# ANDALUSITE VAR. CHIASTOLITE

## *Blue Wing Mountains*

## *Pershing County, Nevada*

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*Extensive sections of the Blue Wing Mountains in western Pershing County, Nevada, contain abundant chiastolite (andalusite) crystals in a matrix of graphite-rich, pelitic pyroxene-hornfels. Some of these crystals range between red and pink and are translucent. Many crystals are altered to sericite, a typical weathering transition for this species. The crystals range from 2 mm to 3 cm across and 2 to 12 cm along the c-axis, with a high proportion of longer crystals. Crystal terminations are rare, but in some cases one end is tapered. The land is administered by the United States Department of the Interior, Bureau of Land Management, and there are currently no restrictions to collecting.*

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## INTRODUCTION

Andalusite var. chiastolite[1] occurs in well-formed crystals in the Blue Wing Mountains, western Pershing County, Nevada. A brief reference to this occurrence is given in *Minerals of Nevada* (Castor and Ferdock, 2003, p. 137 ). Therein, the occurrence is said to be at the "Auld Lang Syne mine" within the Blue Wing Mountains, credited to a verbal communication. There is no such mine in the Blue Wing

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[1] *The Glossary of Geology* ($5^{th}$ edition, 2005) defines chiastolite as "an opaque variety of andalusite containing black carbonaceous impurities arranged in a regular manner so that a section normal to the longer axis of the crystal shows a black Maltese cross formed as a result of the pushing aside of the impurities into definite areas as the crystal grew in metamorphic shales."

Mountains. In fact, there has never been any mining activity within these mountains, except for two placer claims on their northwestern edge. According to *mindat.org*, the Auld Lang Syne mine is located southwest of Lovelock, Nevada, within the Sierra mining district in the West Humboldt Range, approximately 30 miles to the east of the Blue Wing Mountains. Accordingly, the present article represents the first detailed description of the Blue Wing Mountain chiastolite occurrence.

Pough (1995) attributes the formation of the chiastolite Maltese-cross pattern to the migration of "dark particles." But, Hurlbut (1971) and many other authors more specifically note that these dark particles are carbon. In fact, the chiastolite at the Blue Wing Mountains occurs in a black, graphite-rich politic pyroxene-hornfels. The presence of carbon in the chiastolite and the high graphite content of the hornfels suggest that the Blue Wing Mountains were formed by a granite intrusion into an oil-rich shale.

