PRELIMINARY ANALYSES OF COAL REFUSE MATERIAL FROM VANCOUVER ISLAND

Barry Ryan¹

ABSTRACT

The first period of coal mining on Vancouver Island lasted from 1847 to 1967, and during that period, waste material from the coal cleaning accumulated in a number of areas along the east coast of Vancouver Island. Three of these areas were sampled and analysed for coal related properties, major oxides, and trace metals. Results indicate that the material is generally similar in composition to average shale.

Ryan, B., (2008): Preliminary Analyses of Coal Refuse Material from Vancouver Island; Geoscience Reports 2008, B.C. Ministry of Energy, Mines and Petroleum Resources, pages 99-118.

Resource Development and Geosciences Branch; Oil and Gas Division; BC Ministry of Energy, Mines and Petroleum Resources; 250-952-0377; barry.d.ryan@gov.bc.ca.

Key Words: Waste coal, trace metals, coal refuse, Vancouver Island.

THE EARLY VANCOUVER ISLAND COAL **INDUSTRY**

Coal mining on Vancouver Island started in 1847 near Port Hardy on the northeast coast. Subsequently mining moved south to the Nanaimo and Cumberland areas, where activity continued until 1967. This early period of coal mining activity has left a legacy of coal mine waste. There are a number of coal refuse piles on Vancouver Island, especially in the Nanaimo area, and the total accumulation may be as high as 2.5 million tonnes (Gardner 1997).

The early mines removed rock from raw coal using simple wash plants and hand picking tables to remove large rock fragments. This produced a waste product composed of large fragments of rock and high-ash coal and referred to as coarse rejects. In some areas where clean coal was being loaded onto barges, some fell off conveyors or trains to accumulate as finer, cleaner coaly material.

Coal waste in the Ladysmith area originates from the Extension Mine, which opened in the 1890s as an extension of the Wellington Mine. Workers were moved to the new town of Oyster Harbour, later to be called Ladysmith. A wash plant was built in the area, and waste from the plant now forms Slag Point. Coal from the wash plant was shipped out from the harbour.

THE ENVIRONMENTAL HAZARDS OF **COAL REFUSE**

Coal in situ contains varying amounts of rock and water in addition to the organic carbon and associated volatile material. It is very difficult to totally separate the included rock and report a weight percent, so the organic material is burnt off and the remaining weight reported as percent ash, which is a bit less than the original weight of included rock. Thermal coals are shipped, after removal of rock, at ash concentrations up to about 15%. Coking coals (metallurgical coals), which are made into coke (the fuel in blast furnaces), are washed to ash contents generally less than 10%. The definition of coal varies, but generally anything over about 50% ash is not considered coal. This means that most coal mines, whether they are mining thermal or coking coal, have to process the coal to remove included rock. These wash plants usually produce two streams of waste material—coarse reject (greater than 0.6 mm) and tailings (less than 0.6 mm). Generally, modern wash plants have a yield of 65% to 85%, which means that 35% to 15% of the weight of raw material entering the wash plant becomes waste material dumped somewhere close to the mining activity. It is usually buried or re-contoured and vegetated, but it does represent a concentration of material from a specific geological environment.

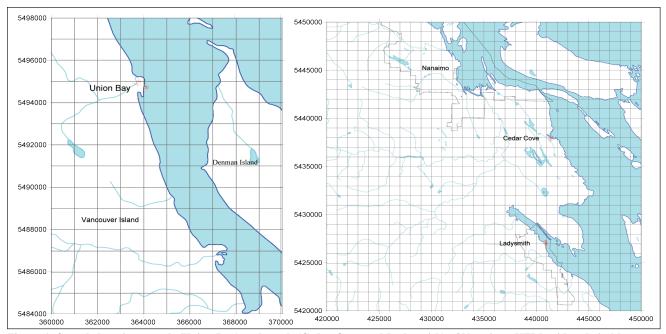


Figure 1: Sample locations north (Union Bay) and south (Cedar Cove and Ladysmith) of Nanaimo. UTM grid scale is 1 km.

Most of the concern about coal waste involves the possibility that the coal waste is leaching harmful trace metals into the environment. Coal itself is composed of environmentally benign organic carbon; unfortunately, coal and the rock closely associated with coal seams often contain appreciable amounts of sulphides and some trace elements. Sulphide minerals, predominantly pyrite (FeS₂), often contain trace amounts of elements other than iron and will oxidize to produce acidic water that releases and mobilizes these elements. There may also be increased concentrations of certain trace elements in rock material associated with coal, which was deposited in conjunction with vegetation in an oxygen-deficient, slightly acid, swamp environment; some trace elements are bound in insoluble forms and concentrated in this type of environment.

It is important to clarify the terms trace metals and trace elements as they are used in literature. The term trace metal may refer either to a metal (element) that is indeed rare or to the amount that occurs in a particular environment. The term is often applied to metallic elements such as iron, magnesium, zinc, copper, chromium, nickel, cobalt, vanadium, arsenic, molybdenum, and selenium. Possibly only selenium and vanadium are actually rare in overall terms. In contrast, the term trace element is broader and generally is used to refer to any element that occurs in very small concentrations in a particular environment.

In 2007, BC coal mines were expected to produce over 25 million tonnes of clean coal and over 5 million tonnes of coarse and fine refuse. This material will be permanently sequestered within mine lease areas in such a way as to not cause environmental problems. The record for safe disposal of this material is good based on the fact that there

has been large-scale surface coal mining in BC for the last 40 years without major environmental problems related to coal waste handling.

STUDY AREAS

Samples were collected in 3 areas along the east coast of Vancouver Island, including Union Bay, Cedar Cove (Canary Cove and Clam Bay), and Ladysmith Slag Point areas (Figure 1). Union Bay was the site of the major wash plant and load-out for coal mined in the Cumberland area. Mining started in the area in 1869 when Baynes Sound Coal Company started operations in the Tsable River area; however, most of the activity soon moved to the Cumberland area, where mining continued until 1953. The Tsable River Mine continued operation, finally by removing coal from mine pillars, until 1967, when it closed as the last operating coal mine on the island.

SAMPLING AND ANALYSIS

Samples were collected from beaches, exposed banks of waste material, and from the top surface of piles of waste material. Fragment size varied from pebble to fine sand, and the mass of each sample collected varied based on fragment size and ranged from less than 1 kg to about 5 kg. Wherever possible, shallow holes up to 1 m deep were dug so that one or two samples could be collected to represent a simple stratigraphic section. On beaches, this required digging a hole up to 1 m deep (Figure 2). In some banks it was possible to sample a section up to 2 m thick (Figure



Figure 2: Photo; Union Bay intertidal zone, location 646.

3). In some places (Union Bay intertidal zone), there was a heavy iron staining (Figure 4). A total of 43 samples were collected (Table 1). Larger samples were split, with one split screened into 2 sizes to provide coarse-sized and finesized samples.

Inspection of samples provided some information on amount of coal in samples, and those that were noticeably coaly were sent for coal-specific analyses as well as x-ray fluorescence (XRF) major oxide and ICP-MS analyses (Table 2). Other samples not visibly coal-rich were sent for ash, XRF (Table 3), and ICP-MS (using a hot aqua-regia digestion; Table 4) analyses.

The XRF analysis provides a good estimate of the amount of organic matter in samples because samples are fused prior to analysis and the loss of weight is a measure of organic carbon and the remaining weight correlates closely to American Society for Testing and Materials (ASTM) ash measurements (Figure 5). It appears that ash concentration determined by XRF is about 0.5% lower, but the correlation between the 2 methods is generally very good.



Figure 3: Photo; Union Bay; bank into waste coal pile, l ocation 662.



Figure 4: Photo; Union Bay intertidal zone, location 646; heavy iron staining on surface.

TABLE 1: SAMPLE LOCATIONS AND DESCRIPTIONS.

Sample No		lat	long	Zone 10		Notes
Union Bay			•	easting	northing	
	641	49-35.209	124-53.083	363773	5494180	Vertical bluff Sample top 40 cm coaly
	642					Vertical bluff Sample middle 1 m down from top coaly
	643					Vertical bluff Sample bottom 2 m down from top coaly
Intertidal zo	one Sa	ımpling				
	644	49-35.475	124-52.773	364159	5494663	top 3cm mdst+coaly
	645					middle 8-12 cm mdst+coaly
	646					bottom 15-20 cm mdst+coaly
	647	49-35.512	124-52.763	364173	5494732	low inter tidal zone top 4 cm mdst+coaly
	648					low inter tidal zone 10-15 cm middle sample mdst+coaly
	649					low inter tidal zone aprox depth 40 cm mdst+coaly
Intertidal						
	650	49-35.524	124-52.784	364148	5494754	1 of 3 top heavy iron stain 0-4 cm
	651					middle 10-15 cm black layer
	652					deeper layer 20-30 cm grey/black
	653	49-35.514	124-52.842	364078	5494738	upper inter tidal zone iron cemented surface layer hard pan
	654	49-35.516	124-52.836	364085	5494741	top of coal pile15-20cm mdst
	655					surface top 4 cm coaly mdst
Estuary						
	660	49-35.661	124-53.078	363800	5495017	by creek black sand layer surface sample top 10-20 cm coaly
	661					15-20 cm deep iron stained coaly
	662	49-35.597	124-53.215	363632	5494903	waste coal/rock pile 30 cm down from top mdst
	663					waste coal/rock pile 1.5 m down from top mdst
Top of wast	te Pile					
l [*]		49-35.564	124-53.000	363894	5495002	top of coal hills 30 cm deepmdst
	665	49-35.564	124-53.1	363769	5494838	Surface sample top 4 cm mdst
Cedar Cove	/Cana	ıry Cove				
	666	49-05.566	123-48.152	441408	5437859	coal waste pile adjacent to beach surface top 4 cm coaly
	667					depth 30-35 cm taken coal waste pile adjacent to beach coaly
	668	49-05.577	123-48.192	441360	5437880	surface top 4 cm coaly
	669					65 cm deep coaly
Intertidal Zo	one					
	670	49-05.614	123-48.188	441365	5437949	surface sample top 4 cm
	671					depth to sample 20 cm coaly
Clam Bay						
	672	49-05.498	123-48.184	441368	5437734	surface top 4 cm coaly
	673					deep sample 30-40 cm hole 80 cm deep coaly
	674	49-05.497	123-48.188	441363	5437732	surface top 4 cm mdst
	675					sample 20 cm deep mdst
Ladysmith S	Slag F	Point				
	676	48-59.706	123-48.537	440824	5427007	beach surface sample top 5 cm coaly
	677					beach asmple 20-30 cm deep coaly
	678	48-59.740	123-48.494	440877	5427070	surface top 5 cm coaly
	679					30 cm deep sample coaly
Intertidal S	E side	e of pile beacl	h on ocean side			
	680	48-59.669	123-48.418	440968	5426937	surface sample top 5 cm coaly
	681					sample 20 cm deep coaly
Coaly Bluff	Ì					
	682	48-59.612	123-48.457	440920	5426832	surfce to 30 cm mdst
	683					1.5 m down from top mdst
Beach Abov	ve tide	2				
	684	48-59.698	123-48.522	440842	5426992	surface top 5 cm sandy
	685					50 cm deep Lots of iron/cable debris
Top of Was	te pile	e				
	686	48-59.728	123-48.496	440874	5427047	surface top 5 cm coaly
I	687					sample 40 cm deep coaly

TABLE 2: COAL-SPECIFIC ANALYSES OF SOME SAMPLES.

										lfur	
gampla	Moist adb	A ab a db	Moist res	VM odb	EC odb	CV db	CV	S%	Pyritic S%	sulphate S%	Organic S%
sample		Asii ado	Moist les	v ivi aub	rc ado	CV db	CV	370	370	370	370
Union Bay		40.15	1.22	21.10	20.24			0.54			
641	2.14	48.15	1.33	21.18	29.34			0.54	0.225	0.001	0.420
642	2.12	28.34	1.26	26.27	44.13			0.66	0.235	0.001	0.420
643	1.86	53.13	1.08	20.34	25.45			0.50			
644	1.29	87.49	0.79	9.69	2.03	3506	3478	0.31			
645	1.77	66.37	0.81	16.55	16.27	4431	4395	0.50			
646	1.08	85.80	0.69	8.95	4.56	3401	3378	0.54			
647	1.94	76.27	1.16	13.08	9.49						
648	1.38	67.37	1.07	16.15	15.41						
649	1.17	91.88	0.63	7.72	-0.23						
660	3.40	39.46	1.67	23.95	34.92	4477	4402	0.87			
661	1.50	74.81	1.05	13.67	10.47	979	969	1.22			
Cedar Cov	e										
666	2.75	24.57	1.82	32.10	41.51	5463	5364	0.55			
667	2.51	27.66	1.64	31.06	39.64	5440	5351	0.59			
668	31.17	61.31	1.11	20.16	17.42	2509	2481	0.47			
669	2.42	37.98	1.30	26.44	34.28	4657	4596	0.55			
670	1.92	55.53	1.12	21.07	22.28						
671	1.27	60.00	0.86	21.04	18.10						
672	1.57	69.75	1.03	16.59	12.63						
673	1.60	67.93	0.93	18.19	12.95						
Ladysmith	Slag Poi	int									
676	2.06	60.36	1.07	19.57	19.00						
677	2.02	49.50	1.04	23.82	25.64						
678	1.46	83.89	0.92	11.49	3.70	600	594	0.14			
679	1.67	75.36	1.00	14.48	9.16	981	971	0.31			
680	1.54	75.65	0.94	15.74	7.67						
681	1.52	71.33	1.10	16.61	10.96						
684	1.75	77.94	0.83	12.89	8.34	786	779	0.23			
685	2.14	60.23	1.24	18.93	19.60	2349	2320	0.28			
686	1.61	82.82	0.90	11.87	4.41	20.0	2020	0.20			
687	1.74	76.44	1.04	14.59	7.93						

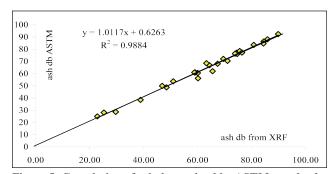


Figure 5: Correlation of ash determined by ASTM standard method and by XRF.

ECONOMIC CONSIDERATIONS

There are a number of coal refuse piles on Vancouver Island, especially in the Nanaimo area, and the total tonnage may be as high as 2.5 million tonnes (Gardner 1997). Portable wash plants exist that can upgrade the material by removing some of the ash until the remaining product has a useable heat value. Generally this means reducing the ash content to less than 15%. A number of companies have investigated the possibility of upgrading material to a marketable thermal coal product, but at present there are no active proposals. Coking coal properties such as fluidity (a measure of coal rheology) or free-swelling index (FSI) are lost as the coal weathers or ages at surface, so that there is no possibility of processing refuse piles to produce a coking coal product.

Most of the samples collected for this study have high ash contents (Table 3) with the exception of samples collected at Cedar Cove. It should be remembered that when

TABLE 3: XRF MAJOR OXIDE ANALYSES.

sample	Ash	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P205	Ba(F)
641	48.5	57.34	1.26	30.63	5.39	0.04	0.49	1.27	0.38	1.43	0.19	0.03
642	29.7	51.54	1.35	29.47	4.57	0.04	0.39	6.16	0.38	1.27	0.26	0.04
643	51.0	57.53	1.30	30.59	4.28	0.02	0.59	1.91	0.34	1.47	0.10	0.03
644	85.9	57.00	0.99	19.71	10.65	0.05	1.81	4.46	2.11	1.08	0.13	0.03
645	64.4	55.80	1.20	24.96	7.02	0.05	1.39	3.74	1.55	1.25	0.12	0.03
646	84.6	57.50	1.03	16.97	8.85	0.07	2.64	6.63	2.62	0.90	0.13	0.03
647	74.5	56.16	1.03	23.26	7.97	0.03	1.32	3.88	1.81	1.33	0.18	0.03
648	67.4	52.38	1.21	23.65	7.59	0.05	1.93	6.40	1.79	1.13	0.16	0.03
649	89.9	53.03	1.06	13.55	8.17	0.10	3.52	12.56	3.08	0.63	0.13	0.02
650	71.5	39.05	0.84	13.89	34.56	0.04	1.80	4.06	2.45	0.67	0.22	0.02
651	74.3	54.30	1.42	23.32	7.19	0.10	2.15	6.17	1.62	0.91	0.15	0.02
652	93.5	51.27	1.19	14.15	9.61	0.13	4.84	12.04	3.16	0.53	0.14	0.01
654	78.0	55.52	1.07	23.61	11.40	0.03	1.57	2.51	1.28	1.35	0.16	0.03
655	85.3	45.75	1.11	17.43	22.68	0.08	2.80	5.15	1.72	0.78	0.21	0.02
662	58.7	56.77	1.18	28.12	3.05	0.01	0.43	2.84	0.56	1.67	0.07	0.06
663	69.0	52.75	1.14	23.92	2.74	0.01	0.34	6.65	0.55	1.57	0.05	0.05
664	54.8	52.28	2.22	26.25	9.84	0.05	2.10	3.42	1.12	0.93	0.13	0.05
665	49.1	57.47	1.67	29.40	6.73	0.01	0.40	0.19	0.52	1.50	0.12	0.05
666	22.9	55.25	1.26	24.55	6.68	0.06	2.60	2.49	0.78	1.72	0.99	0.20
667	25.3	51.71	1.16	22.67	5.51	0.04	2.76	6.61	0.73	1.56	0.82	0.17
668 S	65.6	56.60	0.91	21.70	7.23	0.07	3.66	3.66	1.12	1.76	0.18	0.05
668 T	59.7	55.59	0.92	21.12	6.97	0.06	3.50	4.81	1.17	1.71	0.21	0.05
669 T	38.9	57.67	1.27	23.49	5.88	0.05	2.86	2.27	1.54	1.65	0.31	0.08
669 S	31.5	55.06	1.15	23.71	6.54	0.07	3.52	2.10	1.91	1.76	0.53	0.09
670	60.2	58.89	0.79	18.70	5.27	0.05	2.72	5.02	2.28	1.70	0.24	0.06
671	60.1	54.27	0.81	17.45	5.20	0.06	2.89	9.40	2.24	1.46	0.31	0.08
672 T	71.1	59.98	0.76	17.41	8.12	0.13	2.85	3.94	1.40	1.36	0.22	0.04
672 S	63.3	57.66	0.88	19.84	7.64	0.10	3.45	3.29	1.76	1.65	0.26	0.05
673 T	70.0	57.88	0.83	18.04	8.31	0.14	3.07	3.98	1.69	1.46	0.21	0.04
673 S	58.5	56.14	0.94	21.10	7.72	0.09	3.63	3.25	1.91	1.71	0.29	0.06
674	67.1	56.12	0.82	18.34	7.50	0.08	3.06	5.99	1.55	1.44	0.29	0.05
675	68.1	53.44	0.79	17.61	9.47	0.07	2.92	6.19	1.45	1.38	0.25	0.05
676 T 676 S	56.6	59.51	1.14	24.04	4.11	0.03	2.05	2.45	1.93	1.85	0.13	0.06
	59.2	60.07	1.14	23.66	4.31	0.03	2.10	1.67	1.90	1.85	0.12	0.06
677 T 677 S	46.9 49.6	59.12 59.25	1.19 1.19	25.10 24.71	4.06 4.06	0.03 0.02	2.00	1.26 1.69	1.88 1.85	1.88	0.13	0.07 0.07
678 t	84.4	58.46	1.19	21.86	6.38	0.02	2.02 2.58	3.58	1.42	1.88 1.72	0.13 0.16	0.07
678 S	81.3	58.60	1.08	23.40	5.57	0.05	2.17	3.11	1.09	1.87	0.10	0.05
679 T	74.7	58.56	1.10	23.40	5.05	0.05	2.05	3.11	1.69	1.87	0.09	0.05
679 S	74.0	58.55	1.10	24.06	5.03	0.05	2.10	2.72	1.32	1.90	0.10	0.06
680 T	73.9	56.49	1.08	24.81	4.30	0.05	1.94	4.24	1.08	1.86	0.10	0.05
680 S	74.1	56.49	1.06	24.40	3.89	0.04	1.90	4.97	1.19	1.87	0.09	0.05
681 T	69.6	57.47	1.11	25.31	4.08	0.02	1.92	3.54	1.09	1.92	0.08	0.06
681 S	68.6	57.45	1.12	25.09	3.94	0.03	1.90	4.00	1.05	1.93	0.09	0.05
682	77.4	58.90	1.13	25.26	4.11	0.04	1.77	3.50	0.57	1.80	0.12	0.07
683	73.6	57.49	1.10	24.40	4.69	0.05	1.95	4.25	0.53	1.82	0.07	0.06
684 T	74.2	61.32	1.03	22.24	5.05	0.04	2.10	2.63	1.72	1.72	0.10	0.05
684 S	76.6	62.19	0.99	21.80	4.81	0.04	2.11	2.17	1.92	1.74	0.09	0.05
685 T	58.9	60.13	1.24	25.85	4.53	0.03	1.99	0.81	1.27	1.90	0.18	0.06
685 S	58.2	60.04	1.22	25.80	4.59	0.04	2.03	0.88	1.27	1.91	0.12	0.07
686 t	80.8	58.23	1.07	22.67	5.77	0.05	2.50	3.66	1.44	1.78	0.09	0.05
686 S	80.4	58.84	1.08	24.03	5.05	0.04	2.25	2.99	1.10	1.92	0.08	0.05
678 T	76.5	58.25	1.07	23.65	4.89	0.04	2.18	3.67	1.11	1.89	0.11	0.06
678 S	76.3	58.37	1.10	24.47	4.90	0.03	2.17	2.88	1.09	1.92	0.10	0.06

