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Investigation of Material and Technical Analysis of Fresco-painted Sculptures around the World and India and Their Depiction in Cultures

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Abstract

The most famous painting method is fresco painting. It is renowned for being resilient and long-lasting against all environmental factors. Fresco paintings are put to wet lime-plaster using a mixture of dried mineral pigments and water as a medium. This study covers the standard ingredients and the deduced formulae for the fresco paints. Paints utilized in coats of arms, polychromy on statues, and pigments employed in frescoes not only define the era in which they were created but also specific artists or teams of artists who worked on the projects. X-ray fluorescence spectroscopy is an appropriate non-destructive technique for figuring out these artifacts' chemical makeup. A summary of the measurements of the pigments employed for the polychromy of the coats of arms and busts in the 14th century in St. Vitus Cathedral of Prague is given in this study. This is performed to understand the effectiveness of fresco-painted sculptures that are long-lasting. X-ray fluorescence examination differentiates between medieval pigments and more recent repainting. This study highlights the fresco paintings and how they are portrayed in Sikh culture in India, as well as the continuous tradition of sculptures, wall paintings, and frescos in India. The study will begin the process of conservation and restoration, which entails documentation, analysis, research, and treatment to ensure the long-term viability of frescoes.

Keywords: Indian sculpture, Fresco painted sculpture, Culture, India, Fresco-paintings, Sikh culture

1. Introduction

The fresco method dates back hundreds of years **[1].** The first known fresco paint dates to roughly 1600 B.C., and it was previously recognized during the Aegean culture. The Greeks, Etruscans, Romans, and Mediaeval Ages all employed this approach. Numerous well-known

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art pieces demonstrate that fresco painting was one of the most famous painting styles. Fresh, wet lime plaster is painted straight away using earth colors in a technique known as fresco, which comes from the Italian term meaning fresh. A chemical reaction joins the pigment and plaster while the plaster dries. Calcium hydroxide, the primary component of the substrate, gets carbonated during the drying phase. The calcium carbonate compound is created when calcium hydroxide, or "hydrated lime," combines with carbon dioxide from the air and water **[2-3].** Equations (1), (2), and (3) allow us to give a summary of the procedure.

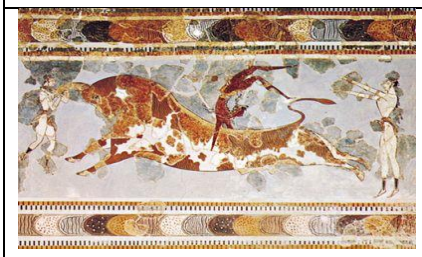
$$CaCO_3 + \text{heat} \rightarrow CaO + CO_2 \quad (1)$$

$$CaO + H_2O \rightarrow Ca(OH)_2 \quad (2)$$

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2 2 \quad (3)$$

When calcium hydroxide, commonly called burned marble or limestone, coupled with water and carbon dioxide, calcium carbonate, or marble and limestone, is created. The freshly made calcite crystal traps the pigment. It is comparable to "Melting Marble Painting." Few selected Fresco paintings are shown in **Table 1.**

Table 1 Few selected Fresco paintings.

Image of the Fresco paintings	Details
	In the Archaeological Museum in Iráklion, Crete, is the restored wall fresco known as the Toreador Fresco, originally located in the Palace at Knossos, Crete, circa 1550 BCE. The height is 81 cm, which includes the borders.
	Fra Angelico's 1438–1445 fresco, called the Annunciation, is housed in Florence's Museums of San Marco.
	Oil on canvas vaulting by Juan Gersón, 1562, is located in the Franciscan cathedral in Tecamachalco, Puebla, Mexico.

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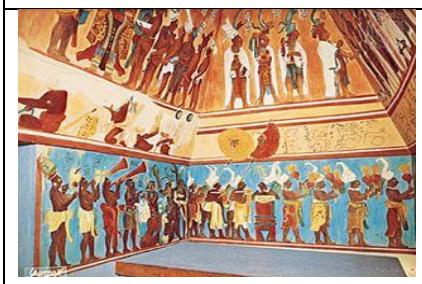
	The Asinou Church in Nikitari, Cyprus, has Byzantine frescoes. The Apostles of Christ are shown in the picture taking communion.
	A reconstructed Mayan fresco from Bonampak in Chiapas, Mexico, created around 800 CE, depicts a parade accompanied by percussion and trumpets.
	Painting in the throne room of King Minos' palace in Knossos, Crete, circa 1700–1400 BCE.

The historical and artistic significance of the ancient frescoes and the difficulties associated with their preservation and restoration make them more and more relevant every year. The strength and durability of the mural artworks may be impacted by various elements **[4],** including environmental conditions, which include seasonal variations in humidity and temperature, the colonization of plants or animals, human activity, etc. Non-invasive and non-destructive methods must be used for preventive conservation **[5].** The investigation of frescoes involves a wide range of analytical approaches, such as mass spectrometry **[6],** Raman spectroscopy **[7],** X-ray fluorescence (XRF) **[8],** Fourier transform infrared spectroscopy **[9, 10],** scanning electron microscopy **[11, 12, 13],** X-ray diffraction **[14, 15],** and optical microscopy **[16].** Multi-analytical methods were used to get reliable results, including Fourier transform infrared spectroscopy, micro-Raman spectrometry, calorimetry, XRF, and optical microscopy **[17].** The most common components and the inferred recipes for the fresco paintings are displayed in**.** Bold text indicates the dominant compounds, whereas italic text indicates the subordinated ones in **Table 2 [18].**

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Table 2. Bold text indicates the dominant compounds, whereas italic text indicates the subordinated ones

