

CANADA - SASKATCHEWAN MINERAL DEVELOPMENT PROGRAM \*\*\* REGIONAL GEOCHEMICAL LAKE SEDIMENT SURVEY, EAST-CENTRAL SASKATCHEWAN, 1974

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GEOLOGICAL SURVEY OF CANADA OPEN FILE 488

REGIONAL LAKE SEDIMENT GEOCHEMICAL RECONNAISSANCE DATA, EAST-CENTRAL SASKATCHEWAN (NTS 63M, 64D, AND PARTS OF 63K, 63L, 63N, 73I, 73O, 73P AND 74A)

THE MAJORITY OF THE DATA IN THIS OPEN FILE WAS RELEASED AS OPEN FILE 266 ON AUGUST 5, 1975. THE ADDITIONAL DATA IN THIS OPEN FILE ARE FOR MERCURY, AND URANIUM DETERMINED BY DELAYED NEUTRON COUNTING. THE OPEN FILE 488 DIGITAL RELEASE CONTAINS ALL DATA FOR 13 ELEMENTS AND LOSS ON IGNITION. THIS HARD COPY RELEASE OF OPEN FILE 488 ONLY DISPLAYS DATA FOR 5 ELEMENTS (U-F,U-DNC,HG,FE,MN) AND LOSS ON IGNITION, HOWEVER THIS TEXT COVERS ALL ELEMENTS. FOR HARD COPY DISPLAY OF ELEMENTS NOT GIVEN HERE PLEASE REFER TO OPEN FILE 266.

THIS REGIONAL LAKE SEDIMENT GEOCHEMICAL RECONNAISSANCE PROJECT WAS JOINTLY UNDERTAKEN AND PLANNED BY THE GEOLOGICAL SURVEY OF CANADA AND THE SASKATCHEWAN GEOLOGICAL SURVEY UNDER THE AUSPICES OF THE CANADA-SASKATCHEWAN AGREEMENT ON MINERAL EXPLORATION AND DEVELOPMENT IN NORTHERN SASKATCHEWAN.

MR. E.H.W. HORN BROOK DIRECTED GEOLOGICAL SURVEY OF CANADA ACTIVITIES AND SUPERVISED THE FIELD SAMPLING CONTRACT LET TO TRIGG, WOOLLETT & ASSOCIATES LTD., UNDER G.S.C FIELD PROJECT 740079, 'REGIONAL SURVEYS (LAKE SEDIMENTS)'. DR. L.S. BECK COORDINATED ACTIVITIES AT THE SASKATCHEWAN GEOLOGICAL SURVEY. THE CHEMICAL ANALYSES WERE ALSO CARRIED OUT UNDER CONTRACT BY BARRINGER RESEARCH LTD. AND AECL COMMERCIAL PRODUCTS DIVISION, THE CONTRACTS BEING SUPERVISED FROM THE GEOLOGICAL SURVEY OF CANADA BY MR. J.J. LYNCH. DATA MONITORING, COMPILATION AND MAP PRODUCTION WAS CARRIED OUT AT THE GEOLOGICAL SURVEY OF CANADA IN THE GEOCHEMISTRY AND GEOLOGICAL CARTOGRAPHY SECTIONS UNDER THE DIRECTION OF DR. R.G. GARRETT. THE DATA PLOTTING WAS CARRIED OUT USING PHOTO-HEAD PLOTTING FACILITIES FOR DIRECT PHOTOGRAPHIC PLOTTING MADE AVAILABLE BY THE MAP PRODUCTION DIRECTORATE, SURVEYS AND MAPPING BRANCH.

THIS GEOCHEMICAL LAKE SEDIMENT RECONNAISSANCE SURVEY IS PART OF THE RECONNAISSANCE GEOSCIENCE SURVEYS PROJECT OF THE AFOREMENTIONED FEDERAL- PROVINCIAL AGREEMENT. THE AGREEMENT IS A COST SHARED VENTURE DESIGNED TO IMPROVE THE ECONOMIC BASE OF NORTHERN SASKATCHEWAN BY CONDUCTING SCIENTIFIC SURVEYS THAT COULD LEAD TO THE DISCOVERY OF NEW MINERAL DEPOSITS, OR THE FURTHER DEVELOPMENT OF KNOWN DEPOSITS.