TABLE 4: ICP-MS MAJOR AND MINOR ELEMENT ANALYSES.

	-0	-			17	n	0	n		D.	0.1		-	-	-0				2.77	DI.	CI	0		201	201	7.1	1.7	- 0
sample	Ca %	Fe %	Mg %	Na %	K %	P ppm	S %	Ba ppm	As ppm	Bi ppm	Cd ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	La ppm	Mn ppm	Mo ppm	Ni ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Th ppm	TI ppm	U ppm	V ppm	Zn ppm
Union B								- 11																				
641	0.81	3.21	0.22	0.05	0.46	514	0.12	118	13	0.3	0.3	11	59	74	16.7	20	395	1.8	217	10.7	0.4	21.1	147	3.8	0.6	1.0	136	70
642	4.08	2.45	0.15	0.04	0.41	1294	1.01	202	17	0.2	0.2	17	69	89	16.4	20	372	2.4	167	12.8	0.4	25.1	332	3.4	0.6	1.2	238	70
643	1.21	2.37	0.25	0.04	0.50	418	0.32	137	9	0.2	0.2	16	60	72	15.9	21	255	2.1	32	12.7	0.3	22.9	150	3.5	0.4	1.2	187	85
644 645	1.80	6.78 4.32	0.62	0.24	0.40	579 550	0.53	70 154	15 10	0.1	0.1	9 17	59 88	43 76	11.1 16.5	10 16	261 363	2.8	25 38	6.1 10.9	0.1	11.8 19.1	116 164	1.9 2.9	0.2	0.9	90 125	46 62
646	2.66	5.09	0.77	0.34	0.34	606	0.51	76	12	0.1	0.1	15	100	44	10.6	5	355	1.4	32	5.8	0.1	11	160	1.5	0.4	0.6	112	49
647	2.18	5.15	0.58	0.42	0.59	885	0.60	108	23	0.2	0.1	6	90	49	14.7	15	276	1.8	27	9.8	0.2	16.3	185	2.6	0.3	1.1	117	52
648	3.50	4.83	0.65	0.39	0.56	809	0.84	127	24	0.1	0.1	10	101	66	16.5	10	301	1.7	37	9.1	0.2	17.5	298	2.6	0.4	1.3	133	60
649	6.19	3.97	1.06	0.37	0.20	527	0.17	38	11	<.1	<.1	11	91	47	9.2	<2	458	0.8	29	3.1	<.1	9.8	394	0.7	<.1	0.3	120	49
650	1.48	19.70	0.55	0.64	0.31	1015	0.57	87	22	0.1	0.1	3	78	55	9.7	8	256	13.2	21	6.9	0.3	9.5	162	1.3	0.1	3.1	90	22
651	2.70	3.45	0.52	0.17	0.34	687	0.44	59	11	0.1	0.1	14	89	58	13.8	10	566	0.9	31	6.6	0.1	15	105	1.9	0.2	0.6	118	48
652	4.80	3.99	1.24	0.26	0.15	584	0.14	29	13	<.1	<.1	16	83	54	9.7	<2	538	0.6	33	2.0	<.1	9	284	0.6	<.1	0.2	115	47
654 655	0.64	6.55 13.39	0.50	0.22	0.44	597 698	0.20	83 59	20 20	0.1	<.1 0.1	7 7	56 46	48 65	11.1 9.9	13 10	207 291	5.4 12.7	373 447	7.6 5.8	0.3	11.8 9.7	72 85	2.3 1.5	0.1	2.0	96 93	48 37
662	2.09	1.90	0.21	0.13	0.63	270	1.50	89	27	0.2	<.1	<1	49	18	12.6	19	28	2.6	10	11.3	0.2	15	243	3.0	0.5	1.5	104	23
663	4.89	1.70	0.15	0.07	0.58	185	3.60	45	25	0.2	<.1	<1	45	15	11.0	14	28	2.3	10	6.0	0.9	11.8	224	2.3	0.6	1.1	77	18
664	1.12	5.37	0.42	0.27	0.39	535	0.10	389	149	0.1	<.1	6	127	55	18.6	16	101	1.8	34	9.7	1.1	15.7	200	2.8	0.7	0.8	204	27
665	0.13	5.00	0.20	0.07	0.69	542	0.08	325	79	0.2	<.1	3	131	38	20.3	17	39	2.6	28	12.5	0.7	21.5	222	3.7	0.6	1.9	196	31
		Hg all v	values le	ess than :	20 ppb		Se only	1 value	greater	than 1	ppm																	
\vdash	Ca	Fe	Mg	Na	K	P	S	Ba	As	Bi	Cd	Co	Cr	Cu	Ga	La	Mn	Мо	Ni	Pb	Sb	Se	Sr	Th	TI	U	V	Zn
sample	%	%	%	%	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Cedar C																												
666	1.70	4.08	1.24	0.19	0.80	4914	0.58	394	14	0.3	0.3	13	219	111	17.6	15	487	2.1	140	32.6	0.2	27.7	2317	3.1	0.4	1.3	195	85
667 668 S	4.75 2.74	3.71 4.79	1.55 1.96	0.16	0.71	4067 961	0.58	150 254	24 11	0.2	0.2	16 11	208 180	113 56	18.5 16.1	7 12	432 614	2.4 0.8	147 144	12.5 15.8	0.1	28.7	2409 376	2.9	0.4	1.3 0.8	187 145	75 104
668 T	3.33	3.89	1.65	0.33	0.88	946	0.58	270	9	0.1	0.1	9	146	55	15.2	10	503	1.0	116	11.1	0.1	20.8	479	2.1	0.2	0.8	135	79
669 T	1.25	3.25	1.35	0.62	0.90	1499	0.51	421	10	0.2	0.1	11	182	99	18.0	14	402	1.7	109	18.4	0.2	24.3	673	2.9	0.2	1.7	175	77
669 S	1.59	4.35	1.89	0.93	1.04	2413	0.88	274	14	0.1	0.1	15	254	118	19.3	12	615	2.2	166	11.9	0.2	26.5	1013	2.4	0.2	1.8	217	77
670	2.72	2.77	1.20	0.56	0.63	1000	0.53	245	5	0.1	0.1	6	148	44	13.3	9	319	0.7	87	12.0	<.1	17.3	461	1.9	0.2	0.8	107	59
671	6.22	3.15	1.42	0.67	0.67	1522	0.83	303	10	0.1	0.1	8	169	61	12.9	2	397	1.3	95	13.9	0.1	17.9	1073	1.8	0.2	1.1	127	61
672 T	2.69	5.26	1.58	0.36	0.72	1008	0.71	206	12	0.1	0.1	12	125	45	12.5	15	1018	1.3	112	10.1	0.1	17.5	301	1.9	0.2	0.8	112	92
672 S 673 T	2.44	5.88 6.27	2.11 1.85	0.61	0.99	1390 1100	0.64	309 210	15 26	0.1	0.1	16 18	192 170	99 57	16.4 13.7	14 17	878 1248	1.2	158 153	14.1 9.2	0.1	22.3	458 284	2.4	0.3	1.0	152 134	131 120
673 S	2.24	4.80	1.85	0.41	0.91	1348	0.63	328	21	0.1	0.1	13	167	79	16.9	14	731	1.7	142	12.5	0.1	23.6	567	2.1	0.4	1.0	152	94
674	4.35	5.39	1.68	0.54	0.83	1569	1.10	235	23	0.1	0.1	13	155	55	14.1	10	720	1.2	127	11.2	0.1	19.3	692	1.9	0.2	0.9	131	95
675	5.00	8.29	1.83	0.54	0.90	1531	1.93	157	44	0.1	0.1	15	167	59	13.7	10	722	1.2	145	13.2	0.1	18.3	640	1.8	0.8	0.7	135	114
		Hg all v	values le	ess than :	20 ppb		Se only	1 value	greater	than 1	ppm																	
	Ca	Fe	Mg	Na	K	Р	S	Ba	As	Bi	Cd	Co	Cr	Cu	Ga	La	Mn	Мо	Ni	Pb	Sb	Sc	Sr	Th	Tl	U	V	Zn
sample Ladysmi	% th	%	%	%	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
676 T	1.33	2.16	0.97	0.74	0.95	542	0.38	339	11	0.2	0.2	6	116	87	16.2	19	226	1.4	55	27.3	0.2	20	205	3.0	0.3	1.2	139	114
		-									0.2		170	94	17.3	21	276	1.5	67	29.7	0.2							134
676 S	0.79	2.69	1.12	0.74	1.12	658	0.35	366	7	0.2	0.2	8	170	/ 7	17.3		270				0.2	20.9	178	3.1	0.3	1.2	158	134
676 S 677 T	0.79 0.72	2.69 2.57	1.12	0.74 0.86	1.12	707	0.35	366 470	7	0.2	0.2	10	207	102	19.3	21	240	5.0	76	24.7	0.2	24.8	284	3.1	0.3	1.5	182	141
677 T 677 S	0.72 0.92	2.57 2.48	1.10 1.08	0.86 0.75	1.17 1.08	707 652	0.41 0.41	470 451	7 4	0.3 0.3	0.3 0.3	10 9	207 168	102 94	19.3 18.1	21 20	240 243	5.0 5.6	76 70	24.7 25.7	0.2	24.8 23.1	284 247	3.7 3.5	0.4 0.4	1.5 1.3	182 164	141 122
677 T 677 S 678 t	0.72 0.92 2.11	2.57 2.48 4.26	1.10 1.08 1.30	0.86 0.75 0.33	1.17 1.08 1.04	707 652 511	0.41 0.41 0.20	470 451 274	7 4 10	0.3 0.3 0.2	0.3 0.3 <.1	10 9 10	207 168 114	102 94 55	19.3 18.1 16.2	21 20 21	240 243 500	5.0 5.6 1.5	76 70 73	24.7 25.7 17.4	0.2 0.3 0.1	24.8 23.1 19	284 247 142	3.7 3.5 2.7	0.4 0.4 0.3	1.5 1.3 0.6	182 164 122	141 122 166
677 T 677 S 678 t 678 S	0.72 0.92 2.11 2.03	2.57 2.48 4.26 3.63	1.10 1.08 1.30 1.10	0.86 0.75 0.33 0.33	1.17 1.08 1.04 1.06	707 652 511 431	0.41 0.41 0.20 0.19	470 451 274 275	7 4 10 10	0.3 0.3 0.2 0.2	0.3 0.3 <.1 0.1	10 9 10 7	207 168 114 102	102 94 55 56	19.3 18.1 16.2 15.9	21 20 21 22	240 243 500 444	5.0 5.6 1.5 0.6	76 70 73 67	24.7 25.7 17.4 20.5	0.2 0.3 0.1 0.1	24.8 23.1 19 18.6	284 247 142 118	3.7 3.5 2.7 2.6	0.4 0.4 0.3 0.3	1.5 1.3 0.6 0.7	182 164 122 113	141 122 166 178
677 T 677 S 678 t 678 S 679 T	0.72 0.92 2.11	2.57 2.48 4.26	1.10 1.08 1.30	0.86 0.75 0.33	1.17 1.08 1.04	707 652 511	0.41 0.41 0.20	470 451 274	7 4 10	0.3 0.3 0.2	0.3 0.3 <.1	10 9 10	207 168 114	102 94 55	19.3 18.1 16.2	21 20 21	240 243 500	5.0 5.6 1.5	76 70 73	24.7 25.7 17.4	0.2 0.3 0.1	24.8 23.1 19	284 247 142	3.7 3.5 2.7	0.4 0.4 0.3	1.5 1.3 0.6	182 164 122	141 122 166
	0.72 0.92 2.11 2.03 2.25	2.57 2.48 4.26 3.63 3.31	1.10 1.08 1.30 1.10 1.08	0.86 0.75 0.33 0.33 0.47	1.17 1.08 1.04 1.06 1.08	707 652 511 431 410	0.41 0.41 0.20 0.19 0.33	470 451 274 275 313	7 4 10 10 8	0.3 0.3 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1	10 9 10 7 8	207 168 114 102 115	102 94 55 56 70	19.3 18.1 16.2 15.9 16.8	21 20 21 22 22	240 243 500 444 441	5.0 5.6 1.5 0.6 0.6	76 70 73 67 64	24.7 25.7 17.4 20.5 20.1	0.2 0.3 0.1 0.1 0.2	24.8 23.1 19 18.6 20.9	284 247 142 118 150	3.7 3.5 2.7 2.6 2.9	0.4 0.4 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8	182 164 122 113 128	141 122 166 178 130
677 T 677 S 678 t 678 S 679 T 679 S 680 T	0.72 0.92 2.11 2.03 2.25 1.90	2.57 2.48 4.26 3.63 3.31 3.37	1.10 1.08 1.30 1.10 1.08 1.14	0.86 0.75 0.33 0.33 0.47 0.50	1.17 1.08 1.04 1.06 1.08 1.09	707 652 511 431 410 484	0.41 0.41 0.20 0.19 0.33 0.27	470 451 274 275 313 311	7 4 10 10 8 10	0.3 0.3 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1	10 9 10 7 8 8	207 168 114 102 115 117	102 94 55 56 70 72	19.3 18.1 16.2 15.9 16.8 17.2	21 20 21 22 22 22	240 243 500 444 441 449	5.0 5.6 1.5 0.6 0.6 0.6	76 70 73 67 64 67	24.7 25.7 17.4 20.5 20.1 18.8	0.2 0.3 0.1 0.1 0.2 0.1	24.8 23.1 19 18.6 20.9 21.7	284 247 142 118 150 143	3.7 3.5 2.7 2.6 2.9 3.1	0.4 0.4 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7	182 164 122 113 128 131	141 122 166 178 130 147
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09	707 652 511 431 410 484 423 371 373	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42	470 451 274 275 313 311 300 259 308	7 4 10 10 8 10 12 11 13	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6	207 168 114 102 115 117 111 93 115	102 94 55 56 70 72 66 63 82	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2	21 20 21 22 22 22 22 20 21 24	240 243 500 444 441 449 391 367 322	5.0 5.6 1.5 0.6 0.6 0.3 0.3	76 70 73 67 64 67 74 55 66	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1	284 247 142 118 150 143 172 163 166	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1	0.4 0.3 0.3 0.3 0.3 0.5 0.4	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7	182 164 122 113 128 131 127 118 134	141 122 166 178 130 147 119 96
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09	707 652 511 431 410 484 423 371 373 438	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35	470 451 274 275 313 311 300 259 308 314	7 4 10 10 8 10 12 11 13 7	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 8 5 6 7	207 168 114 102 115 117 111 93 115 120	102 94 55 56 70 72 66 63 82 84	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2	21 20 21 22 22 22 22 20 21 24 22	240 243 500 444 441 449 391 367 322 339	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5	76 70 73 67 64 67 74 55 66	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1	284 247 142 118 150 143 172 163 166 191	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9	182 164 122 113 128 131 127 118 134	141 122 166 178 130 147 119 96 114 129
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10	707 652 511 431 410 484 423 371 373 438 302	0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13	470 451 274 275 313 311 300 259 308 314 467	7 4 10 10 8 10 12 11 13 7	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 7 8	207 168 114 102 115 117 111 93 115 120 109	102 94 55 56 70 72 66 63 82 84 74	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7	21 20 21 22 22 22 20 21 24 22 25	240 243 500 444 441 449 391 367 322 339 439	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5	76 70 73 67 64 67 74 55 66 68 65	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4	284 247 142 118 150 143 172 163 166 191	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9	182 164 122 113 128 131 127 118 134 138 137	141 122 166 178 130 147 119 96 114 129 139
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S 682	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05	707 652 511 431 410 484 423 371 373 438 302 366	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13	470 451 274 275 313 311 300 259 308 314 467 371	7 4 10 10 8 10 12 11 13 7 11	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3	10 9 10 7 8 8 8 5 6 7 8	207 168 114 102 115 117 111 93 115 120 109 123	102 94 55 56 70 72 66 63 82 84 74 80	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5	21 20 21 22 22 22 20 21 24 22 25 24	240 243 500 444 441 449 391 367 322 339 439	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4	76 70 73 67 64 67 74 55 66	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8	284 247 142 118 150 143 172 163 166 191 151 183	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2	0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6	182 164 122 113 128 131 127 118 134 138 137 141	141 122 166 178 130 147 119 96 114 129 139
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S 682 683	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10	707 652 511 431 410 484 423 371 373 438 302	0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13	470 451 274 275 313 311 300 259 308 314 467	7 4 10 10 8 10 12 11 13 7	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 7 8	207 168 114 102 115 117 111 93 115 120 109	102 94 55 56 70 72 66 63 82 84 74	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7	21 20 21 22 22 22 20 21 24 22 25	240 243 500 444 441 449 391 367 322 339 439	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5	76 70 73 67 64 67 74 55 66 68 65 84	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4	284 247 142 118 150 143 172 163 166 191	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9	182 164 122 113 128 131 127 118 134 138 137	141 122 166 178 130 147 119 96 114 129 139
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S 682 683 684 T	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34 1.17	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11 1.16 0.94	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 1.03 0.87	707 652 511 431 410 484 423 371 373 438 302 366 509	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19	470 451 274 275 313 311 300 259 308 314 467 371 255	7 4 10 10 8 10 12 11 13 7 11 10	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3	10 9 10 7 8 8 8 5 6 7 8 10 6	207 168 114 102 115 117 111 93 115 120 109 123 132	102 94 55 56 70 72 66 63 82 84 74 80 74	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 17.8 14.0	21 20 21 22 22 22 20 21 24 22 25 24 18	240 243 500 444 441 449 391 367 322 339 439 487 329	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6	76 70 73 67 64 67 74 55 66 68 65 84 59	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.2 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2	284 247 142 118 150 143 172 163 166 191 151 183 129	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 3.2	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7	182 164 122 113 128 131 127 118 134 138 137 141	141 122 166 178 130 147 119 96 114 129 139 150