Type of the color	Inferred Recipes	Dominant chemical element
	Main pigments	The Dominant compounds
Blue C	**Slaked lime**—**Azurite** *(Egyptian blue?)*—**Stibnite**	**Ca** – **Cu** – **Sb**
Blue B	**White lead (Anglesite)** + *Blue lead (Galena)*	**Pb**
Blue A	**Blue ochre (Vivianite)**	**Fe**
Green B	**Anglesite**—*Yellow ochre*—*Orpiment*	**Pb** – *Fe* – *As*
Green A	**Green earth**—**Slaked lime**—*Malachite? (Chrysocolla?)*	**Fe** – **Ca** – *Cu*
Black C	**Plattnerite**	**Pb**
Black B	**Galena**—**Magnetite**	**Pb** – **Fe**
Black A	**Bone black**—**Stibnite**—*Slaked lime*	**P** – **Sb** – *Ca*
Grey C	**Anglesite** (*As*)	**Pb***(As)*
Grey B	**Slaked lime**—**Stibnite**	**Ca** – **Sb**
Grey A	Magnetite	**Fe**
Red B	**Litharge (Minium)**—**Red ochre**—**Realgar**	**Pb** – **Fe** – **As**
Red A	**Red ochre**	**Fe**
Brown C	**Bone black**—*Yellow ochre*	**Ca** – **P** – *Fe*
Brown B	**Massicot**	**Pb**
Brown A	**Yellow ochre**—*Bone black*	**Fe** – *P*
Pink B	**Litharge (Minium)**—*Slaked dolomitic lime*	**Pb** – *Mg*
Pink A	**Red ochre**—*Litharge* (*Minium*)—*Slaked lime*	**Fe** – ***Pb*** – *Ca*
Orange	**Slaked lime**—*Slaked dolomitic lime*—**Red** and **yellow ochre**	**Ca** – *Mg* – **Fe**
Yellow	**Slaked lime**—*Slaked dolomitic lime*—**Yellow ochre**	**Ca** – *Mg* – **Fe**
White B	**Slaked lime**—*Slaked dolomitic lime*—*Antimony white*	**Ca** – *Mg* – *Sb*
White A	**Anglesite**—*Slaked dolomitic lime*	**Pb** – *Mg*

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Indian frescos are one-of-a-kind, and creating one is a singular experience. Painting on recently plastered walls allows the paint to become a part of the wall, absorbing into the plastered surface. They are referred to as "traditional wallpapers" by several artists. Indian frescoes, one of the oldest art forms, would be an outstanding historical and cultural experience. The Ellora and Ajanta caves are arguably the oldest examples of fresco art in India is shown in **Figure 1**. These are from between 200 and 600 B.C. and feature examples from the life of the Buddha. The most ancient frescoes are at the Badami Cave Temples, Bagh Cave, and Shekhawati Havelis in Rajasthan. Many frescos had political overtones and were purposeful. An illustration of the political undertones can be found in this 1732 fresco depicting festivities during the Shekhawati Rajputs' conquest and expulsion of the Mughals. A team of painters from Kala Bhavana, Santiniketan, painted these frescos. This study covers the standard ingredients and the deduced formulae for the fresco paints. Paints utilized in coats of arms, polychromy on statues, and pigments employed in frescoes not only define the era in which they were created but also specific artists or teams of artists who worked on the projects. X-ray fluorescence spectroscopy is an appropriate non-destructive technique for determining these artifacts' chemical makeup. A summary of the measurements of the pigments employed for the polychromy of the coats of arms and busts in the 14th century in St. Vitus Cathedral of Prague is given in this study. This is performed to understand the effectiveness of fresco-painted sculptures that are long-lasting. X-ray fluorescence examination differentiates between medieval pigments and more recent repainting.

Figure 1 The Ellora and Ajanta caves- the oldest examples of fresco art in India

One of the earliest art forms known to history is sculpture, which dates back to the ancient Mesopotamian period (c. 3100 BC–539 BC) and the Indus Valley Civilization (c. 3300–1300 BCE). Undoubtedly one of the most essential forms of art on the Indian subcontinent,

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sculptures continued to play a vital role in life documentation. The figurines of people and animals and the religious sculptures discovered in the area throughout the ages demonstrate those mentioned above. Ajanta Caves (c. 200 BCE - 650 CE), the Mauryan Empire (c. 270-232 BCE), the Pala Buddhist Art period (8th-12th century AD), the Chola Empire from South India, Sri Lanka (9th-13th century AD), the Kushan Empire (1st-6th century AD), the Gupta Empire (c. 320-550 AD), the Pallava and Pandya Empires of South India (c. 600-900 AD), and the Mughal Empire (c. 1526 - 1857 AD) are just a few of the periods in between that are still being studied today. When one looks back at the history of sculptures from antiquity, they can be used as a valuable tool for understanding and reconstructing the past. For instance, sculptures unearthed during excavations from the Mesopotamian and Harrapan civilizations provide information about our ancient ancestors' strange customs. Mythological and religious characters have always captivated Indian sculptors, as our culture is deeply ingrained with them. From ancient times, sculptures depicting Hindu deities, Lord Buddha, Christian figures, and other characters have been among the most popular subjects in sculpture art. India is also known for its sculptures that show people, animals, and birds engaged in various activities from daily life. This study highlights the fresco paintings and how they are portrayed in Sikh culture in India, as well as the continuous tradition of sculptures, wall paintings, and frescos in India. The study will begin the process of conservation and restoration, which entails documentation, analysis, research, and treatment to ensure the long-term viability of frescoes.

2. Literature Reviews

2.1 Frescoes Techniques

Since the Mediterranean Bronze Age and Dynastic Egypt, mural paintings and frescoes have been documented **[19–20].** They were becoming increasingly prevalent from ancient times to the present **[21-22].** There are three recognized fresco techniques, all of which include painting a plaster base.

