The importance of High Purity water for ICP-MS

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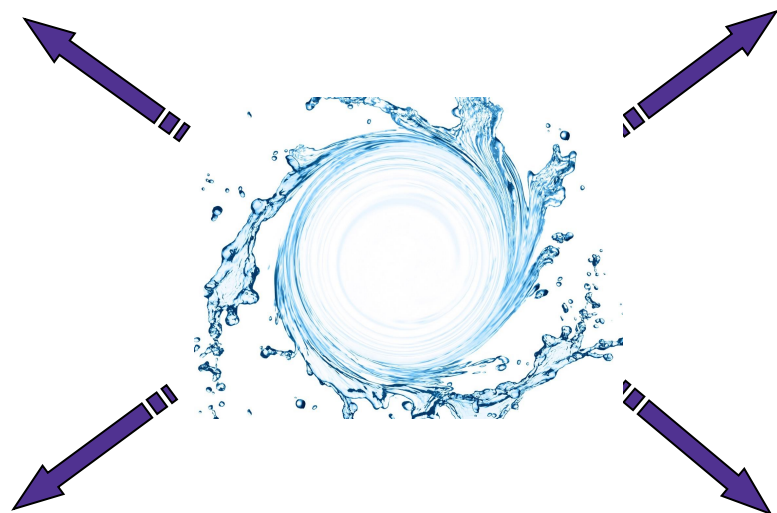**Water is the main solvent in the laboratory**

The role of water in ICP-MS

Sample Preparation (dilution, etc.)

Preparation of standards

Blanks

Washing, rinsing of sample and reagent containers

Water should be free of any contamination that could compromise the results of any given experiment:

- Free of the analytes of interest
- Free of contaminants that may interfere with the performance of the instrument

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Potential effects of water contamination

Need to troubleshoot

Need to clean or maintain instrument more often

Erroneous results

Loss of samples / reagents

Difficulties in data interpretation

Need to repeat analyses

Poor calibration curves

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Agenda

1 Water contaminants & water quality monitoring

2 Impact of water quality on results

3 How is water purified?

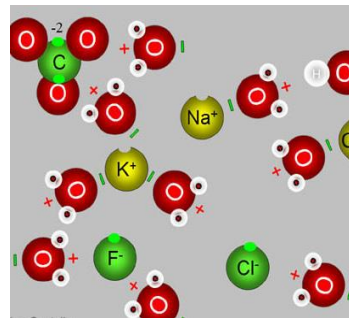**MERCK**

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Water Contaminants and quality monitoring

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Water contaminants

Water is H_2O and …

Organics

Ions

Bacteria

Particles
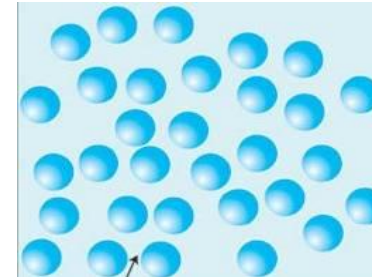
Gases

Water quality monitoring

Ionic purity (Resistivity)

Organic purity (TOC)

Water purification

Tap water → Pretreatment → **Pure water** (Type 2 or 3) → Polishing → **Ultrapure water** (Type 1)