THE LAKE SEDIMENT SURVEY WAS UNDERTAKEN TO OBTAIN INFORMATION ON THE DISTRIBUTION AND CONCENTRATION OF TRACE METALS IN THE LAKE SEDIMENTS. THE AIM WAS TO DELINEATE BROAD BELTS OF INCREASED METAL CONTENT, POSSIBLY CORRELATIVE WITH FEATURES OF ECONOMIC INTEREST, WORTHY OF FURTHER FIELD INVESTIGATION. THE PROJECT HAS BEEN DESCRIBED BY HORN BROOK AND GARRETT (1976) AND ASPECTS OF THE DATA BY GARRETT AND HORN BROOK (1976) AND GARRETT AND LYNCH (1976). THE LATTER PAPER MAKES A COMPARISON OF THE TWO SETS OF URANIUM DATA.

CENTRE LAKE BOTTOM ORGANIC RICH SAMPLES WERE COLLECTED AT AN AVERAGE DENSITY OF 1 SAMPLE PER 5 SQUARE MILES THROUGHOUT THE 20,000 SQUARE MILE SURVEY AREA. THE SAMPLING WAS CARRIED OUT BY 2 TWO MAN TEAMS IN A HELICOPTER SUPPORTED PROGRAM DURING THE PERIOD JULY 30 TO SEPTEMBER 4, 1974. A SAMPLING RATE OF 15 SAMPLE SITES PER HOUR WAS ACHIEVED AND MAINTAINED DURING THE PROGRAM, WHICH WAS UNDERTAKEN THROUGH A CONTRACT TO TRIGG, WOOLLETT AND ASSOCIATES LTD. OF EDMONTON, ALBERTA.

SAMPLE DRYING AND PROCESSING OPERATIONS WERE CARRIED OUT AT LA RONGE, SASKATCHEWAN, BY STAFF OF THE SASKATCHEWAN GEOLOGICAL SURVEY. SAMPLES WERE AIR DRIED AND SIEVED TO MINUS 80 MESH. AT THIS TIME CONTROL REFERENCE SAMPLES AND BLIND DUPLICATES WERE INSERTED AT A FREQUENCY OF 5%, I.E. IN EACH BLOCK OF 18 FIELD SAMPLES TO YIELD ANALYTICAL BLOCKS OF 20. THE PROCESSED SAMPLES WERE THEN SHIPPED TO THE ANALYTICAL CONTRACTORS FOR THE DETERMINATION OF 13 TRACE METALS.

WITH THE EXCEPTION OF LOSS ON IGNITION AND URANIUM BY DELAYED NEUTRON COUNTING ALL ANALYSES WERE CARRIED OUT BY BARRINGER RESEARCH LTD., TORONTO, ONTARIO ON A CONTRACTUAL BASIS WITH THE GEOLOGICAL SURVEY OF CANADA. LOSS ON IGNITION WAS DETERMINED IN THE GEOCHEMISTRY SECTION LABORATORIES OF THE GEOLOGICAL SURVEY IN OTTAWA. THE URANIUM DETERMINATIONS WERE CARRIED OUT BY A.E.C.L. IN OTTAWA UNDER A SIMILAR CONTRACT FOR ANALYTICAL SERVICES.

FOR THE DETERMINATION OF ZN, CU, PB, NI, CO, AG, MN, FE AND U, A 1 GRAM SAMPLE WAS REACTED WITH 6 ML OF A MIXTURE OF 4M HCL AND M HNO<sub>3</sub> IN A TEST-TUBE OVERNIGHT AT ROOM TEMPERATURE. AFTER THE OVERNIGHT DIGESTION THE TEST-TUBE WAS IMMERSSED IN A HOT WATER BATH AT ROOM TEMPERATURE AND BROUGHT UP TO 90C AND HELD AT THIS TEMPERATURE FOR 1 HOUR WITH PERIODIC SHAKING. THE SAMPLE SOLUTION WAS THEN DILUTED TO 20 ML WITH METAL FREE WATER AND MIXED. ZN, CU, PB, NI, CO, AG, MN AND FE WERE DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING AN AIR-ACETYLENE FLAME. BACKGROUND CORRECTIONS WERE MADE FOR PB, NI, CO AND AG. A 0.1 ML ALIQUOT OF THE ABOVE SAMPLE SOLUTION WAS USED TO DETERMINE U BY A FLUOROMETRIC METHOD DESCRIBED BY SMITH AND LYNCH (1969). A TURNER FLUOROMETER WAS USED FOR THE FLUORESCENCE MEASUREMENTS IN PLACE OF THE JARREL-ASH DESCRIBED IN THE SMITH AND LYNCH PAPER.

