Uma imagem com texto, mapa, captura de ecrã

Descrição gerada automaticamente

**Figure S1.** Ukraine’s heritage destroyed during the Russian invasion of Ukraine (https://www.unesco.org/en/articles/damaged-cultural-sites-ukraine-verified-unesco), distributed by Oblasts (A) and heritage type (B).

**Table S1.** Cultural heritage and the materials used for its construction, including its characteristics, applications, examples, and fungi associated with its degradation (the most common fungi are presented in bold).

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| --- | --- | --- | --- | --- | --- |
| **Material** | | **Characteristics** | **Applications** | **Examples** | **Fungi associated with degradation** |
| Stone | Marble | • Metamorphic rock  • Composed of calcite (CaCO3)  • Translucency  • Ability to be polished  • Various colors | • Building material (columns, facades)  • Decorative elements (flooring, sculptures, and statues) | • Parthenon in Athens, Greece  • David by Michelangelo | • *Acanthostigma* spp.  • *Acremonium charticola*  • *Aeminium* spp.  • ***Alternaria* *alternata***  • ***Aspergillus flavus***  • ***Aspergillus fumigatus***  • ***Aspergillus protuberus***  **• *Aspergillus niger***  **• *Aspergillus versicolor***  **• *Aureobasidium pullulans***  • *Botrytis* spp.  • *Caloplaca* spp.  • *Capnobotryella* spp.  **• *Chaetomium* spp.**  **• *Cladosporium allicinum***  • ***Cladosporium cladosporoides***  • ***Cladosporium herbarum***  • ***Cladosporium sinuosum***  **• *Cladosporium sphaeospermum***  • *Clitopilus* spp.  • *Coniosporium uncinatum*  • *Constantinomyces* sp.  • *Cunninghamela echinulata*  • *Curvularia lunata*  • *Cyphellophora olivacea*  • *Dematium* spp.  • *Epicoccum* *purpurascens*  • *Eurotium amsteldomi*  • *Exophiala bonariae*  • *Exophiala oligosperma*  • *Fusarium oxysporum*  • *Hortaea werneckii*  • *Knufia karalitana*  • *Knufia marmoricola*  • *Knufia mediterrânea*  • *Knufia petrícola*  • *Lithophila* sp.  • *Moniliales*  • *Mucor hiemalis*  • *Mucor racemosus*  • *Mycocalicium* sp.  • *Neocatenulostroma* sp.  • *Neodevriesia bulbillosa*  • *Neodevriesia capensis*  • *Neodevriesia sardiniae*  • *Neophaeotheca triangularis*  • *Ochroconis* sp.  • *Paecilomyces variotti*  • *Parengyodontium album*  ***• Penicillium brevicompactum***  ***• Penicillium chrysogenum***  • ***Penicillium citrinum***  *•* ***Penicillium crustosum***  **• *Penicillium frequentans***  **• *Penicillium verrucosum***  • *Phaeosclera* spp.  • *Phaeococcomyces* spp.  **• *Phoma* spp.**  • *Pseudotaeniolina* spp.  • *Rhinocladiella* spp.  • *Rhodotorula* spp.  • *Salinomyces thailandicus*  • *Schizophyllum commune*  • S*accotheciaceae* spp.  • *Sarcinomyces* sp.  • *Saxophyla tyrrhenica*  • *Sporobolomyces* spp.  • *Stachybotrys chartarum*  • *Stereum hirsutum*  • *Tapesia fusca*  • *Talaromyces purpurogenus*  • *Tolypocladium* spp.  • *Toxicocladosporium* spp.  • ***Trichoderma* spp.**  • *Trimmatostroma* spp.  • *Vermiconidia calcícola*  • *Verrucocladosporium dirinae*  • *Xanthoria* spp. |
| Limestone | • Sedimentary rock  • Composed of calcium carbonate (CaCO3), in the form of calcite or aragonite, magnesium carbonate (MgCO3; dolomite), and minor constituents (e.g., clay, iron carbonate, feldspar, pyrite, and quartz)  • Relatively soft  • Easy to carve  • Various colors | • Building material  • Decorative elements (architectural details and sculptures) | • Chartres Cathedral in Chartres, France  • Great Sphinx in Giza, Egypt |