Plaster creates a smooth, uniform surface while hiding the wall's minor imperfections. Plaster composition is erratic and contingent upon the availability of time, place, and raw material **[23].** It is often made by combining slaked lime (or slaked dolomitic lime) with quartzitic sand and, rarely, gypsum **[24].** The plaster is referred to as "arricio" if the sand is coarse and as "intonaco" if it is fine. Applying paint to wet plaster (also known as "buon" or "fresco sensu stricto"), almost-dry plaster (also known as "mezzo" fresco), or fully dry plaster (also known

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as "secco" fresco techniques) is all possible. When using the "buon" fresco approach, paint must be put either immediately or within 8 hours of the plaster being finished. Because of a chemical reaction between the slaked lime (Ca (OH) $_2$) and air CO2, the fluid paint gets absorbed into the moist and porous plaster, and they will dry out and solidify concurrently. The pigments are trapped by the ensuing mass of calcite crystals **[25],** which then separates the pigments into a thin (a few mm) unique "pictorial layer" **[26]** from the non-colored plaster underneath. Nonetheless, Edwards and Farwell **[27]** showed that plaster that is a millennium ancient continues to have remnants of slaked lime that did not re-carbonate to calcite. The paints are composed of pigments suspended in fluids, such as limewater (a solution containing calcium hydroxide), slaked lime, or water, which serves as a binder and glue. All colors were frequently derived from a standard mixture of slaked lime, dolomitic slaked lime, bone white, and quartz. It assisted in controlling the lighter hues and adding heft to the paint. The "primary colors" are red, yellow, and blue and cannot be created by combining different hues. They are the source of "tertiary" and "secondary" colors. For instance, red and blue combine to form violet, yellow and blue combine to create green, and yellow plus some red produces orange. Black is created by combining the three primary colors—red, yellow, and blue. Black is created by combining the three primary colors—red, yellow, and blue. To achieve the desired colors of yellow, pink, blue, light green, or grey, blend a tiny quantity of the matching pigment with white paint. "Ochres" or "earthy pigments" have been the most widely used coloring agents from prehistoric times **[28, 29].** They are all inorganic by nature and typically consist of a combination of several minerals **[30].** "Yellow ochre," sometimes known as "limonite," is primarily composed of goethite, with smaller amounts of quartz, feldspar, jarosite (optional), muscovite, and lepidocrocite. Manganese oxide, as opposed to goethite, quartz, and clay minerals, is present in dark brown ochre, sometimes called "umber" **[31].** Like "red ochre," the reddish brown color "burned umber" primarily comprises hematite. Hydrated iron silicates, such as amphibole, serpentine, chlorite, celadonite, and glauconite, make up "green earth" **[32].** "Blue ochre" or "blue iron oxide" is hydrated iron phosphate termed vivianite **[33].** Because lead minerals typically have vivid, transparent colors, they were employed as fresco pigments. Paints have been made using lead oxides, including plattnerite (PbO2: black), minimum (Pb3O4: red), litharge (PbO: red), and massicot (PbO: yellow). Lead white and massicot react to produce plattnerite as an altered result **[34, 35].** Although minimal was mentioned in frescoes [36], it is unstable if a binder isn't employed to safeguard it **[37].** As pigments,

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numerous various minerals and even rocks have been used. White paints included limestone, chalk, calcite, marble, and slaked lime **[38].** Since ancient times, hydrated copper carbonates, like blue azurite and green malachite, have been used as pigments. "Verdigris" is a blue-green combination of compounds derived primarily from copper acetate mineral modification. The artificial cuprorivaite, or copper silicate and calcium known as "Egyptian blue," was created in historical Egypt **[39].** Lapis lazuli, also called "ultramarine blue" when synthesized **[40],** is a deep blue pigment composed of a combination of lazurite, diopside, calcite, and pyrite **[41].** A variety of materials, including arsenic, galena (also known as "blue lead"), stibnite (sometimes known as "antimony"), magnetite (also known as "black powder"), graphite, coal, stibnite (sometimes known as "antimony"), galena (also known as "blue lead"), or arsenic were used to produce the colors black and grey. Animal bones that have been burned into "bone white" and "bone black" consist of apatite and calcium carbonate **[42].** Graphite has been added to "Bone Black". Pigments such as dark grey, black, and even white may be made from native arsenic. The arsenic sulfides orpiment and realgar produce the colors yellow and vivid red-orange. The primary constituents of "antimony ochre," exhibiting a white, grey, or yellow hue, are stibinonite and cervantite **[43].**Paints in black and dark grey were made with stibnite. Roasting stibnite yields an antimony oxide known as "antimony white." "Naples yellow," a lead antimonite, dates back to the 17th century.

2.2 Frescoes painted sculptures in India

For this research project, we conducted a case study on the painted sculptures and frescoes of Prague's St. Vitus Cathedral. There has also been no examination of the coats of arms and murals in the Church of St. Vitus Cathedral in Prague. The sculptural creations of Petr Parléř (1356–1399), the cathedral's second constructor, served as the model for the "Beautiful Style" (Weicher Stil) that had an impact on all of central Europe, Prussia, Silesia, and Austria. Prague led the way in European art until the end of the 14th century because of its exquisite style. **[44-45].** Indian fresco is a style of mural painting made with colors applied on wet plaster using a method known as fresco-secco. These murals, which may be observed in caves, temples, and other historical places around India, were standard in ancient times. The Ajanta Caves include one of the oldest historical frescoes, dating back to the second century BC. Despite the weather, the paintings have endured to this day. Beneath the Nayak period, paintings were found to be Chola frescoes. There was something shaky about these frescoes. Likely, the sculptures and