ARSENIC WAS DETERMINED COLORIMETRICALLY USING SILVER DIETHYLDITHIOCARBAMATE. DECOMPOSITION WAS ACCOMPLISHED BY HEATING A 0.5 GRAM SAMPLE WITH 10 ML OF 6 M HCL AT 90C FOR 1 HOUR. COLORIMETRIC MEASUREMENTS WERE MADE AT 520 NM.

MOLYBDENUM WAS DETERMINED BY ATOMIC ABSORPTION SPECTROSCOPY USING A NITROUS OXIDE-ACETYLENE FLAME. A 0.5 GRAM SAMPLE WAS REACTED WITH 1.5 ML CONCENTRATED HNO<sub>3</sub> AT 90C FOR 30 MINUTES. AT THIS POINT 0.5 ML CONCENTRATED HCL WAS ADDED AND THE DIGESTION WAS CONTINUED AT 90C FOR AN ADDITIONAL 90 MINUTES. AFTER COOLING, 8 ML OF 1250 PPM AL SOLUTION WERE ADDED AND THE SAMPLE SOLUTION WAS DILUTED TO 10 ML BEFORE ASPIRATION.

MERCURY WAS DETERMINED BY THE HATCH AND OTT PROCEDURE WITH SOME MODIFICATIONS, THE METHOD IS DESCRIBED BY JONASSON ET AL (1973). A 0.5 GRAM SAMPLE WAS REACTED WITH 20 ML CONCENTRATED HNO<sub>3</sub> AND 1 ML CONCENTRATED HCL IN A TEST-TUBE FOR 10 MINUTES AT ROOM TEMPERATURE PRIOR TO 2 HOURS OF DIGESTION WITH MIXING AT 90C IN A HOT WATER BATH. AFTER DIGESTION, THE SAMPLE SOLUTIONS WERE COOLED AND DILUTED TO 100 ML WITH METAL FREE WATER. THE HG PRESENT WAS REDUCED TO THE ELEMENTAL STATE BY THE ADDITION OF 10 ML OF 10% W/V SNSO<sub>4</sub> IN M H<sub>2</sub>SO<sub>4</sub>. THE HG VAPOUR WAS THEN FLUSHED BY A STREAM OF AIR INTO AN ABSORPTION CELL MOUNTED IN THE LIGHT PATH OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER. ABSORPTION MEASUREMENTS WERE MADE AT 253.7 NM.

LOSS ON IGNITION WAS DETERMINED USING A 200 MG SAMPLE; SHORTAGE OF MATERIAL DICTATED THIS RELATIVELY SMALL SAMPLE WEIGHT. THE SAMPLE, CONTAINED IN A 30 ML BEAKER, WAS PLACED IN A COLD MUFFLE FURNACE AND BROUGHT UP TO 500C OVER A PERIOD OF 2-3 HOURS. THE SAMPLE WAS LEFT AT THIS TEMPERATURE FOR 4 HOURS, THEN ALLOWED TO COOL TO ROOM TEMPERATURE FOR WEIGHING.

URANIUM WAS DETERMINED USING A NEUTRON ACTIVATION METHOD WITH DELAYED NEUTRON COUNTING. A DETAILED DESCRIPTION OF THE METHOD IS PROVIDED BY BOULANGER ET AL (1975). IN BRIEF A 1 GRAM SAMPLE IS WEIGHED INTO A 7 DRAM POLYETHYLENE VIAL, CAPPED AND SEALED. THE IRRADIATION IS PROVIDED BY THE SLOWPOKE REACTOR WITH AN OPERATING FLUX OF 10\*\*12 NEUTRONS/SQ CM/SEC. THE SAMPLES ARE PNEUMATICALLY TRANSFERRED FROM AN AUTOMATIC LOADER TO THE REACTOR, WHERE EACH SAMPLE IS IRRADIATED FOR 60 SECONDS. AFTER IRRADIATION, THE SAMPLE IS AGAIN TRANSFERRED PNEUMATICALLY TO THE COUNTING FACILITY WHERE AFTER A 10 SECOND DELAY THE SAMPLE IS COUNTED FOR 60 SECONDS WITH SIX BF<sub>3</sub> DETECTOR TUBES EMBEDDED IN PARAFIN. FOLLOWING COUNTING, THE SAMPLES ARE AUTOMATICALLY EJECTED INTO A SHIELDED STORAGE CONTAINER. CALIBRATION IS CARRIED OUT TWICE A DAY AS A MINIMUM USING NATURAL MATERIALS OF KNOWN URANIUM CONCENTRATION.

