

## Barium

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The element Barium (Ba) occurs primarily in sulphate as Barite ( $\text{BaSO}_4$ ), and as a carbonate in Witherite ( $\text{BaCO}_3$ ). Barium may also occur in substitution for K-Ca in silicate minerals, most notably as a substitute in K-feldspar. Sr and Ca may substitute for Ba in barite and Witherite. Barite occurs in base metal deposits, with gold deposits, and may form fine grained black bedded barite in sedimentary sequences. The Carlin gold deposits of Nevada USA contain a beautiful honey yellow barite crystals along open fractures and voids within the deposit (Figure 1).



Figure 1: Mineral Barite ( $\text{BaSO}_4$ )

The most common mineral in ore deposits is Barite, a transparent to opaque vitreous mineral of high specific gravity (4.5) with color varying from white-brown-yellow. It is a non-magnetic, phosphorescent mineral with white streak. The carbonate mineral Witherite ( $\text{BaCO}_3$ ) is a fairly non-descript colorless to white mineral that forms in aggregates or concretions, still with high specific gravity (4.3) and white streak, fluoresces light blue, occurring in caves or voids as a low temperature precipitate at higher pH.



Figure 1: Mineral Witherite ( $\text{BaCO}_3$ )

The high density and resistant nature of barite leads to usefulness in industrial applications. It is used to increase the density of drilling muds. It is the source of green in fireworks, and because of its insolubility, barium sulphate is used as an x-ray tracer by physicians studying stomach and intestines.

Barium in carbonate and oxide forms is easily soluble (aqua regia digestions and either ICP-AES or ICP-MS determinations, ME-MS41). Barium occurring in K-feldspar may require a stronger 4-acid digestion for complete dissolution (ME-MS61). Barium in barite is insoluble and largely untouched by acid dissolution, in which case a fusion or XRF instrumental total analysis is required for determination. The whole rock Litho geochemistry package includes BaO from 0.01 - 100%. A pressed pellet-XRF method provides Ba from 10ppm - 1%. The high grade assay fusion method provides Ba from 0.01 - 50% Ba. Concentrate samples may be analyzed by a gravimetric method (Ba-GRA81, 0.01 - 100% Ba).

In soil, sediment and regolith samples, Ba may be weakly bound within the sample matrix in colloid, oxide, hydroxide, organic or as a carbonate phase. Super-trace Ba in these materials can be analyzed using the super-trace aqua regia multi-element geochemical method (ME-MS41L, range 0.5ppm - 1%), or using one of the available selective leaches such as Ionic leach (ME-MS23, Ba detection limit 10 ppb), or oxide specific leaches (ME-MS05, 06, Ba detection limit 50 ppb).

The mobility of Ba in the secondary environment is low in oxidizing and lower pH conditions (Figure 3). In high pH solutions, Ba may be mobile as a carbonate complex. Some fault systems in high pH environments have pronounced low level Ba anomalies along the length of the fault.

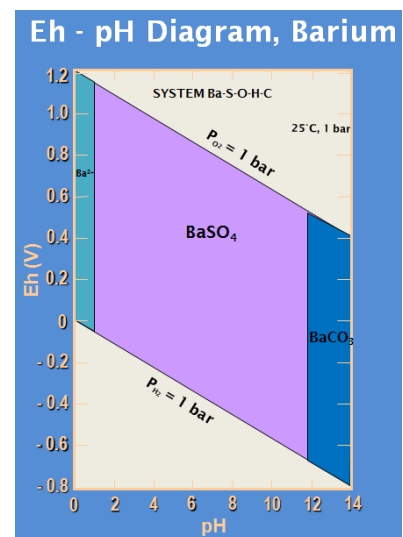


Figure 3: Redox Diagram for Ba, 25C, 1Bar (Brookins, p 169).



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### Barium Analytical Methods, ALS Minerals

| Method Type                             | Description   | Range           | ALS Code             |
|---|---|-----------------|----------------------|
| Assay                                   | Lithium borate fusion, XRF determination.   | 0.01 - 50%      | Ba-XRF10             |
| Instrumental Total                      | Ba Pressed Pellet XRF determination.  | 10 ppm - 1%     | Ba-XRF05             |
| Concentrate                             | Barium by carbonate fusion and gravimetric finish.  | 0.01 - 100%     | Ba-GRA81             |
| Multi-element Geochemical               | Multi-element aqua regia digestion, 51 elements determined by Combined ICP-AES and ICP-MS.            | 10ppm - 1%      | ME-MS41              |
|   | Multi-element aqua regia digestion, 34 elements determined by ICP-AES.                                | 50ppm - 5%      | ME-ICP41a            |
|   | Multi-element 4 acid near total digestion, 48 elements determined by Combined ICP-AES and ICP-MS.     | 10ppm - 1%      | ME-MS61              |
|   | Multi-element 4 acid near total digestion, 33 elements determined by ICP-AES.                         | 50ppm -5%       | ME-ICP61a            |
|   | Lithium borate fusion, XRF or ICP determination as part of the Whole Rock Litho geochemistry package. | 0.01 - 100% BaO | ME-XRF06<br>ME-ICP06 |
| Super-trace Soil/Regolith Multi-element | 'Super-trace' aqua regia digestion, 51 elements determined by Combined ICP-AES and ICP-MS.            | 0.5ppm - 1%     | ME-MS41L             |
|   | 'Ionic Leach' selective leach to pH 8.5, 60 elements and Pb isotopes determined by ICP-MS.            | 10ppb - 1000ppm | ME-MS23              |
|   | 'Mn-oxide' selective leach Hydroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS.    | 50ppb - 1000ppm | ME-MS05              |
|   | 'Fe-oxide' selective leach Hydroxylamine-HCl, 63 elements and final leach pH determined by ICP-MS.    | 50ppb - 1000ppm | ME-MS06              |

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