Technical Note

Direct determination of trace cadmium in soils, sediments and rocks by slurry sampling electrothermal atomic absorption spectrometry

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Electronic supplementary information

1. **Fig. 1S.** Real-time monitoring the process of slurry sampling ETAAS by a TubeView™ color furnace camera: (a) slurries sampling, (b) slurries drying, (c) slurries ashing, and (d) Cd atomization.

2. **Fig. 2S.** The formation of the homogenous and stable slurries under different sonication duration: (a) 0 min, (a) 5 min, (a) 15 min; and (a) 20 min.

3. **Table 1S.** The Cd levels in 86 solid geological SRMs by the proposed method, μg g^{-1}.

4. **Table S2.** Closed pressurized digestion with a mixture of HF + HNO_3.

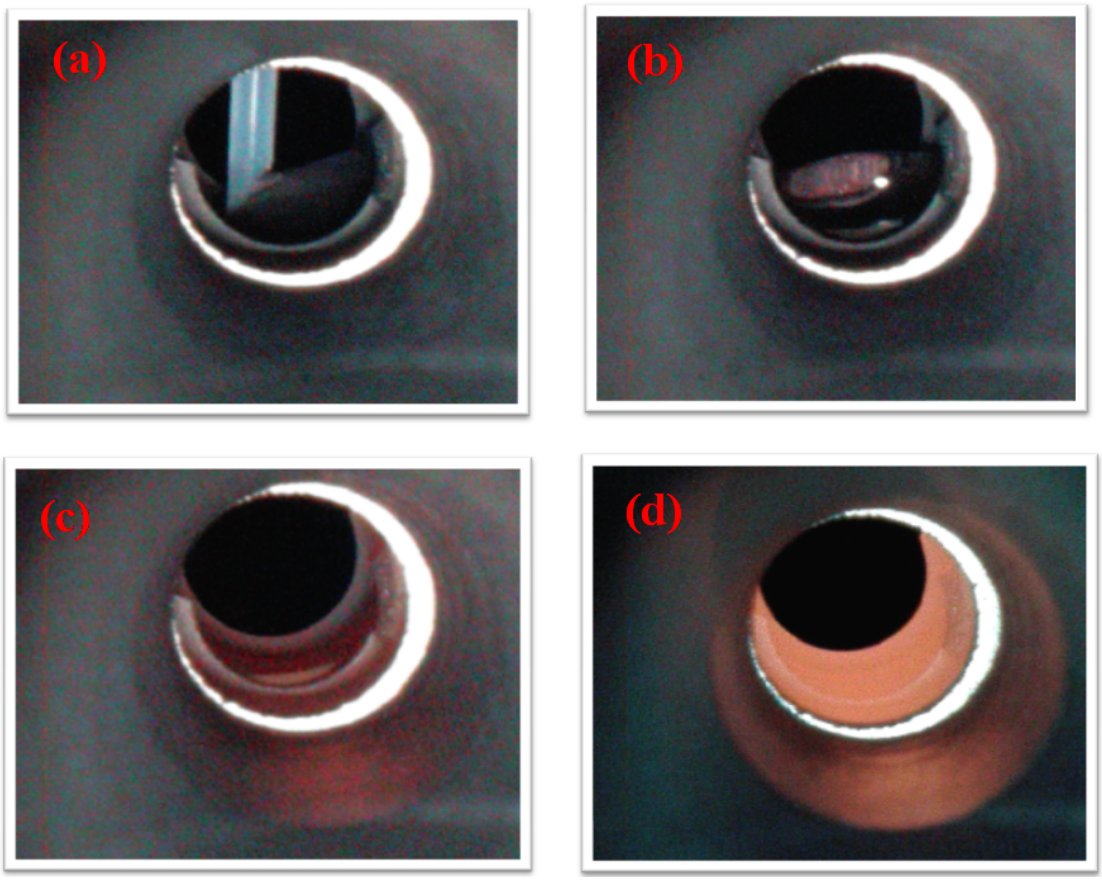

Fig. 1S. Real-time monitoring the process of slurry sampling ETAAS by a TubeView™ color furnace camera: (a) slurries sampling, (b) slurries drying, (c) slurries ashing, and (d) Cd atomization.