ON RECEIPT FIELD AND ANALYTICAL DATA WERE PUNCHED ONTO 80 COLUMN CARDS AND ALL SUBSEQUENT PROCESSING WAS CARRIED OUT WITH THE AID OF COMPUTERS. THE FIELD DATA WERE RECORDED BY THE FIELD CONTRACT STAFF ONTO STANDARD LAKE SEDIMENT FIELD CARDS (REV. 74) USED BY THE GEOLOGICAL SURVEY OF CANADA (GARRETT, 1974). THE SAMPLE SITE COORDINATES WERE RECORDED IN THE FIELD USING A PLASTIC ROAMER AND THE APPROPRIATE 1/250000 SCALE NTS MAP. THE DOMINANT ROCK TYPES IN THE LAKE CATCHMENT BASINS WERE PICKED OFF THE SASKATCHEWAN GEOLOGICAL SURVEY'S 1 INCH TO 20 MILE GEOLOGICAL COMPILATION MAP OF THE PROVINCE. THE ANALYTICAL DATA WERE RECORDED AS FOLLOWS (SEE GARRETT, 1974, FOR DETAILS) AND FOR CONVENIENCE THE DETECTION LIMITS OF THE ANALYTICAL METHODS USED ARE ALSO GIVEN.

ELEMENT	ANAL. CARD	COLUMNS	DETECTION LIMIT	
ZN	1	21-25	2	(1)
CU	1	26-30	2	(1)
PB	1	31-35	2	(1)
NI	1	36-40	2	(1)
CO	1	41-45	2	(1)
AG	1	46-50	0.2	(0.1)
MN	1	51-55	5	(2)
U (F)	1	56-60	0.5	(0.2)
AS	1	61-65	1	(0.5)
MO	1	66-70	2	(1)
FE %	1	71-75	0.02	(0.01)
HG PPB	1	76-79	10	(5)
LOI %	2	21-25		
U (DNC)	3	21-25	0.2	(0.1)

UNLESS OTHERWISE NOTED THE UNITS OF MEASUREMENT FOR THE ANALYSES ARE PPM. THE SECOND FIGURE UNDER DETECTION LIMIT IS THE FIGURE TO WHICH VALUES WERE SET IF THEY FELL BELOW THE DETECTION LIMIT. LOSS ON IGNITION WAS A GRAVIMETRIC DETERMINATION AND THERE WAS NO DETECTION LIMIT ESTABLISHED.

GENERAL INSPECTIONS OF THE FIELD AND ANALYTICAL DATA WERE MADE TO CHECK FOR ANY MISSING INFORMATION AND/OR GROSS ERRORS. THE SAMPLE SITE COORDINATES WERE CHECKED BY PLOTTING SAMPLING LOCATION MAPS ON A FLAT-BED PLOTTER FROM THE FIELD RECORDED COORDINATES AND THEN OVERLAYING THESE OVER THE FIELD CONTRACTOR'S FINAL REPORT SAMPLE LOCATION MAPS.

