

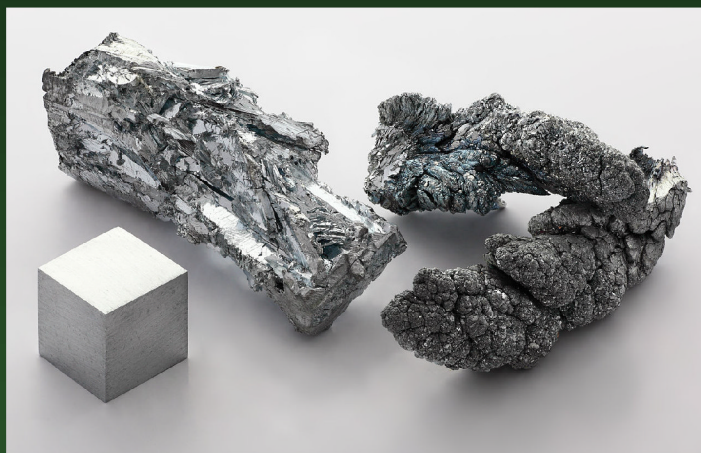
# Feature

## Element of the Month

### Zinc

With 30 protons in its nucleus, it is the first element of Group 12 on the Periodic Table, and the 24th most abundant element in the Earth's crust. But its propensity to form beautiful secondary minerals is what makes it of particular interest to collectors.

Examples of the use of impure zinc in ancient times have been discovered, where ores containing zinc were used to make the zinc-copper alloy, *brass*, many centuries prior to the discovery of zinc as an element. Though not recognized and isolated as a metal, per se, zinc was alloyed with copper as far back as 10th century BC Judea! This may have been accidental in the



earliest manufacturing of brass, as the smelting of zinc-rich copper ores probably produced the earliest known brass artifacts. But at least by the Roman Era, brass was deliberately manufactured.

Zinc is extensively used in various industrial applications. It is employed to

form numerous alloys besides brass, including nickel-silver, typewriter metal, commercial bronze, spring brass, German silver, soft solder, and aluminum solder.

*Prestal* is an alloy consisting of 78% zinc and 22% aluminum which is as strong as steel, but as easy to mold as plastic. Zinc is also extensively used to *galvanize* other metals, such as iron, to prevent corrosion. Zinc oxide is widely used in

the manufacture of paints, cosmetics, pharmaceuticals, plastics, shampoo, soap, storage batteries, textiles, electrical equipment, and many more products.

Elemental zinc is rarely found in nature as a mineral in an uncombined state, because of its moderately high

reactivity. However, it is one of the most common of base metals to be found in numerous secondary minerals that occur in hydrothermal oxidation zones, creating specimens that are popular in collections; these include such minerals such as hydrozincite, smithsonite, willemite, and hemimorphite. It is the metal's inherent qualities that are responsible for being included in a large suite of minerals.