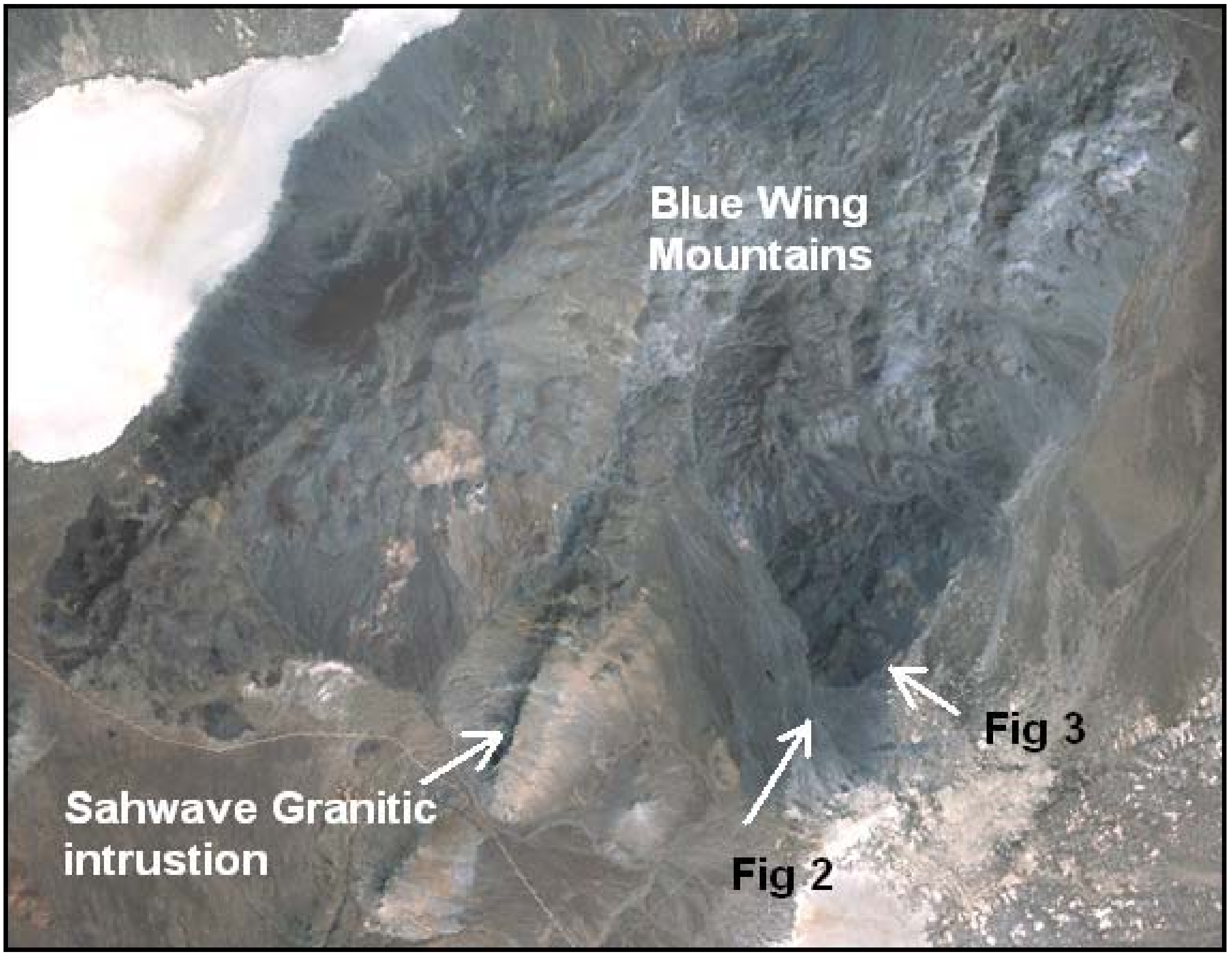


***Figure 1.*** **A true-color image composite of Landsat 7 ETM+ bands 1 (blue), 2 (green) and 3 (red); path 42 row 32; acquisition date July 27, 2000. Arrows indicate the granitic intrusion that is believed to be responsible for contact metamorphism and look directions for the digital photos shown in Figures 2 and 3. Satellite image data was obtained from the University of Maryland, Global Land Cover Facility (http://glcf.umiacs.umd.edu/data/landsat/). Assembly into a true-color composite was accomplished using Visual_Data (Carr, 2002).**

***Figure 2.*** **Digital photo of the southern end of the andalusite-bearing hornfels. Photographer: James R. Carr.**

## LOCATION AND GEOLOGY MAP

The Blue Wing Mountains are located in northwestern Nevada, in western Pershing County, 23 miles east of the border with Washoe County. The highest elevation in the area is Black Mountain at 2017 meters. Most of the rock that outcrops within the Blue Wing Mountains is hornfels having a high graphite content. The Blue Wing Mountains are consequently relatively dark (blue-black), explaining the word “blue” in their name. The hornfels is interpreted to have formed when a granite pluton, exposed in the Sahwave Mountains to the south, intruded a sequence of oil-rich shale. The intrusion separates the Blue Wing Mountains into two portions, a western “wing” and an eastern “wing,” accounting for the other word (“wing”) in their name.

Quartz fragments, mostly milky with occasional euhedral crystals, are locally abundant in float associated with the weathering of hornfels. There is enough iron content in the hornfels to enable a more or less red weathering coating to develop on longer-exposed outcrops. Fresh, broken hornfels tends to be dark gray to black and occasional pockets of powdered graphite are encountered.

Two different hornfels units have been mapped, distinguished by the presence or absence of chiastolite. Both are rich in graphite, but the hornfels unit without chiastolite is paler in tone, gray as opposed to dark gray to black for the chiastolite-bearing hornfels. A pure quartzite unit is present on the east side of the collecting site. This unit is thinner to the south and thickens to the northeast. This quartzite is pale tan in color and relatively pure (that is, no macroscopic aluminum silicates are observed within it); float originating from it stands out against the very dark, graphite-rich hornfels and float.

