



Molybdenum

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The element Molybdenum (Mo) occurs most frequently in mineral deposits as the mineral molybdenite (MoS_2), a metallic luster, grey-black, non-magnetic, non-fluorescent opaque mineral which smears greenish gray, has a high specific gravity (5.5), and is somewhat hydrophobic in mineral processing (Figure 1).



Figure 1: Mineral Molybdenite

Mo in molybdenite is best analyzed using the 4-acid "near-total" digestion. It should be noted that the aqua regia digestion may not provide complete dissolution of molybdenite. Figure 2 shows a sample data set for which the 4-acid digestion provides 10-30% higher concentrations for samples with > 200 ppm Mo (average 17% higher Mo in the 4-acid digestion for samples with Mo > 200 ppm).

The multi-element geochemical methods ME-MS61 (trace concentrations up to 1%), ME-ICP61a (intermediate concentrations up to 5%) may be followed by the higher precision assay method of Mo-OG62, for concentrations up to 10%.

If the Mo occurs with resistate minerals, higher grade samples may be analyzed using a total instrumental method such as a pressed pellet to XRF (Mo-XRF05). Mo in concentrates should be determined at trace levels using the multi-element concentrate method (ME-MS61c, Mo up to 10%), or by a concentrate method, Mo-CON02 (Mo range 0.01 - 100%).

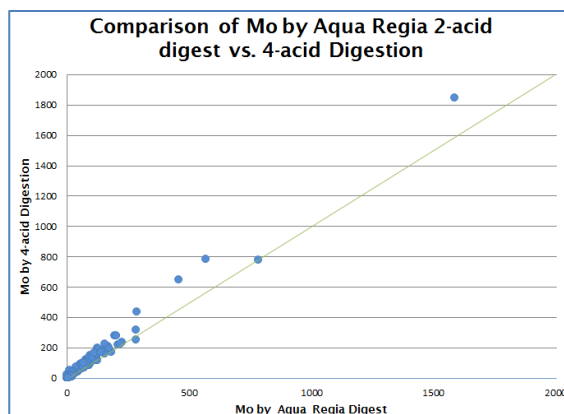


Figure 2: Mo comparison, aqua regia and 4- acid digestions

Molybdenum in oxide form can be selectively dissolved if a project requirement is the distinction of sulfide vs. oxide minerals phases.

In soil, sediment and regolith samples, Mo may be weakly bound within the sample matrix in colloid, oxide, hydroxide, or organic phases. Super-trace Mo in these materials can be analyzed using the super-trace aqua regia multi-element geochemical method (ME-MS41L, detection limit 10 ppb), or using one of the available selective leaches such as ionic leach (ME-MS23, Mo detection limit 0.5ppb), or oxide specific leaches (ME-MS05, 06, Mo detection limit 10 ppb).

Elements associated with Mo in mineral deposits include Re, which frequently occurs within the mineral molybdenite, and in various minerals: Sn, W, Cu and Au. (Rose, Hawkes and Webb, 1979, p. 562).

The movement of Mo in the surficial minerals environment is highly dependent upon oxidizing and acidity (pH) conditions.

Mo is generally mobile in the secondary environment in highly alkaline and oxidizing conditions, whereas it forms immobile oxide phases at low pH and high redox. In the presence of salts, Mo may transport long distances as MoCl_2 .

Eh - pH Diagram, Molybdenum

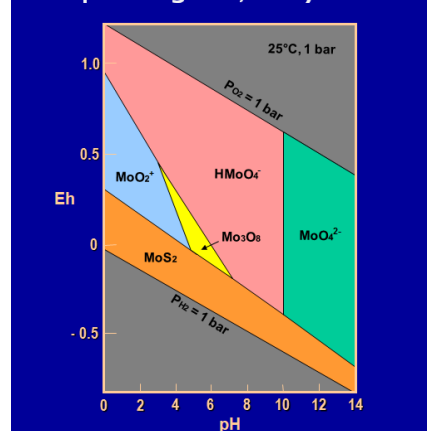


Figure 3: Redox Diagram for Mo, 25C, 1 Bar for Mo-S-O-H (Brookins, p 105)



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Molybdenum Analytical Methods, ALS Minerals

Method Type	Description	Mo Range	ALS Code
Trace	4 acid near total digestion and ICP or AAS finish.	1ppm - 1%	Mo-AA61 Mo-ICP61
Assay	Ore grade Mo method - 4 acid near total digestion and ICP or AAS finish.	0.001 - 10%	Mo-AA62 Mo-OG62
Instrumental Total	Mo Pressed Pellet XRF determination.	4ppm - 1%	Mo-XRF05
Instrumental Total	Mo Pressed Pellet XRF determination.	0.01 - 50%	Mo-XRF07
Concentrate	Mo Concentrate.	0.01 - 100%	Mo-CON02
Multi-element Geochemical	Multi-element 4 acid near total digestion, 48 elements determined by combined ICP-AES and ICP-MS.	50ppb - 1%	ME-MS61
	Multi-element 4 acid near total digestion, 33 elements determined by ICP-AES.	10ppm - 5%	ME-ICP61a
Super-trace Soil/Regolith Multi-element	'Super-trace' aqua regia digestion, 51 elements determined by combined ICP-AES and ICP-MS.	10ppb - 1%	ME-MS41L
	'Ionic Leach' selective leach to pH 8.5, 60 elements and Pb isotopes determined by ICP-MS.	0.5ppb - 1000ppm	ME-MS23
	'Mn-oxide' selective leach Hydroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS.	10ppb - 1000ppm	ME-MS05
	'Fe-oxide' selective leach Hydroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS.	10ppb - 1000ppm	ME-MS06