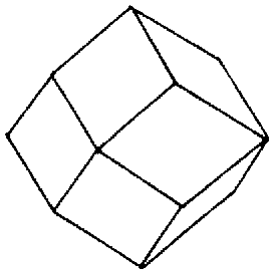
February 2001 Mineral of the Month: Uvarovite

"One of the favorite groups in which to specialize is the fascinating family of garnets. They are important because of their beauty and perfection of crystallization, their variation in color, and their very wide distribution in a large number of geological environments."– Robert B. Cook, Rock & Minerals, 1998

PHYSICAL PROPERTIES

Chemistry: $Ca_3Cr_2(SiO_4)_3$ Calcium Chromium Silicate
Class: Silicates Subclass: Nesosilicates Group: Garnet
Dana's: Insular SiO_4 Groups
Crystal System: Isometric
Crystal Habits: Fine- to coarse-grained aggregates and druses of very small dodecahedrons or trapezohedrons or combinations of the two; Compact or massive



Color: Deep rich green, rusty green, very dark green in large crystals
Luster: Vitreous (Glassy)
Transparency: Transparent to translucent
Streak: White
Refractive Index: 1.87
Cleavage: None
Fracture: Uneven to conchoidal; Brittle
Hardness: 7.5
Specific Gravity: 3.40-3.83, depending on Cr content
Distinctive Features and Tests: Size and color; Infusible, while other garnets fuse easily
Dana Classification Number: 51.4.3b.3

NAME

The name for this small green garnet was given in 1832 in honor of Count Sergei Semeonovich Uvarov (1786-1855), Russian statesman and avid amateur mineral collector. It is pronounced ū-varʹ-ō-vīt or oo-varʹ-ō-vīt.

COMPOSITION

Our sixtieth featured mineral gives the lie to the common misconception that all garnets are red. We can understand the cause of this misconception as the garnet used as a gemstone for thousands of years is dark-red and highly recognizable. But the reality is that garnets come in all colors except blue. The name "garnet" comes from the Latin *granatus*, meaning "pomegranate," and was given because garnet crystals were thought to look like pomegranate seeds.

Uvarovite is the third garnet we have featured, after almandine in March 1997 and spessartine in August 1998. Garnet, of course, is the name for a group of minerals that includes the fifteen end-members found in the box on the next page. Mineralogists and collectors alike love garnets, as one writer said: "Well-formed garnet crystals are rather common, for the mineral has an extremely strong crystallizing power and is able to develop its characteristic crystal shapes under adverse conditions." All garnet group members crystallize in the isometric crystal system and commonly form as 12-sided dodecahedrons and 24-sided trapezohedrons or as combinations of these two forms.

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Extensive solid solution exists between many members of the garnet group, with uvarovite forming a complete solid solution with grossular and a partial solid solution with andradite.

As you may note from the chart, only uvarovite and the rare garnet knorringite contain the element chromium (Cr), although other garnets can be green in color. (So far, knorringite has only been found in kimberlite, the common diamond matrix, in Lesotho, and in diamonds from Yakutia, Russia.) Chromium in the form of Cr^{3+} is the cause of the beautiful emerald green in uvarovite, as mentioned in our 1996 Crocoite write-up: “Chromium, the source of crocoite's gorgeous trademark color, was isolated in 1797 by the French chemist Louis Nicolas Vauquelin. He chose the name chromium, from the Greek *chroma*, meaning "color," because compounds including chromium come in a variety of colors. What puts the red in ruby and the green in emerald? Chromium! Kammererite is a red-violet mineral, uvarovite is a green type of garnet, and chrome diopside, the "Siberian Emerald," is a translucent green gemstone, all because of containing chromium! Chemical compounds containing chromium show a similar wide range of bright colors. A fairly common element, chromium ranks about 21st in natural abundance among the elements in crustal rocks.” Unlike quartz varieties such as amethyst and citrine whose characteristic colors are caused by impurities, the various colors exhibited by garnet group members are caused by their varying chemical make-up. Thus, garnets are known as **idiochromatic**, meaning “self-colored.”

