

Gemological Characterization of Emeralds from North Carolina, USA



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Emerald deposits in North America are few and far between. Of the known mining deposits, the emeralds discovered in the piedmont region of North Carolina have both a historical significance & a gemological distinctiveness. Known as "Green Bolts" by the local population prior their world-renowned fame, these emeralds have been classified by their colorless core & distinct green zoning with a chemistry that differentiates them from other geographical origins. Here, we will discuss that chemistry, & other characteristics that can aid in the identification of North Carolina emeralds, focusing on the mines in Alexander County as well as a comparison of those found in Mitchell County.



Distinct color zoning in a rough NC emerald crystal from Alexander Co.
Courtesy of The Smithsonian

LA-ICP-MS Chemistry

Trace-element composition of emeralds from North Carolina & other deposits in ppmw

Element	Li	K	Fe	Rb	Cs
Alexander County	Range: 2140 – 6790 Average: 3319	11.1 – 207 53.2	125 – 3500 1272	2.6 – 21.3 11.3	77.5 – 375 207
Mitchell County	106 – 405 210.9	5.5 – 577 112.1	1040 – 4450 2625	1.5 – 48.2 17.32	215 – 1840 753.9
Colombia	24.2 – 139 62.9	Bdl – 359 17.7	117 – 2030 553	Bdl – 4.92 2.03	3.17 – 19.0 10.9
Afghanistan	78.2 – 268 115	51.7 – 1590 639	849 – 9820 3780	3.87 – 110 46.9	11.3 – 97.0 46.2
Brazil	31.3 – 359 80.8	33.2-1150 231	2460-9120 5120	7.42-91.8 31.4	16.8-1130 148
Kafubu, Zambia	360-1140 604	305-890 500	4620-11600 8139	17.4-116 65.9	375-2430 1344
Russia	300 – 1640 751	Bdl – 8830 319	864 – 8800 2613	9.10 – 361 39.9	107 – 2180 714
Detection Limits	0.016-0.71	0.27-3.15	0.71-5.57	0.003-0.040	0.005-0.99



Rough specimen & cabochon of emerald in matrix from Crabtree, Michell Co. (left)

Rough & faceted emerald from Adams Farm, Alexander Co. (right)

Photos by Robert Weldon/GIA©, Crabtree Rough courtesy of GIA
Crabtree cabochon & Adams Farm emeralds courtesy of Eric Fritz



From the collections of the Natural History Museum, London, a rough emerald measuring 15.2 cm long, weighing 102.32 grams (511.6 carats)
Purchased from G. F. Kunz in April 1884.
specimen registration number 'BM.55467', © The Trustees of the Natural History Museum, London Licensed under CC-BY-4.0

Alexander Co. Geology:

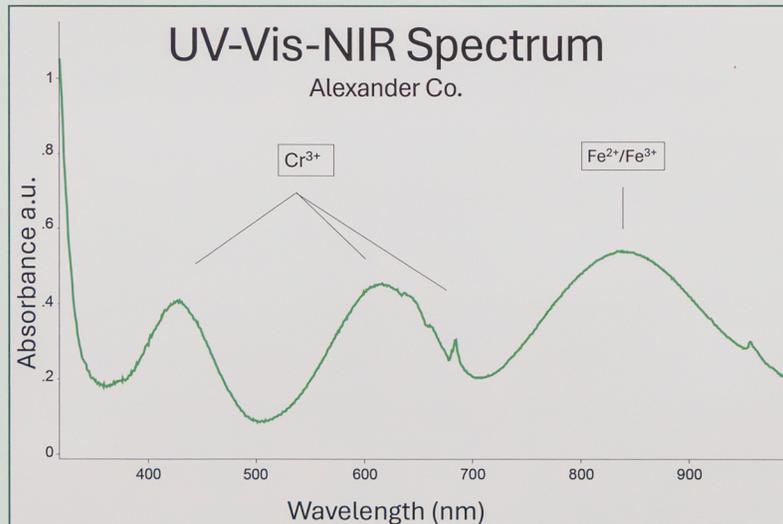
- Hydrothermal event during late-stage regional metamorphism
- Vertical quartz veins
 - Not interconnected but subparallel
 - Run northeast to southwest
- Range in size
 - 2 cm to 1 m wide
 - 30 cm to 7 m long