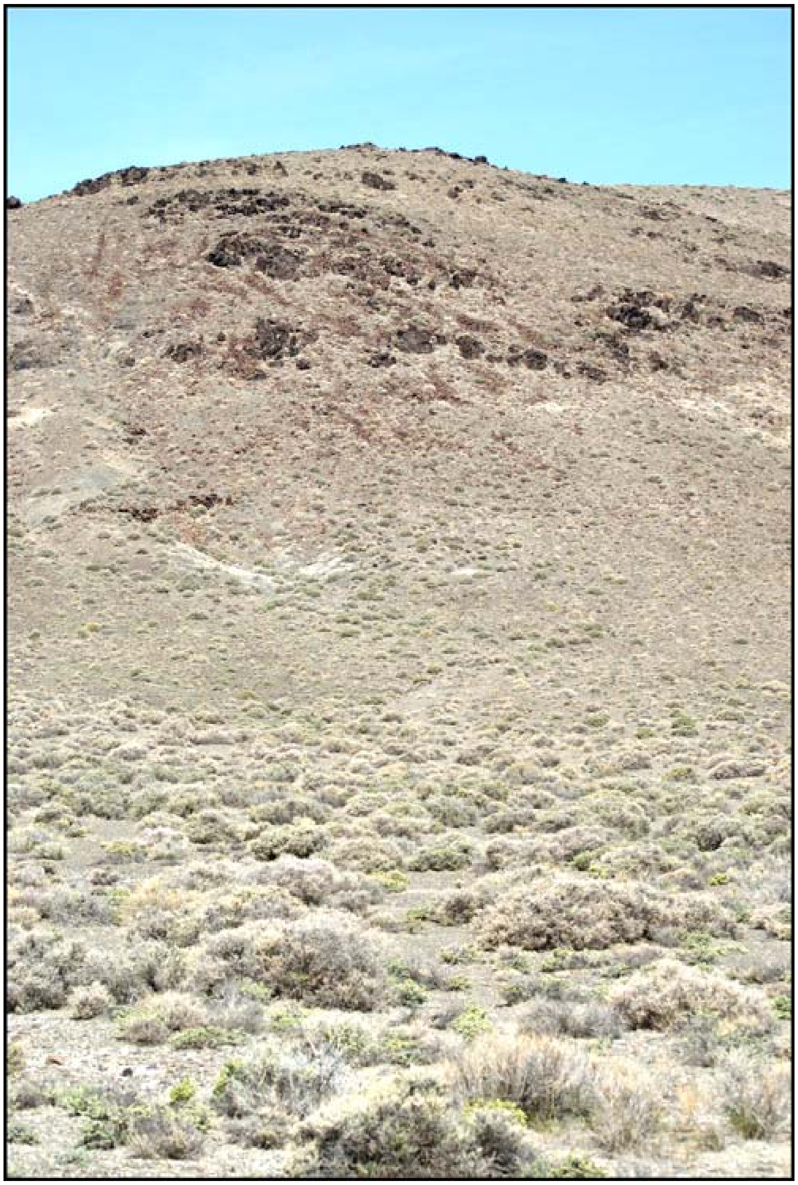

***Figure 3.*** **Andaluste-bearing hornfels outcrops (dark brown layers). The lighter colored float visible below these layers originates from a thin, pure quartzite bed. James Carr photo.**

Basin and Range normal faulting truncates all rock units on the eastern edge of the study area. The offset along this fault is recent, and displaces alluvial deposits to the east. No other faulting is clearly distinguishable within the hornfels and quartzite units. A prominent joint system having a west-northwest strike with near-vertical dip is present. In some instances, stream drainages have developed along these joints. No offset is observed, although some rock units, most notably the quartzite unit, seem truncated by these structures. No fault gouge or slickensides have been observed in association with these joints.

Metamorphism has not altered the geologic structure of the original sedimentary beds. The contact between hornfels and quartzite is sharp, striking 10°NNE and dipping 20°NW. The contact zone is discernible on satellite images and is shown on the geologic map.