QUALITY CONTROL AND MONITORING OF THE GEOCHEMICAL DATA WAS UNDERTAKEN USING A STANDARD METHOD USED BY THE GEOCHEMISTRY SECTION AT THE GEOLOGICAL SURVEY OF CANADA WHICH IS BASED ON DUPLICATE AND REPLICATE SAMPLES AND ANALYSES. THIS REQUIRES THAT FIELD DUPLICATE, BLIND (ANALYTICAL) DUPLICATE AND CONTROL REFERENCE SAMPLES BE INSERTED AT A 5% FREQUENCY. IN PRACTICE THE REQUIRED EXTRA SAMPLES ARE INSERTED RANDOMLY IN EACH BLOCK OF 20 TOTAL SAMPLES, I.E. EACH BLOCK WILL CONTAIN 17 REGIONAL SAMPLES, 1 FIELD DUPLICATE TAKEN AT ONE OF THE 17 REGIONAL SITES, 1 BLIND DUPLICATE OF ONE OF THE 18 FIELD SAMPLES AND A CUT OF A CONTROL REFERENCE SAMPLE. DUE TO THE FACT THAT THIS PARTICULAR PROJECT IS PART OF A MUCH LARGER ON-GOING PROGRAM WHERE ANALYTICAL SERVICES ARE OBTAINED BY CONTRACT AND CONTROL REFERENCE SAMPLES ARE STILL IN USE ONLY THE OVERALL ACCEPTABILITY OF THE DATA IN TERMS OF COMBINED SAMPLING AND ANALYTICAL ERRORS VERSUS OVERALL FIELD VARIABILITY WILL BE DISCUSSED. THESE ERRORS ARE STUDIED WITH THE AID OF AN ANALYSIS OF VARIANCE (GARRETT, 1973).

ELEMENT	GEOM. MEAN	TEST MEAN	F RATIO	RELIABILITY FACTOR
ZN	88	88	9.2	1.28
CU	29	29	15.0	1.31

PB	2	2	3.6	2.18
NI	24	24	27.1	1.26
CO	10	10	9.7	1.38
AG	0.2	0.2	1.1	2.37
MN	495	446	16.1	1.40
U (F)	2	2	4.2	2.51
AS	2	2	3.5	2.47
MO	2	2	1.9	1.85
FE %	2.5	2.3	32.0	1.22
HG PPB	50	46	18.4	1.45
LOI %	22	26	11.6	1.56
U (DNC)	4.9	4.7	14.7	1.41

UNLESS OTHERWISE NOTED THE UNITS OF MEASUREMENT FOR THE ANALYSES ARE PPM. GEOM. MEAN IS THE OVERALL GEOMETRIC MEAN OF THE DATA FOR THE 3808 SITES THAT HAVE COMPLETE DATA, NOT INCLUDING THE SECOND SAMPLE OF THE 225 FIELD DUPLICATE PAIRS. TEST MEAN IS THE GEOM. MEAN OF THE FIRST SAMPLE OF THE FIELD DUPLICATE PAIRS. 225 PAIRS OF SAMPLES WERE USED IN THE ANALYSIS OF VARIANCE. THE F RATIO IS THE RATIO OF THE OVERALL FIELD SURVEY VARIANCE TO THE COMBINED SAMPLING AND ANALYTICAL VARIANCE. THE CRITICAL VALUE OF THE F RATIO WITH 224 AND 225 DEGREES OF FREEDOM (SEE GARRETT, 1973, FOR FULL EXPLANATION) IS APPROXIMATELY 1.3 AT THE 95% LEVEL AND 1.4 AT THE 99% LEVEL. FROM THE TABLE IT IS EVIDENT THAT THE DATA FOR AG MUST BE TREATED WITH CARE. THE REASON FOR THE POOR SHOWING OF THIS ELEMENT IS THE FACT THAT THE VAST MAJORITY OF THE DATA ARE AT, OR CLOSE TO, THE DETECTION LIMIT. THE IMPLICATION IS THAT IF A SAMPLE SHOWS HIGH AG THERE IS PROBABLY HIGH AG AT THE SITE, HOWEVER IF NO AG IS OBSERVED IT DOES NOT NECESSARILY MEAN THAT NONE IS AT THE SAMPLE SITE. THEREFORE THE DATA MAY BE USED TO AID INTERPRETATION BUT IT SHOULD NOT BE SUBJECTED TO ANY RIGOROUS DATA ANALYSIS. THE MO DATA IS ALSO CLOSE TO THE BORDERLINE BUT SHOULD BE ADEQUATE FOR NORMAL USAGE. THE REMAINDER OF THE ELEMENTS SHOW THE REGIONAL VARIATIONS TO BE IN EXCESS OF TWICE THE LOCAL SITE VARIATIONS AND THEREFORE THESE DATA MAY BE INTERPRETED WITH CONFIDENCE, AND THE HIGHER THE F RATIO THE GREATER THE CONFIDENCE.

