rhyolite laccoliths of the Sierra Blanca peaks and the adjacent Cretaceous sedimentary rocks is the setting that is most prospective for fluorine and beryllium mineralization. The sedimentary rocks underlying the floor of the laccoliths are especially favorable locations for mineralization. A schematic cross section of the Cypress Beryllium Corporation's exploration adit on Round Top (figure 2 in Rubin and others, 1988) well illustrates this geologic relationship. Henry (1992) reported resources totaling 25 million pounds of beryllium oxide having a grade greater than 2 percent BeO.

The lease area contains favorable settings for fluorite or beryllium, but little exploration for these mineral commodities on the lease area is apparent from our reconnaissance study. For example, no evidence of test drilling (as occurs extensively in analogous geologic settings on the north edge of the Sierra Blanca Peak laccolith, immediately west of the lease area) is present. Within the lease area, the contact between the rhyolite and the adjacent Cretaceous sedimentary rocks is generally covered by alluvial fans and colluvium. This contact is exposed in one roadcut on the access road to a currently active mine site on the lease area. Neither the geometry nor the potential mineralization of this contact on the lease area can be adequately evaluated by using currently available data. The lateral extent of the contact between the rhyolite and the Cretaceous rocks that is present in the lease area is approximately 8,000 ft.

Rhyolite Aggregate

The Meridian Aggregates Company (Meridian) is the only company known to be actively conducting mining activities in the study area. Meridian is excavating and processing rhyolite in the lease area on Sierra Blanca Peak to sell as aggregate. Although rock properties related to lithology are essential to aggregate quality, the economic potential of a deposit also depends on nongeologic factors, such as transportation, demand for product, access, ease of excavation and processing, land ownership, and contractual relationships with the aggregate buyer. The relatively short distance to the main railroad and the rail spur from the mine site to the main railroad aid in making this resource economic.

The rhyolite that is being mined and processed by Meridian generally resembles that present on Sierra Blanca Peak within the lease area but outside the limits of the current mining plan, as well as that present in the other nearby rhyolite laccoliths. Minor variations in rock properties, however, may impact the quality of the aggregate and determine its commercial value. Such factors may include minor changes in mineralogy or texture, degree of weathering, presence of fractures, and presence of dikes of unsuitable rock types. Topography unfavorable to mining or an excessive thickness of overburden may also adversely impact the economics of potential mine sites.

It would appear, however, that the general characteristics of the rhyolite currently being mined are not significantly different from those present in other parts of the Sierra Blanca Peak laccolith. Other considerations aside, the volume of rhyolite available for use as aggregate in the laccoliths appears to far exceed any conceivable demand for aggregate. Other igneous rocks are also present locally in the Trans Pecos that have generally similar characteristics and may represent additional potential sources of aggregate.

Sand and Gravel

Sand and gravel deposits are common within the lease study area, as well as throughout the region. The economic potential of these deposits depends mostly on local demand, transportation costs, ease of excavation, and quality of the materials. The close proximity of these deposits to the active rhyolite quarry may increase whatever economic potential exists because of the potential for lower cost transportation. Units that contain gravel and sand are the alluvial-fan deposits and the alluvium of the drainageways. Most of these deposits are poorly sorted. Gravel in the study area is locally derived so that most of the alluvial-fan gravel within the lease area contains abundant rhyolite.

Limestone and Sandstone

Limestone and sandstone units that could possibly be exploited for some types of aggregate use are covered mostly by alluvium (as thick as 60 ft and possibly thicker) within the lease area. Although only small limestone outcrops with little economic potential occur within the lease area, limestone and sandstone are common along the west flank of nearby Triple Hill east of the study area, and limestone makes up the smaller hills south of the study area. Limestone and sandstone are abundant within the mountain and plateau areas throughout the region. The economic potential of these deposits probably depends on local demand and transportation costs, as well as specific rock properties.

Limestone units include the Campagrande and Finley Formations and several thinner units that are often mapped together as an undivided unit, the Kiamichi (Benevides), Espy, Buda, and Chispa Summit Formations. The Cox Sandstone is the major sandstone of the region.

ACKNOWLEDGMENTS

Work for this project was funded under GLO contract No. 99-178R and UTA contract No. 98-0542. We thank GLO staff for providing information and field support. Illustrations and plates were drawn by William Bergquist under the supervision of Joel L. Lardon, Graphics Manager. Word processing and design were done by Susan Lloyd, and the text was edited by Lana Dieterich, both under the direction of Susann Doenges.

REFERENCES

Albritton, C. C., Jr., and Smith, J. F., Jr., 1965, Geology of the Sierra Blanca area, Hudspeth County, Texas: U.S. Geological Survey Professional Paper 479, 131 p.

Barker, D. S., 1980, Cenozoic igneous rocks, Sierra Blanca area, Texas, *in* Dickerson, P. W., and Hoffer, J. M., eds., Trans-Pecos region, southeastern New Mexico and West Texas: New Mexico Geological Society 31st Field Conference Guidebook, p. 219–223.

Henry, C. D., 1992, Beryllium and other rare metals in Trans-Pecos Texas: Permian Basin Section, Society of Economic Paleontologists and Mineralogists Newsletter, v. 31, no. 6, p. 15.

Henry, C. D., McDowell, F. W., Price, J. G., and Smyth, R. C., 1986, Compilation of potassium-argon ages of Tertiary igneous rocks, Trans-Pecos Texas: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 86-2, 34 p.

McAnulty, W. N., Sr., 1974, Fluorspar in Texas: The University of Texas at Austin, Bureau of Economic Geology Handbook 3, 31 p.

___________ 1980, Geology and mineralization of the Sierra Blanca Peads, Hudspeth County, Texas, *in* Dickerson, P. W., and Hoffer, J. M., eds., Trans-Pecos region, southeastern New Mexico and West Texas: New Mexico Geological Society 31st Field Conference Guidebook, p. 263–266.

Murry, D. H., 1980, Mineralization in the northern Quitman Mountains, Hudspeth County, Texas, *in* Dickerson, P. W., and Hoffer, J. M., eds., Trans-Pecos region, southeastern New Mexico and West Texas: New Mexico Geological Society 31st Field Conference Guidebook, p. 267–270.

Price, J. G., Henry, C. D., and Standen A. R., 1983, Annotated bibliography of mineral deposits in Trans-Pecos Texas: The University of Texas at Austin, Bureau of Economic Geology, Mineral Resource Circular No. 73, 108 p.

Rubin, J. N., Price, J. G., Henry, C. D., Pinkston, T. L., Tweedy, S. W., Koppenaal, D. W., Peterson, S. B., Harlan, H. M., Miller, W. T., Thompson, R. J., Grabowski, R. B., Laybourn, D. P., Schrock, G. E., Johnson, A., Staes, D. G., Gaines, R. V., and Miller, F. H., 1988, Mineralogy of beryllium deposits near Sierra Blanca, Texas, *in* Torma, A. E., and Gundiler, I. H., eds., Precious and rare metal technologies: Amsterdam, Elsevier, p. 601–614.