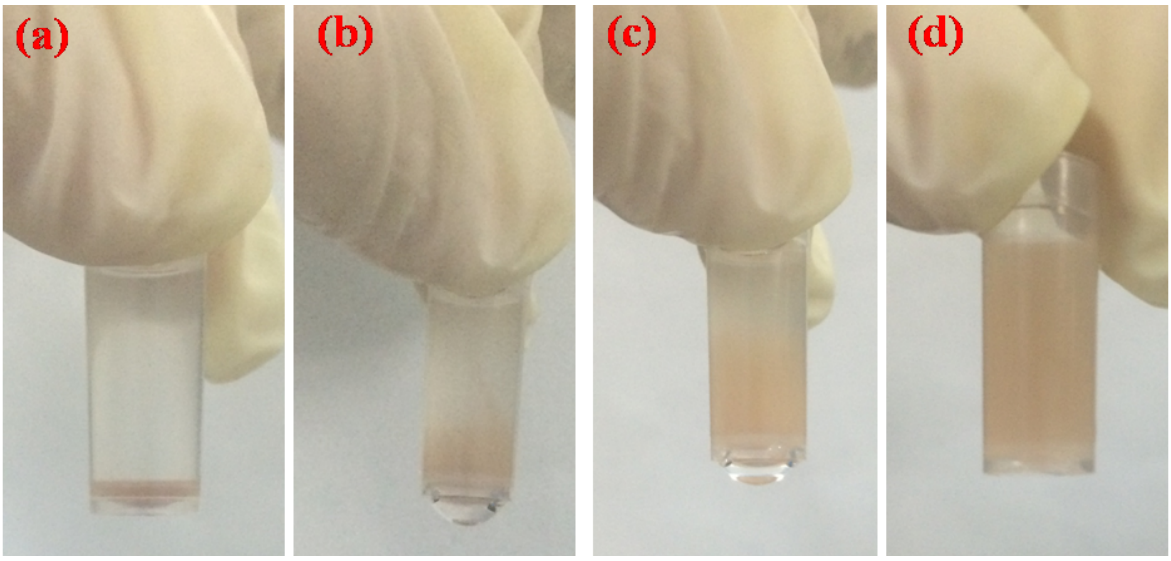

Fig. 2S. The formation process of the homogenous and stable slurries under different sonication duration: (a) 0 min, (b) 5 min, (c) 15 min; and (d) 20 min.

Table 1S.

The Cd levels in 86 solid geological SRMs by the proposed method, μg g^{-1}.

