CLEANING MINERAL SPECIMENS

Specimens in a mineral collection or minerals offered for sale or exchange should be in pristine condition. This means that each specimen should be without serious or obvious damage and should be as free from dirt and contamination as possible.

When collected, mineral specimens are usually covered with dirt of several kinds and may be stained with oxides or other chemical substances. Such specimens need to be cleaned before they can be considered for any useful purpose. Additionally, specimens on display in collections or in stock boxes, can accumulate dirt and debris over time and will need to be cleaned periodically.

DUST is public enemy number one. If they are dusted too often, the minerals are prone to damage and, if they are not dusted enough, then they lose their natural beauty and lustre. Certain fibrous and delicate species, cuprite, malachite and mesolite are examples, are impossible to dust. Many species are in this category and it would be a good policy to actually identify those as you get them and protect them by keeping them in transparent boxes or showcases.

Brushing with a soft camel hairbrush to remove dust can clean tougher samples. If the sample is capable of being scrubbed with a brush then harder, even metal brushes can be used. Never use nylon or plastic brushes as they can leave traces of their bristles on the specimen, especially if a solvent has been used. On very hard specimens toothpaste, pumice powder, or other cleaning powders can be useful. Soap or detergents may be used providing they do not harm the sample.

Porous or clayish minerals may only be brushed using a soft brush. Do not try to dampen them as they are water absorbent and may disintegrate. Examples of this type of mineral are ammonium salts, kaolinite, potassium alum, sideronatrite and ulexite.

A great number of minerals are soluble in water and would be ruined by washing. Examples are autunite, borax, goslarite, gypsum, sulphur, halite and kainite.

Capillary crystals, not soluble in water can be cleaned by dipping them in demineralised water (distilled), rinsing carefully and slowly and allowing them to dry in the sun or air. If you are going to use an additive to the water it is better to use a small amount of detergent rather than acid. Soap is by far the best for gold. Lukewarm water is better than hot water because the combination of hot water and detergent produces oxygen which, in turn can promote oxidisation on the mineral and, hence, discolouration.

Partially soluble minerals should be washed in detergents such as benzene, kerosene, or carbon tetrachloride. Be warned, however, that the vapours should not be inhaled and the products are highly inflammable. Use well ventilated work area.

RUST is public enemy number two, produces hues of yellow, brown or red to deface many very good samples in just about everyone's collections. Lacquering can protect many samples from this problem. However, then the rust stain is there it can be removed by using sodium citrate, sodium hydrosulphate, oxalic acid. Hydrogen sulphide, or tartaric acid.

Acids should not be used on any calcium carbonate based mineral because of their reaction with it. Test on a spare sample with dilute acid if acid cleaning is required.

Individual stains can be removed using cotton wool soaked in sodium citrate. After the cotton wool is applied for about fifteen minutes, the mineral should be cleaned with demineralised water and carefully dried. Hydrogen sulphide may also be used in the same way.

Pink chalcedony can be cleaned with a mixture of detergents and sodium hypochlorite. The solution should be warmed, cooled, applied and then rubbed with oxalic acid. Oxalic acid can be used a number of ways to clean your samples. The simplest is to rinse and brush the sample in running water, dip into vinegar, then ammonia and rinse well in water. Immerse your sample for a prolonged period in the oxalic acid.

Dry thoroughly after the wash. Check your sample and repeat the process if necessary. Quartz can be immersed in a 50% solution of hydrochloric acid for about an hour and then soaked in oxalic acid overnight. Finally it should be washed thoroughly in water and dried.

Tartaric acid can be used instead of oxalic acid and is more readily available. In fact, tartaric acid does not produce any discolouration on quartz.

Quartz geodes should be washed with a solution of ammonia and distilled water, which will return their sheen.

Iridescent geodes, such as brown calcite should never be cleaned in any fluid as its natural iridescence is destroyed.

Tar can be removed from samples using caustic soda, then washed with detergent, dried and brushed with a soft brush.

Before any cleaning operation is carried out it is wise to consider the following matters:

1 the stability of the minerals in the specimen to be cleaned,
2 the fragility of the minerals in the specimen to be cleaned
3 the nature of the material that is to be removed
4 the nature of the mineral to be exposed, and
5 the purpose of the procedure to be used.

