

Technique

ICP-OES Inductively-Coupled Plasma - Optical Emission Spectrometry
Company: Varian, Australia; Agilent Technologies, Inc. USA
Type: VISTA AX, with axial observation direction of the optics to the plasma

Elements

With the ICP-OES **70 elements** up to the atomic number 83 together with Th and U can be measured simultaneously (see sheet "Determination limits").
C, N, O, Tc, Pm, the halogens and nobel gases can not be measured.

Samples

The measurements are performed on **liquid samples**. We need at least **5-10 ml** for the analysis. If you have less sample volume we need to dilute the sample (increase of the determination limit!).
If you have **solid samples** please provide at least **1 g** (fine powder or chips). We digest the sample with the respective method. It would be less time-consuming for us, if you could do the digestion of solid samples by yourself. Favoured acids are **HNO₃ and HCl**. Please use HF only, if nothing else works! The acid concentration in the solution should be around **0.2-2 M**. Organic solvents are not well suited. We need to dilute the samples strongly, resulting in higher determination limits.

Sample delivery

Please deliver liquid samples in closed containers (e.g. 15ml PP tube, PSI Zentralmagazin).
Solid samples can be stored in plastic bags (Mini-Grip), boxes, or other containers that can be opened easily.
Please take the samples direct to Silvia Köchlis lab (OFLG/205) or send it by mail.
Fill out the **"Werkstattauftrag"** (<https://intranet.psi.ch/PSI/FormulareEN>).

"Werkstattauftrag"

Please provide at this form: **"Kostenstelle", "SAP-PSP Element", name, phone number**, informations about the sample(s):
identification, material, elements and their expected concentrations (if known), composition of matrix, acid concentration in the solution.
Matrix: Please provide a rough estimation of the sample material composition. For solid samples this helps to choose the proper digestion method. The matrix composition is essential for us to know, if there are overlapping emission lines from different elements, for instance. Please provide also the acid concentration in the solution.

Blanks

If you digest solid samples yourself, please provide a **blank solution (50ml)** (all components you used to dissolve your sample, e.g. acids and water). We use it to determine the method blank and to produce standard solutions.

Standards

Calibration is performed with ICP-OES standards adjusted to your sample matrix. One example: For the determination of Barium in seawater we prepare Barium standards in a NaCl matrix (with a concentration corresponding to your sample).

Thus, for the preparation of standards it is essential to know the composition of your sample matrix.

Determination limit

The respective determination limits for the elements are listed in the sheet "Determination limits". Please note that the determination limits are strongly dependent on the sample matrix, the measurement range, and the element emission lines used for evaluation.

Uncertainty

The uncertainty of measurement is $\leq 5\%$ (sample weigh in, dilution, measurement), but $\leq 20\%$ close to the determination limits.

Results

Results are provided on a data sheet or in an Excel-File.

The unit is ppm = μg element per g sample or μg element per ml sample.

Deadlines

Jobs are processed corresponding to the order of the receipt.

Generally, it takes about one month until you can pick up your samples together with the results.

Costs

For the analyses we charge **84.- CHF/hour**.

If the sample characteristics is known (composition of matrix, expected concentrations of analytes), you can provide a matrix (or blank) solution, and without further complications, the analyses of 1-2 elements in 10 samples takes about four hours.

The given time includes preparation of adjusted standard solutions, sample digestion (if necessary), the measurement, and data evaluation.

If you have further questions, do not hesitate to write an E-Mail:

silvia.koechli@psi.ch

anja.eichler@psi.ch

Determination limits

measured with the cyclotron-nebulizer in an aqueous solution.

In order to obtain the respective determination limit for the sample material values need to be multiplied with the dilution factors from digestion and dilution.

The given determination limit corresponds to the 3-fold detection limit.

(ppm: μg element per ml sample solution)

Element	Determination limit ppm
Ag	0.002
Al	0.003
As	0.05
Au	0.01
B	0.01
Ba	0.0001
Be	0.0001
Bi	0.01
Ca	0.0002
Cd	0.001
Ce	0.004
Co	0.005
Cr	0.002
Cs	2
Cu	0.002
Dy	0.002
Er	0.002
Eu	0.001
Fe	0.001
Ga	0.01
Gd	0.001
Ge	0.05
Hf	0.002
Hg	0.01
Ho	0.01
In	0.05
Ir	0.02
K	0.005
La	0.001
Li	0.003
Lu	0.0005
Mg	0.0001
Mn	0.0002
Mo	0.003
Na	0.005

Element	Determination limit ppm
Nb	0.005
Nd	0.005
Ni	0.01
Os	0.01
P	0.05
Pb	0.02
Pd	0.003
Pr	0.01
Pt	0.03
Rb	0.02
Re	0.01
Rh	0.005
Ru	0.01
S	0.2
Sb	0.03
Sc	0.0003
Se	0.05
Si	0.01
Sm	0.003
Sn	0.02
Sr	0.00005
Ta	0.01
Tb	0.004
Te	0.1
Th	0.01
Ti	0.0004
Tl	0.03
Tm	0.002
U	0.02
V	0.001
W	0.02
Y	0.0002
Yb	0.0002
Zn	0.002
Zr	0.001