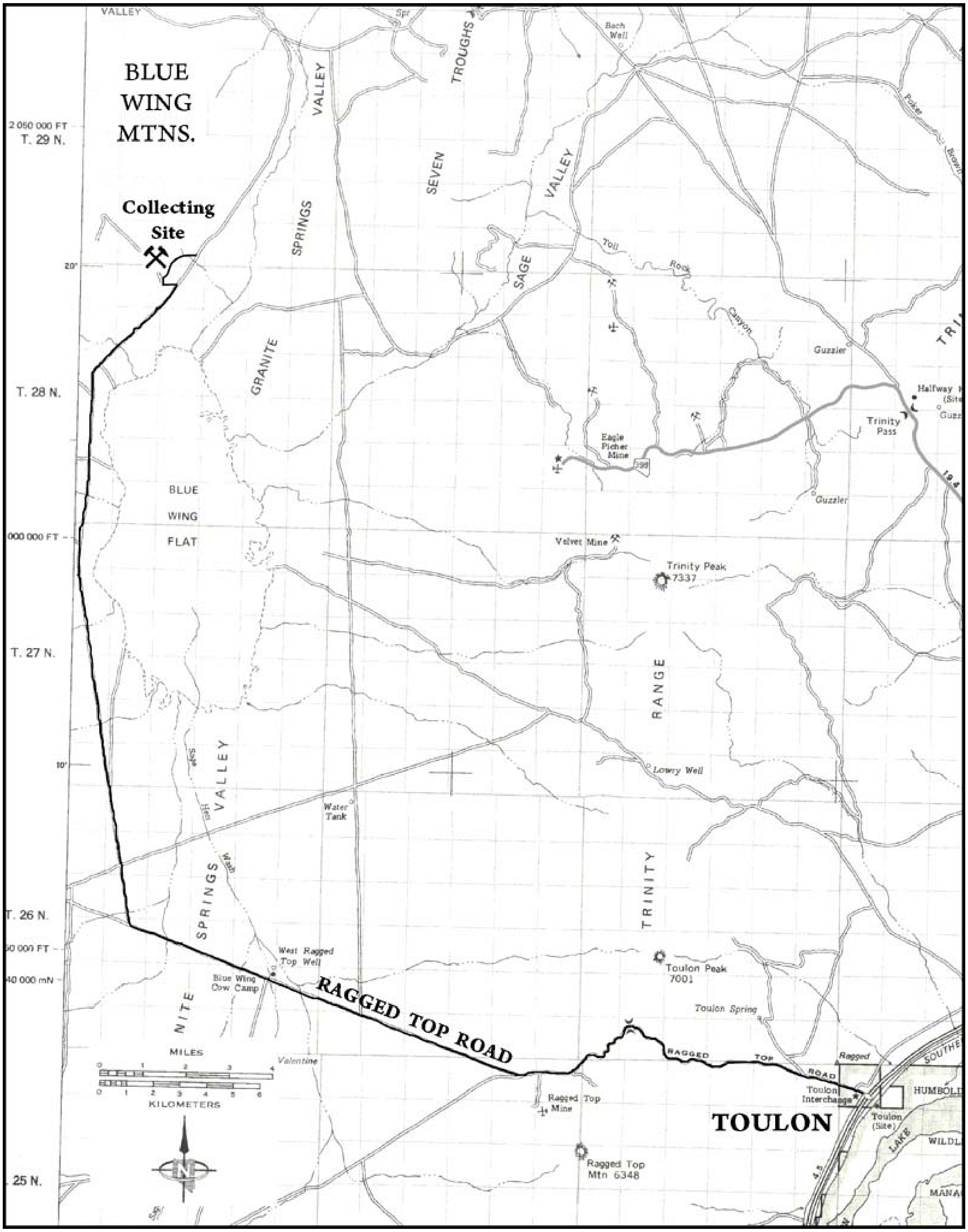


*Figure 4.* **A portion of Quadrangle 4-10, Nevada Department of Transportation. The Ragged Top Road route, starting at Toulon on Interstate 80, is highlighted in the lower portion of the map proceeding to the left-hand side of the map.**