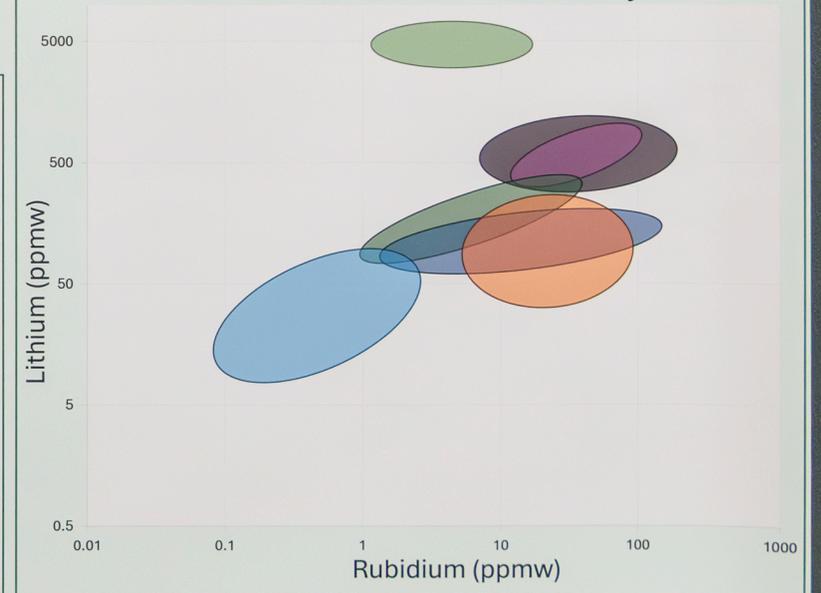
Quartz Vein in Alexander Co.
Courtesy of Ed Speer

Standard Gemological Data

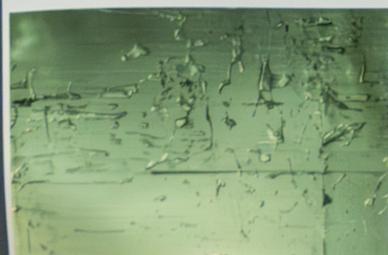
Refractive Index	1.589 – 1.581 (+/-0.002)
Birefringence	0.008 (+/-0.001)
Optic Sign/Character	Uniaxial (-)
Pleochroic colors	Yellowish Green & Greenish Blue
Specific Gravity	2.73 (+0.03)
LW & SW UV Fluorescence	None
Handheld Spectroscopy	Chromium Related Features



Lithium vs Rubidium Chemistry Plot



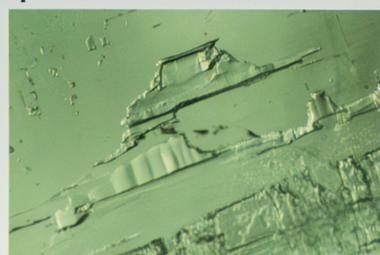
Photomicrographs of Inclusions in Emeralds From Alexander County



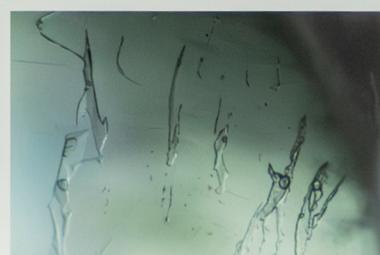
Irregular Fluid Inclusions FoV 1.79 mm



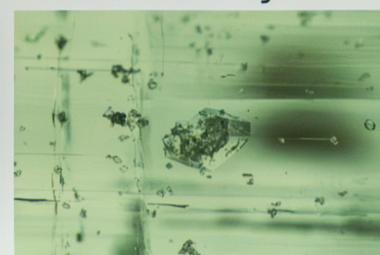
Irregular Fluid Inclusions FoV 1.90 mm



Irregular Fluid Inclusions FoV 1.44 mm



Irregular Fluid Inclusions FoV 1.11 mm



Transparent Zircon & Feldspar Crystals FoV 2.87 mm



Rutile Crystal & Parallel Growth Tubes FoV 3.34 mm