Ions:	ppm	→	sub-ppb	ppt
Organics:	ppm	→	< 50 ppb	< 5 ppb

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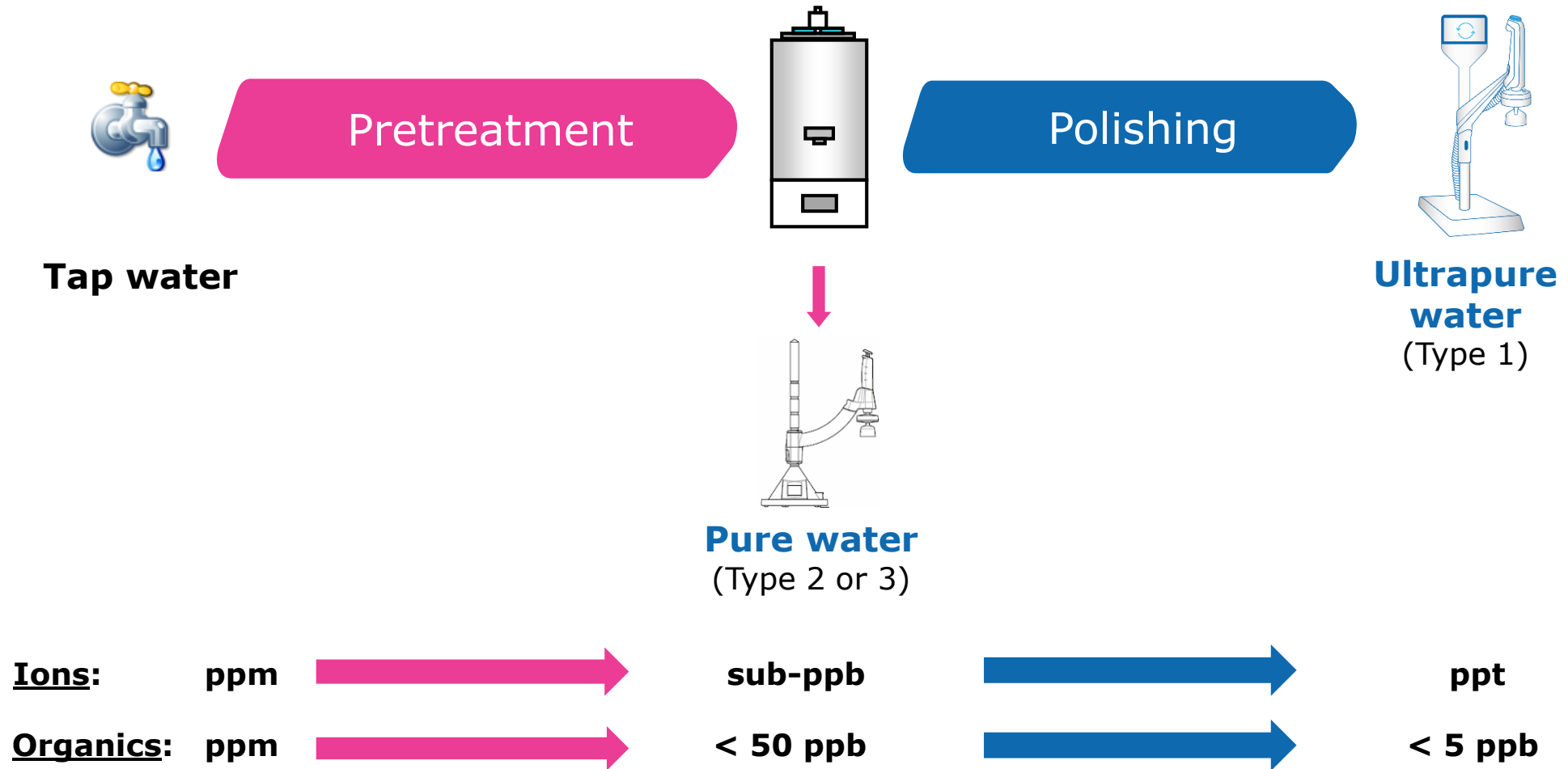
Impact of water quality on results

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Method performance and sensitivity

ICP-OES ➡️ **ICP-MS**

Increasing importance of laboratory conditions
Sample preparation, operator expertise,
clean room, dedicated instrument

Increasing importance of water quality

Effects of water contaminants on ICP-MS analyses

Ions

- Interference with measured elements ($\rightarrow$ false positives, poor repeatability, high blanks…)

Particles

- May clog the nebulizer spray chamber and cause poor aerosol formation ($\rightarrow$ noise, poor sensitivity)
- May deposits on the torch ($\rightarrow$ interferences)

Organics

- May form deposits on the torch or on the MS interface ($\rightarrow$ affects ionization, requires frequent cleanings)
- May chelate ions, causing interferences