Environmental SRMs		Description	Certified values	Determined values (N=10)
Sediment (IGGE)	GSD-1	Granite area sediment	0.088 ± 0.014	0.080 ± 0.010
	GSD-3	Porphyry copper deposit sediment	0.100 ± 0.020	0.100 ± 0.030
	GSD-4	Limestone ore district sediment	0.190 ± 0.020	0.210 ± 0.011
	GSD-5	Skarn mining area sediment	0.820 ± 0.050	0.830 ± 0.020
	GSD-6	Porphyry copper deposit sediment	0.430 ± 0.030	0.480 ± 0.030
	GSD-8	Acidic volcano rock area sediment	0.081 ± 0.012	0.070 ± 0.030
	GSD-9	Yangtze River sediment	0.260 ± 0.040	0.220 ± 0.026
	GSD-10	Carbonate area sediment	1.12 ± 0.08	1.00 ± 0.02
	GSD-11	Multi metal mining area sediment	2.30 ± 0.20	2.20 ± 0.060
	GSD-13	Quartz sand area sediment	0.045 ± 0.015	0.040 ± 0.012
	GSD-14	Sediment	0.200 ± 0.030	0.193 ± 0.040
	GSD-15	Multi metal mining area sediment	0.340 ± 0.020	0.320 ± 0.090
	GSD-16	Metamorphic rock area sediment	0.093 ± 0.090	0.096 ± 0.001
	GSD-18	Granite area sediment	0.095 ± 0.010	0.100 ± 0.009
	GSD-19	Copper nickel mine sediment	0.120 ± 0.010	0.110 ± 0.010
	GSD-20	Acidic volcano rock area sediment	0.220 ± 0.100	0.240 ± 0.040
	GSD-21	Copper ore district sediment	0.760 ± 0.030	0.750 ± 0.040
	GSD-22	Multi metal mining area sediment	0.165 ± 0.010	0.168 ± 0.013
	GSD-1a	Granite area sediment	0.110 ± 0.030	0.100 ± 0.040
	GSD-2a	Granite area sediment	0.108 ± 0.090	0.097 ± 0.011
	GSD-3a	Copper nickel mine sediment	0.500 ± 0.060	0.450 ± 0.010
	GSD-4a	Limestone area sediment	0.900 ± 0.050	1.00 ± 0.062
	GSD-5a	Skarn mining area sediment	1.37 ± 0.10	1.45 ± 0.04
	GSD-7a	Lead zinc mine sediment	5.60 ± 0.60	5.40 ± 0.100
	GSD-8a	Acidic volcano rock area sediment	0.160 ± 0.010	0.150 ± 0.011
Soil (IGGE)	GSS-1	Lead zinc mine in dark brown forest soil	4.30 ± 0.40	4.00 ± 0.08

	GSS-2	Chestnut soil	0.071 ± 0.014	0.070 ± 0.009
	GSS-3	Yellow brown soil	0.060 ± 0.009	0.055 ± 0.016
	GSS-4	Limestone differentiation soil	0.350 ± 0.060	0.330 ± 0.050
	GSS-6	Multi metal mine in yellow soil	0.130 ± 0.030	0.150 ± 0.010
	GSS-7	Basalt Latosol soil	0.080 ± 0.020	0.080 ± 0.030
	GSS-8	Loess soil	0.130 ± 0.020	0.130 ± 0.020
	GSS-9	Soil	0.100 ± 0.020	0.086 ± 0.012
	GSS-10	Farming soil	0.105 ± 0.013	0.088 ± 0.010
	GSS-11	Soil	0.125 ± 0.012	0.126 ± 0.010
	GSS-12	Soil	0.150 ± 0.020	0.142 ± 0.010
	GSS-13	Soil	0.130 ± 0.100	0.134 ± 0.030
	GSS-15	Soil	0.210 ± 0.020	0.216 ± 0.060
	GSS-16	Soil	0.250 ± 0.020	0.218 ± 0.013
	GSS-17	Sandy soil	0.058 ± 0.011	0.060 ± 0.014
	GSS-18	Saline-alkali soil	0.150 ± 0.010	0.144 ± 0.013
	GSS-19	Brown desert soil	0.108 ± 0.009	0.120 ± 0.040
	GSS-20	Saline-alkali soil	0.108 ± 0.011	0.093 ± 0.020
	GSS-21	Sierozem soil	0.139 ± 0.080	0.150 ± 0.030
	GSS-22	The Yellow Sea tidal flat soil	0.065 ± 0.012	0.061 ± 0.020
	GSS-23	The East China Sea soil	0.150 ± 0.020	0.130 ± 0.030
	GSS-24	Tidal flat soil	0.106 ± 0.007	0.100 ± 0.020
	GSS-25	Soil	0.175 ± 0.010	0.160 ± 0.030
	GSS-26	Huai River soil	0.140 ± 0.010	0.130 ± 0.013
	GSS-27	Yangtze River soil	0.590 ± 0.040	0.550 ± 0.040
	GBW03103	The composition of clay	/ [a]	0.108 ± 0.009
Rock (IGGE)	GSR-2	Andesite	0.061 ± 0.014	0.052 ± 0.020
	GSR-3	Basalt	0.067 ± 0.016	0.060 ± 0.015
	GSR-4	Quartz sandstone	0.060 ± 0.016	0.050 ± 0.020
	GSR-5	Shale	0.033 ± 0.012	0.032 ± 0.010
	GSR-6	Argillaceous limestone	0.070 ± 0.020	0.056 ± 0.017
	GSR-21	Limestone	0.760 ± 0.030	0.672 ± 0.060

