



# MINERALS in the Artist's Palette

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While synthetic pigments are readily available in the modern world, until the 19th century natural pigments were the basis of the artist's paint palette. An entire rainbow of colors can be produced by crushing various minerals and mixing them with a binder such as water, oil, eggs, saliva, or animal fat. Historically, some of these minerals were accessible only in certain areas of the world. Civilizations so valued these pigments that they were widely traded and transported around the globe.



Cross-hatches on a piece of red ochre, Blombos Cave, South Africa (*photo: Chris Henshilwood*).

This piece of engraved red ochre from Blombos Cave in South Africa is considered the world's oldest example of art, and thus one of the earliest representations of modern human behavior. It is thought to be around 70,000 years old, and was found with thousands of other ochre pieces ground smooth as if used to make pigment powder.



Ladder-shaped figure and other designs in red ochre, La Pasiega Cave, Spain (*photo: Pedro Saura*).

The oldest known paintings are from three cave sites in Spain. Dated to around 65,000 years ago, these red ochre pigment images were created 20,000 years before the arrival of modern humans in Europe from Africa, and so are likely the artwork of Neanderthals.



Paint brushes, Egypt (photo: British Museum); paint palette, Egypt (photo: Metropolitan Museum of Art).

Ancient Egyptians used these early paint brushes made from palm fibers, and the ivory palette above, which dates from 1390-1353 BCE.



*Pictura (An Allegory of Painting)*, Frans van Mieris.

This 1661 painting by Van Mieris shows the typical portrait artist's "flesh palette," including lead white, yellow ochre, vermilion, green earth, madder, umber, and carbon black.

# RED

The oldest red pigment is **red ochre**, composed mainly of the mineral hematite (an iron oxide). Hematite is one of the most abundant minerals found at the Earth's surface. Red ochre was used in cave paintings, the oldest of which are estimated to have been painted around 65,000 years ago in Spain, possibly by Neandertals.

The color **vermilion** was originally produced from the mineral cinnabar (mercury sulfide). This bright red paint was prized by the Romans and used extensively on frescos in Pompei. The cost would have been extraordinary since at that time, vermilion was as expensive as gold! The largest reserve of cinnabar is found in Almaden, Spain where it was mined by the Romans. Because it contains mercury, the ore is highly toxic, and the prisoners and slaves who were forced to mine the mineral under dangerous conditions often perished.



## Lascaux Cave Paintings

France, c. 15,000 BCE

Pigment on rock

The Lascaux Cave paintings of France, some of the most well-known Paleolithic cave paintings, incorporate red and yellow ochre, manganese black, and calcite white into depictions of a variety of prehistoric creatures.



Peter Paul Rubens (1577-1640,  
Belgium)

***The Descent from the Cross,***  
1612-1614

Oil on wood

The robe of St. John is painted with  
vermilion, a pigment which fades  
over time. What was once vivid  
red is now a dull brown in many  
famous Renaissance paintings.

# ORANGE

The only pure orange pigment prior to the creation of artificial orange hues was **realgar**, an arsenic sulfide that is highly toxic. It was used by ancient Egyptians to paint tombs, and later by medieval artists to color manuscripts. It was also used in early China, and for 17th century Dutch still lifes and 16th century Venetian oil paintings.





Rachel Ruysch (1664-1750,  
Netherlands)

***Flowers in a Vase***, 1690

Oil on canvas

The bright orange flowers of this still life are painted with realgar.