### Chemistry 101

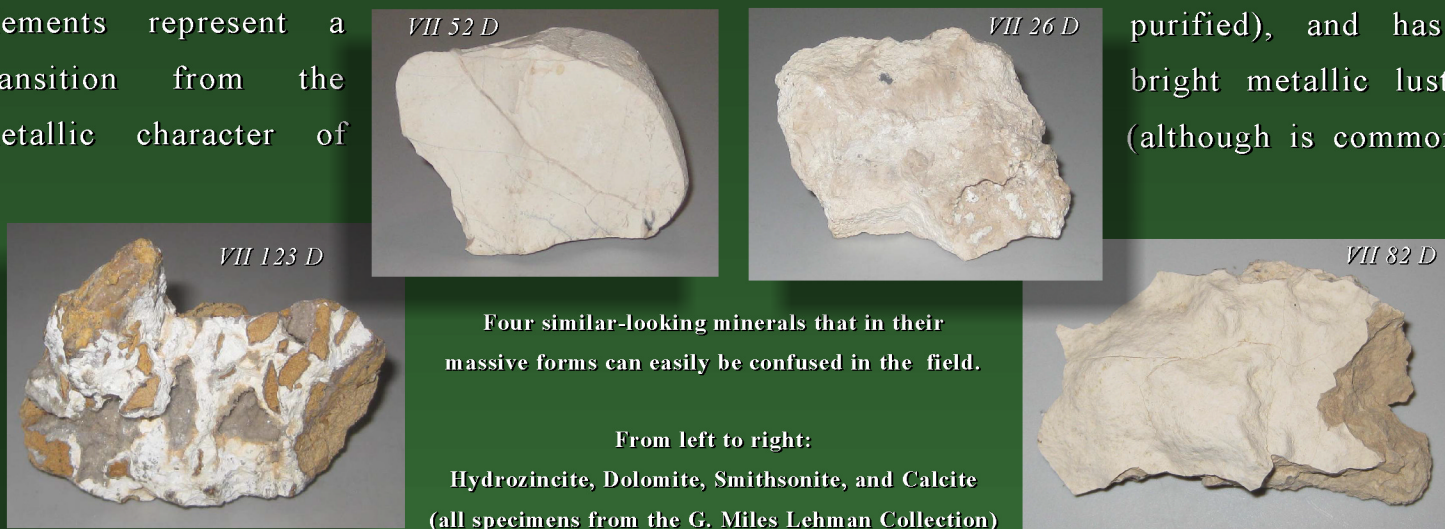
Technically, zinc is a *post-transition metal*, that is, it occurs in the so-called “*d*-block” of the Periodic Table between the true transition metals to the left (*s*-block) and the metaloids to the right (*p*-block). *D*-block elements represent a transition from the metallic character of

*s*-block elements to the non-metallic character of *p*-block elements.

Thus, zinc exhibits significant reduction in physical metallic character from the true metals, and differs from the true transition metals as it has the electron configuration of *d*10*s*2, with no incomplete *d* shell. Its usual oxidation state is 2+, which means the outer shell *s* electrons have been lost, yielding a bare and reactive zinc ion with an electron configuration of *d*10. Because of this filled *d* shell, zinc compounds are *diamagnetic* (repelled by an applied magnetic field) and *colorless*. Zinc can also exist in an oxidation state of 1+, which allows it to craft a covalent bond with another zinc atom

to form a diatomic molecule [Zn<sub>2</sub>]<sup>2+</sup>, thus maintaining an overall oxidation state of 2+. These compounds, however, are rare. More important to collectors who also enjoy performing tests on unknown specimens collected from the field, as I do, weak basic solutions containing Zn<sup>2+</sup> ions form the hydroxide Zn(OH)<sub>2</sub>, yielded as a white precipitate (see **Tests for Zinc** page 23).

Furthermore, unlike such true metals as gold and copper, zinc is hard and brittle at most temperatures, (but then becomes malleable when heated to 150 degrees), and has melting and boiling points that are lower than the transition metals. But like the true metals, it is ductile at room temperature (if highly purified), and has a bright metallic luster, (although is commonly





dulled by a carbonate coating when it reacts with carbon dioxide in the air).

### ***So what does all this mean to collectors?***

Freed from the primary mineral sphalerite (zinc sulfide) through oxidation, rapacious ions of zinc seek out covalent partnerships with a wide array of available anions—particularly  $\text{CO}_2$ ,  $\text{SO}_2$ , and  $\text{SiO}_2$ —in the ambient environment to form stable molecules.

Sphalerite is commonly found in hydrothermal veins and replacements, and is almost always associated with galena and pyrite. The oxidation of the pyrite, which usually dominates the mineral suite, creates a highly acidic environment that in turn leads to the alteration of the galena and sphalerite—and any other primary minerals—in the deposit. The actual process is the subject of an article in the next issue, so the details won't be reviewed here. Suffice to say, this frees up a soup of radicals (Pb, Cu, Zn, Fe,  $\text{SO}_2$ ,  $\text{CO}_2$ ,  $\text{SiO}_2$ , etc.) that readily recombine to form the secondary minerals so coveted by collectors. It is unfortunate to note that many splendid examples were relegated to the smelter for their metal content by miners who did not appreciate the minerals' aesthetic qualities and specimen value!

