Geochemical Procedure

# ME-MS61
# Ultra-Trace Level Method Using ICP-MS and ICP-AES

## Sample Decomposition:

$HF-HNO_3-HClO_4$ acid digestion, HCl leach

## Analytical Method:

Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP - AES)
Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)

A prepared sample is digested with perchloric, nitric and hydrofluoric acids. The residue is leached with dilute hydrochloric acid and diluted to volume. It is then analyzed by inductively coupled plasma-atomic emission spectrometry and inductively coupled plasma-mass spectrometry. Results are corrected for spectral interelement interferences.

**NOTE**: Four acid digestions are able to dissolve most minerals; however, although the term "*near-total*" is used, depending on the sample matrix, not all elements are quantitatively extracted.

| Element | Symbol | Units | Lower Limit | Upper Limit |
|---|---|---|---|---|
| Silver | Ag | µg/g | 0.01 | 100 |
| Aluminum | Al | % | 0.01 | 50 |
| Arsenic | As | µg/g | 0.2 | 9,900 |
| Barium | Ba | µg/g | 10 | 10,000 |
| Beryllium | Be | µg/g | 0.05 | 990 |
| Bismuth | Bi | µg/g | 0.01 | 9,900 |
| Calcium | Ca | % | 0.01 | 50 |
| Cadmium | Cd | µg/g | 0.02 | 990 |
| Cerium | Ce | µg/g | 0.01 | 500 |
| Cobalt | Co | µg/g | 0.1 | 9,900 |
| Chromium | Cr | µg/g | 1 | 10,000 |
| Cesium | Cs | µg/g | 0.05 | 500 |
| Copper | Cu | µg/g | 0.2 | 10,000 |
| Iron | Fe | % | 0.01 | 50 |
| Gallium | Ga | µg/g | 0.05 | 9,900 |
| Germanium | Ge | µg/g | 0.05 | 500 |

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| Element | Symbol | Units | Lower Limit | Upper Limit |
|---|---|---|---|---|
| Hafnium | Hf | µg/g | 0.1 | 500 |
| Indium | In | µg/g | 0.005 | 500 |
| Potassium | K | % | 0.01 | 10 |
| Lanthanum | La | µg/g | 0.5 | 5,000 |
| Lithium | Li | µg/g | 0.2 | 1,000 |
| Magnesium | Mg | % | 0.01 | 50 |
| Manganese | Mn | µg/g | 5 | 100,000 |
| Molybdenum | Mo | µg/g | 0.05 | 9,900 |
| Sodium | Na | % | 0.01 | 10 |
| Niobium | Nb | µg/g | 0.1 | 500 |
| Nickel | Ni | µg/g | 0.2 | 9,900 |
| Phosphorous | P | µg/g | 10 | 10,000 |
| Lead | Pb | µg/g | 0.5 | 9,900 |
| Rubidium | Rb | µg/g | 0.1 | 9,900 |
| Rhenium | Re | µg/g | 0.002 | 50 |
| Sulphur | S | % | 0.01 | 10 |
| Antimony | Sb | µg/g | 0.05 | 10,000 |
| Scandium | Sc | µg/g | 0.1 | 9,900 |
| Selenium | Se | µg/g | 1 | 1,000 |
| Tin | Sn | µg/g | 0.2 | 500 |
| Strontium | Sr | µg/g | 0.2 | 10,000 |
| Tantalum | Ta | µg/g | 0.05 | 100 |
| Tellurium | Te | µg/g | 0.05 | 500 |
| Thorium | Th | µg/g | 0.2 | 5,000 |
| Titanium | Ti | % | 0.005 | 10 |
| Thallium | Tl | µg/g | 0.02 | 1,000 |
| Uranium | U | µg/g | 0.1 | 9,900 |
| Vanadium | V | µg/g | 1 | 10,000 |
| Tungsten | W | µg/g | 0.1 | 1,000 |
| Yttrium | Y | µg/g | 0.1 | 500 |
| Zinc | Zn | µg/g | 2 | 9,900 |
| Zirconium | Zr | µg/g | 0.5 | 500 |