STABILITY

Many minerals have high chemical stability - they are not affected by common cleaning agents and aggressive environments. On the other hand, some minerals react chemically to gentle cleaning agents. Consequently, it is necessary to have a reasonably good idea about how the minerals in a particular specimen may respond chemically to a particular cleaning process. If in doubt, try the method on a small discardable fragment.

FRAGILITY

Many minerals are quite hard and tough and will not be damaged by brushing or other processes in which the surface is attacked to a greater or lesser extent. Other minerals are less hard and tough and need to be treated with great care otherwise individual crystals will suffer severe damage. Filamentary, fibrous or platy specimens can be very delicate and must be treated with great respect.

FOREIGN MATTER

The nature of the dirt, debris, staining or other material which must be removed should be ascertained before any cleaning operation is carried out. Foreign matter loosely attached to the surface can usually be removed quite easily whereas foreign matter adhering tightly to the surface, particularly in crevices, will require a different approach. Stains are usually bonded chemically to the surface and are usually resistant to mechanical removal, but often respond to appropriate chemical cleaning.

PURPOSE OF PROCEDURE

The objectives of a procedure used to clean a particular specimen should be to remove dirt and debris from the surface and remove any staining without incurring damage to any of the minerals which comprise the specimen. Every procedure will be mechanical in nature or chemical in nature or both. Mechanical procedures use a force of some kind to dislodge material from the surface. Chemical procedures use a solution of some kind to attack material on the surface of the specimen and remove it by dissolution.

MECHANICAL PROCEDURES

Mechanical procedures are used to remove natural dirt and home dirt. Natural dirt is the soil, clay and other decomposed mineral matter adhering to specimens as they are collected in the field. It may or may not contain water. Home dirt is a mixture of dry dust pulverised mineral matter and organic matter such as smoke, spores, pollen, wood and textile lint which settles from the atmosphere. This dirt can contain grease and a wide range of vaporous materials that arise in human environments.

The simplest mechanical procedure for removal of these materials is blowing with a stream of gas (air) from a compressor or compressed gas bottle or a bulb blower, a squeeze syringe or the mouth. The latter will be generate a moist stream with particles of spittle that could contaminate some specimens. Only loosely adherent dirt can be removed by this method and care should be taken in using compressed gas as a strong blast can damage fragile specimens.

The next simplest procedure is brushing but care must be exercised to ensure that the specimen is not damaged. Metal wire brushes (steel, brass) will scratch or chip even quite hard minerals and should be avoided. Bristle brushes (tooth brushes) are usually safe but fibrous specimens cannot be cleaned by this process. Soft bristle brushes (paint brushes) cause least damage but will remove only very loose dirt.

One of the most effective mechanical procedures is washing with water possibly accompanied by gentle brushing. Kitchen detergent in the water can help to dislodge adherent dirt particularly if there is grease present on the mineral surface. Heavy encrustations of dirt and clay may soften and be easier to remove if the specimen is first soaked for up to several days in water containing some detergent.

It is possible that soaking in kerosene or vinegar may soften clay deposits sufficiently for subsequent removal. However it should be remembered that vinegar is dilute acetic acid and can damage many minerals particularly carbonate minerals.

A jet of water can be highly effective in removing dirt of many kinds from non-fragile mineral specimens. It is also the best method for removal of dirt from crevices, cavities, cracks, holes and other surface irregularities. Coarse water jets, produced by water pumps such a Gerni, are good for removal of heavy adherent dirt but not for cleaning out surface irregularities, cleaning fragile specimens or cleaning small specimens. Fine water jets, produced by a water gun, are needed for these applications. A water gun can be made from a paint spray gun by replacing the spray nozzle with a jet nozzle.

Tightly adherent material in deep crevices can sometimes be removed by picking with a sharpened sliver of wood, tooth pick, bamboo stick or a needle (gripped in a needle vice). This method of cleaning is highly laborious but sometimes is the only effective method available. Dental picks and sharp tweezers can be useful for some specimens.

Deeply ingrained dirt in fragile specimens often responds to ultrasonic cleaning. An ultrasonic cleaner is a device that produces high frequency sound waves in a fluid, usually water containing a few drops of detergent. The sound waves vibrate foreign matter on a specimen in the fluid, thereby dislodging the matter from the surface. However, the waves can also damage some minerals so that caution must be exercised; e.g. Beryls. Specimens are loaded upside down so that dirts falls to the bottom of the tray.