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S 682 683 684 T 684 S 685 T 685 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.91 0.98 0.95	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 1.03 0.87 0.85 0.98	707 652 511 431 410 484 423 371 373 438 302 366 509 462 641 583	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 11 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.3 0.2 0.3	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 <.1 <.1	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 17.8 14.0 12.9 15.6 16.8	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20	240 243 500 444 441 449 391 367 322 339 439 487 329 316 397 350	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0	76 70 73 67 64 67 74 55 66 68 65 84 59 53 70 61	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 73.0	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.1 0.2 0.1 0.1 0.2 0.3	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 20.8 22.2	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 3.2 2.4 2.4 3.0 3.3	0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7	182 164 122 113 128 131 127 118 134 137 141 122 112 154 136	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 681 S 682 C 683 C 684 T 684 S 685 T 685 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37 1.81	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47 3.09	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.91 0.98 0.95 1.02	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 1.03 0.87 0.85 0.98 0.97	707 652 511 431 410 484 423 371 373 438 302 366 509 462 641 583 427	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11 0.16	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 10 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127 87	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 14.0 12.9 15.6 16.8 15.2	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21	240 243 500 444 441 449 391 367 322 339 439 487 329 316 397 350 354	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0 1.1	76 70 73 67 64 67 74 55 66 68 65 84 59 53 70 61	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 73.0 31.5	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.1 0.2 0.3 0.3 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 20.8 22.2 17.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 3.2 2.4 2.4 3.0 3.3 2.8	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 1.9	182 164 122 113 128 131 127 118 134 137 141 122 112 154 136 95	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 688 S 684 T 684 S 685 T 685 S 686 t 685 S 686 t	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47 3.09 2.78	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.91 0.98 0.95 1.02	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 1.03 0.87 0.85 0.98 0.97	707 652 511 431 410 484 423 371 373 438 302 366 509 462 641 583	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 11 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1 <.1	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 17.8 14.0 12.9 15.6 16.8	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20	240 243 500 444 441 449 391 367 322 339 439 487 329 316 397 350	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0	76 70 73 67 64 67 74 55 66 68 65 84 59 53 70 61	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 73.0	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.1 0.2 0.1 0.1 0.2 0.3	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 20.8 22.2	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 3.2 2.4 2.4 3.0 3.3	0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7	182 164 122 113 128 131 127 118 134 137 141 122 112 154 136	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 688 S 684 T 684 S 685 T 685 S 686 t 685 S 686 t	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 0.68 0.40 0.37 1.81 1.72	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47 3.09 2.78 Hg all v	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.91 0.95 1.02 1.01	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27 0.26 ess than i	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.03 0.87 0.85 0.95 0.95	707 652 511 431 410 484 423 371 373 438 302 366 509 462 641 583 427 337	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11 0.16 0.15	470 451 274 275 313 311 300 259 308 314 467 371 225 202 371 337 223 221 Se only	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 11 10 10 12 11 11 10 10 10 10 10 10 10 10 10 10 10	0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1 0.1 <.1 than 1	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9 7 6	207 168 114 102 115 117 111 93 115 120 109 123 132 121 121 136 127 87	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 14.0 12.9 15.6 16.8 15.2 14.9	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23	240 243 500 444 441 449 391 367 322 339 487 329 316 350 354 328	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 1.0 0.5 0.4	76 70 73 67 64 67 74 55 66 68 84 59 53 70 61 57 57	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 5.3 73.0 31.5 20.0	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 15.6 20.8 22.2 17.5 18.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.2 3.2 3.2 2.4 2.4 3.0 3.3 2.8 2.6	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 1.9 0.6 0.6	182 164 122 113 128 131 127 118 134 138 137 141 122 154 136 95 94	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141
677 T 677 S 678 t 678 S 679 T 679 S 680 T 680 S 681 T 688 S 684 T 684 S 685 T 685 S 686 t 685 S 686 t	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47 3.09 2.78	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.91 0.98 0.95 1.02	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27 0.26	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 1.03 0.87 0.85 0.98 0.97	707 652 511 431 410 484 423 371 373 438 302 366 509 462 641 583 427	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11 0.16	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 10 10 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1 <.1	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127 87	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 14.0 12.9 15.6 16.8 15.2	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21	240 243 500 444 441 449 391 367 322 339 439 487 329 316 397 350 354	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0 1.1	76 70 73 67 64 67 74 55 66 68 65 84 59 53 70 61	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 73.0 31.5	0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.1 0.2 0.3 0.3 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 20.8 22.2 17.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 3.2 2.4 2.4 3.0 3.3 2.8	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 1.9	182 164 122 113 128 131 127 118 134 137 141 122 112 154 136 95	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108
677 T C C C C C C C C C C C C C C C C C C	0.72 0.92 2.11 2.03 2.25 1.90 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37 1.81 1.72	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.07 2.81 3.02 2.47 3.02 2.47 4.79 4.79 4.79 4.79 4.79 4.79 4.79 4	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 Wag %	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27 0.26	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 0.87 0.85 0.98 0.98 0.98 0.95	707 652 511 431 410 484 423 371 373 302 366 509 462 641 337 337	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11 0.15 0.15	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221 Se only	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 10 10 11 11 10 10 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1 c.than I	10 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127 87 87	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 16.5 17.2 16.7 19.5 17.8 14.0 15.6 16.8 15.2 14.9	21 20 21 22 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23	240 243 500 444 441 367 322 339 439 487 329 316 350 354 328	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 0.6 0.6 0.7 0.4 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	76 70 73 67 64 67 74 55 66 68 65 84 59 70 61 57 57	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 31.5 20.0	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 20.8 22.2 17.5 18.5	284 247 142 118 150 143 166 191 151 183 129 94 163 154 125 112	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 2.4 2.6 1.6 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 0.6 0.6	182 164 122 113 128 131 127 118 134 138 137 141 122 154 136 95 94	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141
677 T 677 S 678 t 678 t	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.30 3.34 1.17 0.68 0.40 0.37 1.81 1.72	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.00 3.26 3.07 2.81 3.02 2.47 3.09 2.47 3.09 Fe %	1.10 1.08 1.30 1.10 1.08 1.11 1.02 1.11 1.12 1.11 1.12 0.94 0.95 1.02 1.01 1.01 Walance k	0.86 0.75 0.33 0.37 0.50 0.47 0.50 0.48 0.51 0.12 0.10 0.38 0.44 0.42 0.27 0.26 Na %	1.17 1.08 1.04 1.06 1.08 1.11 1.05 1.09 1.110 1.05 0.87 0.85 0.98 0.97 0.88 0.97 0.88 0.95	707 652 511 431 410 484 423 371 373 3438 302 645 509 462 641 583 337 Pppm	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.13 0.19 0.42 0.35 0.13 0.19 0.17 0.15 0.11 0.16 0.15 0.15	470 451 274 275 313 300 259 308 314 467 371 255 202 371 232 221 Se only	7 4 10 10 8 8 10 12 11 13 7 11 10 10 12 11 11 10 10 12 11 11 10 10 10 10 10 10 10 10 10 10 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 Cd	10 9 10 7 8 8 8 8 5 6 7 8 10 6 6 6 9 9 9 7 6	207 168 114 102 115 117 111 120 109 123 132 121 136 127 87 87	102 94 55 56 70 72 66 63 82 84 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 14.0 12.9 15.6 16.8 15.2 14.9	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 21 23	240 243 500 444 441 391 367 322 339 439 316 397 350 354 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 1.0 0.5 0.4	76 70 73 67 64 67 74 55 66 68 84 59 53 70 61 57 57	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 31.5 20.0	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 17.2 15.6 20.8 22.2 17.5 18.5	284 247 142 118 150 143 166 191 151 183 129 94 163 154 125 112 Sr ppm	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 3.0 3.3 2.8 2.6	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.5 TI ppm	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 1.9 0.6 0.6	182 164 122 113 128 131 127 118 134 138 137 141 122 112 154 136 95 94	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141
677 T S 678 t F 678 S T 679 S T 679 S S 679 T S 679 S S 680 T S 681 T S 681 S 682 S 683 S 684 S 685 S S 685 S S 686 S S 686 S S	0.72 0.92 2.11 2.03 2.25 1.90 3.59 2.73 3.14 2.97 3.34 1.17 0.68 0.40 0.37 1.81 1.72	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.07 2.81 3.02 2.47 3.02 2.47 4.79 4.79 4.79 4.79 4.79 4.79 4.79 4	1.10 1.08 1.30 1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 Mg %	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27 0.26	1.17 1.08 1.04 1.06 1.08 1.09 1.11 1.05 1.09 1.10 1.05 0.87 0.85 0.98 0.98 0.98 0.95	707 652 511 431 410 484 423 371 373 302 366 509 462 641 337 337	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.13 0.11 0.15 0.15	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221 Se only	7 4 10 10 8 10 12 11 13 7 11 10 10 12 11 10 10 11 11 10 10 10 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <.1 <.1 c.than I	10 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6	207 168 114 102 115 117 111 93 115 120 109 123 132 121 136 127 87 87	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 16.5 17.2 16.7 19.5 17.8 14.0 15.6 16.8 15.2 14.9	21 20 21 22 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23	240 243 500 444 441 367 322 339 439 487 329 316 350 354 328	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 0.6 0.6 0.7 0.4 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	76 70 73 67 64 67 74 55 66 68 65 84 59 70 61 57 57	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 15.4 14.7 22.3 25.4 55.3 31.5 20.0	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 20.8 22.2 17.5 18.5	284 247 142 118 150 143 166 191 151 183 129 94 163 154 125 112	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 2.4 2.6 1.6 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9 2.9	0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 0.6 0.6	182 164 122 113 128 131 127 118 134 138 137 141 122 154 136 95 94	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141
577 T S 577 S S 578 t t 578 t t 579 T T 579 S S 580 T 5880 T 5880 T 5881 S 5881 T 5881 S 5881 T 5885 S S 5881 T 5885 S S S 5886 t t 5886 S S S S S S S S S S S S S S S S S S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.14 2.97 0.68 0.40 0.37 1.81 1.72	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32 2.73 3.00 3.26 3.07 2.81 3.09 2.78 Hg all V	1.10 1.08 1.30 1.10 1.10 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 values k	0.86 0.75 0.33 0.33 0.47 0.50 0.48 0.51 0.50 0.49 0.12 0.10 0.38 0.43 0.43 0.42 0.27 0.26 ess than :	1.17 1.08 1.04 1.06 1.09 1.11 1.05 1.03 0.87 0.85 0.98 0.95 20 ppb	707 652 5111 431 484 423 371 373 302 366 509 462 641 583 427 337	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.11 0.16 0.15 %	470 451 274 313 311 300 259 308 314 467 371 255 202 371 337 223 321 Se only Ba ppm 339 467 470 451	7 4 10 10 8 10 12 11 13 7 11 10 10 10 11 11 11 10 10 10 10 10 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 Classification of the control of the	10 9 10 7 8 8 8 8 5 6 7 8 10 6 6 6 9 9 7 7 6	207 168 114 102 115 117 111 93 115 120 109 123 121 136 127 87 87 Cr ppm	102 94 55 56 70 72 66 63 82 84 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 17.8 14.0 12.9 15.6 16.8 15.2 14.9	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23	240 243 500 444 441 449 391 367 322 339 487 329 316 357 350 354 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0 1.1 0.5 0.4	76 70 73 67 64 67 74 55 66 68 84 59 53 70 61 57 57	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 22.3 25.4 44.7 22.3 25.4 20.0 Pb ppm 27.3 27.3 27.3 27.4 27.4 27.3 27.4 27.4 27.4 27.4 27.4 27.4 27.4 27.4	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2 0.3 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 15.6 20.8 22.2 17.5 18.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112 Sr ppm	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.2 3.2 3.2 2.4 4.3.0 3.3 2.8 2.6 5.6 5.7 7 7 7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.6 0.7 0.7 1.7 1.9 0.6 0.6	182 164 122 113 128 131 127 118 134 137 141 122 112 154 136 95 94 V ppm	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141
577 T S 577 S 578 S 578 S 579 T 578 S 579 T 588 S 579 T 588 S 581 T 588 S 581 T 588 S 581 S 582 S 584 T 586 S 585 S 586 S 587 T 587 S 587 T 587 S 587 S 587 S 588	0.72 0.92 2.11 2.03 3.30 3.59 2.73 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th th 1.33 0.79 0.72 2.21	2.57 2.48 4.26 3.63 3.31 3.37 2.66 3.00 2.81 3.02 2.47 3.09 2.78 Hg all v 2.69 2.57 2.49 4.26	1.10 1.08 1.30 1.10 1.10 1.10 1.11 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 Mg % 0.97 1.12 1.10 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.60 0.47 0.12 0.70 0.10 0.38 0.43 0.44 0.42 0.27 0.26 0.74 0.74 0.74 0.86 0.75 0.33	1.17 1.08 1.04 1.06 1.09 1.11 1.05 1.03 0.87 0.85 0.97 0.88 0.95 1.12 1.17	707 652 511 431 4410 484 423 371 373 438 302 641 509 462 641 337 9 Pppm 542 658 707 652 551	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.42 0.35 0.13 0.17 0.13 0.11 0.16 0.15 8 %	470 451 274 275 313 311 300 259 308 314 467 371 255 202 337 223 221 Ba ppm 339 346 470 451 274	7 4 10 10 8 10 12 11 13 7 11 10 10 11 11 10 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 <.1 <.1 <.1 cthan I Cd ppm 0.2 0.2 0.3 <.1 0.3 0.3 <.1	10 9 10 7 8 8 8 8 8 5 6 6 7 8 8 10 6 6 6 9 9 7 6 7 6 7 6 7 6 9 7 6 9 9 9 9	207 168 114 102 115 117 111 93 120 109 123 132 121 136 127 87 87 Er ppm	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.8 14.0 12.9 15.6 16.8 15.2 14.9 Ga ppm	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23 23	240 243 500 444 441 449 391 367 322 339 487 329 316 397 350 354 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.6 0.6 0.6 0.4 0.4 0.5 0.4 0.5 0.4 1.1 1.1 1.1 1.5 5.0 6.6 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	76 70 73 67 64 67 74 55 66 68 65 84 59 70 61 57 57 87 Ni ppm	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.3 20.0 Pb ppm 27.3 29.7 24.7 17.4	0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 22.1 23.4 20.8 22.2 15.6 20.8 22.2 17.5 18.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112 Sr ppm	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 2.6 Th ppm	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.4 0.4 0.4 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.7 0.7 0.7 0.7 0.9 0.6 0.7 0.7 1.9 0.6 0.6 0.6 Uppm 1.2 1.2 1.5 1.3 0.6	182 164 122 113 128 131 127 118 134 133 141 122 115 141 136 95 94 V ppm	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 2n ppm