| Granite | • Igneous rock  • Composed by feldspar, quartz, and mica, and minor constituents (e.g., hornblende, biotite, and pyroxene)  • Hardness, durability, and elevated resistance to erosion and weathering  • Various colors | • Building material  • Decorative element (sculptures or flooring) | • Mount Rushmore National Memorial in South Dakota, USA  • Avukana Buddha Statue in Sri Lanka |
| Wood | Oak | • Hardwood  • Strength  • Durability  • Resistance to decay | • Building material (frameworks)  • Decorative elements (flooring, furniture, cabinetry, and other elements) | • The Hall of Mirrors in the Palace of Versailles, France | *• Acremonium charticola*  *• Aleurodiscus fennicus*  *• Alternaria tenuissima*  *• Antrodia serialis*  *• Antrodia sinuosa*  *• Antrodia sordida*  *• Antrodia vailantii*  *• Antrodia xantha*  *• Antrodiella* spp.  *• Armilaria ostoyae*  *• Aspergillus conicus*  *• Aspergillus niger*  *• Asterostroma cervicolor*  *• Athelia epiphylla*  *• Athelia neuhoffii*  *• Aureobasidium pullulans*  *• Auricularia mesenterica*  *• Bjerkandera adusta*  *• Botryobasidium candicans*  *• Cadophora* spp.  *• Ceriporia excelsa*  *• Ceriporis purpúrea*  *• Chaetomium elatum*  *• Chaetomium globosum*  *• Ceraceomyces sublaevis*  *• Ceriporia reticulata*  *• Cladosporium cladosporioides*  *• Cladosporium phaenocomae*  *• Coniochaeta* spp.  ***• Coniophora arida***  ***• Coniophora puteana***  *• Coprinellus* aff. *radians*  *• Coprinopsis* sp.  *• Crepidotus mollis*  *• Cylindrobasidium evolvens*  *• Dacryobolus sudans*  *• Engyodontium álbum*  *• Eupenicillium tropicum*  *• Fomitopsis pinícola*  *• Fusarium* spp.  *• Gleocystidiellum cf luridum*  ***• Gloeophyllum abietinum***  ***• Gloeophyllum sepiarium***  ***• Gloeophyllum trabeum***  *• Graphium* spp.  *• Hyphoderma obtsusum*  *• Hyphoderma praetermissum*  *• Hyphoderma puberum*  *• Hyphodontia alutacea*  *• Hyphodontia aspera*  *• Hyphodontia crustosa*  *• Hypholoma fasciculare*  *• Hypochniciellum spp.*  *• Hypochnicium bombycinum*  *• Hypochnicium punctulatum*  *• Laeticorticium roseum*  *• Lecanicillium sp.*  *• Lentinus lepideus*  *• Leucigyrophana pinastri*  *• Leucigyrophana pseudomolusca*  *• Meruliopsis corium*  ***• Meruliporia incrassate***  *• Mocladium* spp.  *• Mortierella* spp.  *• Mucor* spp.  *• Oligoporus caesius*  *• Oligoporus placentus*  *• Oligoporus tephroleucus*  *• Paxillus panuoides*  *• Penicillium commune*  *• Penicillium chrysogenum*  *• Penicillium crustosum*  *• Penicillium digitatum*  *• Penicillium expansum*  *• Penicillium granulatum*  *• Penicillium virgatum*  *• Peniophora cinereae*  *• Peniophora incarnata*  *• Phaeolus schweinitzii*  *• Phanerochaete sordida*  *• Phanerochaete tuberculata*  *• Phanerochaete velutina*  *• Phebiopsis gigantea*  *• Phellinus chrisoloma*  *• Phlebiopsis gigantea*  *• Pholiota* spp.  *• Phoma* spp.  *• Pluteus semibulbosus*  ***• Postia placenta***  ***• Postia stiptica***  *• Pseudotaeniolina globosa*  *• Pycnoporellus fulgens*  *• Resinicium bicolor*  *• Schizopora paradoxa*  *• Scytinostroma cf. Odoratum*  *• Sebacina calcea*  ***• Serpula himantioides***  ***• Serpula lacrymans***  *• Shizophyllum commune*  *• Skeletocutis carneogrisea*  *• Stachybotrys chartarum*  *• Stereum sanguinolentum*  *• Thielavia hyalocarpa*  ***• Trametes versicolor***  *• Trichaptum abietinum*  *• Trichoderma atroviride*  *• Trichoderma viride*  *• Trichopyton* sp.  *• Tubulicrinis glebulosus*  *• Umbelopsis isabellina*  *• Vesiculomyces citrinus* |
| Cherry | • Hardwood | • Decorative elements (cabinetry, fine cravings, furniture, paneling, and moldings) | • Shaker Village of Pleasant Hill in Kentucky, USA |