Bacteria
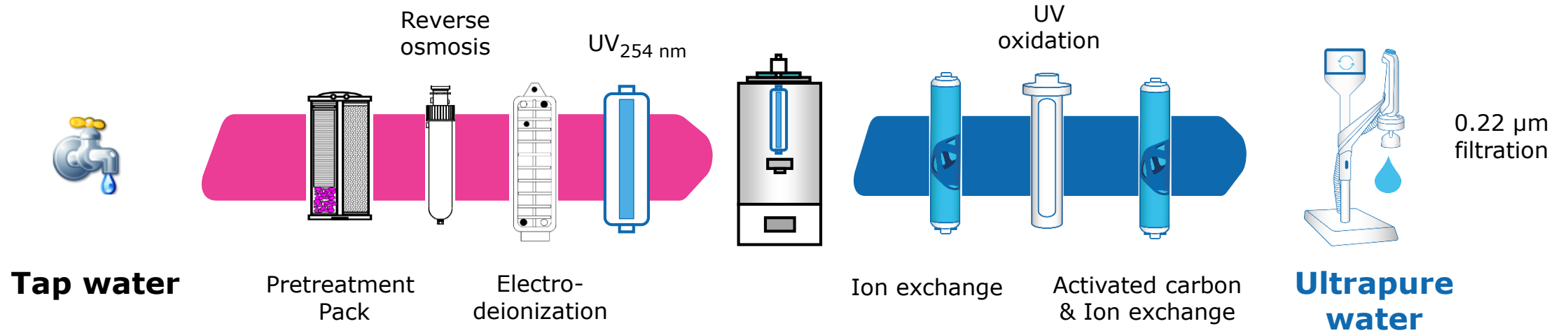
- May release ions, metals, organics
- Behave as particles

3   How is water Purified?

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Water purification: Combination of technologies

Reverse osmosis

UV$_{254\,nm}$

UV oxidation

0.22 μm filtration

Tap water

Pretreatment Pack

Electro-deionization

Ion exchange

Activated carbon & Ion exchange

Ultrapure water

	RO	EDI	UV 254 nm	UV 254 nm	Ion exchange	UV oxidation	Activated carbon	0.22 μm screen filter*
Organics	X					X	X	
Ions	X	X			X			
Particles	X							X
Bacteria	X		X	X				X

*Note: Other final polishers are available, depending on your application

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Background Equivalent Concentration (BEC) values

Isotope	Element	BEC [ppt]	MDL [ppt]
7	Li	0.0082	0.0030
9	Be	0.2368	0.2791
23	Na	17.4891	2.7230
24	Mg	13.1659	0.5200
27	Al	0.5590	0.0648
39	K	38.7177	1.0014
40	Ca	63.5938	2.1719
52	Cr	2.1016	0.3743
55	Mn	4.7001	0.1418
56	Fe	0.5981	0.1920
59	Co	0.2987	0.1124
60	Ni	0.7627	0.1755
63	Cu	0.6410	0.1100
66	Zn	30.7891	1.1653
75	As	3.1033	0.7240
111	Cd	0.1890	0.2009
121	Sb	0.0551	0.1105
137	Ba	3.9013	0.5029
205	Tl	0.4971	0.2126

