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ALPINE-TYPE BERYL-EMERALD DEPOSITS NEAR HIDDENITE, NORTH CAROLINA

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ABSTRACT

Occurrences of beryl and its chromium-bearing variety emerald in the vicinity of Hiddenite, Alexander County, North Carolina have been known since 1875. Several previous attempts to exploit the deposits for mineral specimens and gemstones have met with only limited success. Most descriptions of the deposits class them as pegmatites enclosed in the local biotite-gneiss but field examinations in 1969 showed that they are hydrothermal veins deposited along a series of cross-cutting fractures in the gneiss. In non-saprolitized portions, wall alteration extends to several centimeters with the production of replacement muscovite and albite with some rutile. Within the veins, many of which are only partly filled, quartz (milky, smoky, late amethystine), muscovite, albite, goethite (pseudomorphous after Fe-bearing carbonate), beryl (aquamarine, late emerald), and rutile are common species. The morphology of the veins as well as the mineralization bear strong resemblances to the Alpine klufts classed as "Fundortgruppe 10f" by H.A. Stalder, and others, in Die Mineralfunde der Schweiz (1973). Despite the presence of small pegmatite bodies intercalated in the gneiss, beryl mineralization appears to be confined to the veins mentioned. For these reasons the veins are classed as Alpine in type and possibly represent a unique mode of emerald occurrence. Although no spodumene-bearing body was examined during the suthor's visit in 1969, it is likely that the chromium-bearing spodumene (hiddenite) is also unique in its mode of occurrence.

HISTORICAL BACKGROUND

The earliest recognition of emerald near Hiddenite, Alexander County, North Carolina occurred in 1875 when J.A.D. Stephenson[1] of Stony Point (later changed to Hiddenite) obtained several crystals from a property that was later exploited as the Emerald and Hiddenite Mine. Other crystals were obtained locally in 1876 and 1879, and the Cr-bearing variety of spodumene (hiddenite) in 1879. These finds were made known to W.E. Hidden who visited Stephenson and was shown the productive ground in 1879. Shortly afterward, Hidden obtained leases on the ground, later purchasing same, and commenced mining in 1881, but was forced to suspend mining in 1885 due to litigation.

In 1907, the American Gem Mining Syndicate reopened the original Hidden mine and also opened a deposit known as the Ellis Mine, lying just east of the town. Apparently only one season of work was accomplished and no further work was done until the brothers B.S. Colburn and W.B. Colburn of Statesville, North Carolina mined the Emerald and Hiddenite Mine during 1926 and 1927.[2] The large paper on the geology and mineralogy of this deposit by Palache, et al[3] was based on specimens recovered by the Colburns and S.C. Davidson in 1926. The Hiddenite field remained quiescent until 1969 when C.G. Rist of Pennsylvania purchased several tracts of land and the adjacent Ellis Mine property, organising American Gems, Inc. with the intention of mining emeralds and other minerals. From the beginning of this venture, which still continues under the name of Emerald Valley, collectors were allowed upon the land after paying a fee. In October, 1969, the author visited the property and rendered a report to Mr. C.G. Rist on the nature of the deposits and the prospects for future profitable operation[4].

GEOLOGY AND MINERALOGY

Sterrett[5] visited the Hiddenite area in 1908 and found that the rock enclosing the emerald-hiddenite deposits was a much compressed and distorted biotite gneiss, replaced along the vein walls by quartz, muscovite, rutile, pyrite, and other minerals, with the veins containing quartz, calcite, dolomite, muscovite, rutile, black tourmaline, beryl, hiddenite, pyrite, chalcopyrite, and monazite. In 1927, Davidson[6] reported a visit to the emerald-hiddenite deposit while it was being worked by the Colburns, and described the enclosing rock as a fine-grained, quartz-biotite-garnet gneiss, "probably representing a completely recrystallized argillaceous quartzite of Pre-cambrian age." Further remarks on the rock and its composition appear in Palache, et al,[3] and also descriptions of three stages of pegmatitic mineralization, namely, lit-par-lit pegmatite, thought to have been injected prior to complete folding of the gneiss, hiddenite-bearing pegmatite, concordant to gneiss foliation, and hiddenite cavities or vugs that occur along fissures cross-cutting the gneiss, and which "remind one very strongly of the Alpine clefts in form, structure and the habit and nature of the contained minerals" (p.286).

