



# Rare Earth & Precious Metals – Critical Elements for a Sustainable Future



## Why are Rare Earth and Precious Metals important?

Rare Earth Elements (REEs) and Precious Metals are widely recognized as being crucial to Canada's transition to a sustainable low-carbon economy. Notable Rare Earth Element applications with importance to sustainable energy and climate change reduction include batteries for electric and hybrid cars, wind turbines, solar panels, and permanent magnets. In fact, REEs are known as green-tech metals because of their importance to clean energy technologies. They also have important uses within modern electronics such as cell phones, TVs, computers, as well as in aerospace and defense. Precious Metals include gold, silver, and the six platinum group elements, which have important functions as catalysts within catalytic converters, which minimize pollution produced by internal combustion engines.

Canada is the 3<sup>rd</sup> largest producer of mined platinum group elements in the world. Canada has some of the largest proven REE reserves, but was not a producer of mined REEs until June 2021, when its first REE mining project began production in the Northwest Territories. Globally, most REEs are produced as by-products from other mined elements, particularly titanium and tin. Because of their increasing global importance to clean technologies, analytical testing of REEs and Precious Metals has become far more important in recent years, both for geochemical exploration purposes and for environmental monitoring within the mining industry.



REEs: Important for Electric Cars, Wind Turbines, Solar Power

## Analysis of Rare Earth and Precious Metals by QQQ-ICPMS

The preferred analytical technology for environmental analysis of Rare Earth and Precious Elements is Triple Quadrupole ICPMS (QQQ-ICPMS); this is partly because QQQ-ICPMS eliminates interferences of rare earth oxides on other rare earth elements that cannot be addressed with classical collision/reaction cell ICPMS technology, and partly because of the higher sensitivity and low detection limits afforded by this instrumentation, which permits detection at ultra-trace and background levels for trend monitoring or exploration purposes.

The key technological advancement with QQQ-ICPMS is the additional quadrupole placed between the sample introduction interface and the collision/reaction cell (CRC), which gives very selective control over the ions that enter the reaction cell. This permits the use of reactive gases like oxygen and ammonia, which are far better at removing interferences compared to the use of hydrogen on standard CRC-ICPMS. Reaction gases may be selected either to change the mass of an interfering substance, or to change the mass of the target element to an interference-free mass (mass-shifting). These techniques effectively eliminate REE interferences that cannot be fully addressed with standard CRC-ICPMS.

## Analyte Lists for REEs and Precious Metals

The ALS Environmental laboratory in Vancouver has over three decades of experience with ultra-trace metals testing and sample preparation techniques, and is accredited to the ISO 17025 standard for analysis of the rare earth and precious metals listed in Tables 1 & 2 using QQQ-ICPMS. Limits of Reporting (LORs) for most elements in these groups are 0.005 µg/L (5 parts per trillion). Routine Trace Metals analytes may also be analyzed from the same sample.

[Continued >](#)



# Rare Earth & Precious Metals – Critical Elements for a Sustainable Future

**Table 1: Rare Earth Metals in Water (Total/Dissolved)**

ANALYTE	LOR(µg/L)	ANALYTE	LOR (µg/L)
cerium	0.005	neodymium	0.005
dysprosium	0.005	praseodymium	0.005
erbium	0.005	samarium	0.005
europium	0.005	scandium	0.005
gadolinium	0.005	terbium	0.005
hafnium	0.005	thulium	0.005
holmium	0.005	ytterbium	0.005
lanthanum	0.005		

**Table 2: Precious Metals in Water (Total/Dissolved)**

ANALYTE	LOR(µg/L)	ANALYTE	LOR (µg/L)
gold	0.005/0.02 <sup>1</sup>	rhenium	0.005
iridium	0.005	rhodium	0.005
palladium	0.005	ruthenium	0.005
platinum	0.005/0.02 <sup>1</sup>	silver	0.005

<sup>1</sup> Dissolved/Total LORs listed for gold and platinum

## Sampling Considerations for Rare Earth and Precious Metals

The use of suitable sampling equipment and supplies is a crucial component of quality assurance for the testing of any ultra-trace metals. ALS has conducted extensive testing to identify suitable sampling supplies, including sample containers and other sampling materials such as gloves, syringes, and syringe filters, which we offer to our clients by request.

For Dissolved Metals, ALS strongly recommends field filtration, together with submission of field filtration blanks, especially where client-supplied filtration media is used. To minimize opportunities for contamination, ALS recommends lab-preservation for both Total and Dissolved (field-filtered) Metals.

For these tests, ALS provides 60-120 mL HDPE sample collection bottles, proofed for cleanliness to ultra-trace levels for all routinely analyzed trace metals. Preserved samples are stable for 6 months. Samples for Rare Earth Elements and Precious Metals testing may be submitted to any ALS Canada location or service centre.

**For further information, please contact the specialty metals group at the [ALS Vancouver laboratory](#) (Trace Metals Laboratory Manager or Client Services Manager).**

## Periodic Table of the Elements with Trace Metal Categories Offered by ALS Canada

Routine Metals (39)
Precious Metals (7)
Rare Earth Metals (19)

1 H Hydrogen																	2 He Helium																														
3 Li Lithium	4 Be Beryllium																	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon																								
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon																								
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton																														
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon																														
55 Cs Cesium	56 Ba Barium		72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon																														
87 Fr Francium	88 Ra Radium		104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson																														
<table border="1" style="width: 100%; text-align: center;"> <tbody> <tr> <td>57 La Lanthanum</td> <td>58 Ce Cerium</td> <td>59 Pr Praseodymium</td> <td>60 Nd Neodymium</td> <td>61 Pm Promethium</td> <td>62 Sm Samarium</td> <td>63 Eu Europium</td> <td>64 Gd Gadolinium</td> <td>65 Tb Terbium</td> <td>66 Dy Dysprosium</td> <td>67 Ho Holmium</td> <td>68 Er Erbium</td> <td>69 Tm Thulium</td> <td>70 Yb Ytterbium</td> <td>71 Lu Lutetium</td> </tr> <tr> <td>89 Ac Actinium</td> <td>90 Th Thorium</td> <td>91 Pa Protactinium</td> <td>92 U Uranium</td> <td>93 Np Neptunium</td> <td>94 Pu Plutonium</td> <td>95 Am Americium</td> <td>96 Cm Curium</td> <td>97 Bk Berkelium</td> <td>98 Cf Californium</td> <td>99 Es Einsteinium</td> <td>100 Fm Fermium</td> <td>101 Md Mendelevium</td> <td>102 No Nobelium</td> <td>103 Lr Lawrencium</td> </tr> </tbody> </table>																		57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium																																	
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium																																	