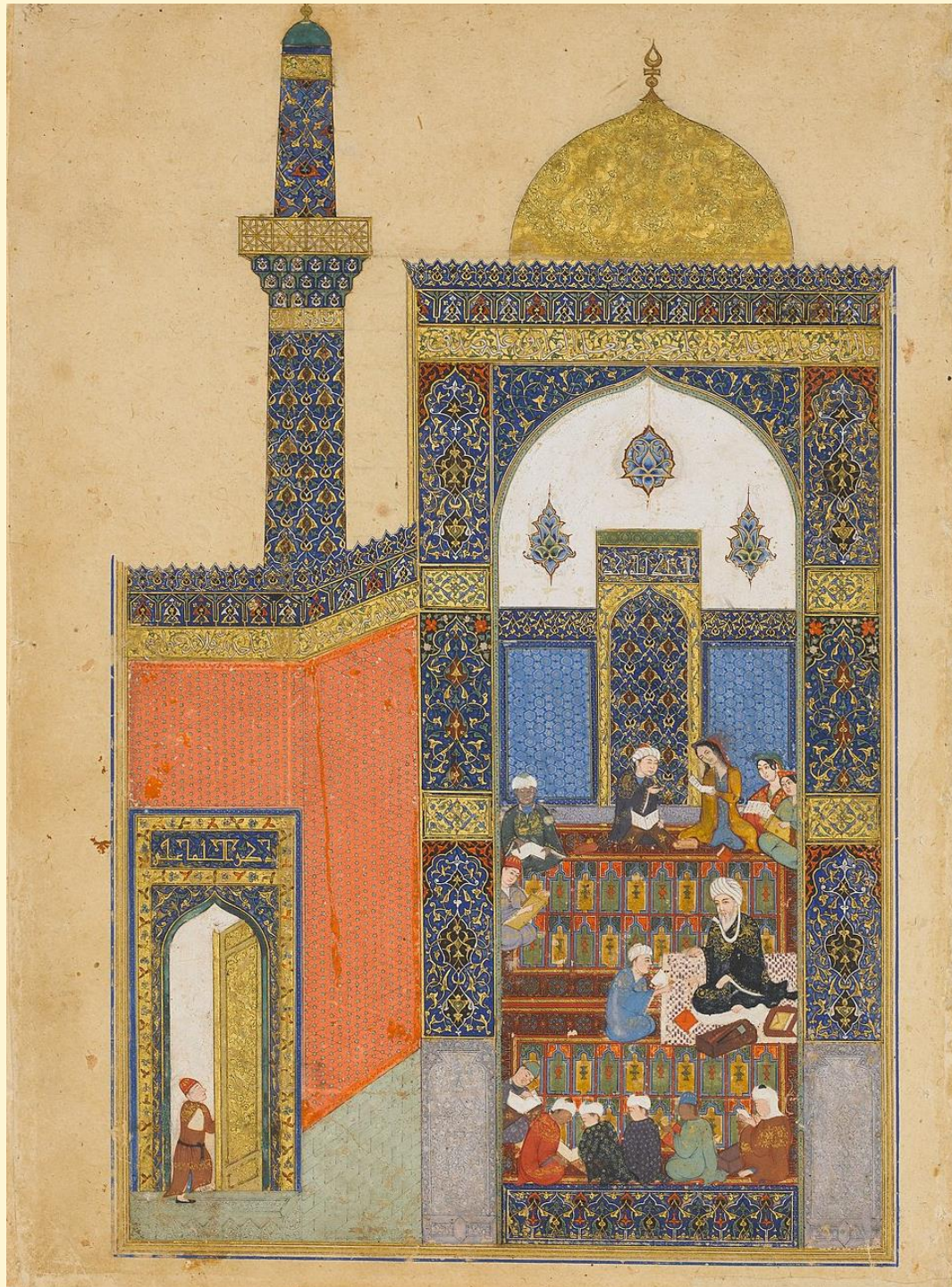
# YELLOW

**Yellow ochre** was one of the first pigments used by humans and is derived from limonite. Limonite is a mineraloid composed of various iron oxide minerals. The famous Lascaux cave paintings in France, dated to around 17,000 years ago, were painted in part with yellow ochre. Later, **orpiment**, an arsenic sulfide, was used in the East as a brighter yellow pigment.



**Tomb of Sennedjem**  
Egypt, c. 1400 BCE  
Tempera on plaster

The paintings on the walls of the Tomb of Sennedjem in Egypt are on a brilliant background of yellow ochre.



Jafar Baisunghuri (1412-1431, Persia)  
***Laila and Majnun at School***, 1431  
Watercolor on paper

Persian miniatures, a movement from the 13th-16th centuries, served as illustrations for stories and poems and often utilized orpiment.