Neither beryl nor hiddenite were found in the lit-par-lit bodies while hiddenite, of an "olive green" color, was found in the hiddenite pegmatites, and beryl (aquamarine and emerald) was found in the cavities, along with a number of species found only in these cavities. The cavity species are quartz, amethyst, albite, adularia, hiddenite, holmquistite, beryl, tourmaline, garnet, muscovite, nontronite, rutile, apatite, monazite, pyrite, arsenopyrite, calcite, ankerite, siderite, and aragonite.

The hiddenite/beryl-bearing cavities observed by Palache, et al were remarkable for their sharp contacts against the enclosing gneiss in some places, but in others, some "were less sharply delineated and are surrounded by zones of bleached and altered gneiss," and that "cavities may well be the result of destructive attack on parts of earlier-formed pegmatites." Sterrett[5] remarked that the enclosing rock was highly silicified, attributing numerous quartz veinlets in the gneiss to ingress of this mineral from the mineralized veins. He noted alteration of the gneiss and the fact that the zone next to the vein consisted largely of quartz with emerald green ("chrome") muscovite, with a little rutile and pyrite, the alteration gradually lessening to about 2 inches [5 cm) from the vein wall. Pegmatite is mentioned only once by Sterrett (p.801), who noted that "the vein at the Ellis emerald mine is pegmatite, with cavities and pockets included in it."

During my visit in 1969, I found that the Ellis mine had been cleared of debris and the country rock well exposed. Several common granitic pegmatite blocks were present but contained no cavities nor traces of species other than the usual feldspar-quartz-mica assemblage. However, a vein, similar to the kind seen by Sterrett and Palache, et al was clearly exposed in fresh gneiss, enabling close examination over a distance of about 15 meters. In one place, an elliptical opening of about one meter in length and one-half meter in width showed a lining of milky quartz sharply in contact with the gneiss. Some distance away, the vein changed in character, displaying uneven alteration of the wall rock to depths of from several cm to 10 cm. In one place, alteration had proceeded so far that the vein opening was lined with slab-like porous masses of interlocked green muscovite crystals of hexagonal outline, upon which were perched numerous white blocky albite crystals, some quartz crystals, a little chlorite and pyrite, and reticulated twins of rutile. In still another place along the same vein, wall alteration was very minor and here was found a mass of white ankerite (?) crystals, quartz crystals, chlorite, albite, and, crossing over some of the depressions in the specimen, very long prismatic crystals of white to colorless beryl, no thicker than several mm.

Elsewhere on the American Gems property, numerous pits were examined that had been sunk through the reddish topsoil and the saprolitized gneiss to depths of from two to four meters. Most of these followed outcrops of quartz float, sometimes resulting in discovery of a vein, but at other times finding nothing because of lateral displacements from the original vein outcrops. Some of the pits clearly exposed the gneiss structure and lit-par-lit stringers intercalated in the gneiss. Because of severity of alteration and general slumping of the decayed gneiss, it was not possible to detect the degree of alteration that had occurred along vein walls. However, it was determined that all such veins cross-cut the gneiss foliation in nearly vertical dips. The sequence of minerals filling these veins showed milky quartz at the top, clear quartz and euhedrons below, small to large rhombs (up to 10 cm on edge) of altered Fe-bearing carbonate (ankerite?), small druses of amethyst crystals, rutile, emerald, crystals of muscovite and albite, black tourmaline crystals, and rarely monazite crystals. This sequence was confirmed by Mr. W.D. Baltzley, mine property manager, who had accomplished much exploratory trenching using a mechanical back-hoe. In none of the pits were seen any granitic pegmatite bodies exceeding about 5 cm in thickness, and those that were found appeared to be of the lit-par-lit type mentioned previously. Whether any of these bodies contain the suite of minerals, including hiddenite, mentioned by Palache, et al is not known. Despite much care in examining vug contents, Baltzley confirmed that no hiddenite had been found on the American Gems tract up to the time of my visit.

Only one body of ordinary beryl-bearing granitic pegmatite was found on the American Gems tract, this being a lens-like body almost a meter in thickness and perhaps 10 meters long which appeared to be concordant with the enclosing gneiss foliation. The beryl in this body was the common variety, yellowish in hue, and much fractured. No connections of this body to vug mineralization could be observed. The presence of similar pegmatite in the Ellis Mine was remarked upon by Sterrett, with the implication that aquamarine and emerald were obtained from vugs and pockets within it but no evidence for this was seen during my visit. Furthermore, no beryl was found in the lit-par-lit bodies previously mentioned, and the source of the beryllium in the vein cavities remains unknown.