577 T S 577 S 578 S 578 S 578 S 579 T 579 S 580 S 581 T 580 S 581 T 581 S 582 S 583 S 584 T 585 S 585 S 585 S 586 S 587 T 587 S 587 T 587 S 587 T 587 S 587 S 587 S 587 S 587 S	0.72 0.92 2.11 2.03 3.30 3.59 2.73 3.34 1.17 0.68 % th 1.33 0.79 0.72 0.92 2.11 2.03	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.52 2.73 3.00 3.26 3.07 2.81 3.02 2.47 3.09 2.78 Hg all t 2.69 2.69 2.59 2.69 2.69 2.69 2.69 2.69 2.69 2.69 2.6	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.91 0.95 1.02 1.01 walues lo	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.44 0.42 0.27 0.60 0.88s than:	1.17 1.08 1.04 1.08 1.09 1.11 1.05 1.01 1.05 1.03 0.87 0.85 0.98 0.97 0.88 0.95 K % 0.91 1.12 1.17 1.08	707 652 511 431 440 484 423 366 509 462 641 583 337 438 707 658 707 652 512 641 441	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.18 0.19 0.17 0.15 0.15 0.13 0.15 0.19 0.17 0.15 0.19 0.17 0.19	470 451 274 313 311 300 259 308 314 467 371 337 223 221 Se only Ba ppm 336 470 451 274 275	7 4 10 10 8 110 111 113 7 111 10 10 111 1 value As ppm 11 7 7 4 10 10 10 10 10 10 10 10 10 10 10 10 10	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 9 7 6 Pppm Coppm 6 8 10 9 9 10 9 10 9 10 9 10 9 10 9 10 9	207 168 114 102 115 117 111 93 115 120 109 123 132 121 121 87 87 87 Ppm	102 94 55 56 70 72 66 63 82 84 74 70 107 104 95 55	19.3 18.1 16.2 17.6 16.8 17.2 17.6 16.5 17.2 16.7 19.5 17.8 19.5 14.0 12.9 15.6 16.8 16.2 14.9	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23 23 21 23 21 23 21 23 21 21 21 21 21 21 21 21 21 21 21 21 21	240 243 500 444 441 449 391 397 322 339 487 329 316 397 350 243 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.6 0.6 1.0 1.1 0.5 0.4 1.1 0.5 0.4 1.5 5.0 5.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6	76 70 73 67 64 67 74 55 66 68 65 84 70 61 57 57 57 Ni ppm	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.4 25.3 20.0 Pb ppm 27.3 29.7 24.7 25.7 17.4 20.5	0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 22.2 15.6 20.8 22.2 25.1 8.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112 205 178 284 247 142	3.7 3.5 2.7 3.1 3.1 3.1 3.2 3.2 3.2 3.2 3.2 2.4 2.4 3.0 3.3 2.8 2.6 	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.4 0.3 0.2 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.8 0.9 0.6 0.7 1.7 1.9 0.6 0.6 0.7 1.1 1.2 1.2 1.5 1.3 0.6 0.7	182 164 122 113 128 131 127 118 134 134 137 141 122 112 95 94 V ppm 139 158 182 164 122 113	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 141 122 134 141 141 142 144 141 142 144 144 144 14
577 T S 577 S 578 S 578 S 579 T S 579 S 580 S 581 T S 581 S 582 S 583 S 584 T S 584 S 585 S 586 T S 586 S 579 T 577 S 577 T 577 S 577 T 577 S 577 T 577 S 577 T 577 S	0.72 0.92 2.11 2.03 3.30 3.59 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th th 1.33 0.79 0.72 2.21	2.57 2.48 4.26 3.63 3.31 3.37 2.66 3.00 2.81 3.02 2.47 3.09 2.78 Hg all v 2.69 2.57 2.49 4.26	1.10 1.08 1.30 1.10 1.10 1.10 1.11 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 Mg % 0.97 1.12 1.10 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.60 0.47 0.12 0.70 0.10 0.38 0.43 0.44 0.42 0.27 0.26 0.74 0.74 0.74 0.86 0.75 0.33	1.17 1.08 1.04 1.06 1.09 1.11 1.05 1.03 0.87 0.85 0.97 0.88 0.95 1.12 1.17	707 652 511 431 4410 484 423 371 373 438 302 641 509 462 641 337 9 Pppm 542 658 707 652 551	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.42 0.35 0.13 0.17 0.13 0.11 0.16 0.15 8 %	470 451 274 275 313 311 300 259 308 314 467 371 255 202 337 223 221 Ba ppm 339 346 470 451 274	7 4 10 10 8 10 12 11 13 7 11 10 10 11 11 10 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6 6 8 10 9 10 7 8 8	207 168 114 102 115 117 111 93 120 109 123 132 121 136 127 87 87 Trppm	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.8 14.0 12.9 15.6 16.8 15.2 14.9 Ga ppm	21 20 21 22 22 22 20 21 24 22 25 24 18 16 20 20 21 23 23	240 243 500 444 441 449 391 367 322 339 487 329 316 397 350 354 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.6 0.6 0.6 0.4 0.4 0.5 0.4 0.5 0.4 1.1 1.1 1.1 1.5 5.0 6.6 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	76 70 73 67 64 67 74 55 66 68 84 59 53 70 61 57 57 57 Ni ppm	24.7 25.7 17.4 20.5 20.1 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 25.3 20.0 Pb ppm 27.3 29.7 24.7 17.4	0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 22.1 23.4 20.8 22.2 15.6 20.8 22.2 17.5 18.5	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112 Sr ppm	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.2 3.2 2.4 2.4 3.0 3.3 2.8 2.6 Th ppm	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.4 0.4 0.4 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.7 0.7 0.7 0.7 0.9 0.6 0.7 0.7 1.9 0.6 0.6 0.6 Uppm 1.2 1.2 1.5 1.3 0.6	182 164 122 113 128 131 127 118 134 133 141 122 115 141 136 95 94 V ppm	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 141 141 141 141 141 141 141 141
577 T S 577 S S 578 S S 578 S S 579 T S 578 S S 580 T S 580 S S 581 T S 581 S S 582 S 583 S S 584 T S 585 S S 585 S S 586 S S 587 T T S 577 G T S 577 S S 577 S S 578 S S 578 S S	0.72 0.92 2.11 1.90 3.30 3.59 2.27 3.34 2.97 3.34 2.97 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % 6 0.79 0.72 0.92 2.11 3.24 3.25 3.36 3.37 3.3	2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.66 3.07 2.81 3.02 2.47 3.09 2.78 Hg all V 2.69 2.69 4.26 3.26 3.30 3.26 3.26 3.26 3.26 3.27 3.26 3.26 3.26 3.26 3.26 3.26 3.26 3.26	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 walues le Mg % 0.97 1.12 1.10 1.08 1.10 1.08 1.10 1.10 1.10 1.08	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.38 0.43 0.42 0.27 0.26 esss than	1.17 1.08 1.04 1.05 1.09 1.11 1.05 1.09 1.10 1.05 1.09 1.10 1.05 1.09 1.11 0.85 0.98 0.95 20 ppb K % 1.12 1.17 1.08 1.04 1.06 1.04 1.06	707 652 511 431 440 484 423 371 373 438 302 641 509 462 641 658 427 337 Ppm 652 511 431 431	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.42 0.35 0.13 0.17 0.13 0.19 0.17 0.13 0.19 0.15 0.19 0.11 0.16 0.15 0.15 0.15 0.15 0.17 0.13 0.19 0.10	470 451 274 275 313 311 300 259 308 314 467 225 202 371 225 202 337 221 223 221 Ba ppm 451 451 470 451 274 451 275 313	7 4 10 10 8 10 12 11 13 7 11 10 10 10 11 11 11 11 11 11 17 1 1 1 1	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 9 7 6 Pppm Coppm 6 8 10 9 9 10 9 10 9 10 9 10 9 10 9 10 9	207 168 114 102 115 117 111 93 120 109 123 121 136 127 87 87 Cr ppm	102 94 55 56 70 72 66 63 82 84 74 70 107 104 49 55 Cu ppm 87 94 55 56 70	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 16.7 19.5 15.6 15.2 14.9 Ga ppm	21 20 21 22 22 22 20 21 24 22 25 24 20 20 21 23 21 23 21 23 21 23 22 22 22 20 20 21 21 22 22 22 22 25 20 21 21 21 21 21 21 21 21 21 21 21 21 21	240 243 500 444 441 449 391 322 339 439 439 316 350 354 328 Mn ppm	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.3 0.4 0.5 0.4 0.6 0.6 1.0 1.1 0.5 0.4	76 70 73 67 64 67 74 55 66 68 65 84 70 61 57 57 57 Ni ppm	24.7 (25.7 17.4 18.8 15.9 15.8 16.3 17.5 15.4 14.7 22.3 32.5 4 20.0 27.3 29.7 24.7 25.7 17.4 20.1 17.4 20.1 17.4 20.1	0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 15.6 20.8 17.2 15.6 20.8 Se ppm 20 20.9 24.8 23.1 19 18.6 20.9	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 154 125 112 205 178 247 142 247 142 151	3.7 3.5 2.7 3.1 3.1 3.1 3.2 3.2 3.2 3.2 3.2 2.4 2.4 3.0 3.3 2.8 2.6 	0.4 0.3 0.3 0.3 0.5 0.4 0.3 0.4 0.3 0.4 0.3 0.2 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.8 0.9 0.7 0.7 0.7 0.7 0.7 0.7 0.7 1.7 1.9 0.6 0.6 0.6 Uppm 1.2 1.2 1.2 1.3 0.6 0.7 0.7 0.8	182 164 122 131 128 131 127 118 134 138 137 141 122 154 136 95 94 V ppm 139 158 182 164 122 164 122	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 141 122 166 178 134
577 T S 577 S 577 S 577 S 577 S 577 S 578 L 577 S 578 L 577 S 578 L 577 S 588 S 588 T 588 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.35 2.97 3.14 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th 1.33 0.79 2.91 2	2.57 2.48 4.26 3.63 3.31 3.37 2.66 3.00 3.26 3.07 2.81 3.02 2.47 4.26 4.26 9.2.57 2.48 4.26 3.63 3.31 3.37 3.10 2.32	1.10 1.08 1.30 1.10 1.08 1.14 1.10 1.10 1.08 1.14 1.12 1.11 1.16 0.94 0.95 1.02 1.10 Mg % 0.95 1.02 1.10 1.01 1.01 1.01 1.01 1.01 1.01	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.44 0.42 0.27 0.26 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.347 0.50 0.74 0.50 0.75 0.74 0.50 0.75 0.75 0.75 0.75 0.75 0.75 0.75	1.17 1.08 1.04 1.05 1.09 1.10 1.05 1.09 1.10 1.05 1.03 0.87 0.885 0.98 0.97 0.98 0.97 1.12 1.17 1.10 1.08 1.09 1.10 1.01 1.01 1.02 1.03 1.03 1.04 1.06 1.08 1.04 1.06 1.08 1.09 1.11 1.05	707 652 511 431 410 484 423 371 373 366 509 462 641 583 3427 707 652 511 431 431 444 423 371	0.41 0.41 0.20 0.20 0.33 0.27 0.51 0.31 0.42 0.35 0.13 0.11 0.16 0.15 8 96 0.38 0.35 0.41 0.40 0.15 0.17 0.13 0.15 0.17 0.13 0.19 0.19 0.19 0.35 0.41 0.42 0.45	470 451 274 275 313 311 300 259 308 314 467 225 202 223 221 337 223 221 223 221 467 467 451 467 467 451 467 467 467 467 467 467 467 467 467 467	7 4 10 10 10 8 10 12 11 1 10 10 10 11 1 1 value As ppm 11 7 7 4 10 10 8 10 10 10 10 10 10 10 10 10 10 10 10 10	0.3 0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 9 7 6 Pppm Coppm 6 8 8 10 7 8 8 10 10 10 10 10 10 10 10 10 10 10 10 10	207 168 114 1102 115 117 111 120 109 123 132 121 136 127 87 87 Cr ppm 116 170 207 168 114 102 115 117 110 117 117 117 117 117 118 118 119 119 119 119 119 119 119 119	102 94 55 56 70 72 66 63 82 84 74 70 107 107 104 49 55 Cu ppm 87 94 102 94 55 66 66 63 63 63 66 74 74 70 72 72 74 74 74 75 76 76 76 76 76 76 76 76 76 76 76 76 76	19.3 18.1 16.2 15.9 16.8 17.2 16.5 17.2 16.7 17.8 14.0 15.6 16.8 15.2 14.9 Ga ppm 16.2 17.3 19.3 19.3 19.3 19.3 19.3 19.3 16.6 16.8 17.2 16.9	21 20 21 22 22 20 21 La ppm 19 21 20 21 22 22 22 22 20 21 24 25 25 24 18 8 16 20 20 21 23 20 21 21 20 21 22 22 20 21	240 243 344 441 449 367 322 487 350 350 226 276 240 243 500 444 441 449 391 367	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.4 0.5 0.4 0.6 1.0 0.5 0.4 1.1 0.5 0.4 1.5 0.6 0.6 0.6 0.6 0.6 0.6 0.0 0.7 0.8 0.8 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	76 70 73 64 67 64 67 74 55 66 68 84 59 53 70 61 57 57 57 Ni ppm	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 15.4 14.7 22.3 25.4 20.0 27.3 20.0 27.3 20.0 27.3 20.0 27.3 20.0 27.3 20.1 18.8 16.9 15.9 15.9 15.8 16.9 15.9 15.8 16.9 15.9 15.8	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 21.5 8c ppm 20 20.9 24.8 23.1 19 18.6 20.9 20.9 21.7 21.6 20.8 20.2 20.1 21.7 21.6 20.8 20.9 20.9 20.9 20.9 20.9 20.9 20.9 20.9	284 247 142 118 150 143 172 163 166 191 151 183 129 94 163 1154 125 112 205 178 284 247 142 218 150 143 151 151 151 151 151 151 151 151 151 15	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 Th ppm	0.4 0.3 0.3 0.3 0.5 0.4 0.3 0.4 0.3 0.4 0.3 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.8 0.9 0.7 0.7 0.7 0.7 0.7 1.7 0.6 0.6 0.6 0.7 1.2 1.2 1.2 1.2 1.3 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	182 164 122 131 128 131 127 118 134 134 132 112 154 95 94 141 122 154 95 94 139 158 182 164 122 113 128 131 131 131 131 131 131 131 131 131 13	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 141 122 166 178 134 141 122 166 178 179 179 179 179 179 179 179 179 179 179
577 T S 577 S S 578 S S 578 S S 578 T S 580 T S 580 S S 581 T S 581 S S 582 S 583 S S 584 T S 585 S S 586 S S 586 S S 587 T T S 577 T S 577 T S 578 S S 578 S S 579 S S 580 T S 579 S S 580 T S 585 S S 586 S S 587 T S 577 S S 577 T S 578 S S 579 S S 580 T S 578 S S	0.72 0.92 2.11 2.03 2.25 1.90 3.35 3.59 2.73 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th 1.72 2.11 2.03 2.25 1.90 0.68 0.40 0.37 1.81 1.72 2.13 1.92 1.92 1.93 1.93 1.94 1.95 1	2.57 2.48 4.26 3.63 3.31 3.37 2.66 3.00 3.26 3.02 2.47 3.09 2.47 4.09 2.57 4.48 4.26 3.63 3.31 3.37 3.33 3.37 3.31 3.37 3.31 3.37 3.31 3.31	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 values le Mg % 0.97 1.12 1.10 1.08 1.10 1.08 1.10 1.08 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.44 0.42 0.27 0.26 0.88 0.74 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.3	1.17 1.08 1.04 1.09 1.09 1.10 1.05 1.03 0.87 0.98 0.97 0.88 0.97 1.12 1.17 1.08 1.11 1.05 1.11 1.11 1.05 1.03 0.87 0.87 0.88	707 652 511 431 431 431 432 3371 333 438 332 366 509 462 641 583 427 7337 542 658 707 652 511 431 410 484 423 331 438 438 438 438 438 438 438 438 438 438	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.18 0.19 0.17 0.13 0.11 0.16 0.15 96 0.35 96 0.35 0.41 0.41 0.41 0.40	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221 8e only 451 470 451 451 451 451 451 451 451 451 451 451	7 4 10 10 8 10 12 11 13 7 11 10 10 10 11 11 17 7 7 4 10 10 8 10 12 11 11 10 10 10 11 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <1 <1 <1 cd ppm 0.2 0.2 0.3 <1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9 7 6 Ppm Co ppm 6 8 8 10 7 6 8 10 7 6 6 8 10 7 7 8 8 10 10 10 10 10 10 10 10 10 10 10 10 10	207 168 114 1102 115 117 93 115 120 123 132 121 136 127 87 87 207 168 170 207 168 114 102 115 117 119 119 121 136 121 136 127 137 137 138 138 138 138 138 138 138 138 138 138	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55 55 Cu ppm 87 94 102 94 55 56 66 63 82 82 84 80 70 70 70 70 70 70 70 70 70 70 70 70 70	19.3 18.1 16.2 15.9 16.8 17.2 16.7 17.6 16.5 17.2 16.7 17.8 14.0 15.6 16.8 15.2 14.9 Ga ppm 16.2 17.3 19.3 18.1 16.2 15.9 15.6 16.8 17.2 17.6 16.6 16.5 17.3	21 20 21 22 22 22 24 18 16 20 20 21 23 21 22 22 22 22 22 22 22 20 21 24 22 22 22 22 22 22 24 24 22 24 24 25 25 25 25 25 25 25 25 25 25 25 25 25	240 243 243 500 444 4411 449 367 322 246 247 359 240 247 240 247 240 247 240 247 240 247 247 240 247 247 240 247 247 247 247 247 247 247 247 247 247	5.0 5.6 1.5 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.6 1.0 1.1 1 0.5 5.0 0.4 1.5 5.0 0.6 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	76 70 73 67 64 67 74 55 66 68 84 59 61 57 57 70 61 57 57 67 76 67 76 67 76 67 76 67 76 67 76 67 76 67 76 67 67	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.3 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 8 22.2 17.5 18.5 20 20.9 24.8 23.1 19 18.6 20.2 20.1 20.9 21.7 21.6 20.2 20.1	284 247 142 118 150 163 166 191 183 129 94 163 154 125 178 284 247 142 118 151 178 247 142 118 151 178 178 178 178 178 178 178 178 178 17	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 3.0 3.3 2.8 2.6 Th ppm	0.4 0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 1.3 1.6 0.7 0.8 0.7 0.7 0.7 0.7 0.8 0.9 0.6 0.7 1.7 1.9 0.6 0.6 0.7 1.1 1.2 1.2 1.5 1.3 0.6 0.7 0.8 0.7 0.8 0.9 0.8 0.9 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	182 164 122 113 128 131 127 118 134 134 137 141 122 154 136 95 94 V ppm 139 158 182 122 113 122 113 121 121 121 121 121 12	141 122 166 178 130 147 119 96 114 129 139 96 137 165 124 108 134 141 122 166 178 134 141 122 166 178 189 189 189 189 189 189 189 189 189 18