Common End-Member Garnet Species

Species	Chemical Formula	Color
Almandine	$Fe_3Al_2(SiO_4)_3$	Red, brown-red, purple-red
Pyrope	$Mg_3Al_2(SiO_4)_3$	Red, purple
Spessartine	$Mn_3Al_2(SiO_4)_3$	Orange, red-orange, red-brown
Grossular	$Ca_3Al_2(SiO_4)_3$	White, orange, brown, green
Andradite	$Ca_3Fe_2(SiO_4)_3$	Yellow, green, brown, black
Uvarovite	$Ca_3Cr_2(SiO_4)_3$	Deep green

Rare End-Member Garnet Species

Calderite	$(Mn^{2+},Ca)_3(Fe^{3+},Al)_2(SiO_4)_3$	Dark yellow to yellow-brown or reddish brown
Goldmanite	$Ca_3(V,Al,Fe^{3+})_2(SiO_4)_3$	Dark green to brownish green or grass green
Hibschite	$Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$	Colorless, white, gray, green, bluish green, pink
Katoite	$Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$	Colorless or milky white
Kimzeyite	$Ca_3(Zr,Ti)_2(Si,Al,Fe^{3+})_3O_{12}$	Brown
Knorringite	$Mg_3Cr_2(SiO_4)_3$	Blue-green to lilac, dark green when synthetic
Majorite	$Mg_3(Fe,Al,Si)_2(SiO_4)_3$	Purple-violet, colorless, or yellowish-brown
Morimotite	$Ca_3TiFe^{2+}Si_3O_{12}$	Black
Schorlomite	$Ca_3Ti^{4+}{}_2(Fe^{3+}{}_2Si)O_{12}$	Black to very dark brown

Some of these rare garnets are, so far, extremely rare: Majorite has only been found in meteorites, and several others have been found in just a very few locations

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COLLECTING LOCALITIES

Though collection-worthy specimens of uvarovite are fairly rare, it is actually a common mineral that tends to be found wherever chromium-rich deposits are, and almost always as tiny crystals. In the United States, uvarovite is found in Pennsylvania, Texas, New Mexico, Arizona, Oregon, and more than twenty localities in California! Canadian localities include Kiglapait, Labrador; MacMillan Pass, Yukon; and Cassiar, British Columbia, where it is found with striking green British Columbian nephrite jade. The largest uvarovite crystals uncovered so far come from a copper mine at Outokumpu, Finland, as dark green crystals up to almost two inches! Not surprisingly, the crystals were found with chrome diopside, chrome tremolite, chrome epidote, and the chrome-bearing muscovite variety fuchite. This mine is currently closed, so such fine specimens will be difficult and no doubt expensive to obtain. Other European localities include Röros, Norway; Karelia, Finland; Silesia, Poland; Val Malenco, Italy; and Pico do Postes near Venasque, Spain. Uvarovite and kammererite are found together at the Kop Krom Mine, Kip Daglari, Turkey.

Uvarovite was initially discovered about 170 years ago near Bisserk, northeast of Zlatoust near the Ural Mountains of Russia. This range extends about 1500 miles from the Arctic Ocean to the steppes of Kazachstan, and is the traditional separation point of the European and Asian continents. A flood of fine minerals have been unearthed from these mountains, including more than three hundred just from the southern Urals. Uvarovite comes from huge chromium deposits in the central Urals, notably at Syssert, Nizhni Tagil, Mt. Saranovsk, and Sarany near Perm', where our lustrous pieces were unearthed. (Perm' is a large enough city that you may find it on a map of Russia, west of the central portion of the Ural Mountains. The apostrophe at the end of its name is the transliteration of the Cyrillic letter Ь, which is not pronounced but serves to soften the pronunciation of the preceding consonant.) Due to the closed nature and the general disinterest in mineral collecting during the years of the former U.S.S.R., it is difficult to find information about these remote Russian localities, so we will have to wait to learn more.

JEWELRY & DECORATIVE USES

As mentioned, red garnet (mainly of the pyrope-almandine series) has been in use as a gemstone for millennia. Currently, the garnet commanding the highest prices is demantoid, a chromium-colored variety of andradite first found in Siberia and later on the western slopes of the Ural Mountains. We will learn more about this fiery gemstone, whose name means "diamond-like," when we feature andradite.