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frescoes in the Ellora and Elephanta cave temples were created later than those in Ajanta. Hindu myths and metaphors are portrayed in these murals and sculptures, which differ stylistically from older Ajanta styles. One distinctive feature of the Ajanta frescoes is the portrayal of the eyes. The monarchs, princesses, and celestial gods all have contemplative eyes to convey the exquisite expression of kindness and grace. These are among India's earliest known frescoes, created between 200 and 600 BC. Here are narratives from the Jataka. One by one, they have been demonstrated. Additional sites with priceless examples of prehistoric and early medieval frescoes that have been conserved are the Badami Cave Temples, Bagh Caves, Ellora Caves, Sittanavasal, Armamalai Cave, and others. Indian frescoes have been created using a variety of methods, including tempera. In the circumambulatory corridor of the Brihadeesvara Temple in India, Chola paintings were discovered in 1931. These frescoes require two to three days to set after a smooth batter of a limestone combination is applied to the stones. Natural organic colors were used to paint such enormous canvases. In the Nayak era, the Chola murals were painted over. Rajaraja Chola the Great completed the temple simultaneously with the Chola frescoes. Frescoes depict Dogra or Pahari landscapes in Sheesh Mahal in Ramnagar, Jammu, and Kashmir. In addition to depictions of local lords, images from the epics of the Mahabharata and Ramayana have been included. Another location of old Dogri frescoes with wall paintings showing scenes of Draupadi Cheer Haran and Radha-Krishna Leela is Rang Mahal in Chamba, Himachal Pradesh. Over numerous thousands of years, the practice and techniques of Indian cliff painting underwent a progressive evolution. At the southern tip of the Deccan Plateau are the Rock Shelters of Bhimbetka. Primitive tools and ornamental rock art discovered in the numerous caves and grottos attest to the long-standing human contact with their surroundings. The Ajanta Caves contain the oldest surviving historical frescoes. Kerala mural painting includes beautifully maintained frescoes on the walls of temples in Ettumanoor, Pundarikapuram, Aymanam, and other places.

3. Frescoes painted sculptures – A Case study on St. Vitus Cathedral in Czech Kingdom

Prague's most prominent and most splendid temple is St. Vitus Cathedral. In addition to religious ceremonies, this location hosted the coronations of Czech monarchs and their wives. Numerous patron saints, archbishops, noblemen, and sovereigns are buried in the church. The Gothic Cathedral is the third cathedral dedicated to the same saint in an identical location. Prince Wenceslas (Václav) established a Romanesque rotunda right here in 925. It was

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transformed into a basilica with two steeples and three naves in 1060. Particularly with the foundation of the Prague bishopric in 973 and the St. Vitus chapter of the body of canons that subsequently developed into a significant administrative and cultural organization, the church's significance increased. Charles IV started building a Gothic cathedral in 1344. The Golden Gate, St. Wenceslas Cathedral, the chancel with its ring of chapels, and the lower part of the Great South Tower were constructed by its original builders, Peter Parler and Matthias of Arras. Peter Parler was the one who initially initiated the building of the South Tower, but he never finished it. It was completed in the sixteenth century with a helmet and a Renaissance viewing gallery. A brand-new dome took the place of the earlier helmet later in the eighteenth century. The first self-portrait of an author in European sculpture is seen in the bust of builder Petr Parléř. The whole bottom inner gallery of the peristyle, located in the St. Vitus Cathedral's so-called triforium, was constructed by the Parléř construction firm. Most busts have corresponding, colorfully painted plastic coats of arms on their left and right sides. Additionally, each bust is painted in a different color **[46].** Paintings of busts and coats of arms took place until 1379–1380 **[47].** The cathedral's building was put on hold at the start of the fifteenth century and wasn't finished until the twentieth. A coat of arms is a representation of a particular family or individual. Thirty Years' War in 1620 caused damage to the busts. Our measurements were intended to ascertain the makeup of the applied pigments, differentiate medieval pigments from repainting and retouching, and compare the applied pigments and those found on coats of arms and frescoes from the fourteenth and fifteenth centuries. Using X-ray fluorescence examination, pigments on busts and coats of arms were examined non-destructively. This instrumental analytical technique counts the quantity of each element present in the material under investigation using distinctive radiation. This non-destructive analytical technique allows information to be obtained in three dimensions, allowing for the evaluation of the measured depth profiles and an inquiry into the sample's composition. The Niton analyzer's usage was entirely appropriate since there was only one layer of pigment in the material under analysis. The primary colors of the herald are yellow and white, which stands for the metals yellow gold and white silver, respectively, and green, black, blue, and red. Generally, the metal-symbolizing colors were blended with other colors on a colored basis rather than layered on top of one another. In certain rare instances, skin tone, orange, purple, and purple were still utilized in subsequent times **[48].**The only colors seen on the triforium coats of arms and busts are yellow (gold), white (silver), black, blue, and red. The only colors

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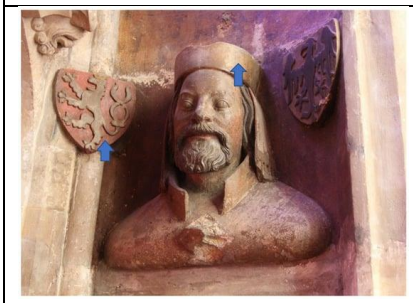
found on the coats of arms above Jan Očko's grave in the Vlašim Chapel are yellow (gold), black, and red. The determined locations of the frescoes and sculptures where the X-ray fluorescence examination of pigments is performed are displayed in **Table 3.**

Table 3 The determined locations of the frescoes and sculptures where the X-ray fluorescence examination of pigments is performed

Frescoes sculptures	Details	Frescoes sculptures	Details
	Arrows indicate Charles IV's bust and measured locations.		"Coats of arms" on the chapel of Vlašim.
	Anna Pfalz's bust and the arrow indicate the measured position.		Bishop's "coat of arms" in Vlašim Chapel and measured places are shown by arrows.

"Coats of arms" typically feature the color red. Red lead Pb3O4 was the most commonly utilized powder during the middle Ages **[49].** Cinnabar (HgS), widely called vermilion, was frequently mixed with the slag. Cinnabar served as the primary pigment component in certain instances. Combining these two pigments results in a surface tone and color change that can be adjusted to achieve the appropriate shade **[50].** The most significant characters in the center of other frescoes were the only ones painted in vermilion, an ostentatious pigment. Thus, red was

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only employed once in the central fresco by Italian painters in the final stages of the 15th century on the robe of Christ the Judge at the chateau in Žirovnice, which belonged to a wealthy tenant of silver mines in Kutná Hora. On some sculptures, red clays of a native origin were employed **[51]**. Cinnabar is often used on a structure as significant as St. Vitus Cathedral. During the middle Ages, azurite was employed as a blue pigment. Cu(OH)2·2CuCO3 is found, for example, on the left portion of Anna Palatinate's "bust" on the Rhine Palatinate "coat of arms". Cobalt blue CoO·Al2O3, which wasn't utilized until the 19th century, is indicated by the existence of Co in the blue pigment. Additionally, cobalt is a part of the blue smalt pigment **[52]. Figure 2** displays an example outcome of the procedure.

