What makes rocks GREEN?

In agates, trace amounts of **chromium, nickel, or iron** present during the silica crystallisation process give the stone a natural green tint. For example, in *Moss Agate*, the moss-like green patterns are caused by mineral inclusions like chlorite or hornblende.

In fluorites, the most common drivers for the green hue are microscopic amounts of impurities trapped within the crystal lattice, most notably **yttrium**, **cerium**, and **iron**.

Green garnets get their signature colour from trace amounts of the chemical elements **vanadium** and/or **chromium** that substitute for other atoms within the gem's crystal structure.

Green calcite is green primarily due to the presence of **chlorite** or **trace amounts of iron** trapped within the calcium carbonate structure during its crystallization process.

The trace elements act as colour-altering impurities in the crystal lattice. They absorb certain wavelengths of visible light (like red or yellow) and reflect only the brilliant greens back to your eyes.

What makes **COPPER** green?

Copper turns green due to a natural chemical process called **oxidation**, which happens when the metal is exposed to air, moisture, and atmospheric gases over time. This green coating is known as a **patina** or **verdigris**. Unlike iron (which rusts and flakes away), this green patina acts as a protective shield. It creates a durable barrier that prevents the copper underneath from further corroding.

1. Initial Reaction: When copper meets oxygen in the air, it forms a thin, brownish layer of copper oxide.

2. Environmental Exposure: As rain, carbon dioxide, and airborne pollutants (like sulphur or chlorides) interact with this layer, it converts into new copper compounds.

3. The Green Colour: The resulting mixture is primarily **copper carbonate** and **copper hydroxide**, which gives the surface its distinct bluish-green hue.

Source: Both images © Getty Images

https://edu.rsc.org/everyday-chemistry/

What makes **MALACHITE** green?

Chemical Formula: $Cu_2CO_3(OH)_2$

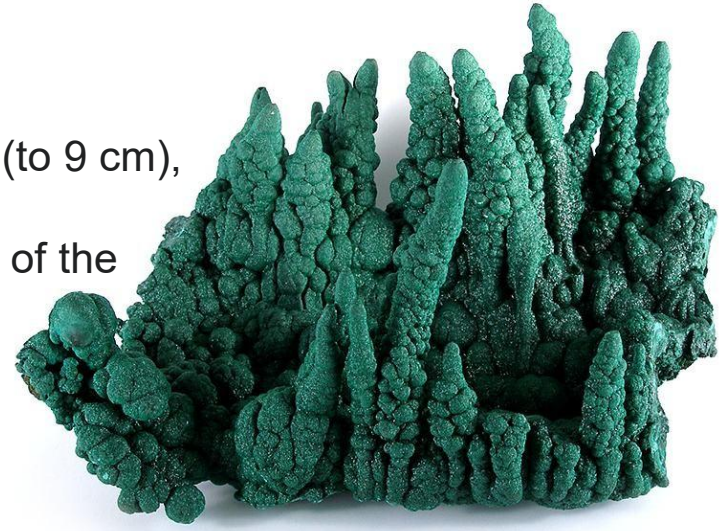
Malachite gets its rich, green colour from its high copper content (50%–60%). It forms as copper ore weathers and interacts with water and carbon dioxide.

The presence and interaction of copper ions dictate how the mineral absorbs and reflects light, resulting in its iconic, banded green appearance. Because of the specific way its copper electrons transition, it absorbs red and yellow light while reflecting green light back to our eyes.

https://www.serendipitydiamonds.com/blog/malachite-green-gemstone-rich-history-and-meaning/

Serendipity Diamonds, Mark Johnson

Malachite stalactites (to 9 cm), from Kasompi Mine, Democratic Republic of the Congo



By Rob Lavinsky, iRocks.com – CC-BY-SA-3.0, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=10146310

What makes **EMERALDS** green?

Emeralds get their rich, iconic green colour from trace amounts of **chromium** and **vanadium**. These elements replace a tiny fraction of the aluminium in the stone's crystal structure (beryl), absorbing blue and yellow light while reflecting green.

If the trace elements are too scarce, the mineral remains pale and is classified simply as "green beryl" rather than a true emerald.

Most emeralds have internal inclusions, poetically referred to as a "jardin" (garden). These unique natural flaws often contain trapped iron, which can subtly shift the stone's colour from a pure, vivid green to a slightly deeper, bluish-green.

Rare "trapiche" emeralds are found in Colombia, distinguished by ray-like spokes of dark impurities.