# GREEN

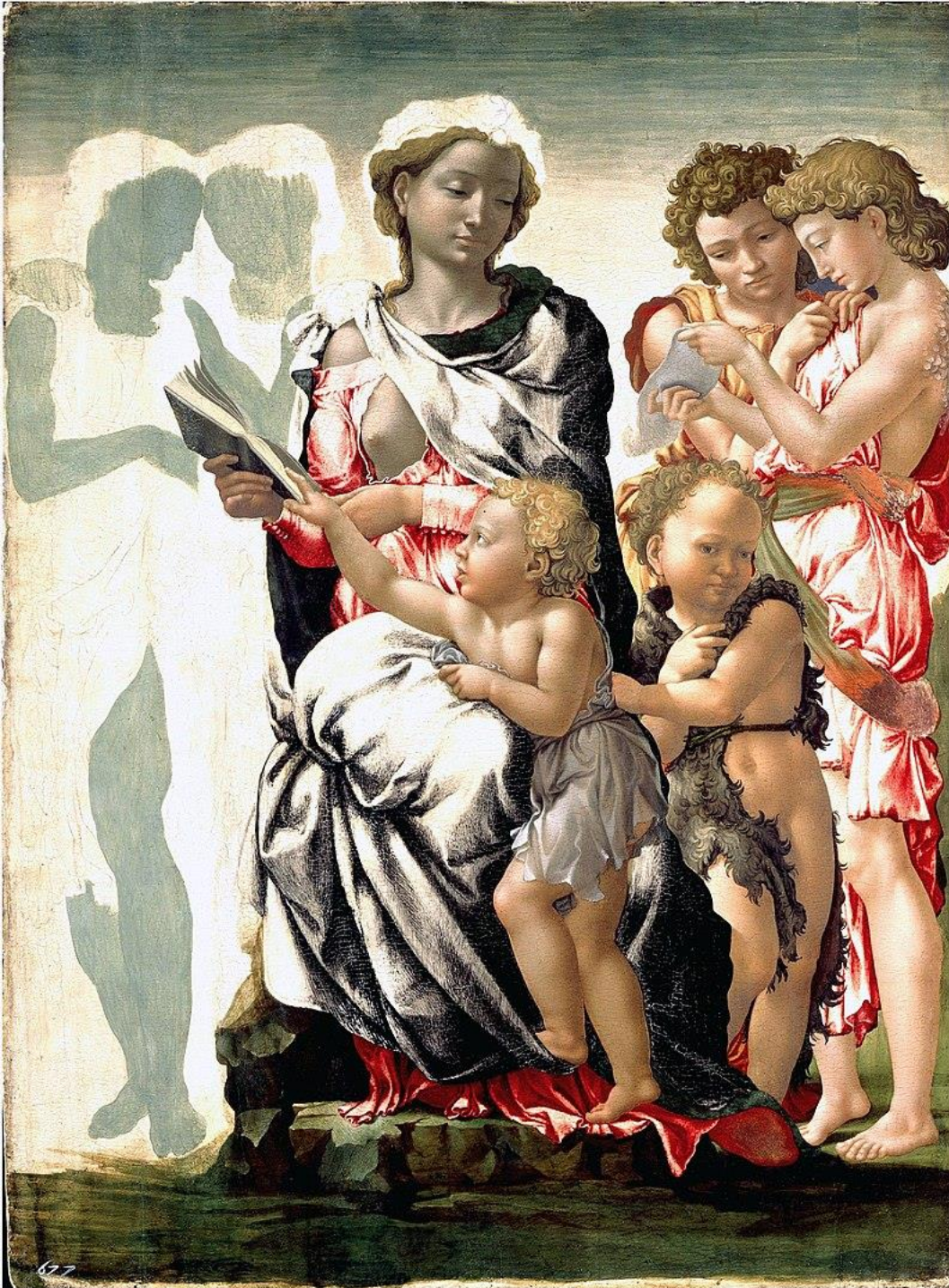
**Malachite**, a copper carbonate mineral, is the oldest green pigment and was used by ancient Egyptians in tomb paintings. It is also found in Buddhist wall paintings from the Horyu-ji temple (a UNESCO World Heritage Site), western Chinese paintings of the 9th and 10th centuries, and European paintings in the 15th and 16th centuries.