COMPARISON WITH ALPINE VUGS

All above findings reinforce the statement originally made by Palache, et al that the cavities in these veins are strongly reminiscent of Alpine clefts. The closeness of this resemblance is verified by comparing the mineralization given for Alpine cleft "Fundortgruppe 10f" described in Stalder, et al <u>Die Mineralfunde der Schweiz</u>[7] (p.253-6), where the chief recognition features of cavities in this paragenetic group is the suite: ankerite-siderite, with calcite, muscovite, quartz, albite, chlorite, rutile, pyrite, and sphalerite, the last species, however, not reported from Hiddenite. Also noted specifically is the occurrence of Fe-bearing carbonates ~~to~~ which alter completely into goethite. In a specific locality at Faido, the clefts contain clear quartz crystals, strongly limonitized siderite penetrated by sagenitic rutile and six-sided muscovite crystals. In another place at Faido, occur weathered carbonate, amethyst, rutile, monazite, and, in limonite masses, long hair-like needles of a mineral identified as beryl.

Therefore, in terms of enclosing rock, type of vein opening, and mineral associations, the strong resemblance noted by Palache, et al seems more than accidental, and confirm that the veins near Hiddenite are most closely related to Alpine clefts than to any granitic pegmatite mineralization.

ORIGIN OF BERYL-EMERALD DEPOSITS

Field evidence suggests that a system of tension or flexure fractures appeared in the gneiss and provided channels for ingress of hydrothermal solutions which partly altered the walls of the fractures, perhaps obtaining therefrom constituents that contributed to the formation of vein silicate species as quartz, albite, muscovite, chlorite, and others. The lithium necessary for spodumene formation may have been leached from the hiddenite-pegmatites of Palache, et al, or like, the beryllium needed for beryl, obtained from distant and as yet unidentified sources as granitic pegmatites or granitic magmatic rocks. The absence of spodumene in the large tract of American Gems suggests that lithium is not as widespread in the vein system as beryllium. The source of chromium necessary to impart the typical blue-green hue to hiddenite and emerald is also unknown, none of the rock so far described from the Hiddenite area containing any identified Cr-bearing species. However, if the fracture systems extend to considerable distances laterally and in depth, some bodies of basic, Cr-containing rocks may have been cut through to provide this coloring ion.

As in the hydrothermal veins of the Muzo type in Colombia, which, however, differ in important respects from those at Hiddenite, introduction of Cr in the mineralization sequence is neither uniform nor consistent. In some places at Hiddenite, veins contain aquamarine or colorless beryl, and no great distance away, similar veins contain emerald. An important distinction is that almost all emerald at Hiddenite is deposited upon pre-existing beryl crystals as a late stage mineral, seemingly in variable amounts because large crystals always are coated with thin layers of emerald and hence appear quite pale, while small crystals, more heavily coated, appear considerably darker in many specimens, and in a few instances, have provided sufficient thickness of emerald to afford cut gems.

NOTES ON PARAGENESIS

In the Ellis Mine vug system, quartz appears to be the first species to line cavities in one place, but muscovite/albite, with quartz and rutile, line the walls elsewhere. Colorless beryl formed very slender colorless prisms perched atop the muscovite/albite linings. In the veins elsewhere on the American Gems tract, the relationships are less clear because of the saprolitization of the gneiss and movements of both the decayed gneiss and vein contents, the latter often appearing as disjointed strings of vein remnants blending imperceptibly into the saprolite. However, quartz appears in three stages, the first as milky quartz forming linings and "hoods" over cavities, followed by clear quartz crystals, some rutilated, and lastly small druses of amethyst whose basal impressions show that they were originally overgrown on carbonate rhombs, also over quartz crystals of the second quartz generation, and over beryl crystals. Rutile is a very early species, forming handsome, brilliant twin reticulations perched on muscovite-albite wall linings, and also enclosed in quartz and by carbonate rhombs. Beryl and emerald appear to be earlier than the carbonate rhombs, some specimens showing penetration of rhombs by emerald crystals. The position of tourmaline, monazite, and other species is not known because these occur loose in vug debris. Calcite is mentioned as a very late, perhaps the last species by Sterrett but was not found during my examinations of the Ellis deposit and those elsewhere on the American Gems tract. In some vein cavities, very late hydrothermal activity resulted in the etching of emerald crystals, pitting the faces of first order prisms, severely pitting those of the second order prism, and dissolving faces of the pinacoid, leaving behind a curious "worm-track" pattern that closely resembles similar markings on tektites and appears to be distinctive for Hiddenite emerald crystals.

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