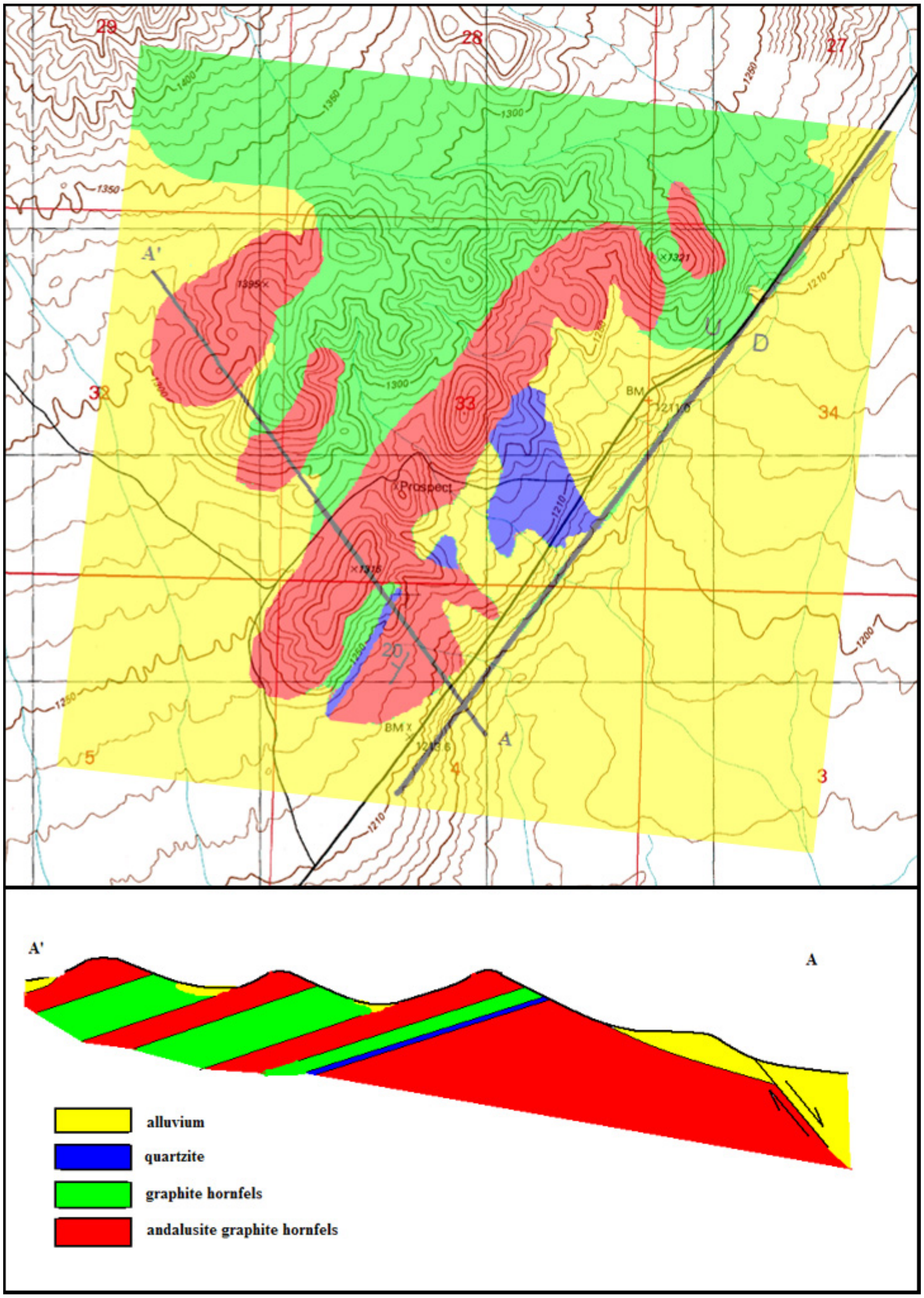


***Figure 5.*** **Geologic map of the southeastern portion of the Blue Wing Mountains. Units shown are: Red: andalusite (chiastolite) graphite hornfels; Blue: quartzite; Green: graphite hornfels; Yellow: alluvium and playa sediments. This map was created using Landsat 7 images fused to 15 m spatial resolution, classified then field checked. Adobe Photoshop 8.0 was used to overlay the geologic map on a digital image of the USGS 7.5 quadrangle maps, Juniper Pass and Blue Wing Flat quads. The line, A to A', locates the cross-section displayed in the cross-section (*below*) showing beds dipping 20 degrees to the northwest.**