577 T S 777 S 7578 t 578 S 7578 T 578 S 7578 T 578 S 7578 T 578 S 758 S 759 T 568 S 759 T 568 S 759 T 568 S 758 T 568 S 758 S 758 T 568 S 758 T 576 T 577 S 757 S	0.72 0.92 2.11 2.03 2.25 1.90 3.30 3.59 2.73 3.34 1.17 0.68 % th 1.33 0.72 0.72 0.97 0.72 0.92 2.11 2.03 2.25 1.90 0.37 1.81 1.72	2.57 2.48 4.26 3.33 3.31 3.37 3.10 2.32 2.73 3.02 2.47 2.81 3.02 2.47 4.26 2.66 2.69 2.47 2.16 2.69 4.26 4.26 3.00 3.26 4.26 4.26 4.26 4.26 4.26 4.26 4.26 4	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.16 0.94 0.91 0.97 1.12 0.98 0.95 1.01 1.02 1.01 1.08 1.09 1.01 1.08 1.01 1.08 1.09 1.01 1.08 1.09 1.09 1.09 1.09 1.09 1.09 1.09 1.09	0.86 0.75 0.50 0.447 0.50 0.47 0.12 0.10 0.38 0.43 0.444 0.42 0.26 0.26 0.74 0.74 0.74 0.74 0.75 0.33 0.47 0.50 0.86 0.75 0.33 0.47 0.50 0.48 0.51	1.17 1.08 1.04 1.05 1.05 1.03 0.87 0.98 0.97 0.95 1.12 0.98 0.97 1.08 1.09 1.11 1.08 1.09 1.09 1.10 1.09 1.10 1.09 1.10 1.05 1.09 1.09 1.09 1.09 1.09 1.09 1.09 1.09	707 652 511 431 440 484 423 371 336 650 9462 641 583 337 Pppm 542 658 511 410 484 423 337 465 83 37 465 83 37 465 84 84 84 84 84 84 84 84 84 84 84 84 84	0.41 0.41 0.41 0.20 0.19 0.33 0.27 0.31 0.42 0.35 0.13 0.11 0.16 0.15 0.38 0.35 % 0.40 0.17 0.13 0.19 0.10 0.1	470 451 274 275 313 311 300 259 308 467 371 255 202 371 337 221 Se only Ba ppm 451 274 470 451 275 313 314 467 371 371 337 221 339 407 407 407 407 407 407 407 407 407 407	7 4 10 10 8 10 12 11 11 10 10 10 11 11 17 1 1 1 10 10 11 17 7 4 11 10 10 8 10 10 12 11 11 10 8 11 11 11 11 11 11 11 11 11 11 11 11 1	0.3 0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6 ppm Co ppm 6 8 8 8 10 9 10 9 10 9 10 9 10 9 10 9 10	207 168 114 1102 115 117 111 115 120 123 132 121 127 87 87 116 127 87 170 207 168 170 207 168 114 102 115 117 111 119 119 119 119 119 119 119 119	102 94 70 72 66 63 82 84 74 70 107 104 955 55 67 70 72 94 55 66 63 82 84 74 74 70 74 70 74 70 74 70 70 70 70 70 70 70 70 70 70 70 70 70	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 17.6 16.5 17.8 14.0 15.6 16.8 17.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3	21 20 21 22 22 20 21 24 18 16 20 20 21 21 22 22 20 21 24 22 22 20 21 24 22 22 20 21 24 22 24 22 24 22 24 22 24 22 24 24 22 25 24 24 22 25 26 26 26 26 26 26 26 26 26 26 26 26 26	240 243 500 444 441 449 367 322 339 316 397 350 354 328 Mn ppm 226 240 243 500 444 441 449 367 329 316 339 350 354 328	5.0 5.6 1.5 0.6 0.6 0.6 0.6 0.3 0.3 0.4 0.4 0.4 0.6 0.6 0.6 1.0 1.1 0.5 0.4 1.5 5.0 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0	76 70 73 67 64 67 74 55 66 68 65 84 65 87 57 57 57 57 57 67 70 73 67 76 67 76 67 67 67 68 67 68 68 68 68 68 68 68 68 68 68 68 68 68	24.7 (25.7 (25.7 (26.1 (0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.3 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 21.5 18.5 Sc ppm 20 20.9 24.8 23.1 19 21.7 24.8 20.9 21.7 22.1 22.1 22.1 22.2 22.1 22.1 22.1	284 247 142 118 150 143 166 161 151 183 129 94 163 154 125 112 205 178 284 247 142 143 154 154 165 178 178 188 188 188 188 188 188 188 188	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 Th ppm	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.7 0.7 0.9 0.6 0.7 1.7 1.9 1.6 0.6 0.6 0.7 0.7 0.7 0.8 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.8 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.8 0.6 0.7 0.7 0.7 0.7 0.7 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	182 164 122 131 128 131 127 118 134 138 134 137 141 122 112 113 154 136 95 94 V ppm 139 158 182 164 122 113 128 113 113 128 131 136 137 141 158 159 169 179 189 189 189 189 189 189 189 189 189 18	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 122 114 121 217 117 121 121 121 121 121 121 121
577 T S 577 S 578 I S 578 S 578 S 579 T S 578 S 581 T S 582 S 583 S 584 T S 584 S 585 T S 586 S 586 T S 587 T T 577 S 577 T S 578 S 579 T S 579 T S 579 T S 579 S 580 T S 580 S 581 T S	0.72 0.92 2.11 2.03 2.25 1.90 3.35 3.59 2.73 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th 1.72 2.11 2.03 2.25 1.90 0.68 0.40 0.37 1.81 1.72 2.13 1.92 1.92 1.93 1.93 1.94 1.95 1	2.57 2.48 4.26 3.63 3.31 3.37 2.66 3.00 3.26 3.02 2.47 3.09 2.47 4.09 2.57 4.48 4.26 3.63 3.31 3.37 3.33 3.37 3.31 3.37 3.31 3.37 3.31 3.31	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 values le Mg % 0.97 1.12 1.10 1.08 1.10 1.08 1.10 1.08 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.44 0.42 0.27 0.26 0.88 0.74 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.3	1.17 1.08 1.04 1.09 1.09 1.10 1.05 1.03 0.87 0.98 0.97 0.88 0.97 1.12 1.17 1.08 1.11 1.05 1.11 1.11 1.05 1.03 0.87 0.87 0.88	707 652 511 431 431 431 432 3371 333 438 332 366 509 462 641 583 427 7337 542 658 707 652 511 431 410 484 423 331 438 438 438 438 438 438 438 438 438 438	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.18 0.19 0.17 0.13 0.11 0.16 0.15 96 0.35 96 0.35 0.41 0.41 0.41 0.40	470 451 274 275 313 311 300 259 308 314 467 371 255 202 371 337 223 221 8e only 451 470 451 451 451 451 451 451 451 451 451 451	7 4 10 10 8 10 12 11 13 7 11 10 10 10 11 11 17 7 7 4 10 10 8 10 12 11 11 10 10 10 11 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.1 <1 <1 <1 cd ppm 0.2 0.2 0.3 <1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9 7 6 Ppm Co ppm 6 8 8 10 7 6 8 10 7 6 6 8 10 7 7 8 8 10 10 10 10 10 10 10 10 10 10 10 10 10	207 168 114 1102 115 117 93 115 120 123 132 121 136 127 87 87 207 168 170 207 168 114 102 115 117 119 119 121 136 121 136 127 137 137 138 138 138 138 138 138 138 138 138 138	102 94 55 56 70 72 66 63 82 84 74 80 74 70 107 104 49 55 55 Cu ppm 87 94 102 94 55 56 66 63 82 82 84 80 70 70 70 70 70 70 70 70 70 70 70 70 70	19.3 18.1 16.2 15.9 16.8 17.2 16.7 17.6 16.5 17.2 16.7 17.8 14.0 15.6 16.8 15.2 14.9 Ga ppm 16.2 17.3 19.3 18.1 16.2 15.9 15.6 16.8 17.2 17.6 16.6 16.5 17.3	21 20 21 22 22 22 24 18 16 20 20 21 23 21 22 22 22 22 22 22 22 20 21 24 22 22 22 22 22 22 24 24 22 24 24 25 25 25 25 25 25 25 25 25 25 25 25 25	240 243 243 500 444 4411 449 367 322 246 247 359 240 247 240 247 240 247 240 247 240 247 240 247 240 247 240 247 247 240 247 247 247 247 247 247 247 247 247 247	5.0 5.6 1.5 0.6 0.6 0.6 0.7 0.4 0.4 0.6 1.0 1.1 0.5 0.4 1.5 5.0 0.4 1.5 5.0 0.6 0.6 0.6 0.6 0.3 0.3 0.4 1.5 5.0 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0	76 70 73 67 64 67 74 55 66 68 84 59 61 57 57 70 61 57 57 67 76 67 76 67 76 67 76 67 76 67 76 67 76 67 76 67 67	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.3 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 15.6 8 22.2 17.5 18.5 20 20.9 24.8 23.1 19 18.6 20.2 20.1 20.9 21.7 21.6 20.2 20.1	284 247 142 118 150 163 166 191 183 129 94 163 154 125 178 284 247 142 118 151 178 247 142 118 151 178 178 178 178 178 178 178 178 178 17	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 3.0 3.3 2.8 2.6 Th ppm	0.4 0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 1.3 1.6 0.7 0.8 0.7 0.7 0.7 0.7 0.8 0.9 0.6 0.7 1.7 1.9 0.6 0.6 0.7 1.1 1.2 1.2 1.5 1.3 0.6 0.7 0.8 0.7 0.8 0.9 0.8 0.9 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	182 164 122 113 128 131 127 118 134 134 137 141 122 154 136 95 94 V ppm 139 158 182 122 113 122 113 121 121 121 121 121 12	141 122 166 178 130 147 119 96 114 129 139 150 137 165 124 108 134 141 114 134 141 112 166 178 18 130 147 119 120 139 139 139 139 139 139 139 139 139 139
577 T S 577 S 578 I S 578 S 578 S 579 T S 5778 I S 578 S 579 T S 578 S 580 T S 580 T S 581 T S 581 S 582 S 583 S 584 T S 584 S 585 T S 585 S 585 T S 586 S 587 T S 587 T S 587 T S 576 T S 576 T S 576 S 577 T S 577 S 577 T S 578 T S	0.72 0.92 2.11 2.03 2.25 1.90 3.59 2.73 3.34 2.97 3.34 2.97 3.34 1.17 0.72 2.11 1.33 0.79 0.72 0.92 2.11 2.03 2.25 1.90 3.39 9.68 9.68 9.69 1.90 2.11 2.11 2.11 2.11 2.11 2.11 2.11 2.1	2.57 2.48 4.26 3.31 3.37 3.10 2.32 2.73 3.00 2.78 Hg all vl 2.66 3.00 2.47 7.28 4.26 3.01 2.247 3.02 2.47 3.00 2.247 3.00 2.247 3.00 2.257 2.48 4.26 3.03 3.31 3.37 2.25 2.25 2.48 4.26 3.03 3.31 3.37 2.25 2.25 2.48 3.33 3.37 2.25 2.35 2.35 2.35 2.35 2.35 2.35 2.35	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.02 1.11 1.16 0.94 0.95 1.02 1.01 1.08 1.30 0.97 1.12 1.10 1.08 1.30 1.10 1.10 1.10 1.10 1.10 1.10 1.11 1.10 1.08 1.11 1.11	0.86 0.75 0.50 0.447 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.43 0.444 0.74 0.62 0.75 0.74 0.75 0.33 0.47 0.50 0.86 0.75 0.34 0.41 0.74 0.75 0.38 0.41 0.75 0.38 0.41 0.75 0.38 0.41 0.75 0.38 0.47 0.50 0.38 0.41 0.50 0.38 0.41 0.50 0.38 0.51 0.50 0.38 0.41 0.50 0.38 0.51 0.50 0.38 0.51 0.50 0.38 0.51 0.50 0.38 0.51 0.50 0.38 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.50 0.68 0.51 0.68 0.51 0.68 0.51 0.68 0.51 0.68 0.51 0.68 0.51 0.68 0.68 0.75 0.68 0.68 0.75 0.68 0.75 0.68 0.75 0.68 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75	1.17 1.08 1.04 1.05 1.05 1.03 0.87 0.98 0.97 0.95 1.12 0.98 0.97 1.08 1.04 1.08 1.09 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.10 1.05 1.03 1.04 1.05 1.03 1.05 1.03 1.05 1.03 1.05 1.03 1.05 1.03 1.08	707 652 511 431 440 484 423 371 336 650 9462 641 583 302 366 652 511 410 484 427 337	0.41 0.41 0.41 0.20 0.19 0.33 0.27 0.31 0.41 0.13 0.11 0.16 0.15 0.35 % 0.35 % 0.40 0.17 0.13 0.19 0.10 0.15 0.17 0.13 0.19 0.17 0.13 0.19 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.17 0.18 0.19 0.19 0.15	470 451 274 275 313 311 300 259 308 467 371 225 222 221 Se only Ba ppm 451 274 313 313 314 467 321 255 321 337 451 339 451 349 451 451 451 451 451 451 451 451 451 451	7 4 10 10 8 11 11 13 7 7 11 10 10 8 11 11 10 10 11 11 10 10 11 11 10 10 11 11	0.3 0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 <.1 <.1 cthan I Cd ppm 0.2 0.2 0.3 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0	10 9 10 7 8 8 8 5 6 7 8 10 6 6 9 9 7 6 ppm Co ppm 6 8 10 7 8 8 8 5 6 7 8 10 6 6 6 9 10 6 6 6 7 8 10 6 6 6 6 9 10 6 6 6 6 7 8 10 6 6 6 6 7 8 8 8 6 7 8 10 6 6 6 7 8 8 8 6 7 8 8 6 7 8 8 6 7 8 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 6 7 8 8 6 7 8 8 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 6 6 6 7 8 8 8 8	207 168 114 115 117 111 93 115 120 109 123 132 121 136 127 87 87 Cr ppm 116 170 109 115 117 110 193 115 117 111 115 117 111 111 120 109 123 132	102 94 70 72 66 63 82 84 74 70 107 104 955 87 94 102 94 55 66 63 82 82 84 74 74 70 70 70 71 95 96 96 96 96 96 96 96 96 96 96 96 96 96	19.3 18.1 16.2 15.9 16.8 17.2 17.6 16.5 17.2 17.6 16.7 19.5 17.8 14.0 16.2 14.9 Ga ppm 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.3 17.4 16.5 17.5 17.8	21 20 21 22 22 22 25 24 18	240 243 500 444 441 449 367 322 339 316 397 350 354 328 Mn ppm 226 240 243 500 449 441 449 367 329 316 397 350 354 328	5.0 5.6 6.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0	76 70 73 67 64 67 74 55 66 68 65 84 59 53 70 61 57 57 57 57 67 70 73 67 64 67 74 67 68 68 68 68 68 68 68 68 68 68 68 68 68	24.7 (25.7 (0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.2 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 20.8 22.2 20.9 20.9 20.9 20.9 20.9 20.9 21.7 23.4 23.8 23.1 23.8 23.1 20.9 21.7 23.4 23.8 23.1 23.1 24.8 25.1 25.8 26.9 27.9 27.9 27.9 28.9 28.9 29.9 21.7 21.6 20.9 21.7 21.6 20.1 23.4 23.8 23.4 23.8 23.1 23.1 24.8 25.8 26.8 27.8 27.8 28.8 28.8 28.8 28.8 28.8 28	284 247 142 118 150 143 166 161 151 183 129 94 163 154 125 112 205 178 284 247 142 143 150 143 151 112 112 112 112 112 112 113 114 115 116 116 116 116 116 116 116 116 116	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 Th ppm 3.0 3.1 3.1 3.1 3.2 2.4 3.0 3.3 3.2 2.4 3.0 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.7 0.9 0.6 0.7 1.7 1.9 1.6 0.6 0.7 1.2 1.2 1.2 1.2 1.3 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	182 164 122 113 128 131 127 118 134 137 141 122 154 136 95 94 V ppm 139 158 182 164 122 113 128 131 128 131 141 129 158 131 141 141 158 158 158 158 158 158 158 158 158 15	141 122 166 178 130 1477 1419 141 122 166 178 130 137 141 141 122 166 178 130 1477 141 141 141 141 141 141 141 141 14
677 T G 677 S G 678 t G 681 T G 682 G 683 T G 684 T G 685 T G 685 T G 685 T G 685 T G 686 T G 686 T G 676 S G 676 T G 677 T G 677 T G 677 T G 677 T G 678 T G	0.72 0.92 1.92 0.93 2.25 1.90 3.59 2.73 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca % th 1.33 0.79 0.72 0.92 2.11 2.03 3.39 3.39 3.34 1.17 0.68	2.57 2.48 4.26 3.33 3.31 3.37 3.266 3.00 2.247 8.426 3.63 3.07 2.81 3.02 2.47 3.09 2.78 Hg all \(\text{V} \)	1.10 1.08 1.30 1.11 1.02 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.11 1.00 0.97 1.12 1.10 1.08 1.10 0.97 1.12 1.10 1.10 1.10 1.10 1.10 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.44 0.74 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.3	1.17 1.08 1.04 1.09 1.09 1.10 1.05 1.09 1.10 1.05 1.03 0.87 0.98 0.97 0.98 0.99 1.12 1.17 1.08 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.10 1.09 1.03 1.09 1.03 1.09 1.03 1.09 1.03 1.09 1.03 1.09 1.03 1.09 1.03 1.03 1.09 1.03 1.03 1.03 1.03 1.03 1.03 1.03 1.03	707 652 511 431 431 431 432 371 373 366 509 P P P P P P P P P P P P P P P P P P P	0.41 0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.42 0.13 0.18 0.19 0.15 0.15 0.13 0.11 0.15 0.15 0.35 0.13 0.11 0.15	470 451 274 275 313 311 300 259 308 467 371 255 202 371 337 223 221 Se only 366 470 451 274 451 274 275 313 311 274 275 313 311 274 275 313 314 275 315 315 315 315 315 315 315 315 315 31	7 4 10 10 8 8 10 12 11 11 10 10 11 11 17 11 10 10 10 11 11 11 11 11 11 11 11 11	0.3 0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 <.1 <.1 <.1 Cd ppm 0.2 0.2 0.3 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 <.1 <.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0	10 9 10 7 8 8 8 5 6 6 7 8 110 6 6 6 9 9 9 110 7 8 8 8 110 7 8 8 8 110 7 7 8 8 8 8 8 110 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	207 168 114 115 117 111 93 115 120 123 132 132 136 127 87 87 87 87 116 170 207 168 114 102 115 117 111 111 113 115 120 109 123 115 117 111 111 111 111 111 111 111 111	102 94 55 66 63 82 474 49 102 994 102 94 102 88 44 74 80 72 66 63 82 87 94 102 94 55 66 70 72 66 88 44 74 80 74 70	19.3 18.1 16.2 15.9 16.8 17.2 16.7 17.6 16.5 17.2 16.7 17.8 14.0 16.2 15.6 16.8 15.2 14.9 Ga ppm 16.2 17.3 19.3 19.3 19.3 19.3 19.3 19.3 19.3 19	21 20 21 22 22 22 25 24 18 16 20 20 21 23 22 22 22 22 22 22 24 24 18 8 16 20 20 21 24 22 22 22 20 21 24 22 25 24 18 16	240 243 344 441 449 367 322 487 350 350 354 328 Mn ppm 226 276 240 243 500 444 441 449 367 322 339 487 329 339 339 339 339 350 354 328	5.0 5.6 6.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0	76 70 73 67 64 67 74 55 66 68 65 84 59 9 70 61 57 57 77 67 73 67 70 64 67 70 73 67 68 68 68 68 68 68 68 68 68 68 68 68 68	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 20.8 22.2 17.5 8c ppm 20 20.9 24.8 23.1 19 18.6 20.9 24.8 23.1 19 21.7 21.6 20.9 22.1 23.4 23.8 11.2 21.7 21.6 20.9 21.7 21.6 20.9 21.7 21.6 21.7 21.7 21.6 21.7 21.7 21.6 21.7 21.7 21.6 21.7 21.7 21.6 21.7 21.7 21.7 21.7 21.7 21.7 21.7 21.7	284 247 142 247 148 150 143 166 161 183 129 94 163 154 125 178 284 247 142 118 170 143 171 171 183 172 205 178 284 181 183 172 299 183 184 185 186 191 181 183 129 94	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 Th ppm 3.0 3.1 3.1 3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.2 4 3.0 3.3 2.8 2.8 2.6 2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 1.3 1.6 0.7 0.8 0.7 0.7 0.7 0.7 0.9 0.6 0.7 1.7 1.9 0.6 0.6 0.7 1.2 1.2 1.2 1.3 0.6 0.7 0.7 0.7 0.8 0.7 0.7 0.7 0.8 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	182 164 122 131 128 131 127 118 134 137 141 122 154 136 95 94 V ppm 139 158 182 113 122 113 122 113 121 124 136 136 137 141 127 136 137 141 127 136 137 137 141 141 141 141 141 141 141 141 141 14	141 122 166 178 130 147 119 96 114 129 150 137 165 124 108 134 141 141 112 166 178 130 147 119 166 178 189 180 180 180 180 180 180 180 180 180 180