If the hydrothermal intrusion was in carbonate rocks (limestone, dolomite, etc), as is often the case in the desert southwest, the prospector or rockhound can expect to encounter smithsonite ( $\text{ZnCO}_3$ ), hydrozincite ( $\text{Zn}_5(\text{CO}_3)_2(\text{OH})_6$ ), calcite ( $\text{CaCO}_3$ ), and cerussite ( $\text{PbCO}_3$ ) in the same environment, thus necessitating qualitative tests to distinguish the often similar-looking minerals. The tests for Zn, Pb, and Ca are easy to perform, and the water in hydrozincite will distinguish it from its anhydrous counterpart, smithsonite. Additionally, if you have a short-wave UV light, hydrozincite fluoresces bright blue; calcite is often fluorescent, but not in blue; and smithsonite is not fluorescent.

It should be remembered that chemical testing is destructive, which is why enough material should always be collected to perform tests on specimens unfit for addition to any display collection. Of course, with experience, testing often becomes a mute point, as the practiced eye learns to differentiate the minerals in the field, which saves one from returning home with a heavy sackful of worthless material!

Zinc is so common in hydrothermal deposits that a field trip to such locations should undoubtedly yield specimens worthy of any collection.

# A Collection of Zinc Minerals

II 38 D



**Sphalerite**

Paloma Mine; Peru

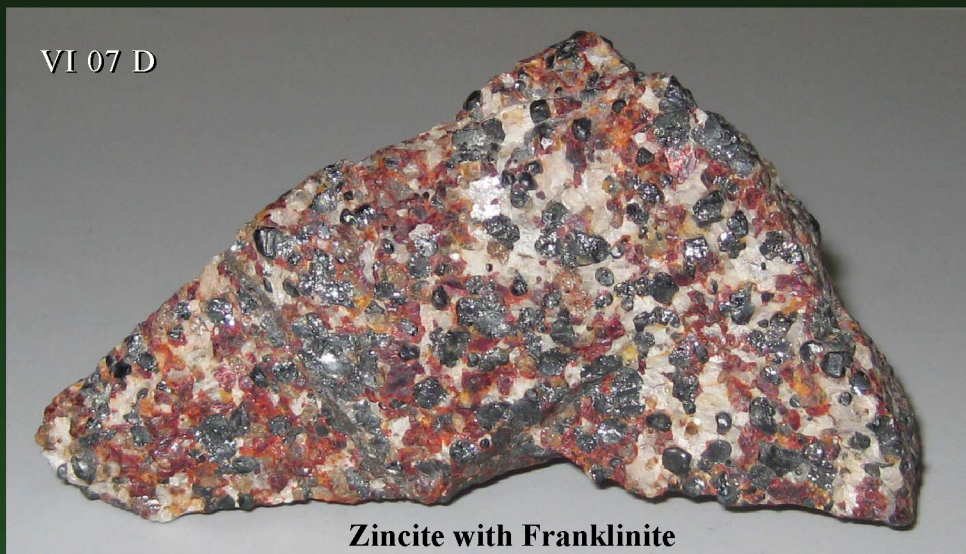
XIII 35 D



**Cuproadamite**

Ojuela Mine; Mapimi Mexico

VI 07 D



**Zincite with Franklinite**

Sterling Mine; Franklin, NJ

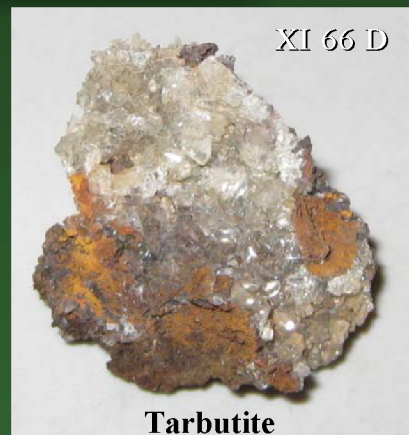
XVIII 19 D



**Hemimorphite**

Ojuela Mine; Mapimi, Mexico

XI 66 D



**Tarbutite**

Ojuela Mine; Mapimi, Mexico

*All specimens from the  
G. Miles Lehman Collection*



# A Collection of Zinc Minerals



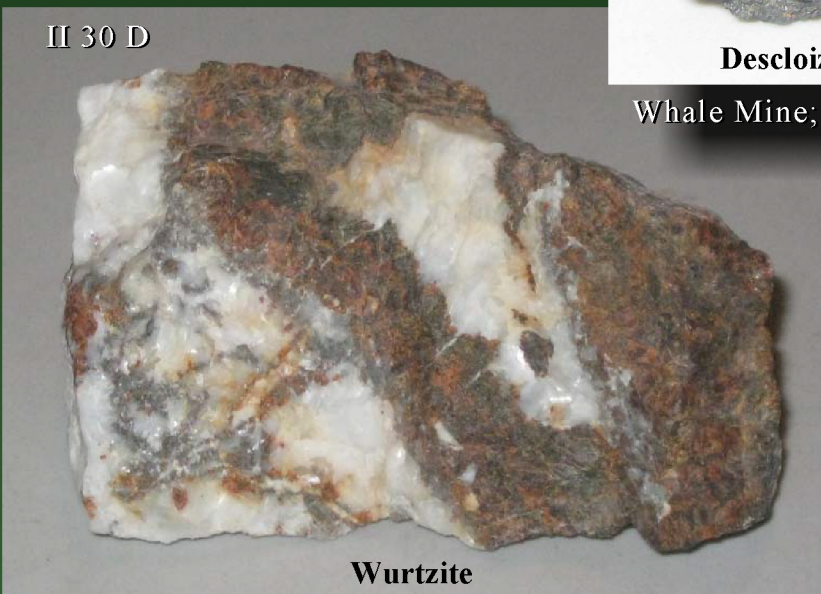
**Adamite**

Ojuela Mine; Mapimi, Mexico



**Descloizite**

Whale Mine; Goodsprings, NV



**Wurtzite**

Green Monster Mine; Goodsprings, NV

*All specimens from the G. Miles Lehman Collection*