**Green earth**, another green pigment, gets its green hue from the iron found in a naturally occurring mixture of the minerals glauconite and celadonite and has been used since the 1st century CE. Green earth has been found in works from around the globe including pottery in Mexico to paintings from Japan, Nepal, and Medieval Europe where the hue was used as an underpainting for flesh tones.



**Amitabha Buddha  
Paradise (No. 6 wall)**  
Japan, late 7th century  
Fresco secco

The murals of the Golden Hall of Horyu-ji, painted onto mud walls, use the mineral pigments malachite, ultramarine, vermilion, and yellow ochre. Many of the murals were damaged by a fire in 1949.



Michelangelo (1475-1564, Italy)  
***Madonna and Child with St. John  
and Angels***, c. 1497  
Tempera on wood

In this unfinished painting, green earth underpainting is visible in the incomplete portion. The Madonna's robe was intended to be overpainted with ultramarine.

# BLUE

**Ultramarine**, a prized blue pigment, was originally made from lapis lazuli, a type of metamorphic rock and semi-precious stone. Mined for thousands of years in Afghanistan, it was exported to Egypt, where it was used in tomb paintings, and later to Europe.

Prior to the creation of modern synthetic pigments, painters were often limited to earthy colors such as reds, yellows, and browns, as they are more readily available in nature. Therefore the use of bright-blue and hard to come by ultramarine signified status when used in a painting. Ultramarine was often used for the robes of the Virgin Mary, and Michelangelo used the hue on the Sistine Chapel.

**Azurite**, a type of copper carbonate, was used occasionally by the Egyptians but did not become commonly used until the Middle Ages. It was the most frequently used blue pigment in European paintings from the Middle Ages through the Renaissance. It degrades over time, shifting to a green hue.





Vermeer (1632-1675,  
Netherlands)

***Girl with a Pearl Earring***, 1665  
Oil on canvas

One of Vermeer's most recognized works, this painting includes mineral pigments of ochres and lead white, but the blue scarf painted with ultramarine stands out most.



Fred Kabotie (1900-1986, Arizona, US)  
**Awatovi Kiva Mural Reconstruction**  
Pigment on adobe

Hopi artist Kabotie likely painted this modern reproduction of portions of a mural (c. 1500) found under layers of plaster in a kiva (an underground ceremonial chamber) at Awatovi Ruins in present-day Arizona. The blue hues are azurite.

# VIOLET

While purple can be produced by mixing red and blue pigments, as was done first by painters in the Middle Ages, violet is not a pigment that is easy to come by in the mineral world. The closest approximation is **purple ochre**, which is chemically the same as red ochre except that the particles are slightly larger and diffract the light differently, producing a maroon tone. Most early violets and purples had organic origins, made from plants or animals, rather than minerals.