CHEMICAL PROCEDURES

Chemical procedures are used to remove coatings and stains that have been deposited onto the mineral surface and so adhere tightly to the surface. The procedures involve submersion of the mineral in a liquid solution of some kind for a period of time that can vary from a few seconds to a few months.

In using this method, it is absolutely essential that only the material to be removed is soluble in the liquid solution while the mineral to be cleaned remains unaffected.

It should be appreciated that some minerals are soluble in water and cannot be immersed in solutions based on water (aqueous solutions), nor moistened in any way: e.g. borax, chalcanthite, cryolite, gypsum, orpiment and ulexite. However, these and similar minerals can be washed or cleaned to some degree with dry cleaning fluid.

Most micaceous minerals are insoluble in water, but water will penetrate between the lamellae/sheets and separate them and so should not be immersed in aqueous solutions.

For most applications, the solutions are reactive chemical substances dissolved in water, and mostly, the solutions are dilute. Dilute solutions of various acids are widely used for cleaning minerals and it needs to be understood that all acidic solutions will react with many minerals. In particular, hydrochloric acid (HCl)

will react with the following minerals:

- sulphides of antimony, bismuth, iron, manganese, zinc
- oxides of manganese, possibly iron, zinc
- hydroxides of aluminium, magnesium
- all carbonates except lead carbonates
- silicates with low $Si0_2$ content
- borates, phosphates, arsenates, vanadanates
- tungstates, molybdates of calcium, copper and ferric iron
- some sulphates

On the other hand, the following minerals (and many others) react exceedingly slowly and can be safely cleaned with solutions of most acids.

gold	platinum	diamond	palladium	graphite
sulphur	cinnabar	quartz	cassiterite	rutile
columbite	chromite	chrysoberyl	orthoclase	albite
beryl	tourmaline	rhodonite	zircon	kyanite
andalusite	corundum	topaz	talc	garnet family

Dilute Hydrochloric Acid
Is very effective for dissolving calcite deposits on other mineral species. The other minerals, having been well protected by the calcite, are usually bright and pristine when the calcite is removed. Note however, that this procedure should not be used for other minerals which are acid soluble. Neutralise after rinsing, with washing soda.

Oxalic Acid ($C_2H_2O_4$)
Oxalic acid is used widely for removal of iron oxide stains or deposits from a range of minerals. Remember, even a dilute solution is acidic and will dissolve most carbonate minerals. The concentration of acid in the solution, the temperature of the solution, the duration of immersion and other variables in the cleaning operation are largely a matter of opinion and preference. Not recommended for lanthanide minerals. Here are some suggestions for developing a procedure.

(a) The higher the concentration of acid in the solution the shorter the time of immersion needed for stain removal. However the down side is that high acid concentrations can result in the formation of a very tenacious yellow deposit on the specimen. Try 1 tsp of acid in 1 litre of warm water, then add more or less as you gain experience with the method.

(b) Use the solution in a plastic bucket or container - preferably with a tight fitting lid. Store in the dark as yellow stains may occur.

(c) Use the solution at room temperature. Should a quick clean be required the solution can be transferred to a stainless steel or enamelled container and heated on a hot plate. Heat to boiling if necessary but do not allow the specimen to cool in the solution.

(d) Periodically remove the specimen from the solution to note the progress of stain removal - if possible brush to expose the surface. The time required for satisfactory cleaning can vary from a day or so to several months.

(e) When stain removal is complete remove the specimen from the solution, wash in water, immerse in a dilute aqueous solution of washing soda to neutralise any remaining acid then rinse in clean water and set aside to dry.

(f) Remember that oxalic acid is an aggressive chemical so that protective gloves should be worn during all stages of cleaning. Oxcalic acid is toxic & can be absorbed through the skin & accumulates in the organs.

Some other solutions that can be used for specific cleaning requirements are as follows.

Ammonia (NH_4OH)
A warm aqueous solution of cloudy ammonia has been used to restore the brilliance of cut and polished quartz geodes.

Ammonium Acetate ($C_2H_7NO_2$)
A dilute solution of ammonium acetate in water is effective for cleaning galena.

Acetic Acid (CH_3COOH)
Dilute vinegar imparts good lustre to dioptase crystals without affecting the colour.

