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NATIONAL WATER QUALITY LABORATORY TECHNICAL MEMORANDUM 1996.04

March 20, 1996

To: Assistant Chief Hydrologist for Technical Support
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Assistant Chief, Office of Water Quality
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From: Peter F. Rogerson, Chief
National Water Quality Laboratory
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Subject: Inductively Coupled Plasma-Atomic Emission Spectrometry to replace Flame Atomic Absorption Spectrometry for the determination of dissolved trace metals and major ions in filtered acidified water samples and the effects of this change

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Revision: No

Effective April 1, 1996, the National Water Quality Laboratory (NWQL) will replace the direct Flame Atomic Absorption (FAA) methods for the determination of dissolved trace metals and major ions in filtered acidified water samples. The FAA methods will be replaced with the Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) method described in Techniques of Water-Resources Investigations of the U.S. Geological Survey (Fishman and Friedman,

1989, p. 517-522) and modified in Open-File Report 93-125 (Fishman, 1993, p. 101-112). The parameters affected are listed in Table 1.

Rationale

The current generation of simultaneous, multielement ICP-AES instruments combines efficiency, accuracy, and precision in a single sample analysis. Twenty trace metals and major ions or more can be determined in a single ICP-AES analysis as opposed to only one by an FAA analysis, making the ICP-AES instrumentation much more efficient. The initial ICP-AES validation data demonstrated that the ICP-AES accuracy and precision for all trace metals and major ions are equivalent to or better than those for the comparable FAA methods.

The FAA instruments in use at the NWQL for the determination of Ca, Mg, and Na incorporate computer programs to sort the samples based on specific conductance. Frequently, one or more dilutions are required because of the limited analytical range of the method. These dilutions raise the minimum reporting level (MRL) and might decrease precision.

Data Quality

For the reasons stated above, the ICP-AES instruments will produce data that are of comparable or better quality than those produced by the FAA methods.

The current MRLs before dilution for the trace metals and major ions determined by the two methods are listed in Table 1.

Table 1.--Codes and reporting-level information for FAA and ICP methods [FAA, Flame Atomic Absorption; MRL, Minimum Reporting Level; ICP-AES, Inductively Coupled Plasma-Atomic Emission Spectrometry; WATSTORE, Water Data Storage and Retrieval System; ug/L, microgram per liter; mg/L, milligram per liter]

Trace metal or Major ion	FAA			ICP-AES		
	Lab code	WATSTORE code	MRL	Lab code	WATSTORE code	MRL
Barium, filtered	7	01005B	100µg/L	641	01005C	1µg/L
Beryllium, filtered	170	01010A	10µg/L	655	01010B	0.5µg/L
Cadmium, filtered	126	01025A	10µg/L	673	01025D	1µg/L
Calcium, filtered	12	00915C	0.1mg/L	659	00915D	0.02mg/L
Cobalt, filtered	148	01035A	50µg/L	644	01035C	3µg/L
Copper, filtered	151	01040A	10µg/L	657	01040C	10µg/L
Iron, filtered	172	01046C	10µg/L	645	01046D	3µg/L
Lead, filtered	191	01049A	100µg/L	646	01049C	10µg/L
Lithium, filtered	39	01130A	10µg/L	664	01130B	4µg/L
Magnesium, filtered	40	00925B	0.1mg/L	663	00925C	0.01mg/L
Manganese, filtered	42	01056A	10µg/L	648	01056C	1µg/L
Nickel, filtered	197	01065A	100µg/L	721	01065E	10µg/L
Sodium, filtered	59	00930B	0.1mg/L	675	00930C	0.2mg/L
Strontium, filtered	62	01080A	10µg/L	652	01080B	0.5µg/L
Zinc, filtered	67	01090A	10µg/L	671	01090	3µg/L

Ordering

Although any combination of trace metals and major ions can be ordered, three ICP-AES schedules are available that include specific analytes: Schedule 146 for six analytes, Schedule 1043 for twenty analytes, and the newly added ICP-AES Schedule 986 for twelve analytes.

Furthermore, analytes can be ordered by Lab Code on the Analytical Services Request (ASR) form in addition to those ordered by the schedules. Also, an individualized schedule of analytes can be arranged and a laboratory schedule number can be assigned for ordering a standard set of analytes by contacting Steve Glodt (SRGLODT) via E-mail or at (303) 467-8021. This individualized schedule will be helpful when the same analytes are requested for several samples over a period.

This new system will give Districts the flexibility to order a customized suite of analyses on the ASR form by ordering individual parameters by laboratory code, by selecting an existing laboratory schedule with or without additional parameters, or by arranging for a customized laboratory schedule.

As noted in The Schedules, Parameters, & Network (SPN) Program, a raw unfiltered (RU) bottle will also be required for any ICP-AES analysis since specific conductance and pH determinations are mandatory prior to this analysis.

NOTE: SiO₂, V, Cr, Mo, and Ag are standard ICP-AES analytes that are not determined by FAA. They are not affected by this change and therefore are not listed in Table 1.

Summary of Planned Changes

The specified dissolved metals and major ions in filtered acidified water samples will be determined by ICP-AES starting in FY 1996 as stated above. All other determinations are unaffected at this time.

Supersedes: None

Key Words: ICP-AES, FAA, trace metals, filtered dissolved metal analysis

Data Base: No impact on existing data.

Distribution: See above plus the netnews USGS.labnews & .waterquality; WRD Secretaries; Field and Project Offices; Hydrologic Technicians; and <http://wwwnwql.cr.usgs.gov/>