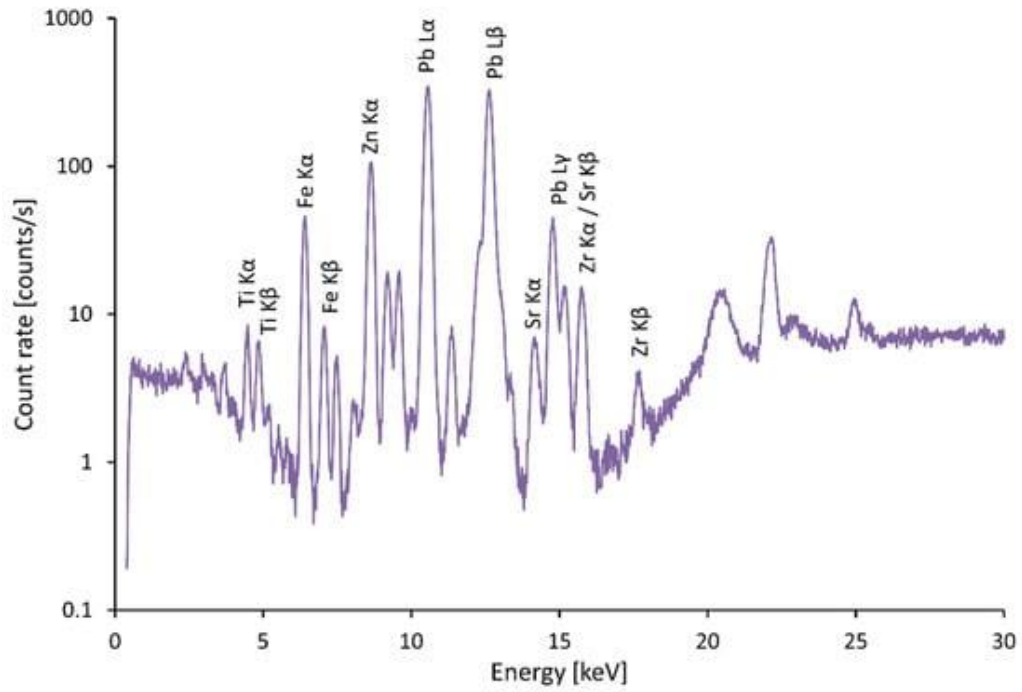

Figure 2. The sample result of the procesdure.

Carbon makes up most of the organic material used to make black colors. Two of the cases showed that the black pigment contained azurite. Repairing using zinc white (ZnO) and Mars black (FeO·Fe2O3) that have been employed until the 18th century and manufactured synthetically until 1920 are indicated by significant peaks of Fe and Zn. White is plentiful as well. The utilization of lead white $2PbCO3 \cdot Pb(OH)_2$ is indicated by the existence of Pb peaks in the spectrum. Since ancient times, artificial production has been used to manufacture this

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alkaline calcium carbonate. The lead white was mixed with different hues. It started to be supplanted by zinc-white ZnO in the 19th century. On "coats of arms," yellow has replaced gold. The inclusion of massicot, lead yellow PbO, is indicated by the presence of substantial lead peaks in the spectra. In contrast, the inclusion of yellow ochers is characterized by Fe peaks [53]. The existence of Zn peaks in the spectrum shows the 19th and 20th centuries' usage of zinc white and repairs. St. Vitus Cathedral houses the funeral grave of Archbishop Jan Očko. Three "coats of arms" that Jan Očko wore throughout his lifetime are shown over the tomb: the family's "coat of arms," including the "coat of arms" of the archbishop, the coat of arms of the bishop, and a cardinal's hat. Twelve distinct locations were used for measuring the pigment compositions. The "coats of arms" at the Vlašim Chapel have three colors: yellow, black, and red. The white and red pigments on the triforium are covered by what has been mentioned regarding the pigments employed; however, the yellow color is lead-tin yellow.

4. Tradition of Frescos paintings in India

For thousands of years, wall paintings known as frescos have been a part of India's culture. From the oldest examples discovered in the rock shelters at Bhimbetka, which date back more than 8000 years, to the Warli paintings of western India that are still in use today and the Madhubani paintings of Bihar, frescos were painted on walls for a variety of reasons, including simple decoration and the commemoration of religious and social events. The life of Buddha and stories from the Jataka were portrayed in the magnificent murals that covered the walls of the Ajanta caves. These paintings go back to the second century BCE at the latest. Next are the murals found in the Badami caves. Throughout India's history, the art of painting murals has been thriving. Chalukya dynasty wall murals can be found in the Badami caves in Karnataka. Other caves have paintings of divine and regal figures. Similarly, paintings were widely used to decorate temples under the Pallava, Pandya, and Chola kingdoms. The Pallava temples at Panamalai, Kanchipuram, Tirumalaipuram, and the Jain caverns at Sithanvasal of the Pandyas were all decorated with murals that showed human and divine figures. Murals illustrating Shiva-related stories were painted in the Nartamalai and Brihadisvara temples during the Chola era. Murals of the Virupaksha temple in Hampi, painted in the Vijayanagara style, feature scenes from the Ramayana and Mahabharata, amongst other subjects. Lepakshi, Andhra Pradesh, has Vijayanagara art imprints as well. Murals from the Nayaka period may be seen in Thiruparakunram and Brihadisvara. Kerala's unique mural history thrived between

