

## Nb & Ta

### Niobium and Tantalum

The elements Niobium (Nb) and Tantalum (Ta) are classified as Rare Metals, occurring frequently with Rare Earth Elements (REE elements include La-Ce-Pr-Nd-Pm-Sm-Eu-Gd-Tb-Dy-Ho-Er-Tm-Yb-Lu). They occur in the solid solution series Columbite-Tantalite  $(\text{Fe,Mn})(\text{Nb,Ta})_2\text{O}_6$ . They can also occur in pyrochlore,  $(\text{Ca,Na})_2(\text{Nb,Ta})\text{O}_6(\text{O,OH,F})$  and an oxide mineral, Fergusonite  $(\text{REE}-(\text{Nb,Ta})\text{O}_4)$ . Nb and Ta may also occur as substitutions in other resistate minerals such as rutile (solid solution substitution for Ti), ilmenite, cassiterite, zircon, and in substitutions of less resistant minerals biotite, amphibole and other Ti- minerals.

Niobium and Tantalum are lithophile elements, occurring with rare earth elements in granites and pegmatites, and enriched in carbonatites. They reflect a late stage fractionation of pegmatites and carbonatites thus occurring with other unusual resistate minerals. They may also occur in late hydrothermal veins in alkalic complexes. Nb and Ta form stable complexes with F, explaining mobility into these late stage phases. Tantalum occurs ubiquitously with Nb, in a solid solution Nb-Ta series, with Nb usually dominating by 10:1, depending upon source rock. Nb may be enriched in bauxites developed from alkali rocks. Both Nb & Ta are useful pathfinder elements for carbonatites and kimberlites. They are mined from placer deposits, alkali occurrences and carbonatites.



Figure 1: Columbite  $(\text{Fe,Mn})\text{Nb}_2\text{O}_6$   
<http://thefestresureskaiaai.com>



Figure 2: Pyrochlore  $(\text{Ca,Na})_2(\text{Nb,Ta})\text{O}_6(\text{O,OH,F})$   
<http://www.goldposters.com/>



Figure 3: Fergusonite  $(\text{REE-NbO}_4)$   
<http://www.commonswikimedia.org>

Columbite is a heavy resistate mineral in the orthorhombic crystal system. It is black, sub-metallic with prismatic or tabular habit, strong cleavage, streak dark red-black, specific gravity of 4-7. Pyrochlore is a vitreous to sooty black-brown heavy mineral (SG 5), isometric structure, with light brown streak, sub-conchoidal fracture. Fergusonite is a REE bearing tetragonal crystal of sub-metallic luster, variable color grey-brown, poor cleavage, sub-conchoidal fracture, density of 5.5-6.

The resistant and non-corrosive nature and high melting point makes Nb a useful steel alloy for stainless steel, in use for chemical equipment and medical applications. The name 'Tantalite' is from Tantalus, directly alluding to the difficulty of dissolving in acid.

Nb and Ta are commonly in resistate minerals, and an instrumental total XRF method is recommended for most sample types. Nb-Ta occurring as a substitution in silicate minerals (amphiboles, biotite) may be accessible using a 4-acid digestion. A lithium borate fusion/acid dissolution-ICP-MS method routinely used for rare earth element determinations may be effective to provide lower concentration ranges, although it is noted that there is a solubility problem specific to Nb-Ta which requires special care in the analysis. A special method for the dissolution of Nb in ilmenite concentrates is available (ME-ICP84, 0.01 - 100%  $\text{Nb}_2\text{O}_5$ ).

In regolith and soil samples, Nb and Ta are most frequently present in resistate minerals. Mechanical enrichment in placers and heavy mineral concentrates are noted. They are insoluble in most Eh and pH surface conditions (Figure 4). However, they may form organic complexes so that sampling and analysis of humus or organic media offer potential (Sodium pyrophosphate method ME-MS07, 10 ppb - 1000 ppm).

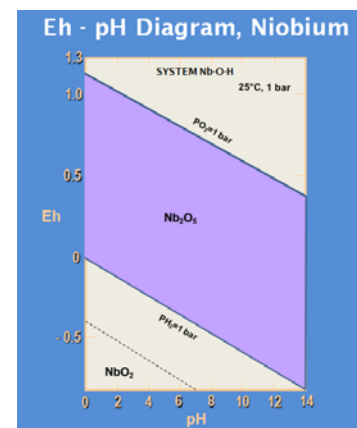


Figure 4: Redox Diagram for Nb, 25C, 1Bar (Brookins, p 111).



## Nb & Ta

### Niobium (Nb and Tantalum (Ta) Analytical Methods, ALS Minerals

Method Type	Description	Range	ALS Code
<b>Instrumental Total</b>	Pressed Pellet XRF determination.	2 ppm - 1% Nb 10 ppm - 1% Ta	(Nb,Ta) XRF05
	Lithium Borate Fusion XRF determination.	0.01 - 10% Nb 0.01 - 50% Ta	(Nb, Ta) XRF10
<b>Ilmenite Concentrate</b>	Fusion-ICPAES Analysis of Ilmenite Products, 12 elements including Nb.	0.01 - 100% Nb <sub>2</sub> O <sub>5</sub>	ME-ICP84
<b>Multi-element Geochemical</b>	Lithium borate fusion/acid dissolution, multi-element, 31 elements determined by ICP-MS. **	0.2 - 2500 ppm Nb 0.1 - 2500 ppm Ta	ME-MS81
	High grade Lithium borate fusion/acid dissolution, multi-element, 31 elements determined by ICP-MS. **	1 - 5000 ppm	ME-MS81h
<b>Super-trace Soil/Regolith Multi-element</b>	'Super-trace' aqua regia digestion, 51 elements determined by Combined ICP-AES and ICP-MS.	0.05 - 500 ppm Nb 0.01 - 500 ppm Ta	ME-MS41L
	Ionic Leach' selective leach to pH 8.5, 60 elements determined by ICP-MS.	0.1 ppb -1000 ppm Nb 1 ppb - 1000 ppm Ta	ME-MS23
	'Organic' selective leach Sodium Pyrophosphate, 63 elements and final leach pH determined by ICP-MS.	10ppb - 1000ppm	ME-MS07

\*\* Fusion/acid method may have difficulty with full dissolution of Nb-Ta

February, 2012

RIGHT SOLUTIONS RIGHT PARTNER

www.alsglobal.com