What makes **JADE** green?

Jade is a decorative rock that can be made of *either* **jadeite** *or* **nephrite**

Both the amphibole jade (nephrite) and pyroxene jadeite are mineral aggregates (rocks) rather than mineral species.

Jade is green because of trace minerals absorbed into its crystal structure during formation. Pure jade is actually colourless or white. The iconic green hues come primarily from chromium (which creates vivid, emerald tones) and iron (which produces softer, spinach or olive greens).

Chinese Nephrite Jade Drinking Vessel (202 BC – 111 BC)

Māori *hei matau* jade pendant

Jadeite Pectoral from the Mayan Classic period

https://commons.wikimedia.org/w/index.php?curid=5809468

What makes **MANTLE ROCKS** green?

The vibrant green hue occurs because transition metals in the mineral's crystal structure—specifically iron (Fe^{2+}) and nickel (Ni^{2+})—absorb non-green wavelengths of light, reflecting only the green spectrum.

Olivine: The primary component of the Earth's upper mantle.

Chemical formula $(Mg,Fe)_2SiO_4$

Pyroxenes are often green depending on their iron and magnesium content as well as trace elements such as chromium or vanadium.

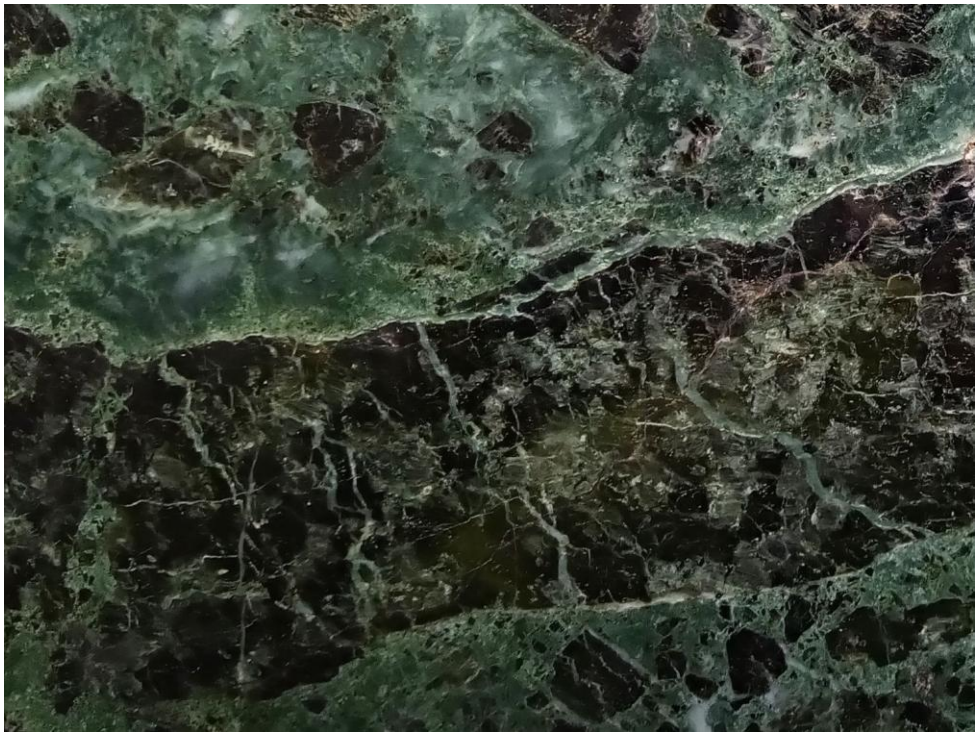
Examples: **Augite, Diopside, Jadeite, Aegirine**

Pyroxene (diopside) crystals from Afghanistan

What makes **SERPENTINITE** green?

Serpentinite is an altered form of **peridotite**, a very common rock in the Earth's deep crust and upper mantle. The main components of peridotite are **olivine** (55%) and **pyroxene** (35%) with small amounts of other minerals.

Serpentinite is created through a process of hydration deep in the earth, when hot seawater interacts with **peridotite**, changing its chemical composition and forming minerals such as lizardite and antigorite. The vibrant green colours of these minerals develop due to the substitution of iron for magnesium, which alters how the minerals absorbs light. Serpentinite also has a greasy, scaly texture resembling snakeskin.



Tectonic forces can cause serpentinite from the depths of the ocean crust to be lifted up onto the land; an example can be seen at the Lizard Peninsula in Cornwall.