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the 16th and 18th centuries CE, taking inspiration from performance traditions and Nayaka and Vijayanagara styles. As may be seen in certain temples and palaces, painting images from epics and Puranic texts was done as a religious practice. In addition, it is worthwhile to notice the wall paintings at Wai, Satara, Pune, and Menavali, among other locations in Maharashtra. The history of mural paintings was perpetuated in the 19th century by notable artists such as Acharya Nandalal Bose and under the guidance of Acharya Abanindranath Thakur, a trailblazing member of the Bengal School of Art, a movement inspired by European academic paintings and allied with the Swadeshi worldview, his artistic instincts blossomed. By using classical and folk painting traditions, the followers of Abanindranath Thakur and other Bengali masters aimed to restore India's former splendour. Acharya Nandalal Bose's paintings are distinguished by characters and landscapes that evoke the tranquil serenity of bygone eras. The masses, leaders, and modern Indian thinkers would subsequently look up to and imagine the stylized characters he drew as a model for India. These tests by Acharya Bose and his contemporaries were first conducted in Calcutta. Around the same time, in opposition to the colonial educational system of school instruction, Gurudev Rabindranath Thakur created Visva Bharati at Santiniketan, modeled after the historic Gurukul. In his perspective, pursuing human excellence revolved around the importance of art and culture. Santiniketan emerged as a hub for developing personal flair and customs. Visva-Bharati began to attract academics and artists from both domestic and foreign backgrounds. In Visva Bharati, Acharya Nandalal Bose started his career as a fine arts teacher before rising to the principal position. He was one of the imposing figures representing Kala Bhavana, Visva-Bharati's fine arts division, which later welcomed Binod Behari Mukhopadhyay and other notables. Acharya Bose created a distinctive painting style that was fundamentally Indian. His artwork and classical Indian architecture inspired his work, based on stories from the Ramayana, Mahabharata, Puranic stories, Jataka tales, and other works. He is also responsible for bringing the mural art back to life. Acharya Bose began studying and instructing in this art form after being influenced by the Ajanta murals. His highly regarded frescos adorned numerous walls in different areas at Santiniketan. He was also commissioned to create a variety of artworks outside of Bengal. He decorated palaces, universities, and the locations of significant political gatherings with murals and other painting. The responsibility of embellishing the calligraphed text of the Indian Constitution was given to Acharya Bose. With the help of his group of gifted artists, which included Biswarup, Gouri, Jamuna, Perumal, Kripal Singh, and others, he started depicting glimmers of

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India's majestic past. Sixteen paintings are displayed in the Constitution Gallery of the Parliament Building as frescoes. Table 4 displays the contents of the paintings selected from the list of pictures included in the Indian Constitution draught. Table 5 provides a list of notable Indian frescoes.

Table 4 the contents of the paintings selected from the list of pictures included in the Indian Constitution draught

S. No	Title of the image	Time Period
1	Scene of the Ocean	Natural Features
2	Netaji Subhash Chandra Bose & other patriots trying to liberate mother India from outside India	Revolutionary Movement for Freedom
3	Bapuji the peacemaker - his tour in the riot affected Noakhali	India’s Freedom Movement
4	Portraits of Shivaji and Guru Gobind Singh	Muslim Period
5	Scene from Mahabalipuram Sculptures (Bhagirath’s penance and the descent of Ganga)	Medieval Period
6	Image of Nataraja	Medieval Period
7	Scene from Orissan Sculptures	Medieval Period
8	Scene depicting one of the ancient universities - Nalanda	Gupta Period
9	Scene from Vikramaditya’s Court	Gupta Period
10	Scene depicting the Spread of Buddhism by Emperor Ashoka in India and abroad.	Mauryan Period
11	Scene from Mahavira’s life	Mahajanapada & Nanda Period
12	Scene from the Buddha’s life	Mahajanapada & Nanda Period
13	Scene from the Mahabharata (Sri Krishna propounding Geeta to Arjuna)	Epic Period

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14	Scene from the Ramayana (Conquest of Lanka & recovery of Sita by Rama)	Epic Period
15	Scene from Vedic Ashrama - Gurukul	Vedic Period
16	Decoration with Mahenjodaro Seal	Mahenjodaro Period

5. Tradition of frescos paintings and their depiction in Sikh Culture

Throughout Punjab and the rest of India, fresco paintings were once widely visible. They may be seen inside or outside residences, mansions, historic structures, and places of worship. These paintings featured exquisite flower patterns, animal images, and original patterns and mosaics made to adorn essential buildings with various color schemes. Sadly, in mainstream Gurdwaras in Punjab, they have either been whitewashed (plastered over) or replaced with gold-gilded artwork. These fresco paintings transport us back to a bygone era when buildings were embellished with exquisite artwork and subtly conveyed messages about the beauty of nature. We refer to fresco paintings as MohraKashi. Renowned artisans from Punjab once created fresco murals adorning our Sikh cultural places. The Kangra Valley wall paintings are thought to pattern frescoes from the same era. They express deep significance **[54]. Figure 3** displays the fresco paintings from Baba Atal Gurdwara, Amritsar. The majority of the fresco paintings depict topics from Hindu mythology. Sikh artists heavily referenced Hindu and Muslim cultures because of the Sikhs' tolerance for other religions. Numerous animals are shown charging at one another in fresco paintings, signifying the struggle for survival. In specific artworks, a Yogi is shown in Padma Asan above several vicious animals, including tigers, lions, and snakes. This represents control over irrational fears and animal impulses. A different depiction might feature a painting of the Kalsa, a water container with fruits, flowers, and leaves serving as symbols of goodwill and material wealth. The most widely recognized fresco of Guru Nanak Dev Ji has his students Bhai Mardana performing the rabab and Bhai Bala waving the fly whisk over Guru Nanak's head. Other Sikh Gurus are also depicted in the paintings.