"With good hardness, and a high refractive index, [uvarovite] would furnish sensational stones if larger crystals were to be found," says June Culp Zeitner in her book *Gem & Lapidary Materials*, a thought echoed in other references. Of course, some modern designers are able to use plates of drusy uvarovite on matrix in wire wrapping and other designs for striking results. In one of the display exhibits at the 2001 Tucson Gem & Mineral Show, featuring minerals and gem art of Russia, was a small statue made of various Russian stones, such as lapis lazuli, malachite and chert. What Russian stone could be used for the patch of green grass on which the figure was standing? A tiny bed of uvarovite crystals, which looked for all the world just like one of our specimens!

At times, you may have heard of YAG (Yttrium Aluminum Garnet) or GGG (Gadolinium Gallium Garnet) or other laboratory-grown garnets used, before the creation of cubic zirconium, as a diamond substitute, now used in high-tech applications. Though these lab-grown substances have a garnet-like crystal structure, they are not silicates and do not fit the accepted chemistry for garnets, and as a result, most mineralogists would not consider them as such.

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HISTORY & LORE

As mentioned above, uvarovite's history dates back to its discovery in 1832. In addition to the metaphysical properties ascribed to other garnet group members, crystal power believers say that uvarovite can help one recognize the universal/galactic/endless nature of the soul, bestow peace, quiet, and solitude without loneliness, promote clarity in the mental process, convert loving thoughts into loving actions, and encourage patriotism.

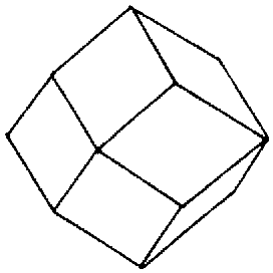
TECHNOLOGICAL USES

Chromium is a vital component of our modern world, and you may read about its technological uses in our October 1996 crocoite write-up. Uvarovite crystals, though numerous, are too small to be a viable source of this element.

ABOUT OUR SPECIMENS

This month's mineral is beautiful in (at least) two ways: As an array of brightly colored, emerald-green crystals on a gray matrix, twinkling like stars in the nighttime sky; and, if viewed up close with a magnifying lens, as near-perfect though very small crystals that look like the twelve-sided dodecahedron drawing to the right! As you look at your piece in the light, remember that each sparkle you see is caused by the light being reflected off a tiny crystal face!

The matrix is evidently massive chromite [$Fe^{2+}Cr_2O_4$], a mineral belonging to the chromium subgroup of the spinel group (see the September 2000 spinel write-up under *Composition* for details.) The green garnets formed in cracks and openings in the massive chromite. You might look over the rest of your piece, especially if you have a 10x power or stronger lens, as the tiny uvarovite crystals have often formed on several sides! A few pieces show a smear of massive uvarovite with no discernable crystal forms.



This information gives us a glimpse into the reasons why garnets are held in such high esteem by collectors. Now that we have featured three of the six common garnets, we will anticipate learning all about the other three in the future, and adding their distinct beauty to our collections!

References: Mineralogy, John Sinkankas, Van Nostrand Reinhold Company; Dana's Manual of Mineralogy, 18th Edition, Cornelius S. Hurlbut, John Wiley & Sons, Inc.; Dana's New Mineralogy, Richard V. Gaines, et al, John Wiley & Sons, Inc.; Fleischer's 1999 Glossary of Mineral Species, Joseph A. Mandarino, The Mineralogical Record, Inc.; Manual of Mineralogy, 21st Edition, Cornelia Klein & Cornelius S. Hurlbut, Jr., John Wiley & Sons; Minerals and Man, Cornelius S. Hurlbut, Random House; Gems & Crystals of the American Museum of Natural History, Anna S. Sofianides & George E. Harlow, Simon & Schuster; Gem & Lapidary Materials, June Culp Zeitner, Geoscience Press; Connoisseur's Choice: Uvarovite, Robert B. Cook, Rocks & Minerals, March-April 1998; The Causes of Color in Garnets, Emmanuel Fritsch & George R. Rossman, Mineralogical Record, January-February 1993; Garnet & Garnets, Frederick H. Pough, Ph.D., Lapidary Journal September 1990; Garnet Are Great, Bob Jones, Rock & Gem July 1980; Microsoft Encarta

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