# Tests for Zinc

**Oxide Coating on Charcoal:** Metallic zinc is easily obtained from the zinc minerals by fusing them with reducing mixture on charcoal. But, since the metal is volatilized at a temperature considerably below that of the flame, no metallic globule can form. Upon meeting the oxygen in the air, it is converted to the oxide ZnO which drops upon the charcoal close to the assay, and is yellow when hot, but white when cold. If moistened with a drop of cobalt nitrate, the coating turns green.

**Flame Color:** Some zinc minerals will reveal a characteristic pale greenish-blue color when a fragment is roasted in the reducing portion of the flame. It takes the form of momentary streaks in the flame. Note: this is not a reliable test.

**Cobalt Nitrate:** When a fragment is roasted, then touched with a drop of cobalt nitrate ( $\text{Co}(\text{NO}_3)_2$ ; usually obtained as the hexahydrate) and reheated, the specimen will turn green if zinc is present. If the zinc mineral is a silicate (e.g. hemimorphite), the fragment will turn blue. Caution must be taken when interpreting this result, as this is also an indication of aluminum. Confirmatory tests must then be undertaken.

**Precipitation as Zinc Sulfide:** The mineral is dissolved in hydrochloric acid, and a few drops of nitric acid are added to oxidize any iron that is present. Upon being made ammoniacal, any precipitates must be filtered off. Add sodium sulfide to the filtrate. A white precipitate indicates the presence of zinc. For best results, the filtrate should not have an excess of ammonium hydroxide.



Specimen of suspected zinc mineral (left). After roasting, moistening with cobalt nitrate, then re-roasting, results indicate presence of mixed zinc minerals (right). Blue indicates zinc silicate (hemimorphite); green indicates zinc in a non-silicate mineral (in this case, hydrozincite).



Same test on another specimen. This time, only the silicate is present. The mineral is hemimorphite, though willemite will give the same result. Willemite, however, is rare compared to hemimorphite, has a different crystal form, and fluoresces bright green in short-wave UV light.