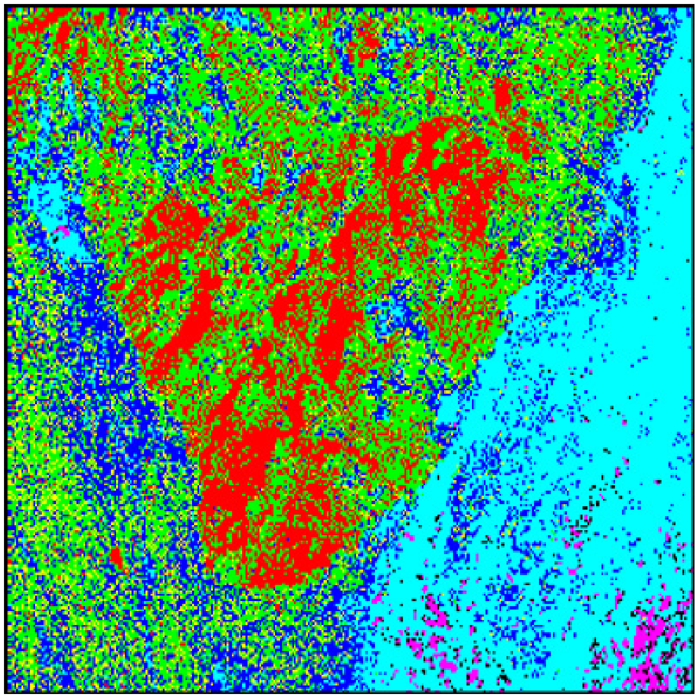

*Figure 6.* **Digital image classification from which the geologic map was drawn, then field checked. Colors: red: chiastolite graphite hornfels; blue: quartzite; green: graphite hornfels; cyan: alluvium. Classification was accomplished using Visual_Data (Carr, 2002).**

Two active mining claims exist on the northwest side of the Blue Wing Mountains. The Tammy and the Blue Wing claims are placer claims located in Section 12, T29N, R26E. The Blue Wing claim is owned by Mary and Myron Goldsworthy of Lovelock, Nevada. The Tammy claim is owned by Comstock Gold Prospectors of Reno, Nevada. With the exception of these two claims, no other currently active mining claims exist anywhere in the Blue Wing Mountains, though a few drill holes are visible in the vicinity of the chiastolite hornfels outcrops in the southeastern Blue Wing Mountains. A number of abandoned mines are marked on the topographic map in the mountains to the east and south; these probably account for much of the existing network of dirt roads in the vicinity.

## SPECIMENS

Typical examples of chiastolite from the Blue Wing Mountains are shown here. Smaller crystals occur toward the southern and western zones of the andalusite-bearing hornfels. Larger crystals, to 3 cm in diameter, occur in the central portion (particularly at 40° 20.319'N, 118° 57.502'W). Many chiastolite crystals exhibit partial to total alteration to sericite. When polished, the sericitic alteration imparts a slight iridescence to the crystal cross-section, lending a moonstone-like quality. These cream-colored crystals are translucent and visually appealing.

Andalusite is orthorhombic, but the crystal cross-sections of chiastolite are typically nearly square. Crystals tend to be roughly shaped along the *c*-axis. Moreover, these crystals are not easily freed from matrix. Abundant crystals, however, have weathered free of the matrix on their own. Crystals typically measure from 5 mm to 8 cm in length and, because they tend to be fractured at many places perpendicular to the *c*-axis, loose crystals usually lack terminations.

On crystals freshly broken from matrix, the graphite coating tends to mask the underlying chiastolite, but imparts a submetallic luster to some crystal surfaces. Many crystals when first freed from matrix are coated by graphite, but weathering mechanically removes the graphite from the outer surfaces. Graphite is immune to chemical reagents and thus mechanical cleaning offers the only way to remove it from chiastolite.