Water quality tailored to your needs: final polisher
for ultra-trace analyses
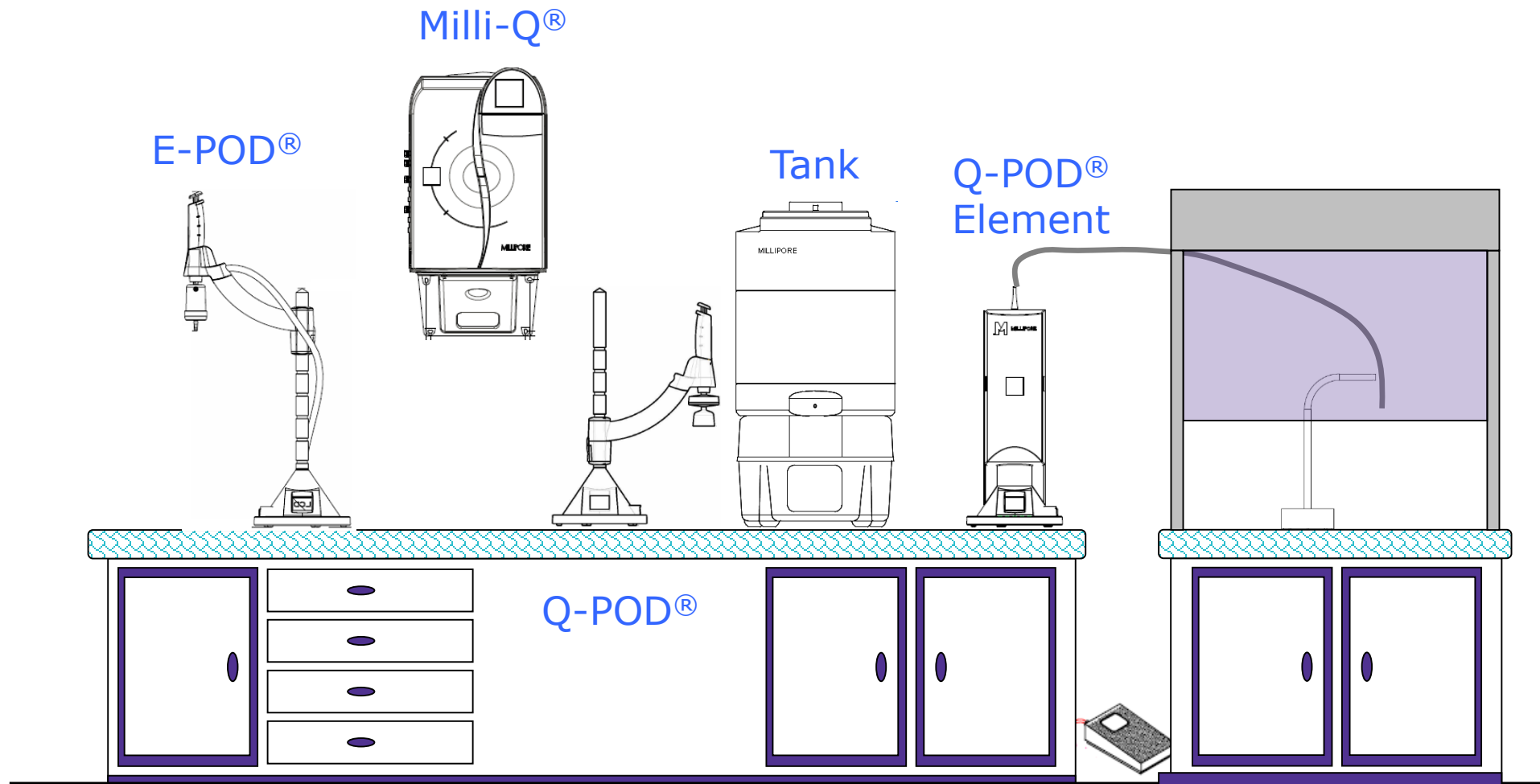
Key elements of the Q-POD® Element unit

- Suitable for ultra-trace elemental analysis (ppt and sub-ppt detection limits)
- Fed with high purity water
- Ion exchange resin cartridge
  - high capacity anionic and cationic resins
  - low ion-releasing O-ring
- 0.1 µm final filter (Optimizer LW)
  - ultra high density polypropylene filter, manufactured in a microelectronic environment
- Solenoid valve
  - no metal part in contact with water
- Water delivery tubing
  - material selection
- Footswitch operation
  - hands-free easy dispensing
  - reduced contamination

BEC values of elements in ultrapure water obtained in a clean room 100 environment using a final polisher

		Agilent® 7500s		Agilent® 8800	
Isotope	Element	BEC [ppt]	MDL [ppt]	BEC [ppt]	MDL [ppt]
7	Li	0.0421	< 2	0.0300	0.1609
23	Na	1.9810	< 2	0.1954	0.1194
24	Mg	0.0910	< 2	0.0367	0.0687
27	Al	0.1485	< 2	0.1222	0.0400
39	K	1.5780	< 2	0.4253	0.1352
40	Ca	2.6200	< 2	0.1656	0.0386
52	Cr	0.2979	< 2	0.1161	0.0474
55	Mn	0.1256	< 2	0.0312	0.0228
56	Fe	NA	< 2	0.4246	0.6187
59	Co	0.0042	< 2	0.0103	0.0154
60	Ni	0.0270	< 2	0.0807	0.1601
63	Cu	0.1865	< 2	0.0879	0.0748

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CONCLUSION

- In ICP-MS, water contaminants (ions, particles, bacteria, organic molecules) strongly affect data quality and instrument performance

- A water purification unit is specifically dedicated to ultra-trace analysis
  - very high and constant water quality
  - water delivery at the point of use to reduce water contamination
  - flexibility to use the purification unit for other applications

- The laboratory environment and operation conditions should be controlled for optimum performance

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Thank you for your attention