## **BROWN** and **BLACK**

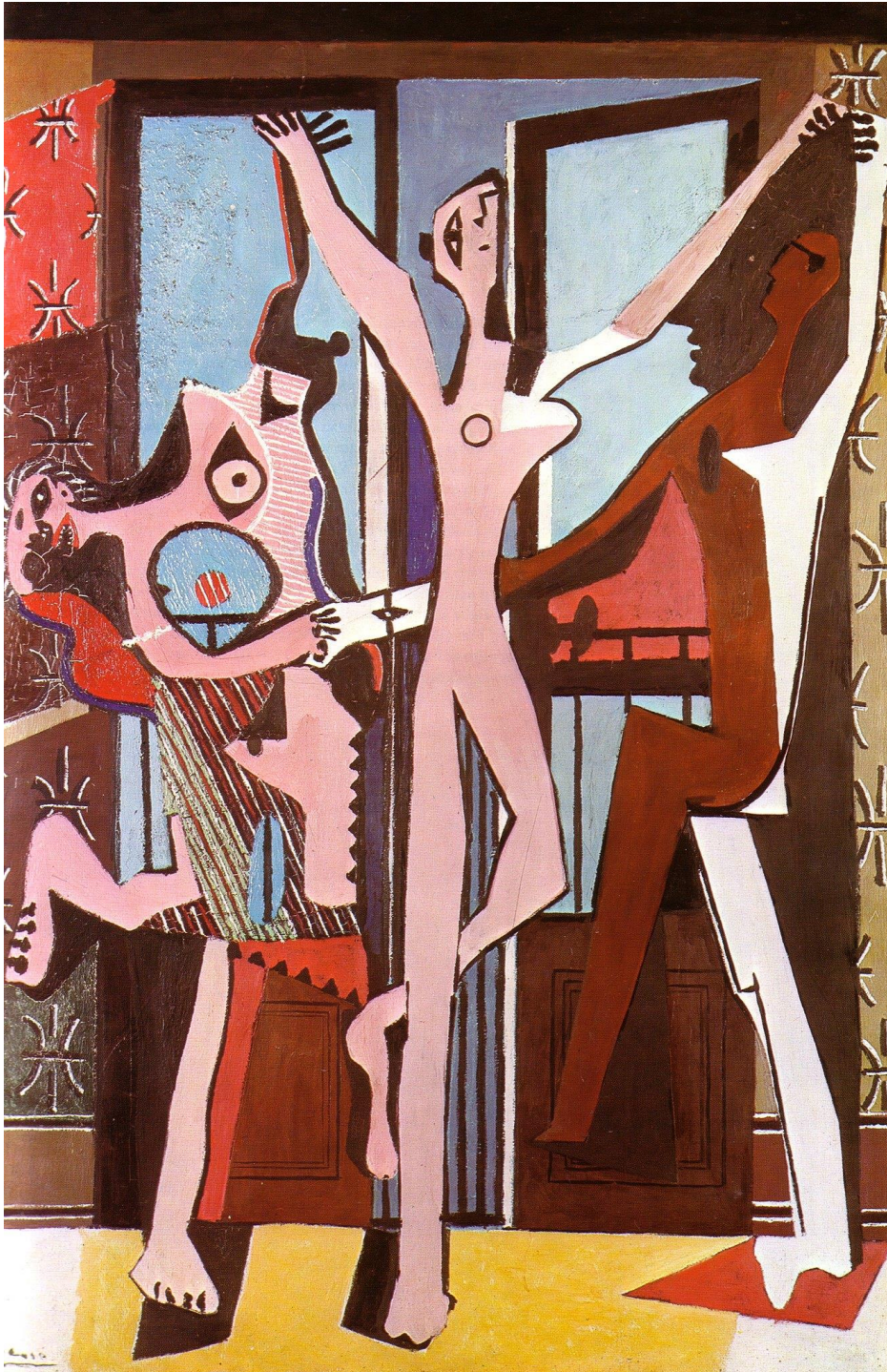
**Umber** is one of the prehistoric pigments used in the earliest cave paintings. Made from soil, umber is a mix of iron and manganese oxides, and can have a variety of earth tones ranging from cream to brown depending on the exact mineral composition. Later, umber hues featured extensively in Renaissance paintings to provide shadow and depth.

The first and most common black pigments were made from burnt wood charcoal, not minerals. However, black mineral pigments historically used in art, including some of the oldest cave paintings, were **Mars black** which came from magnetite, and **manganese black** which came from pyrolusite.

# WHITE

**Chalk** or **calcite white** comes from the mineral forms of calcium carbonate (including calcite, aragonite, and vaterite). One of the most abundant minerals in nature, calcite is the main component of chalk, a soft, fine-grained, porous variety of the sedimentary rock limestone which is formed from the fossilized remains of marine organisms.

**Lead white** is the most historically significant white pigment, being used extensively over many time periods and in many cultures. While the mineral used in lead white, hydrocerussite, is naturally occurring, the compound was produced by soaking metallic lead in vinegar and scraping off the white lead carbonate that formed on the outside. This form of mineral pigment, being lead-based, was of course quite toxic and was later replaced by Chinese white and titanium white.



Pablo Picasso (1881-1973, France)  
***The Three Dancers***, 1925  
Oil on canvas

Lead white is used extensively in this Picasso painting, both in the underpainting and mixed into the other hues such as the yellow floor tiles and blue figures.

The paintings created as part of this exhibit were produced by Stetson art students using only hues associated with traditional mineral pigments. Using a variety of styles and techniques, these works show the colors of the mineral pigment rainbow.