677 T G 677 S 677 S 678 S 679 T 678 S 679 T 679 S 680 T 680 S 681 T 688 S 684 T 685 S 685 S 686 S 686 S 686 S 686 S 686 S 687 T 676 S 677 T 679 S 680 T 679 S 680 T	0.72 0.92 2.11 2.03 2.25 1.90 3.36 3.59 2.73 3.34 1.17 2.03 0.68 0.40 0.37 1.81 1.72 Ca % th 1.33 0.79 0.72 2.11 2.03 3.00 2.25 1.90 3.30 3.59 2.73 3.14 1.17 0.68 0.40 0.40 0.40 0.40 0.40 0.40 0.40 0.4	2.57 2.48 4.26 3.33 3.31 2.66 3.00 3.26 3.00 2.47 3.09 2.57 4.26 4.26 3.63 3.31 3.37 3.10 2.273 2.66 3.63 3.31 3.37 3.10 2.32 2.73 2.66 3.63 3.03 2.73 2.66 3.00 3.26 3.07 2.81 3.00 2.81 3.00 2.81 3.00 2.81 3.00 2.81 3.00	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.01 1.08 0.97 1.12 1.10 1.08 1.10 1.10 1.08 1.10 1.10 1.10	0.86 0.75 0.33 0.47 0.50 0.47 0.50 0.47 0.12 0.10 0.38 0.41 0.42 0.27 0.26 0.88 0.51 0.74 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.47 0.50 0.48	1.17 1.08 1.04 1.09 1.10 1.05 1.09 1.10 1.05 1.03 0.87 0.85 0.98 0.97 1.12 1.17 1.08 1.09 1.10 1.09 1.10 1.01 1.05 1.03 0.87 0.88	707 652 511 431 431 431 432 3371 373 438 509 Pppm 542 658 707 652 511 431 431 431 433 371 373 371 438 652 641 652 652 663 652 663 652 663 665 652 664 665 665 665 665 665 665 665 665 665	0.41 0.41 0.20 0.19 0.33 0.27 0.51 0.31 0.18 0.19 0.17 0.13 0.11 0.16 0.15 8 96 0.27 0.51 0.35 0.35 0.41 0.16 0.17 0.17 0.17 0.17 0.18 0.19	470 451 274 275 313 311 300 259 308 314 467 371 223 221 223 221 8e only 451 274 275 311 300 309 366 470 451 311 309 451 311 309 451 311 309 451 311 311 311 311 311 311 311 311 311 3	7 4 10 10 8 10 12 11 11 10 10 10 11 11 17 7 4 10 10 10 12 11 11 13 7 7 11 11 10 10 10 11 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6 Pppm Coppm Coppm 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 7 6 Pppm 6 8 8 10 6 6 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 9 10 6 6 6 6 9 9 10 6 6 6 6 9 9 10 6 6 6 6 9 9 10 6 6 6 6 9 9 10 6 6 6 6 9 9 10 7 8 8 8 8 10 6 6 6 6 9 9 10 7 8 8 10 6 6 6 6 9 9 10 7 8 10	207 168 114 1102 115 117 111 93 115 120 123 132 121 136 127 87 87 Cr ppm 116 170 207 168 114 102 115 117 111 119 119 115 120 121 131 132 132 133 132 133 133 133 133	102 94 70 72 66 63 82 84 74 70 107 104 955 87 94 102 94 55 66 63 82 82 84 74 74 70 70 70 71 95 96 96 96 96 96 96 96 96 96 96 96 96 96	19.3 18.1 16.2 15.9 16.8 17.2 16.7 17.6 16.5 17.2 16.7 17.8 14.0 Ga ppm Ga ppm 16.2 17.3 19.3 18.1 16.2 17.9 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.8 17.2 17.6 16.5 17.2 16.7 17.8 14.0	21 20 21 22 22 22 24 18 16 20 21 22 22 22 20 21 24 22 25 24 18 20 21 23 20 21 24 22 20 21 24 22 20 21 24 22 25 24 18 16 20	240 243 243 367 309 3444 441 449 367 350 354 37 350 240 240 243 350 444 449 391 367 367 37 37 389	5.0 5.6 6.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0	76 70 73 67 64 67 74 55 66 68 84 59 70 61 57 57 76 67 73 67 74 64 67 74 68 88 65 88 65 65 67 70 68 68 68 68 68 68 68 68 68 68 68 68 68	24.7 25.7 17.4 20.5 20.1 18.8 16.3 17.5 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20	0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 17.5 18.5 Sc ppm 20 20.9 24.8 23.1 19 18.6 20.9 24.8 23.1 19 18.6 20.9 24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 23.4 23.8 17.2 25.6 20.9 20.9 21.7 21.6 20.9 20.9 21.7 21.6 20.9 20.9 20.9 20.9 20.9 20.9 20.9 20.9	284 247 142 118 150 163 166 191 183 129 94 163 154 125 178 284 142 118 205 178 247 142 118 150 166 191 112 103 104 105 105 105 105 105 105 105 105 105 105	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 2.4 2.4 3.0 3.3 2.8 2.6 3.1 3.1 3.1 3.2 2.4 3.3 2.4 3.3 2.6 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1	0.4 0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 1.3 1.6 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.9 0.6 0.7 1.7 1.9 0.6 0.6 0.7 1.2 1.2 1.5 1.3 0.6 0.7 0.7 0.7 0.8 0.9 0.9 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	182 164 122 113 128 131 127 118 134 133 141 122 154 136 95 94 V ppm 158 182 122 113 128 131 127 141 129 154 136 136 141 129 141 141 141 158 158 169 169 179 179 189 189 189 189 189 189 189 189 189 18	141 122 166 178 130 147 179 139 150 137 165 144 141 122 166 178 130 147 179 139 139 130 147 141 122 130 137 150 137 150 137 150 137 155 124 130 137 155 137 155 124 130 137 155 124 130 137 155 124 130 137 155 124 130 137 155 124 130 137 155 124 130 137 155 124 130
677 T G 677 S G 678 t G 680 T G 680 T G 681 S G 681 S G 682 G 683 T G 684 T G 685 S G 685 T G 686 T G 686 T G 676 S G 676 T G 677 T G 677 S G 678 T G 679 S G 688 T S 688 T	0.72 0.92 2.11 2.03 2.25 1.90 3.59 2.73 3.34 1.17 1.81 1.72 Ca % th 1.33 0.79 0.72 2.11 2.03 3.59 2.73 3.34 1.17 2.03 3.14 1.72 2.11 2.03 3.00 3.00 3.00 3.00 3.00 3.00 3.00	2.57 2.48 4.26 3.33 3.31 3.37 3.02 2.47 3.09 2.57 9.4 4.26 3.33 3.37 3.10 2.32 2.47 3.09 2.57 3.10 2.48 4.26 3.63 3.31 3.37 3.10 2.48 4.26 3.63 3.63 3.63 3.63 3.63 3.70 3.10 3.26 3.07 3.10 3.26 3.07 3.10 3.26 3.07 3.10 3.26 3.07 3.10 3.26 3.07 3.07 3.07 3.07 3.07 3.07 3.07 3.07	1.10 1.08 1.30 1.14 1.10 1.08 1.14 1.12 1.11 1.16 0.94 0.95 1.02 1.10 0.97 1.12 1.10 0.98 1.30 1.10 1.10 0.97 1.11 1.10 0.98 1.30 1.10 0.97 1.12 1.11 1.16 0.94 0.95 0.97 1.12 1.10 0.98 0.95 0.97 1.12 1.10 0.98 0.95 0.97 1.10 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.9	0.86 0.75 0.33 0.47 0.50 0.48 0.51 0.50 0.47 0.12 0.10 0.38 0.44 0.42 0.26 0.74 0.74 0.86 0.75 0.33 0.33 0.33 0.33 0.33 0.47 0.50 0.48 0.60 0.79 0.70 0.70 0.70 0.70 0.70 0.70 0.7	1.17 1.08 1.04 1.09 1.10 1.05 1.09 1.10 1.05 1.03 0.87 0.88 0.97 0.88 0.97 1.12 1.17 1.04 1.06 1.08 1.09 1.11 1.05 1.01 0.95 1.12 1.17 1.08 1.04 1.06 1.09 1.11 1.05 1.08 1.09 1.11 1.05 1.08 1.09 1.11 1.05 1.08 1.09 1.11 1.05 1.08 1.09 1.11 1.05 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.10 1.08 1.09 1.08 1.09 1.08 1.09 1.08 1.08 1.09 1.10 1.08 1.08 1.09 1.10 1.08 1.08 1.08 1.08 1.08 1.08 1.08	707 652 511 431 431 431 432 3371 373 438 438 432 6641 583 427 707 652 511 431 431 438 423 337 337	0.41 0.41 0.20 0.33 0.27 0.31 0.18 0.19 0.35 0.13 0.18 0.19 0.15 0.17 0.13 0.11 0.16 0.15 %	470 451 274 275 313 311 300 259 308 467 371 255 202 371 337 223 221 Se only 366 470 470 451 274 275 313 311 325 318 319 319 319 319 319 319 319 319 319 319	7 4 10 10 8 8 10 12 11 11 10 10 10 11 11 10 10 10 11 11 10 10	0.3 0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 6 7 8 110 6 6 6 9 9 9 110 7 8 8 8 110 7 8 8 8 110 7 7 8 8 8 8 8 110 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	207 168 114 115 117 115 120 123 132 132 136 127 87 87 87 116 170 207 168 114 102 115 117 111 111 113 115 120 123 132 136 127 137 138 138 138 138 138 138 138 138 138 138	102 94 55 66 63 82 44 49 102 994 102 994 102 884 80 70 72 66 63 82 87 87 94 102 994 102 994 102 107 107 107 107 107 107 107 107 107 107	19.3 18.1 16.2 15.9 16.8 17.2 16.7 17.6 16.5 17.2 16.7 17.8 14.0 16.2 14.9 Ga ppm 16.2 17.3 19.3 19.3 19.3 19.3 19.3 19.3 19.3 19	21 20 21 22 22 22 25 24 18 16 20 20 21 22 22 22 22 24 4 22 25 24 4 18 8 16 20 20 21 24 4 22 20 21 24 4 22 20 21 24 4 22 25 24 18 8 16 20 20 20 21 21 22 20 20 21 24 4 22 25 24 25 24 25 24 25 24 25 25 24 25 26 20 20 21 21 22 20 20 20 21 24 22 25 24 25 25 24 25 25 24 25 25 25 25 25 25 25 25 25 25 25 25 25	240 243 500 444 441 449 367 322 339 487 350 226 276 240 243 500 444 449 391 367 322 339 487 329 359 359 369 370 369 370 370 370 370 370 370	5.0 5.6 6.6 0.6 0.6 0.5 0.4 0.5 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	76 70 73 67 64 67 74 55 66 68 65 84 59 9 70 61 73 67 76 67 77 64 67 74 68 68 65 68 68 68 68 68 68 68 68 68 68 68 68 68	24.7 (25.7 (17.4 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.5 (20.1 (20.1 (20.5 (20.1 (0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.3 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.2 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 22.1 22.1 23.4 23.8 22.2 17.5 18.5 Se ppm 20 20.9 24.8 23.1 19 21.6 20.8 23.1 19 21.7 21.6 20.8 23.1 19 21.7 21.6 20.8 23.1 21.7 21.6 20.8 23.1 21.7 21.6 20.8 21.7 21.7 21.7 21.7 21.7 21.7 21.7 21.7	284 247 142 118 150 143 166 191 1151 183 129 94 163 154 125 178 284 247 142 118 172 205 178 284 118 159 118 119 119 119 119 119 119 119 119 11	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 Th ppm 3.0 3.1 3.1 3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.2 4 3.0 3.3 3.2 2.8 2.8 2.6	0.4 0.4 0.3 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.4 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.8 0.7 0.7 0.7 0.7 1.9 0.6 0.7 1.9 1.2 1.2 1.5 1.3 0.6 0.7 0.7 0.7 0.8 0.7 0.7 0.7 0.8 0.9 0.9 0.6 0.7 0.7 0.7 0.7 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9	182 164 122 131 128 131 127 118 134 137 141 122 154 136 95 94 V PPM V PPM 139 158 182 122 131 122 134 135 145 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 141 136 137 138 139 149 149 149 149 149 149 149 14	141 122 166 114 129 150 137 165 124 129 150 137 165 124 141 129 166 114 129 150 147 119 150 137 165 124 141 129 166 114 129 150 137 165 124 188 134 141 129 150 137 165 124 108 137 165 124 108 134 134 188 134 134 188 134 134 188 134 134 188 134 134 188 134 134 134 134 134 134 134 134 134 134
677 T T S T S S S S S S S S S S S S S S S	0.72 0.92 2.11 2.03 2.25 1.90 3.59 2.73 3.34 1.17 0.68 0.40 0.37 1.81 1.72 Ca %6 1.07 2.03 2.25 1.90 0.72 2.03 2.25 1.90 0.72 0.92 2.11 0.68 0.40 0.72 0.92 2.11 0.72 0.92 2.11 0.72 0.92 2.11 0.72 0.92 2.11 0.72 0.92 2.11 0.72 0.92 2.11 0.72 0.92 0.93 0.73 0.74 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75	2.57 2.48 4.26 3.63 3.31 2.32 2.73 2.66 3.00 3.26 2.47 3.09 2.57 4.26 4.26 3.63 3.31 3.02 2.47 3.09 2.57 3.09 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.69 2.57 3.03 2.03 2.03 2.03 2.03 2.03 2.03 2.03	1.10 1.08 1.30 1.10 1.08 1.14 1.11 1.12 1.11 1.16 0.94 0.95 1.02 1.10 1.08 0.97 1.12 1.10 1.08 0.97 1.12 1.11 1.10 0.98 0.97 1.12 1.10 1.08 1.10 1.08 1.11 1.12 1.12 1.12 1.12 1.13 1.13	0.86 0.75 0.50 0.447 0.50 0.40 0.47 0.12 0.10 0.38 0.43 0.444 0.74 0.27 0.26 0.75 0.33 0.47 0.50 0.74 0.75 0.30 0.47 0.50 0.74 0.75 0.30 0.47 0.50 0.47 0.50 0.47 0.50 0.48 0.51 0.50 0.49 0.49 0.40 0.40 0.40 0.40 0.40 0.4	1.17 1.08 1.04 1.09 1.10 1.05 1.09 1.10 1.05 1.03 0.87 0.98 0.97 1.12 1.17 1.08 1.14 1.06 1.08 0.95 1.12 1.17 1.08 1.10 1.11 1.05 1.03 0.87 0.88 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	707 652 511 431 410 484 423 371 373 366 652 511 410 487 658 511 410 484 423 371 373 370 652 6511 410 484 423 371 373 302 664 665 670 670 670 670 670 670 670 670 670 670	0.41 0.41 0.41 0.20 0.19 0.33 0.27 0.31 0.41 0.13 0.11 0.13 0.15 0.13 0.19 0.17 0.13 0.15 0.35 0.13 0.19 0.17 0.13 0.19 0.15 0.17 0.13 0.19 0.15 0.17 0.13 0.19	470 451 274 275 313 311 300 259 308 314 467 371 223 221 223 221 8e only 451 339 366 470 451 274 275 311 309 259 311 309 451 311 309 451 311 309 451 311 309 451 311 311 311 311 311 311 311 311 311 3	7 4 10 10 10 8 10 11 11 11 10 10 11 11 17 7 7 4 11 10 10 8 10 10 11 11 11 11 10 8 11 11 11 10 10 11 11 11 11 11 11 11 11	0.3 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.3 0.3 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	10 9 10 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 10 7 8 8 8 5 6 6 7 8 10 6 6 6 9 9 10 7 8 8 8 8 5 6 6 7 8 10 6 6 6 9 9 9 7 6 6	207 168 114 115 117 111 93 115 120 109 123 132 121 136 17 87 87 Cr ppm 116 170 207 168 114 193 115 117 93 115 117 93 115 117 111 120 109 123 121 136 121 136 121 136 121 136 121 136 127	102 94 70 72 66 63 82 84 74 80 107 104 955 Cu ppm 87 94 155 66 63 82 87 94 55 66 63 82 87 70 72 94 70 70 70 70 70 70 70 70 70 70 70 70 70	19.3 18.1 16.2 16.8 17.2 16.8 17.6 16.5 17.2 17.6 16.7 19.5 17.8 14.0 16.2 14.9 Ga ppm 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.2 17.3 18.1 16.3 17.2 16.3 18.1 16.5 17.2 16.6 16.5 17.2 19.5 17.8 18.6 16.6 16.5	21 20 21 22 22 25 24 18 16 20 21 22 22 22 22 22 22 23 21 24 24 22 25 24 25 24 20 21 24 22 22 20 21 24 22 22 25 24 18 16 20 20 20 20 20 20 20 20 20 20 20 20 20	240 243 500 444 441 449 367 322 316 397 350 226 243 500 244 441 449 367 322 316 397 350 399 316 397 350	5.0 5.6 1.5 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	76 70 73 67 64 67 74 55 66 68 65 84 59 70 61 77 57 85 67 76 64 67 70 73 67 64 67 74 55 66 88 65 84 67 70 61 61 61	24.7 (25.7 (25.7 (26.1 (0.2 0.3 0.1 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.2 0.1 0.1 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.2 0.2 0.2 0.3 0.1 0.2 0.2 0.2 0.3 0.1 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	24.8 23.1 19 18.6 20.9 21.7 21.6 20.2 22.1 23.4 23.8 17.2 20.8 22.2 20.9 20.9 20.9 20.9 20.9 20.9 20.9	284 247 142 118 150 143 163 166 191 151 183 129 94 163 154 125 112 205 178 284 247 142 163 163 164 163 165 178 188 172 188 188 188 188 188 188 188 188 188 18	3.7 3.5 2.7 2.6 2.9 3.1 3.1 3.1 3.2 3.2 2.4 3.0 3.3 2.8 2.6 3.1 3.1 3.1 3.2 2.4 3.0 3.3 3.1 3.1 3.1 3.1 3.2 2.4 3.0 3.3 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1	0.4 0.4 0.3 0.3 0.3 0.5 0.4 0.4 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	1.5 1.3 0.6 0.7 0.8 0.7 0.7 0.7 0.7 0.9 0.6 0.7 1.7 1.9 1.2 1.2 1.2 1.3 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	182 164 122 113 128 131 127 118 134 137 141 122 154 136 95 94 V ppm 139 158 182 164 122 113 128 131 128 131 141 122 154 136 137 141 141 154 154 154 154 154 154 154 154	141 122 166 178 130 1477 165 124 141 122 166 178 130 137 165 124 141 122 166 178 130 1477 119 150 150 150 150 150 150 150 150 150 150