Baking Soda

Bleach
Minerals which react to acid solutions, and in particular carbonate minerals, might be cleaned in household bleach which is also quite effective in removing organic growths such as lichen and moss.

Citric Acid ($C_6H_8O_7$)
One teaspoonful dissolved in 100ml of water will effectively remove black manganese oxide stains from crocoite and other minerals

Hydrochloric Acid (HCL) [Formerly Muriatic Acid]
Dissolves Calcite!

Hydrogen Peroxide (H_2O_2)
Removes black manganese stains

Kerosene or Petrol
These hydrocarbons may remove tar deposits on some specimens which should then be washed thoroughly in soapy water. Together with carbon tetrachloride (CCI4) they are also effective in removal or smoke and soot deposits from minerals that have been scorched. However, be warned that these solvents become absorbed into porous materials and subsequent removal is extremely difficult.

Nitric Acid (HNO_3)

Potassium Permanganate ($KMnO_4$)

Sodium Hydroxide (NaOH)
Attacks Quartz

Sulphuric Acid (H_2S0_4)
A 20% aqueous solution of sulphuric acid can be used to remove calcite deposits from copper without damage to the metal. This acid can also be used to remove organic matter from the surface of mineral specimens. After removal from the acid, a specimen should be washed in water then in dilute aqueous washing soda to neutralise any remaining acid then thoroughly washed again in water and dried

Additionally:

• Quartz may be cleaned by immersion in dilute potassium permanganate for 12 hours then by immersion in dilute sodium bisulphate for 30 minutes and washing in water

• coatings of yellow, brown and red rust on various minerals may be removed by soaking in a solution of:

1 part sodium gluconate
1 part sodium citrate
1 part 35% ammonia in water
7 to 10 parts water

THE SOLUTIONS FOR CLEANING MINERALS

MINERAL:	CLEAN WITH:
ACTINOLITE	
ALBITE	Dilute acid
ALMANDINE	Dilute acid
AMBER	Soap & water
ANASTASE	Not acid soluble. Iron stains with oxalic acid
ANDALUSITE	Dilute acid
ANDRADITE	Dilute acid
ANGLESITE	Distilled water
ANORTHITE	Distilled water
ANTIMONY	Any acid other than sulphuric
APATITE	Distilled water
ARAGONITE	Distilled water
ARSENOPYRTTE	HCL
AUGITE	Iron stains with oxalic acid
AZURITE	Distilled water
BARYTE	Not acid soluble. Iron stains with dilute oxalic acid
BERYL	Dilute Oxalic acid [Not ultrasonic]
BIOTITE	Dilute acid
BISMUTH	
BISMUTHENITE	Most acids except conc HNO_3
BONE	Gently with methylated spirit
BORNITE	Water
BUSTAMITE	Dilute acetic acid
CALCITE	Distilled water or Baking Soda 1 tsp/4 litres of water
CASSITERITE	Dilute acid
CELESTINE	Dilute acid
CERRUSITE	Dilute HCL
CHALCOPYRITE	Distilled water
CHLORITE	Distilled water
CHROMITE	Dilute acids
CHRYSOBERYL	Any dilute acid
CHRYSOCOLLA	Distilled water
COPPER	Water; black deposits with 1:3NaOH, 3:KNa Tartrate, 20:H_2O
CORAL	
CORUNDUM	Any acid
CROCOITE	Ultrasonically
CUPRITE	Dilute Oxalic acid
DIAMOND	Boiling conc HF [Dangerous!]
DIOPSIDE	Dilute acetic acid
DIOPTASE	Calcite with dilute acetic acid
DOLOMITE	Distilled water
EPIDOTE	Dilute HCL acid
FLUORITE	Calcite with dilute HCL; Iron stains with dilute oxalic acid
GARNET	Dilute acid
GALENA	Ammonium acetate & water rinse; Calcite with dilute acetic acid
GLAUBERITE	
GOETHITE	Dilute HCL
GOLD	Iron stains with any acid; quartz with strong HF [Dangerous]
GRAPHITE	Not acid soluble
GROSSULAR	Dilute acid
GYPSUM	Iron stains with dilute oxalic acid
HAEMATITE	Dilute HCL
HALITE	Alcohol
HEMATITE	Dilute Oxalic acid