| Maple | • Hardwood | • Decorative elements (cabinetry, flooring, and interior details) | • Maple Leaf Gardens in Toronto, Canada |
| Cedar | • Softwood  • Resistance to decay  • Resistance to insects  • Resistance to rot | • Building material (roofing)  • Decorative elements (doors, and other elements) | • Cedar Shingle Mill at Old Sturbridge Village, Massachusetts, USA) |
| Pine | • Softwood  • Affordable choice for construction  • Can be treated to become durable | • Building material (framing, sheathing, and interior woodwork) | • Old North Church in Boston, USA |
| Redwood | • Softwood  • Durability  • Resistance to insects  • Resistance to decay | • Building material  • Decorative elements (doors and siding) | • Ahwahnee Hotel in Yosemite National Park in California, USA |
| Teak | • Exotic hardwoods  • Durability  • Resistance to insects  • Resistance to moisture | • Decorative elements (carvings, panels, and outdoor elements) | • Phra Thinang Dusit Maha Prasat Hall at the Royal Palace of Bangkok, Thailand |
| Mahogany | • Exotic hardwood | • Building material  • Decorative elements (cabinetry, carvings, furniture, and other elements) | • Mahogany Bay Village in Belize |
| Metal | Bronze | • Alloy of copper and tin  • Durability  • Resistance to corrosion  • Attractive patina | • Decorative elements (plaques, statues, and sculptures) | • Statue of Liberty in New York, USA  • Little Mermaid in Copenhagen, Denmark | • *Acremonium kiliense*  • *Alternaria alternata*  • *Arthrinium phaeospermum*  • ***Aspergillus amstelodami***  • ***Aspergillus fumigatus***  • ***Aspergillus niger***  • ***Aspergillus terreus***  • ***Aspergillus versicolor***  *• Aureobasidium microstrictum*  • ***Aureobasidium pullulans***  • *Chrysosporium merdarium*  • *Cladosporium cladosporioides*  • *Cladosporium herbarum*  • *Cladosporium resinae*  *• Cladosporium tenuissimum*  • *Coniochaeta ligniaria*  • *Cryptococcus laurentii*  *• Cylindrocarpon destructans*  • *Debaryomyces nepalensis*  • *Exophiala dermatitidis*  • *Exophiala jeanselmei*  *• Fusarium moniliforme*  • *Fusarium oxysporum*  • *Fusarium solani*  • *Hormoconis resinae*  *• Mortierella hyalina*  • *Oidiodendron echinulatum*  • *Paecilomyces lilacinus*  • *Paecilomyces parvus*  • *Paecilomyces variotii*  • *Pichia guilliermondii*  • ***Penicillium brevicompactum***  *•* ***Penicillium cyclopium***  *•* ***Penicillium frequentans***  **• *Penicillium polonicum***  • *Rhizopus stolonifer*  *• Scytalidium lignicola*  • *Talaromyces flavus*  • *Trichoderma citrinoviride*  • *Trichoderma harzianum*  *• Trichoderma longibrachiatum* |
| Iron | • Strength  • Versatility | • Building material (structural component)  • Decorative elements (gates, railings, and balconies) | • Eiffel Tower in Paris, France  • French Quarter in New Orleans, USA |
| Steel | • Alloy of iron and carbon  • Versatility  • Robustness | • Building material (structural components, frameworks, and support systems) | • Gateway Arch in Missouri, USA |
| Cooper | • Maleable  • Resistance to corrosion  • Patina over time | • Building material (cladding and roofing)  • Decorative elements | • Top of the Washington Monument in Washington, D.C., USA |
| Stainless steel | • Alloy of iron, chromium, and nickel • Resistancece to corrosion | • Building material (structural components, cladding)  • Decorative elements (sculptures) | • Cloud Gate sculpture in Millennium Park in Chicago, USA |