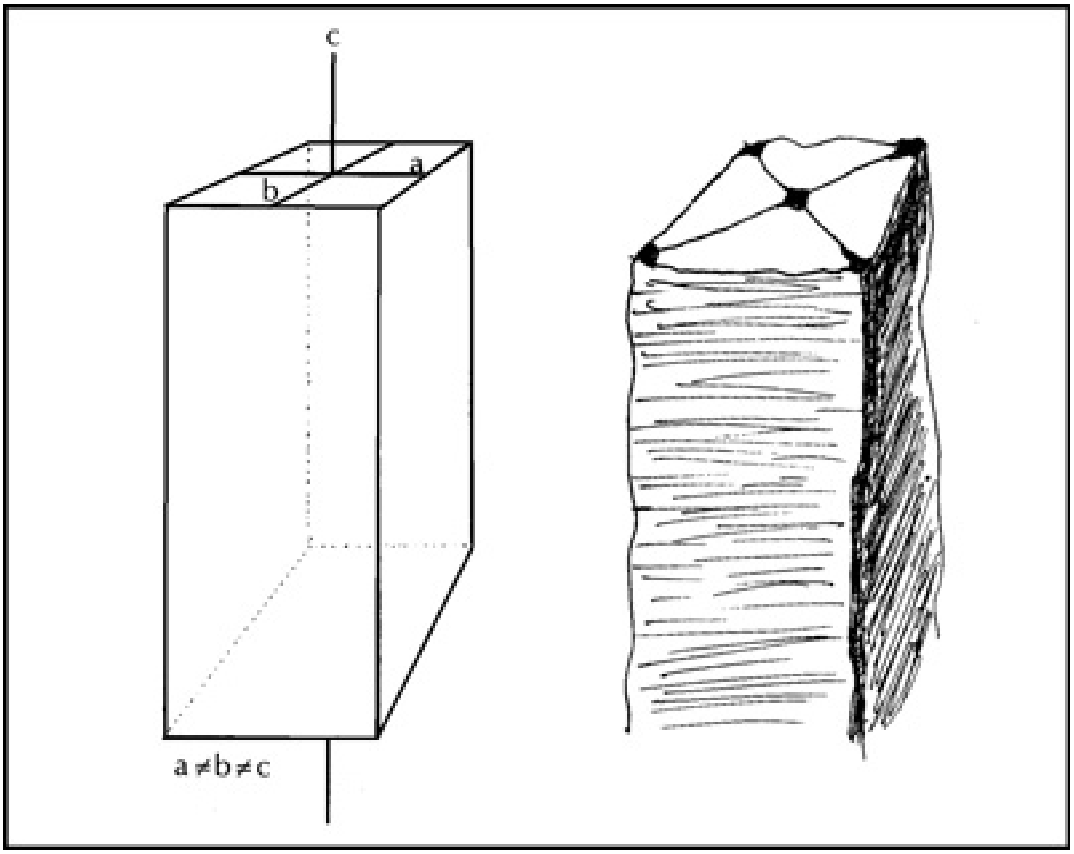


***Figure 7.*** **A sketch of the ideal orthorhombic crystal geometry (left) compared with the actual rough chiastolite crystal (right). The right-hand sketch is typical of the crystals found in the Blue Wing Mountains. James Carr drawings.**

Crystal colors range from white and opaque, if completely altered to sericite; cream-colored and translucent if partially altered; and red and glassy if unaltered. Some red crystals that have partially altered to sericite are pink. Cleavage is well-developed perpendicular to the c-axis. Crystals are easily polished, offering the best way to visualize the cross pattern in the crystal plane perpendicular to the *c*-axis.

## SAFETY CONSIDERATIONS

Even for Nevada, the Blue Wing Mountains are isolated. Access is via the well-maintained but unpaved Ragged Top Road starting at Toulon on I-80. For the first several miles the road crosses the Trinity Range; tight curves make slower vehicle speeds necessary, especially near the crest adjacent to the Ragged Top mine. Once in Granite Springs Valley, the road becomes smooth and straight, but many sections are covered by loose sand. The distance from Toulon to the collecting site is approximately 33 miles (53 km). There are no services at Toulon, but services are available in Lovelock, 10 miles northeast of Toulon on I-80.