a sample is ashed, there is a loss of weight from the mineral matter, so that a concentration of approximately 85% ash corresponds to a mineral matter concentration of 100% (i.e., no organic carbon content).

RESULTS AND DISCUSSION

Major Elements in Coal Waste

Sulphur occurs in coal as sulphides, as sulphates, or as organic sulphur. Trace metals may be associated with sulphur if the sulphur is present as sulphides. These sulphides may be dispersed in coal or associated with ash. Sulphur has a negative correlation with ash and no correlation with Fe (Figure 6), indicating that a lot of the sulphur is occurring as organic or sulphate sulphur associated with the coal. This is probably because sulphides originally present in the coal waste have oxidized and released SO₃. Trace metals would also be released and mobilized by the acidic water.

One of the advantages of pairing XRF and ICP-MS analyses is that it provides information on what proportion of major elements may be in a soluble form. XRF measures the total amount present, whereas ICP-MS measures the amount that is soluble in a hot acid leach. The amount of Fe detected by ICP-MS is similar to that detected by XRF, indicating that most of the iron is probably soluble and probably occurs in sulphides, carbonates, or hydroxides. A similar comparison for Ca, K, and Na indicates that lower percentages of these elements are potentially soluble and mobile (Figure 7).

Trace Elements in Coal Waste

As a starting point, it is important to understand how trace elements are distributed in coal. Coal is not 100% organic carbon—even when washed it contains an amount of included mineral matter analysed as ash. Consequently concentrations of trace elements in coal can have either an ash or an organic carbon affinity. To complicate the picture further, a lot of trace elements are associated with sulphide minerals in coal, and these sulphide minerals (mainly pyrite) may be associated with ash in the seam or with coal in the seam. In coals with varying ash contents, one should try to assign an affinity of the trace elements to either the organic material, the ash, or the sulphides (if present in reasonable amounts). Average trace element concentrations in shales and continental crust are shown in Figure 8. There are some data for coals from Vancouver Island (Van De Flier-Keller and Dumais 1988) and for coals from northeastern and southeastern British Columbia (Grieve 1991) (Figure 9). It is obvious from Figures 8 and 9 that the distribution of trace elements in crustal rocks,

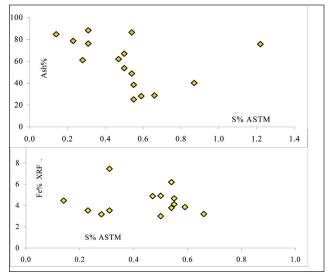


Figure 6: Association of sulphur with ash and iron; data from Union Bay, Cedar Cove, and Slag Point.

shales, and coals is similar. It appears that average element concentrations for coal waste are generally similar to world coal values (Figure 9) and a bit higher than Vancouver Island fresh coal values. The waste coal material has much higher ash concentrations than these suites of coal samples and probably should be compared to the average shale data (Figure 8).

There is no evidence of major enrichment or depletion of elements in the waste coal material, except for possibly enrichment in copper and chromium, which are both higher than the average values for Vancouver Island and world coals (Figure 9).

Trace Element Associations

The association of trace elements for the various areas is demonstrated using linear correlation matrixes. This works well in most cases but can be misleading when the data contain a few very high or low values that overly influence linear correlations. Correlation matrixes are constructed for the 3 study areas—Union Bay, Cedar Cove, and Ladysmith (Tables 5, 6, and 7). These tables help identify elements that have an ash association or a sulphur (possibly pyrite) association. Most of the elements have a negative association with ash, indicating a coal or sulphide association. Plots for copper (Figure 10) indicate that copper has a weak negative correlation with ash and a correlation with sulphur that is possibly positive at low concentrations but negative at high concentrations (secondary sulphate sulphur). Copper also has no correlation with iron (Figure 10), which does not support a sulphide association. The association of copper in samples is therefore not clear, but it may have been released from sulphides and since bound to the organic material. The association of chromium is not

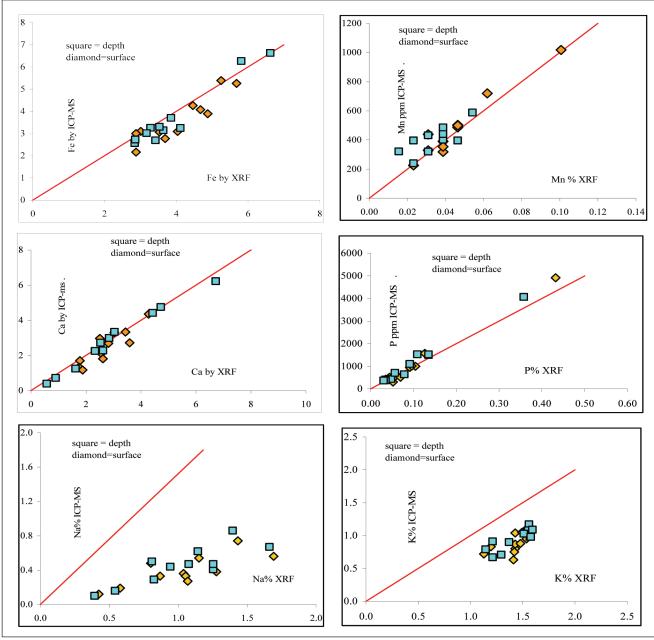


Figure 7: Comparison of Fe, Ca, Na, and K analyses by XRF and ICP-MS.

clear; it has a negative correlation with ash and no correlation with sulphur (Tables 5 and 6), though it does correlate with other trace metals. Copper may have been bound to the organic material after being released from sulphides.

Mercury is a trace element of general concern; however, in this study only 2 analyses were above the detection limit of 10 ppb, and they were both less than 20 ppb.

Arsenic is often associated with pyrite, and in this study there is no correlation with ash and, except for the 2 high values for samples 664 and 665 (Table 4), only a weak correlation with sulphur (Figure 11). There is no explanation for the 2 high arsenic values.

Only 2 elements (chromium and copper) are above both world averages (Clarke and Sloss 1992) and values from the Nanaimo and Comox Basins (Van Der Flier-Keller and Dumais 1988) (Figure 9). These elements do not correlate with sulphur or ash but appear to correlate with other trace metals (Tables 5, 6, and 7). It appears that they are not present in sulphides but may be bound to the organic material.

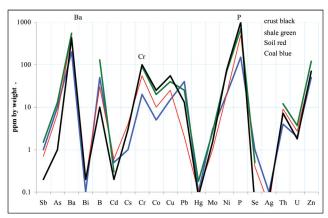


Figure 8: Average trace element data from Clark and Sloss (1992).

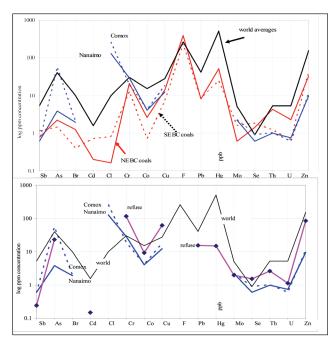


Figure 9: Trace elements concentrations in coals and waste material (BC and world data).

Depth Profile Data

A number of small trench samples were collected at Union Bay, Cedar Cove, and Ladysmith. At each location a sample was collected at surface, a second at about 20 cm, and sometimes a third at about 50 cm depth. Data available for the sets of samples include total ash, major oxide, and trace metal concentrations. The data from Union Bay are displayed in a number of plots (Figure 12 a, b, c, d, and e). Major elements are plotted for some of the profiles—these are concentrations determined by ICP-MS and therefore represent the soluble component of the total concentration. Comparing the total concentration of iron and calcium (by XRF) to the ICP-MS concentration does not indicate a change in concentrations with depth or a change in the proportions extracted by acid leach and ICP-MS analysis

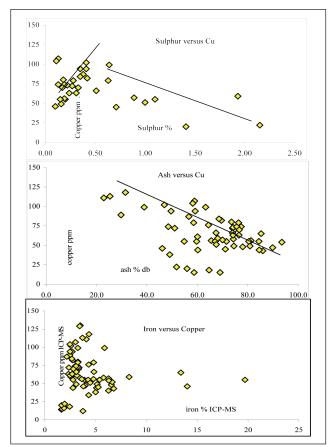


Figure 10: Copper versus sulphur, ash, and iron.

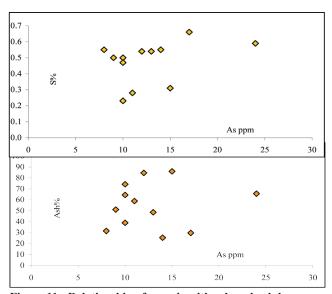


Figure 11: Relationship of arsenic with ash and sulphur.

(Figure 7). For both elements, most of the iron and calcium is acid-leacheable. Trace element concentrations do not vary much with depth, indicating a lack of mobility or that any mobile component has already moved on. Ash contents of all samples are high, with little variation with depth.

TABLE 5: CORRELATION MATRIX FOR TRACE ELEMENTS, UNION BAY AREA.

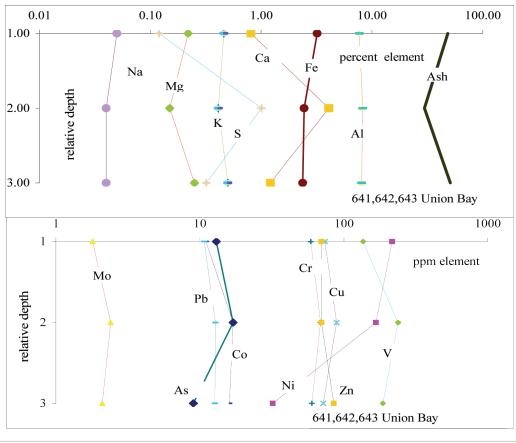
X	ash	As	Ba	Bi	Cd	Со	Cr	Cu	Ga	Mo	Ni	P	Pb	Sb	Sc	Sr	Th	U	S	Zn
ash	1.00																			
As	-0.65	1.00																		
Ba	-0.79	0.92	1.00																	
Bi	-0.42	-0.20	-0.07	1.00																
Cd	0.11	-0.50	-0.24	0.29	1.00															
Co	0.48	-0.35	-0.20	-0.41	0.68	1.00														
Cr	-0.33	0.61	0.73	-0.27	-0.12	0.28	1.00													
Cu	0.06	0.05	0.23	-0.34	0.56	0.78	0.56	1.00												
Ga	-0.80	0.66	0.87	0.09	0.03	-0.08	0.72	0.44	1.00											
Mo	-0.39	0.19	0.24	0.18	-0.27	-0.51	-0.21	-0.35	0.29	1.00										
Ni	0.07	0.17	0.33	-0.47	0.37	0.78	0.75	0.95	0.47	-0.37	1.00									
P	0.22	-0.04	0.08	-0.35	0.11	0.49	0.54	0.72	0.33	-0.22	0.74	1.00								
Pb	-0.86	0.43	0.70	0.46	0.22	-0.20	0.40	0.23	0.87	0.41	0.18	0.18	1.00							
Sb	-0.61	0.80	0.64	0.09	-0.48	-0.52	0.30	-0.23	0.43	0.20	-0.15	-0.40	0.17	1.00						
Sc	-0.75	0.36	0.66	0.35	0.30	-0.03	0.56	0.44	0.93	0.32	0.41	0.34	0.92	0.16	1.00					
Sr	0.12	-0.06	-0.15	0.10	-0.28	-0.07	0.13	0.00	-0.15	-0.61	0.03	-0.02	-0.34	0.27	-0.16	1.00				
Th	-0.91	0.47	0.69	0.54	0.06	-0.38	0.29	0.05	0.84	0.59	0.01	0.01	0.96	0.41	0.88	-0.37	1.00			
U	-0.73	0.23	0.43	0.48	-0.21	-0.54	0.16	-0.19	0.64	0.69	-0.18	0.00	0.77	0.19	0.74	-0.18	0.86	1.00		
S	-0.05	-0.28	-0.43	0.39	-0.09	-0.49	-0.72	-0.61	-0.37	0.25	-0.72	-0.64	-0.20	0.23	-0.29	-0.03	0.01	0.12	1.00	
Zn	0.46	-0.46	-0.27	-0.28	0.62	0.85	0.26	0.83	0.04	-0.41	0.77	0.78	-0.05	-0.66	0.17	0.04	-0.24	-0.28	-0.49	1.00

TABLE 6: CORRELATION MATRIX FOR TRACE ELEMENTS, CEDAR COVE AREA

		1710	LL U		XIXLI	<i>11</i> 11 1 1	J1 (1()	17 11 11	128 1) IX 1	I I I C		EIVII.	1115,	CLD	m c	OIL	AKE.	4.1.	
х	ash	As	Ba	Bi	Cd	Co	Cr	Cu	Ga	Mo	Ni	P	Pb	Sb	Sc	Sr	Th	U	S	Zn
ash	1.00																			
As	0.16	1.00																		
Ba	-0.36	-0.53	1.00																	
Bi	-0.74	-0.02	0.53	1.00																
Cd	-0.72	0.01	0.22	0.82	1.00															
Co	-0.13	0.66	-0.28	0.11	0.17	1.00														
Cr	-0.78	0.04	0.25	0.40	0.46	0.44	1.00													
Cu	-0.86	0.00	0.39	0.62	0.54	0.45	0.88	1.00												
Ga	-0.82	-0.09	0.40	0.57	0.41	0.34	0.82	0.90	1.00											
Мо	-0.84	0.16	0.17	0.67	0.59	0.49	0.73	0.86	0.74	1.00										
Ni	-0.21	0.51	-0.17	0.10	0.18	0.88	0.64	0.53	0.54	0.44	1.00									
P	-0.85	0.12	0.15	0.77	0.93	0.31	0.67	0.73	0.58	0.80	0.32	1.00								
Pb	-0.59	-0.16	0.64	0.79	0.81	-0.06	0.43	0.48	0.40	0.35	0.05	0.68	1.00							
Sb	-0.74	-0.31	0.65	0.54	0.41	-0.02	0.66	0.68	0.64	0.59	0.09	0.50	0.63	1.00						
Sc	-0.89	0.00	0.32	0.72	0.64	0.44	0.82	0.92	0.94	0.86	0.56	0.78	0.49	0.60	1.00					
Sr	-0.84	0.08	0.08	0.72	0.88	0.18	0.60	0.67	0.52	0.77	0.18	0.97	0.59	0.38	0.73	1.00				
Th	-0.87	-0.14	0.49	0.82	0.72	0.30	0.66	0.86	0.82	0.74	0.31	0.76	0.67	0.68	0.90	0.70	1.00			
U	-0.76	-0.19	0.47	0.41	0.25	0.27	0.75	0.79	0.73	0.75	0.26	0.45	0.27	0.82	0.71	0.41	0.69	1.00		
S	0.11	0.90	-0.67	-0.19	-0.03	0.45	0.05	-0.04	-0.17	0.13	0.31	0.13	-0.24	-0.29	-0.11	0.16	-0.25	-0.19	1.00	
Zn	0.45	0.54	-0.19	-0.20	-0.16	0.70	-0.03	-0.05	-0.08	-0.20	0.66	-0.21	-0.10	-0.37	-0.08	-0.36	-0.11	-0.28	0.26	1.00

TABLE 7: CORRELATION MATRIX FOR TRACE ELEMENTS, LADYSMITH AREA.