THE RELIABILITY FACTOR IS AN ESTIMATE OF OVERALL MAP RELIABILITY. ON THE BASIS OF THE DUPLICATE FIELD SAMPLING IT CAN BE STATED THAT THERE IS A 95% CHANCE THAT IF ANY LAKE IS RESAMPLED AND IDENTICAL METHODS OF SAMPLE PREPARATION AND ANALYSIS ARE USED THE NEW VALUE WILL LIE BETWEEN X DIVIDED BY RF AND X TIMES RF WHERE X IS THE ORIGINAL VALUE OBTAINED.

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## DATA LIST LEGEND

MAP-	NATIONAL TOPOGRAPHIC SYSTEM(NTS)- LETTERED QUADRANGLE (SACLE 1:250000). PART OF SAMPLE NUMBER	ROCK TYPE:	PSCS- PELITIC SCHIST AMPB- AMPHIBOLITE MVCC- METAVOLCANIC GRNT- GRANITE UMFC- ULTRAMAFIC MGMT- MIGMATITE MARK- META-ARKOSE MSDM- METASEDIMENT MRBL- MARBLE
ID-	REMAINDER OF SAMPLE NUMBER- YEAR(2), FIELD CREW(1), SAMPLE SEQUENCE NUMBER(3)		
UTM COORDINATES-	UNIVERSAL TRANVERSE MERCATOR(UTM) COORDINATE SYSTEM- SAMPLE COORDINATES	LAKE AREA:	POND- POND LT 1- 1/4 TO 1 SQ KM 1-5- 1 TO 5 SQ KM GT 5- GREATER THAN 5 SQ KM
ZN-	ZONE		
EAST-	EASTING(METERS)		
NORTH-	NORTHING(METERS)		
ROCK TYPE-	MAJOR ROCK TYPE OF LAKE CATCHMENT AREA	RP ST:	00- ROUTINE REGIONAL SAMPLE 10- FIRST OF FIELD DUPLICATE 20- SECOND OF FIELD DUPLICATE 32- ROUTINE SAMPLE-LAYERED WITH LAYER POSITION
LAKE AREA-	AREA OF LAKE SAMPLED		
SMPL DPTH-	SAMPLE DEPTH MEASURED TO THE NEAREST FOOT		
RP ST-	REPLICATE STATUS- RELATIONSHIP OF SAMPLE WITH RESPECT TO OTHERS WITHIN THE SURVEY	RELF:	L- LOW M- MEDIUM H- HIGH
RELF-	RELIEF OF THE SURROUNDING LAKE CATCHMENT BASIN	SMPL COMP:	BLANK- ABSENT 1- MINOR- LESS THAN 33% 2- MEDIUM- 33% TO 67% 3- MAJOR- GREATER THAN 67%
SMPL COMP-	SAMPLE COMPOSITION- BULK MECHANICAL COMPOSITION OF SAND, FINES, ORGANICS AND GEL RESPECTIVELY	GEL:	BLANK- ABSENT 1- PRESENT
CONT-	CONTAMINATION- HUMAN OR NATURAL(WORK-DRILL/TRENCH, CAMP,FUEL OR GOSSAN)	CONT:	BLANK- NONE 1- PRESENT
SAMPLE COLOUR-	SEDIMENT COLOUR		
SUSP-	SUSPENDEd MATTER	SAMPLE COLOUR:	TN- TAN YL- YELLOW GN- GREEN GY- GREY BR- BROWN BK- BLACK
U F-	URANIUM BY FLUOROMETRY(PPM)		
U N-	URANIUM BY DELAYED NEUTRON COUNTING(PPM)		
HG-	MERCURY BY FLAMELESS SPECTROSCOPY(PPB)		
FE-	IRON BY ATOMIC ABSORPTION SPECTROSCOPY(%)		
MN-	MANGANESE BY ATOMIC ABSORPTION SPECTROSCOPY(PPM)		
LOI-	LOSS ON IGNITION BY WEIGHT DIFFERENCE(%)	SUSP:	BLANK- NONE L- LOW H- HIGH