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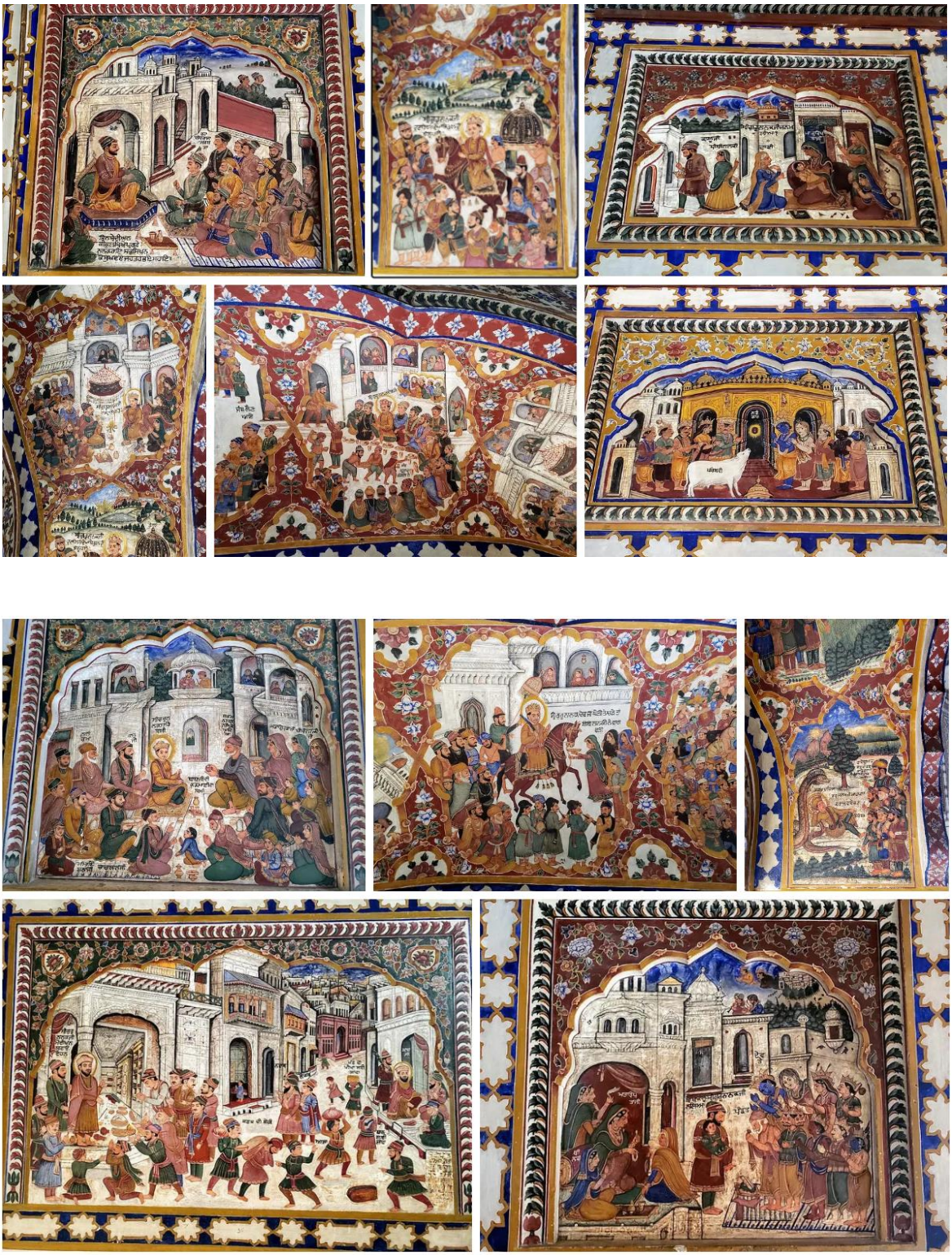

Figure 3. The Fresco paintings from Baba Atal Gurdwara, Amritsar.

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The narratives from Guru Nanak's life stories included in several Janamsakhis are shown in the fresco paintings at Baba Atal Sahib Gurdwara. There are paintings depicting lakes (Water/Jal) with fish, crocodiles, and other aquatic animals drawn on either side, animal figurines in the center, and birds in the upper portion. This concept relates to Jal Jivas, or water creatures: just as creatures cannot exist outside of water, neither can jiva, or beings, exist without maya or desires. On frescoes, elephants stand for the splendor and power of man, while snakes stand for avarice (lobh). Specific artworks depict elephants in chains as a metaphor for how mental discipline and bani recitation may govern and regulate human passions. In fresco, a child symbolizes an innocent spirit. A snake wrapped around a child represents how the world's (Maya) avarice has imprisoned an innocent soul (jiva or being). The concept seems to be that the soul is freed from the grip of avarice by repeating God's name, or Nam and Simran. A few frescoes depict pigeons and a peacock. The pigeon is an emblem of peace, while the peacock represents Man's good self, or superego. Fairies can also be seen in frescoes, trailing one another in a chain. The Persian aspect in these paintings is brought to viewers' attention by the Persian caps worn by the fairies. The fresco murals, which tell tales from the life of our Gurus and promote harmony and syncretism among the many religious beliefs of Punjabi society, are an essential component of our Sikh legacy. They also spread simple teachings to our community, encouraging us to be honest and true despite temptations from the outside world and to lead a life of humility and devotion. For the benefit of future generations, we ought to see that these exceptional paintings are kept intact in Indian private residences and places of worship.

