Zinc

The element Zinc (Zn) occurs in many minerals and rocks in a wide variety of geological settings. In sulphide mineral resources, Zn most frequently occurs in sphalerite (Figure 1), although it may also be included as a substitution in a variety of minerals including pyrite, chalcopyrite and magnetite. Zinc oxide deposits include a variety of oxide species including Zincite (Zn,MnO) (Figure 2). In highly metamorphosed geologic terrains, Zn may occur in the spinel gahnite ($ZnAl_2O_4$) (Figure 3).

Figure 1: Mineral Sphalerite (Zn,Fe)S

Figure 2: Mineral Zincite (Zn,Mn)O

The most common ore mineral, Sphalerite (Zn,Fe)S, is a non-metallic resinous mineral, with color varying from clear to honey brown to black (depending upon Fe content). It is a non-magnetic, fluorescent (yellow-orange) mineral which may occur in euhedral crystals, or more commonly in ore systems in a colloidal mass, streak brownish (Figure 1).

Figure 3: Mineral Gahnite $ZnAl_2O_4$

A wide variety of digestions are available for analysis of Zn, depending upon the mineral of interest and purpose of the analytical program. Trace and assay grade analytical methods are described in the Table below, and include a selection of aqua regia digestions and determination by AA, ICP-AES, or ICP-MS. Oxide specific leaches are available to selectively dissolve Zn oxide (Zn-AA07). Sphalerite dissolved in the aqua regia digestions and can be analyzed by either ICP-AES or ICP-MS depending upon the element range required (Zn-AA45, Zn-OG46 and ME-MS41). The stronger "near-total" 4-acid digestion can also be applied to samples (Zn-AA61, Zn-OG62, ME-MS61), but will still not dissolve gahnite completely. Analysis for gahnite should include the instrumental total procedure (Zn-XRF05). Concentrate samples may be analyzed by a classical titration method (Zn-Vol50).

In soil, sediment and regolith samples, Zn may be weakly bound within the sample matrix in colloid, oxide, hydroxide, or organic phases. Super-trace Zn in these materials can be analyzed using the super-trace aqua regia multi-element geochemical method (ME-MS41L, range 100 ppb – 1%), or using one of the available selective leaches such as Ionic leach (ME-MS23, Zn detection limit 10 ppb), or oxide specific leaches (ME-MS05, 06, Zn detection limit 200 ppb).

The mobility of Zn in the secondary environment is high based on redox conditions (Figure 4). In weakly acidic solutions Zn becomes mobile in oxidizing conditions. As the pH increases above 7 in the surficial environment, Zn carbonate and Zn oxide are formed. Zn weathering products are numerous, and it may occur in sulfates, carbonates, silicates, clay minerals, within organic material and in Fe-Mn oxides. General mobility in the secondary environment is reduced somewhat by tendency to be absorbed by organic material and by Mn oxides. Zn is an essential nutrient for most plant species, contributing to it's broad dispersion in the secondary environment.

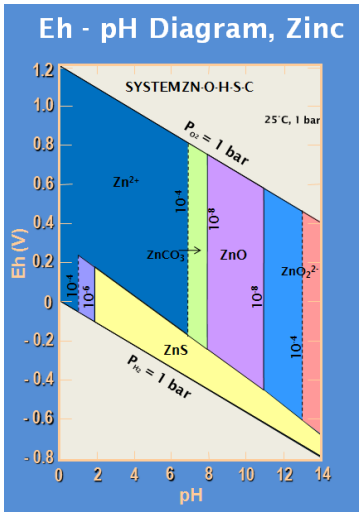

Figure 3: Redox Diagram for Zn, 25C, 1Bar (Brookins, p 55).

Zinc is found in a wide variety of geological and ore settings. It is a chalcophile element, occurring with Cu-Pb-Ag-Au-Sb-As-Se-S, with Ni-Co in some settings, and with Mg. The most common ore occurrence is with Pb (galena). (Rose, Hawkes and Webb, 1979, p. 580).

Zinc

Naturally occurring zinc (Zn) is composed of the 5 stable isotopes ^{64}Zn, ^{66}Zn, ^{67}Zn, ^{68}Zn, and ^{70}Zn with ^{64}Zn being the dominant isotope (50%). Studies have indicated differences across large hydrothermal deposits in the Zn isotope ratios, which may provide valuable deposit vectors and indicators of fluid flow in mineral exploration. Zinc isotopes can be determined at ALS via Multi-collector-ICP-MS (Zn-ISTP02).

Zinc Analytical Methods, ALS Minerals

Method Type	Description	Zinc Range	ALS Code
Trace	Trace Zn method - aqua regia and AAS finish.	1ppm - 1%	Zn-AA45
	Trace Zn method - 4 acid near total digestion and AAS finish.	5ppm - 1%	Zn-AA61
Assay	Aqua regia digestion and ICP or AAS finish.	0.001 - 30%	Zn-AA46 Zn-OG46
	4 acid near total digestion and ICP or AAS finish.	0.001 - 30%	Zn-AA62 Zn-OG62
	Oxide Zn (non-sulphide) by acetic acid digestion-AAS finish.	0.01 - 30%	Zn-AA07
	High sulphide samples.	0.01 - 30%	Zn-ICP81
	High Sulphide Samples, Fusion-XRF method.	0.001 - 20%	Zn-XRF15b
Instrumental Total	Zn Pressed Pellet XRF determination.	10 ppm - 1%	Zn-XRF05
Concentrate	Zn Concentrate, volumetric method.	0.01 - 100%	Zn-Vol50
Multi-element Geochemical	Multi-element aqua regia digestion, 51 elements determined by Combined ICP-AES and ICP-MS.	2ppm - 1%	ME-MS41
	Multi-element aqua regia digestion, 34 elements determined by ICP-AES.	10ppm - 5%	ME-ICP41a
	Multi-element 4 acid near total digestion, 48 elements determined by Combined ICP-AES and ICP-MS.	2ppm - 1%	ME-MS61
	Multi-element 4 acid near total digestion, 33 elements determined by ICP-AES.	10ppm -10%	ME-ICP61a
Super-trace Soil/Regolith Multi-element	'Super-trace' aqua regia digestion, 51 elements determined by Combined ICP-AES and ICP-MS. Zn Range: 0.1 ppm - 1%.	0.1ppm - 1%	ME-MS41L
	Ionic Leach' selective leach to pH 8.5, 60 elements and Pb isotopes determined by ICP-MS. Zn Range 0.5 ppb - 1000 ppm.	10ppb - 1000ppm	ME-MS23
	'Mn-oxide' selective leach Hyroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS. Zn Range: 10 ppb - 1000 ppm.	200ppb - 1000ppm	ME-MS05
	'Fe-oxide' selective leach Hyroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS. Zn Range: 10 ppb - 1000 ppm.	200ppb - 1000ppm	ME-MS06
Isotope	Zn Isotopes by Multi-collector ICP-MS		Zn-ISTP02