*Figure 8.* **Four polished cross-sections showing a variety of forms and colors exhibited by typical crystals from the Blue Wing Mountains. The upper-right cross-section shows the iridescence imparted to the crystal by its partial alteration to sericite. The lower-left crystal is 2 cm on edge. Collection and photo: James Carr.**

*Figure 9.* **A plate of rough pink crystals showing typical growth patterns. This specimen was found in the central portion of the collecting site. The longest crystal is 10 cm. Notice that there is no preferential growth direction in the rock. Collection and photo: James Carr.**

An alternate rout to the site begins at the Nightingale exit on I-80, about 20 miles (32 km) northeast of Fernley. From there, the road heads northwest to the abandoned Nightingale town site, then due north to an eventual intersection with Ragged Top Road. This route is not recommended for those traveling to the Blue Wing Mountains for the first time, because numerous cross roads can make the route confusing, and the road is not as well maintained.

A third route, practical only in summer because of the heavy winter snowfall, begins approximately 8 miles (13 km) south of Empire on Nevada 447 (just south of the Empire Farms Road). This unpaved road crosses the Selenite Range, so named for the extensive gypsum deposits exploited by U.S. Gypsum and processed into sheet rock in Empire. Once over this range, the road heads southeast into Kumiva Valley, reaching the Blue Wing Mountains from the west. The principal reason that this route is not recommended is the difficulty of locating the right road when leaving Nevada 447.

No water is available at or near the Blue Wing Mountains. Cell phone coverage may be absent depending upon service provider. Although I have never personally encountered rattlesnakes, their presence in the Blue Wing Mountains cannot be ruled out. Ground squirrels, a popular prey for the Great Basin rattlesnake, are seen commonly. At other places in Nevada where the I have encountered Great Basin rattlesnakes (except for one instance when a young snake wanted to follow me out of curiosity), they tend to curl up at the base of sagebrush, especially if the ground is hot, and they keep to themselves. The venom of this particular rattlesnake species is not as potent as that of some, but treatment is still required. Lovelock has medical and veterinary care facilities.

*Figure 10.* **Red, unaltered crystal exposed along the c crystal axis. Collection and photo: James Carr.**

## FLORA AND FAUNA

Wild burro are common in the Blue Wing Mountains. If not directly seen, these animals are often heard braying. Once, I passed a golden eagle perched on a fence post along Ragged Top Road. One of the most elegant animals of the desert, the prong-horned antelope (*Antelocapra americana*), is wide-ranging in northern Nevada and is commonly seen on the route to and from the Blue Wing Mountains. Wild flowers are abundant and in bloom throughout the spring. A particularly attractive species is desert indian paintbrush (*Castilleja augustifolia*).

***Figure 11*. Partial alteration to sericite imparts a moonstone-like quality to the chiastolite crystal. The two crystals are each about 8 mm on edge. Collection and photo: James R. Carr.**

## FINAL COMMENTS

The occurrence of chiastolite in the Blue Wing Mountains is probably the best in Nevada. To say that crystals are abundantly available to the collector is an understatement. Collectors for whom mobility is limited will appreciate the large number of free crystals in float at the foot of the hills in the southern and southeastern portions of the collecting site. Summer temperatures in this part of Nevada are in the low to mid-90s F and (approximately 35°C) and thunderstorms are common. The dark tone of the hornfels makes for hot surface temperatures, an important consideration if traveling to the site with dogs. The field mapping and photography shown here were conducted between February and early April, 2009, a pleasant time to visit this collecting site.

## ACKNOWLEDGMENTS

I first learned of the Blue Wing chiastolite occurrence from Dr. Richard Schweickert, a structural geologist at the University of Nevada (Reno) Department of Geological Sciences and Engineering, whose memory of the actual location was vague. It took three trips, starting at the southwestern end of the Blue Wing Mountains and working eastward, to finally locate the chiastolite, a valuable refresher exercise for this geological engineer.

The USGS 7.5-degree Topographic Maps, *Juniper Pass* and *Blue Wing Flat* quadrangles, and Quadrangle *4-10*, Nevada Department of Transportation, were obtained in digital format through the University of Nevada, Reno website: http://keck.library.unr.edu/. Landsat 7 ETM+ images were obtained from the University of Maryland, Global Land Cover Facility (GLCF), at the following website: http://glcf.umiacs.umd.edu/data/landsat/.

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