6. Conclusion

Painting with water-based pigments over recently laid plaster, typically on wall surfaces, is known as fresco painting. The hues, created by pulverizing pigments for dry use in clean water, form an integral wall component and solidify with the plaster. Since fresco painting is robust, matte, and lends itself to a massive style, it's perfect for creating murals. The different paints and materials used are covered in this study. This study covers the standard ingredients and the deduced formulae for the fresco paints. A summary of the findings from the measurements made of the pigments utilized for the polychromy of the "coats of arms" and "busts" in the triforium of St. Vitus Church, an investigation, has been presented in the article. The technique employed, X-ray fluorescence examination, allows pigments from the Middle Ages to be distinguished from more recent repaintings. Although the master artisans of the Middle Ages worked with a restricted range of colors, each color might have several compositions and,

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consequently, distinct hues. For instance, red lead, cinnabar, or red ocher might be used to achieve red. Azure or tiny pearls were used to achieve the color blue. It can also be possible to ascertain these variations in the makeup of distinct colors by X-ray fluorescence studies. The measurements' findings reveal which areas of the "busts" and "coats of arms" have been restored in earlier times and which still have their original polychrome finishes. The measurements' outcomes will be helpful to art historians and potential triforium ornamentation restoration projects. This study focused on the depictions of Sikh culture in India's fresco paintings and the country's ongoing heritage of sculptures, wall paintings, and frescos. To guarantee the long-term survival of frescoes, the study will initiate the conservation and restoration process, which comprises documentation, analysis, research, and treatment.

References

1. Linn, R.; Cline, E.H.; Yasur-Landau, A. Technological study of Middle Bronze Age painted plaster fragments from the Canaanite Palace of Tel Kabri, Israel—Materials and painting techniques. J. Archaeol. Sci. Rep **2017**.
2. Horgnies, M.; Darque-Ceretti, E.; Bayle, M.; Gueit, E.; Aucouturier, M. An exceptionally perennial surface artwork: Fresco on lime or on cement. Surf. Interface Anal. **2014**
3. Piovesan, R.; Mazzoli, C.; Maritan, L.; Cornale, P. Fresco and lime-paint: An experimental study and objective criteria for distinguishing between these painting techniques. Archaeometry **2012**.
4. Deneckere, A.; Schudel, W.; Van Bos, M.; Wouters, H.; Bergmans, A.; Vandenabeele, P.; Moens, L. In situ investigations of vault paintings in the Antwerp cathedral. Spectrochim. Acta Part A 2010, 75, 511–519.
5. Izzo, F.C.; Capogrosso, V.; Gironda, M.; Alberti, R.; Mazzei, C.; Nodari, L.; Gambirasi, A.; Zendria, E.; Nevin, A. Multi-analytical non-invasive study of modern yellow paints from postwar Italian paintings from the International Gallery of Modern Art Cà Pesaro, Venice. X-Ray Spectrom. 2015, 44, 296–304.
6. Nord, A.G.; Tronner, K.; Billström, K.; Strandberg Zerpe, B. Analysis of mediaeval Swedish paintings influenced by Russian-Byzantine art. J. Cult. Herit. 2017, 23, 162–169.
7. Zucchiatti, A.; Prati, P.; Bouquillon, A.; Giuntini, L.; Massi, M.; Migliori, A.; Cagnana, A.; Roascio, S. Characterisation of early medieval frescoes by μ-PIXE, SEM and Raman spectroscopy. Nucl. Instrum. Methods Phys. Res. Sect. B 2004, 219–220, 20–25

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 8, Issue 4, 2019

8. Cesareo, R.; Castellano, A.; Buccolieri, G.; Quarta, S.; Marabelli, M.; Santopadre, P.; Ioele, M.; Gigante, G.E.; Ridolfi, S. From Giotto to De Chirico: Analysis of paintings with portable EDXRF equipment. In Cultural Heritage Conservation and Environmental Impact Assessment by Non-Destructive Testing and Micro-Analysis; Van Grieken, R., Janssens, K., Eds.; Taylor and Francis Group, A.A. Balkema Publ.: Leiden, The Netherlands, 2004; pp. 183–196. ISBN 9789058096814.
9. Čechák, T.; Gerndt, J.; Musílek, L.; Kopecká, I. Analysis of fresco paintings by X-ray fluorescence method. Radiat. Phys. Chem. 2001, 61, 717–719.
10. Mohanu, I.; Mohanu, D.; Gomoiu, I.; Barbu, O.H.; Fechet, R.M.; Vlad, N.; Voicu, G.; Truşcă, G. Study of the frescoes in Ioneştii Govorii wooden church (Romania) using multi-technique investigations. Microchem. J. 2016, 126, 332–340.
11. Marić-Stojanović, M.; Bajuk-Bogdanović, D.; Uskoković-Marković, S.; Holclajtner-Antunović, I. Spectroscopic analysis of XIV century wall paintings from Patriarchate of Peć Monastery, Serbia. Spectrochim. Acta Part A 2018, 191, 469–477.
12. Holclajtner-Antunović, I.; Stojanović-Marić, M.; Bajuk-Bogdanović, D.; Žikić, R.; Uskoković-Marković, S. Multi-analytical study of techniques and palettes of wall paintings of the monastery of Žiča, Serbia. Spectrochim. Acta Part A 2016, 156, 78–88.
13. Uvarov, V.; Popov, I.; Rozenberg, S. X-ray diffraction and SEM investigation of wall paintings found in the Roman Temple Complex at Horvat Omrit, Israel. Archaeometry 2015, 57, 773–787.
14. Linn, R. Layered pigments and painting technology of the Roman wall paintings of Caesarea Maritima. J. Archaeol. Sci. Rep. 2017, 11, 774–781.
15. Hein, A.; Karatasios, I.; Mourelatos, D. Byzantine wall paintings from Mani (Greece): Microanalytical investigation of pigments and plasters. Anal. Bioanal. Chem. 2009, 395, 2061–2071.
16. Samanian, K. Identification of pigment used in Persian wall paintings (AD 1501-1736) using PLM, FT-IR, SEM/EDX and GC-MS techniques. Archaeometry 2015, 57, 740–758.
17. Miriello, D.; Bloise, A.; Crisci, G.M.; De Luca, R.; De Nigris, B.; Martellone, A.; Osanna, M.; Pace, R.; Pecci, A.; Ruggieri, N. Non-destructive multi-analytical approach to study the pigments of wall painting fragments reused in mortars from the archaeological site of Pompeii (Italy). Minerals 2018, 8, 134.