HORNBLENDE	Dilute acid
ILMENITE	Dilute Oxalic acid
IVORY	Gently with methylated spirit
JADEITE	Dilute acid
JET	Soap & water
KYANITE	Iron stains with oxalic acid
LABRADORITE	Dilute acid
LAZULITE	Distilled water
LEPIDOLITE	Dilute acid
LOLLINGITE	Calcite with HCL
MAGNESITE	Do not clean with liquids
MAGNETITE	Water or dilute acid
MALACHITE	Distilled water
MARCASITE	Do not clean
MICROCLINE	Dilute acid
MOLYBDENITE	Iron stains with oxalic acid
MONAZITE	
MULLITE	Dilute acid
MICA	Never washed, just gently dusted
MUSCOVITE	Never washed, just gently dusted
OLIVINE	Dilute Oxalic acid
ORTHOCLASE	Dilute acid
PERIDOT	
PREHNITE	Dilute Oxalic acid
PYRITE	Iron stains with oxalic acid
PYROLUSITE	
PYROMORPHITE	Distilled water
PYROPE	Dilute acid
PYROPHYLLITE	Iron stains with oxalic acid
QUARTZ	Dilute Oxalic/HCL acid or Pottasium Permanganate
RHODOCHROSITE	
RHODONITE	Distilled water
SCHEELITE	Dilute Oxalic acid
SCHORL	Dilute HCL acid
SIDERITE	Dilute Nitric acid
SILLIMANITE	Dilute acid
SILVER	Nitric acid - with care
SMITHSONITE	Distilled water
SODALITE	Distilled water
SPESSARTINE	Dilute acid
SPHALERITE	Calcite with dilute HCL
SPHENE	Dilute acid
SPINEL	Any dilute acid
SPODUMENE	Dilute acid
STAUROLITE	Dilute acid
STIBNITE	Water - no detergents
STICHTITE	Distilled water
STILBITE	Dilute Oxalic acid
STOLZITE	Distilled water
STRONTIANITE	Distilled water
SULPHUR	Never washed, just gently dusted
TALC	Dilute acid
TOPAZ	Dilute acid
TOURMALINE	Dilute Oxalic acid. Kerosene to remove any clay then rinse
TREMOLITE	Dilute acid
TURQUOISE	Distilled water plus wetting agent
UVAROVITE	Calcite with dilute HCL
VANADINITE	Dilute Oxalic acid

VARISCITE	Distilled water
WOLFRAMITE	Dilute acid
WULFENITE	Distilled water
ZIRCON	Dilute acid
ZOISITE	Dilute acid

SAFETY PROCEDURES

N.B: All the chemicals listed have hazards & are dangerous - as is the equipment recommended! Concentrated acids are dangerous & should be handled with great care following the manufacturer's instructions. Please read the manufacturer's instructions & follow them carefully. Also use the correct safety protection equipment; heavy rubber gloves, eye protection, aprons, stainless tongs etc. Many chemicals release dangerous gases or splashes - Use in well ventilated areas & avoid inhaling any fumes. Rinse any splashes immediately with cold running water.

When diluting acids ALWAYS slowly add the acid to water

Use ear muffs when using the Gerni/water jet cleaning & don't point the jet at persons or animals. Specimens needs to be positioned/affixed so that they are not blown away when using the Gerni. The paint sprayer water jet can be used with hand held specimens - but eye protection & care should be used at all times.

SUPPLIERS

Chemicals mentioned in these notes are available from suppliers as follows.

acetic acid - vinegar	Coles or Woolworths
ammonia (cloudy)	Coles or Woolworths
ammonium acetate	try a chemical supplier
baking soda	supermarkets
bleach (Nappysan)	Coles or Woolworths
carbon tetrachloride (CCl_4)	
citric acid	Coles or Woolworths
detergent (Home Brand)	Coles or Woolworths
dry cleaning fluid	try a dry cleaner
hydrochloric acid	Bunnings
hydrofluoric acid (HF)	
kerosene	Coles or Woolworths
oxalic acid	ILC or Bunnings
petrol (unleaded)	any service station
potassium permanganate (Conde's Crystals)	try a produce store
sodium bisulphate (NaHS04)	try a chemical supplier
sodium citrate	try a chemical supplier
sodium gluconate	try a chemical supplier
sulphuric acid	try a chemical supplier
washing soda	Coles or Woolworths

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Roly Smith 2022