| Aluminium | • Lightweight metal • Resistance to corrosion | • Building material (structural components, facades  • Decorative elements (modern architectural designs) | • Christ the Redeemer statue in Rio de Janeiro, Brazil |
| Lead | • Heavy metal  • Maleable  • Density  • Resistance to corrosion | • Building material (roofing)  • Decorative elements (ornamental details in traditional architecture) | • Roof of the Lincoln Memorial in Washington, D.C., USA |
| Gold leaf | • Made from thin sheets of gold | • Decorative elements (gilding architectural details and sculptures) | • Golden Temple in Amritsar, India |
| Glass | Crown Glass | • Characteristic circular pattern • Relatively good optical quality | • Decorative elements (windows of ancient monuments) | • Crown Glass Windows in St. Mary's Church, Fairford, England | • *Alternaria* spp.  • *Aspergillus sp.*  • *Aspergillus arenarioides*  • *A. pullulans*  • *Cladosporium* spp.  • *Coniosporum* spp.  • *Capnobotryella* spp.  • *Engyodontium* spp.  • *Fusarium oxysporum*  • *Geomyces* spp.  • *Hortaea werneckii*  • *Kirschsteiniothelia* spp.  • *Leptosphaeria* spp.  • *Parengyodontium album*  • *Penicillium polonicum*  • *Rhodotorula* spp.  • *Stanjemonium* spp.  • *Trichoderma longibrachiatum*  • *Ustilago* spp.  • *Verticillium* spp. |
| Stained glass | • Small pieces of colored glass assembled to form patterns, images, or scenes | • Decorative elements (windows of ancient monuments) | • Notre-Dame Cathedral in Paris, France  • Sagrada Família, in Barcelona, Spain |
| Glass tesserae | • Small colored glass pieces that create designs or patterns | • Decorative elements (flooring, wall coverings, and other elements) | • Hagia Sophia in Istanbul, Turkey  • Temple of the Reclining Buddha in Bangkok, Thailand |
| Clay-based ceramics | Brick | • Made of clay, shale, or a combination of both  • Different shapes, sizes, and colors  • Durability  • Versatility  • Ease of manufacturing | • Building material (arches, walls, and structural elements) | • Great Wall of China  • Red Fort in Delhi, India | • *Acremonium* spp.  • *Alternaria* spp.  **• *Aspergillus flavus***  **• *Aspergillus niger***  *•* ***Aureobasidium pullulans***  • *Chaetomium* spp.  *• Cladophialophora* spp.  **• *Cladosporium cladosporioides***  • ***Cladosporium halotolerans***  **• *Cladosporium sphaerospermum***  • *Clonostachys rosea*  *• Coniosporium* spp.  • *Devriesia imbrexigena*  • *Didymella* spp.  *• Exophiala* spp.  • *Extremus* spp.  • *Fusarium* spp.  • *Humicola* spp.  • *Knufia* spp.  • *Lecanicillium aphanocladii*  • *Mortierella alpina*  • *Penicillium aurantiogriseum*  • *Penidiella venezuelensis*  *• Phoma glomerata*  *• Rhizopus* sp.  • *Stachybotrys chartarum*  • Lichen-forming fungi(*Verrucaria* and *Acarospora*) |
| Terracota | • Made from clay  • Red-dish-brown color | • Decorative element (architectural detail, sculptures, ornamental facades, and pottery) | • Terracotta Army in China's Qin Shi Huang Mausoleum  • Roof of the Watts Towers in Los Angeles, USA |
|  | Concrete | • Mixture of cement, water, aggregates (e.g., sand, gravel, or crushed stone), and additives  • Strength  • Durability  • Adaptability | • Building material (structural elements) | • Hoover Dam,Colorado River, Arizona and Nevada, USA  • Sydney Opera House, Australia | *• Alternaria* spp.  *• Aspergillus carbonaurius*  *• Aspergillus tamarii*  *• Aureobasidium pullulans*  • *• Cladosporium sphaerospermum*  • *Epicoccum* spp.  • ***Fusarium* *oxysporum***  • *Mucor* spp.  • *Pestalotiopsis* spp.  • *Penicillium* spp  • *Trichoderma* spp. |