X	ash	As	Ba	Bi	Cd	Co	Cr	Cu	Ga	Mo	Ni	P	Pb	Sb	Sc	Sr	Th	U	S	Zn
ash	1.00																			
As	0.05	1.00																		
Ba	-0.11	-0.04	1.00																	
Bi	0.17	0.19	0.82	1.00																
Cd	0.20	0.00	0.88	0.62	1.00															
Co	0.41	-0.29	0.35	0.04	0.64	1.00														
Cr	-0.32	-0.43	0.37	-0.15	0.32	0.66	1.00													
Cu	-0.86	-0.13	0.49	0.12	0.31	-0.06	0.59	1.00												
Ga	-0.19	0.35	0.84	0.81	0.68	0.13	0.10	0.44	1.00											
Mo	0.70	-0.17	-0.30	-0.14	-0.28	0.48	0.09	-0.52	-0.38	1.00										
Ni	0.06	-0.16	0.28	-0.18	0.52	0.82	0.75	0.20	0.07	0.12	1.00									
P	0.32	-0.14	-0.68	-0.54	-0.72	0.17	0.02	-0.42	-0.53	0.69	0.00	1.00								
Pb	0.27	-0.14	-0.46	-0.20	-0.58	-0.21	-0.30	-0.36	-0.33	0.34	-0.43	0.62	1.00							
Sb	0.10	-0.14	0.57	0.67	0.31	0.06	-0.06	0.08	0.54	-0.07	-0.30	-0.38	0.20	1.00						
Sc	-0.63	0.06	0.76	0.42	0.71	0.18	0.52	0.85	0.78	-0.56	0.35	-0.58	-0.54	0.24	1.00					
Sr	-0.67	-0.27	0.26	-0.15	0.27	0.12	0.56	0.66	0.11	-0.43	0.43	-0.42	-0.76	-0.23	0.60	1.00				
Th	-0.68	0.25	0.37	0.31	0.24	-0.24	0.06	0.69	0.69	-0.52	-0.11	-0.28	-0.25	0.13	0.77	0.37	1.00			
U	-0.68	-0.24	-0.32	-0.38	-0.57	-0.47	0.10	0.52	-0.19	-0.27	-0.26	0.19	0.41	-0.05	0.11	0.18	0.38	1.00		
S	-0.57	0.28	-0.46	-0.44	-0.69	-0.43	-0.04	0.19	-0.12	-0.32	-0.18	0.19	0.07	-0.23	0.01	0.26	0.29	0.57	1.00	
Zn	0.69	-0.18	0.03	0.05	0.22	0.56	0.14	-0.40	-0.14	0.60	0.37	0.45	0.46	-0.02	-0.32	-0.58	-0.49	-0.28	-0.60	1.00



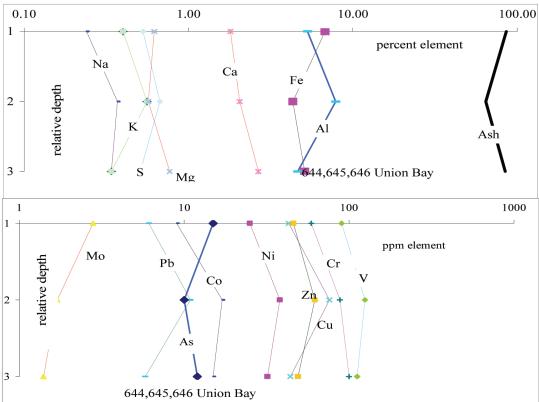
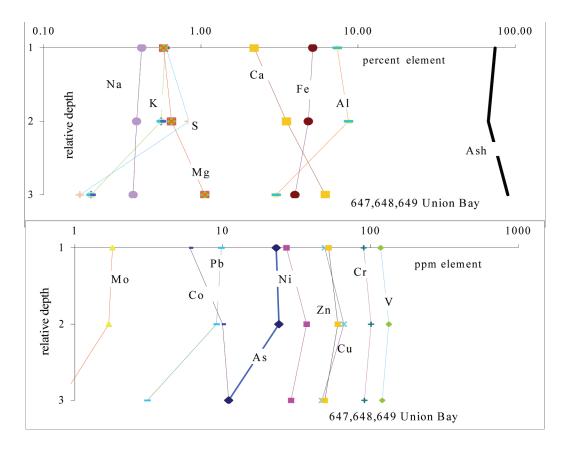


Figure 12a: Depth profile data for major and trace elements for locations Union Bay. Relative depths are surface and approximately 20 cm and 50 cm.



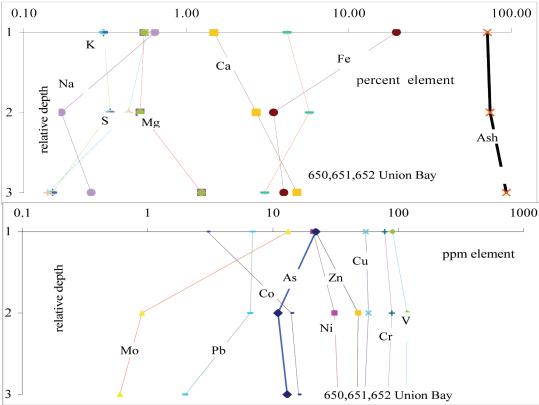


Figure 12b: Depth profile data for major and trace elements for locations Union Bay. Relative depths are surface and approximately $20\ cm$ and $50\ cm$.

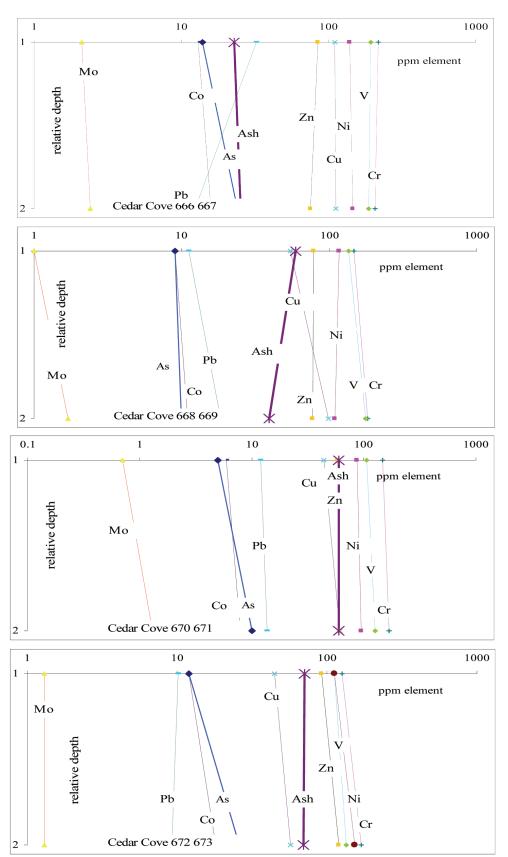


Figure 12c: Depth profile data for major and trace elements for locations Cedar Cove. Relative depths are surface and approximately 20 cm and 50 cm.

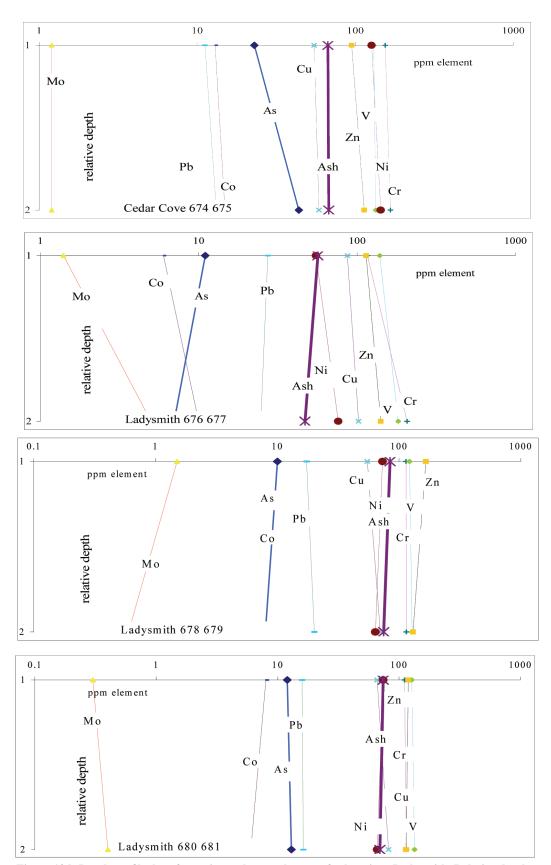


Figure 12d: Depth profile data for major and trace elements for locations Ladysmith. Relative depths are surface and approximately 20 cm and 50 cm.

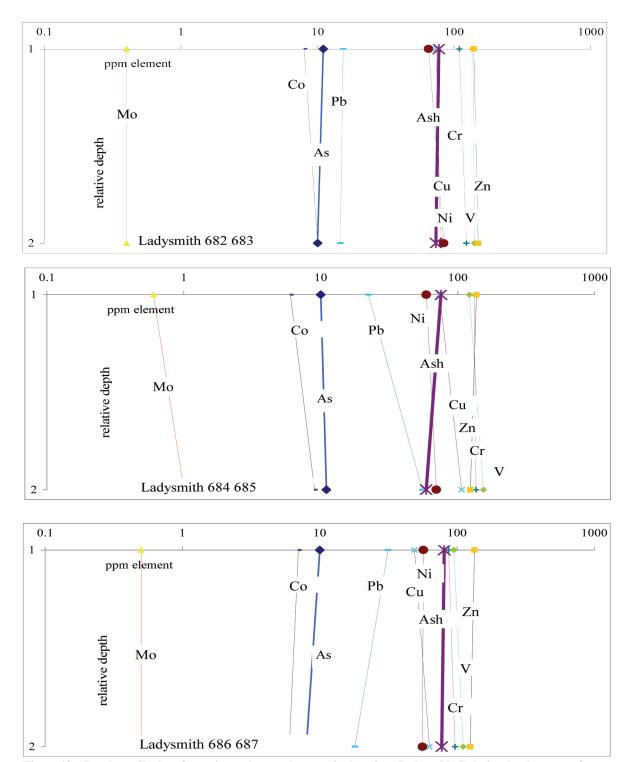


Figure 12e: Depth profile data for major and trace elements for locations Ladysmith. Relative depths are surface and approximately 20 cm and 50 cm.

Union Bay beach is characterized by heavy iron staining and samples (644, 645, 646) (647, 648, 649), and (650, 651, 652) were collected at different depths in 3 test holes dug on this beach. There are no major changes in trace or major element chemistry with depth down to about 0.7 m at the bottom of the holes. Samples of the heavily rust-stained section at the surface have higher concentrations of iron and molybdenum, and in all 3 profiles sulphur decreases with depth. The material is weathered refuse from which most of the pyrite probably has been oxidized to yield sulphates and iron oxides. Samples generally have high ash contents, and this influences major oxide and trace metal concentrations in terms of comparisons to coal with less ash. Swaine (1990) provides a table of average trace element concentration in coal, soils, and shale, and Van Der Flier-Keller and Goodarzi (1992) provide average trace element and major oxide contents for coals from the Comox and Nanaimo coalfields. Data from these sources are plotted with average data from Union Bay (Figure 13). It is apparent that the Union Bay data plot in between average coal and average shale and have higher contents of most elements than do the Nanaimo and Comox coals. This is probably because the Union Bay samples have higher ash contents, which range from 30% to 94% and are generally higher than the coal samples analysed by Van Der Flier-Keller and Goodarzi (1992).

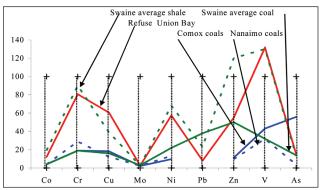


Figure 13: Comparison of trace metal data for Union Bay and Comox and Nanaimo coals.

Sized Data

A number of samples were split, and one split from each sample was screened into coarse and fine fractions (8-mesh). Both the original split and the fine-fraction split were analysed by XRF and ICP-MS. Comparing analyses for the original and fine-fraction splits should provide indications of fractionation of elements by particle size and

possible mobility of trace elements out of fine fractions. Data (Figure 14 a and b) do not indicate any consistent pattern of element distribution. Major element concentrations change little from the original split (numbered 1 on the x axis in the figures) to the fine-fraction split (numbered 2 on the x axis in the figures). Trace element concentrations are more variable but still do not provide a consistent pattern.

Heat Value

The heat value of coal is dependent on organic carbon and volatile matter contents of samples. It decreases with oxidation of coal and destruction of volatile matter, but generally the decrease is not large. In this study, the heat value of the samples has not been degraded, based on a plot of calorific value (dry basis) versus ash (dry basis) (Figure 15), which compares heat values for fresh coals from the Comox and Nanaimo Basins (Coal Quality Catalogue 1992) to the samples in this study. The zero-ash heat value for all samples averages about 7929 kcal/kg, compared to 7993 kcal/kg for fresh coal samples from Nanaimo and Comox coal basins. The main influences on heat value of coal are ash and moisture contents. A sample with 20% ash (dry basis) and 10% water would have a gross calorific value of 5555 kcal/kg (Figure 15). This is a useable heat value, though the ash chemistry becomes important, because boilers must handle and remove large quantities of fly ash or

As an aside, it is important to understand the difference between measured heat values (gross as-received, or GAR) and useable heat (net as-received, or NAR). In a power plant, the moisture associated with the coal is heated and then converted to steam when the coal is burnt. This heat is generally lost, and this is part of the reason that NAR heating value is less than GAR heating value. A gram of water at 20 °C will require 620 calories if it is heated and turned into steam. Consequently, coal with 10% moisture will lose, when burnt, about 62 calories because of water. This means that a 40% ash sample with about 5000 kcal/kg air-dried basis (adb) will actually have about 6% less useable heat, in part because there is 10% less material and in part because of the lost 62 calories.

Tidal samples from Union Bay appear to have higher heat values than other samples at comparable ash contents (Figure 15). These samples (644, 645, and 646) were collected from a flat area of beach covered by a prominent iron-oxide staining. The heat value may be influenced by recent organic matter.

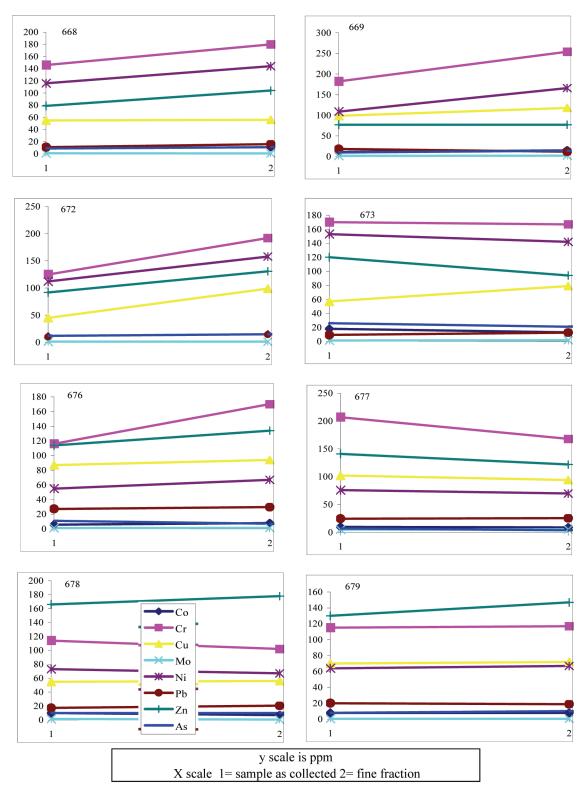


Figure 14a: Comparison trace metal data from original samples and fine fraction of samples.

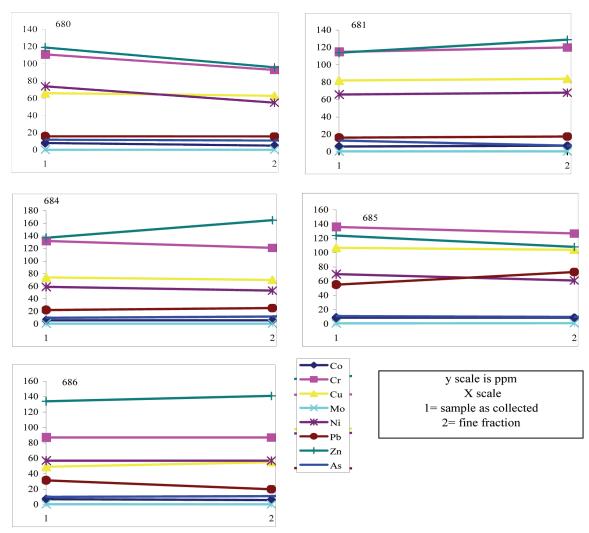


Figure 14b: Comparison trace metal data from original samples and fine fraction of samples.

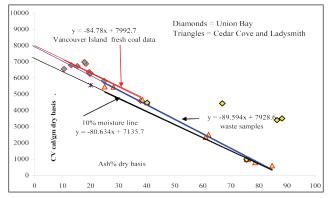


Figure 15: Heat value of fresh Vancouver Island coals and weathered samples from Union Bay, Cedar Cove, and Ladysmith Slag Point.

CONCLUSIONS

The data provide some background information on the major and trace element chemistry of the coal refuse material on and near beaches along the east coast of Vancouver Island. Generally, coal waste is fairly benign, unless it contains high concentrations of pyrite that can release trace metals and generate acid-rock drainage. Samples collected in this study generally do not have abnormally high concentrations of trace metals or high concentrations of pyrite. There is no indication that they are releasing metals into the environment. It is possible that all or most of the pyrite is already oxidized and trace metals released and migrated out of the samples.

ACKNOWLEDGEMENTS

Samples were collected in conjunction with a study by Remi Odense, Risk Assessment and Remediation, Ministry of the Environment, BC Government. Warren Walsh assisted with sampling in the field, and Jessica Verhagen helped with sample preparation.

REFERENCES

- Clarke, L.B. and Sloss, L.L. (1992): Trace elements emissions from coal combustion and gasification; International Energy Agency (*IEA*) Coal Research Publication 49.
- Coal Quality Catalogue (1992): British Columbia Ministry of Energy, Mines and Petroleum Resources, Information Circular 1992-20.
- Gardner, S.L. (1997): Coal Resources and Coal Mining on Vancouver Island; *British Columbia Ministry of Employment and Investment*, BC Geological Survey, Open file 1997-19.
- Grieve, D.A. and Goodarzi, F. (1994): Trace elements in coals of the East Kootenay and Peace River coalfields, *British Columbia; British Columbia Ministry of Energy, Mines and Petroleum Resources*, Open file 1994-15.
- Swaine, D.J. (1990): Trace Elements in Coal; *Butterworths*, London. 1-273.
- Van Der Flier-Keller, E. and Dumais, S. (1988): Inorganic matter content and specialized element potential of the Nanaimo and Comox coalfields, Vancouver Island (92G,F,K) *British Columbia Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork 1987, pages 435–439.
- Van Der Flier-Keller, E. and Goodarzi, F. (1992): Regional variations in coal quality in the Canadian Cordillera; *Geological Society of America*; Special Paper 267, pages 165–175.