	GBW07702	Silicate	0.052 ± 0.005	0.054 ± 0.020
	GBW07703	Silicate	0.100 ± 0.010	0.093 ± 0.030
	GBW07704	Silicate	0.200 ± 0.010	0.220 ± 0.010
	GBW07705	Silicate	0.500 ± 0.020	0.570 ± 0.010
	GBW07706	Silicate	1.00 ± 0.100	1.00 ± 0.020
	GBW07712	Limestone	0.023 [b]	0.020 ± 0.008
	GBW07713	Limestone	0.053 ± 0.010	0.048 ± 0.010
	GBW07714	Limestone	0.100 ± 0.020	0.100 ± 0.010
	GBW07715	Limestone	0.200 ± 0.030	0.220 ± 0.020
	GBW07716	Limestone	0.500 ± 0.100	0.500 ± 0.010
	GBW07102	Ultrabasic rocks	0.034 [b]	0.024 ± 0.008
	GBW07109	Nepheline syenite	0.070 ± 0.020	0.070 ± 0.020
	GBW07111	Granodiorite	0.080 ± 0.030	0.081 ± 0.020
	GBW07112	Gray rock	0.090 ± 0.040	0.115 ± 0.010
	GBW07113	Gabbro	0.140 ± 0.030	0.190 ± 0.100
	GBW07114	Dolomite	0.070 ± 0.030	0.072 ± 0.030
	GBW07122	Long gray rock	0.140 [b]	0.130 ± 0.010
	GBW07123	Diabase	0.390 ± 0.080	0.420 ± 0.020
	GUI-1	Limestone	/ [a]	0.056 ± 0.005
	GUI-2	Limestone	/ [a]	0.176 ± 0.012
	DIAN-1	Limestone	/ [a]	0.134 ± 0.009
	DIAN-2	Limestone	/ [a]	0.335 ± 0.005
	DIAN-3	Limestone	/ [a]	0.244 ± 0.004
	GBW07101	Ultra-basic rocks	0.024 [b]	0.044 ± 0.002
Rock (USGS)	AGV-2	Andesite	0.069 [b]	0.070 ± 0.003
	BHVO-2	Basalt	0.060 [b]	0.120 ± 0.012
	SBC-1	Shale	0.400 [b]	0.400 ± 0.003
	SGR-1b	Oil shale	0.900 [b]	0.900 ± 0.040
	BCR-2	Basalt	0.130 [b]	0.155 ± 0.013

[a] No reported value;
[b] Reference value by IGGE and USGS.

Table S2. Closed pressurized digestion with a mixture of HF + HNO_3

Step	Description
1	50 mg sample powder (< 200 mesh) was weighed into a Teflon bomb, moistened with a few drops of ultrapure water.
2	1.0 mL HNO_3+1.0 ml HF were added. The sealed bomb was heated at 190 °C in oven for > 48 h.
3	Open the bomb and evaporate the solution at ~120 °C to dryness. This was followed by adding 1 ml HNO_3 and evaporating to the second round of dryness.
4	The resultant salt was re-dissolved by adding ~3 ml of 30% HNO_3 and resealed and heated in the bomb at 190 °C for >12 h.
5	The final solution was diluted to ~100 g with mixture of 2% HNO_3 for ICP-MS analysis.