THE HISTORY OF DISCOVERY AND THE DESCRIPTION OF THE EAST KEMPTVILLE TIN DEPOSIT SOUTHWEST NOVA SCOTIA

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INTRODUCTION AND REVIEW OF PREVIOUS WORK

WHILE TIN OCCURRENCES HAVE BEEN KNOWN IN NOVA SCOTIA IN THE NEW ROSS AREA OF LUNENBURG COUNTY FOR MANY YEARS, THERE IS NO RECORD PRIOR TO 1975 OF EXPLORATION FOR OR OF DISCOVERIES OF TIN IN THE SOUTHWESTERN PART OF THE PROVINCE. EXPLORATION FOR AND DEVELOPMENT OF GOLD DEPOSITS IN YARMOUTH COUNTY WAS ACTIVE FROM 1881 TO 1928 AND LIMITED PRODUCTION WAS ACHIEVED AT KEMPTVILLE AND CRANBERRY HEAD 6 MILES NORTH OF YARMOUTH. PROSPECTORS TRENCHED AT DOMINIQUE NEAR ARCADIA SEARCHING FOR GOLD WITHOUT LUCK (MALCOLM, 1929; MULLIGAN, 1975; TAYLOR, 1967).

DURING THE EARLY 1970'S MARITIME EXPLORATION LIMITED COMPLETED LIMITED DIAMOND DRILLING AT KEMPTVILLE WHERE THEY ENCOUNTERED THIN GRANITIC VEINS CONTAINING TUNGSTEN AND SPHALERITE WHICH WERE IN ADDITION TO THE KNOWN GOLD VEINS. THE GRANITIC VEINS SUGGESTED TO AVARD HUDGINS OF MARITIME EXPLORATION LIMITED THAT GRANITES COULD HAVE SOME ROLE IN THE GENESIS OF THE KEMPTVILLE GOLD DEPOSIT AND HE DECIDED TO PROSPECT OTHER GRANITIC INTRUSIVES IN THE GENERAL AREA. DURING THE COURSE OF THIS PROSPECTING TUNGSTEN-MOLYBDENUM BEARING GREISEN-STYLE ALTERATION ZONES WERE FOUND ADAMELLITE AT PINKNEY POINT, AND BASE METAL-TIN MINERALIZED CHLORITIZED SEDIMENT BOULDERS WERE FOUND IN FILL BEING USED TO CONSTRUCT A NEW PORTION OF HIGHWAY 101, AND IN MATERIAL BEING USED TO CONSTRUCT A WHARF AT ROBERTS ISLAND. MERTON STEWART, A PROSPECTOR

WORKING FOR MARITIME PROSPECTING LIMITED, WHO WAS RESPONSIBLE FOR THESE FINDS TRACED THE MINERALIZED SEDIMENT BOULDERS TO THEIR SOURCE IN GRAVEL PITS AT PLYMOUTH SIMPLY BY FOLLOWING DUMP TRUCKS FROM THE CONSTRUCTION SITES. TIN WHICH OCCURS AS FINE GRAINED CASSITERITE IN THE MINERALIZED SEDIMENTS IS GENERALLY NOT VISIBLE AND WAS RECOGNIZED FROM ROUTINE 30 ELEMENT SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSES DONE FOR MARITIME EXPLORATION LIMITED (A. HUDGINS, PERSONAL COMMUNICATION).

MARITIME EXPLORATION LIMITED IN 1976 ACQUIRED A SIGNIFICANT LAND POSITION IN THE ARCADIA AREA NEAR YARMOUTH AND THROUGH THE MILLMOR SYNDICATE INTERESTED SEVERAL PARTIES IN OPTIONING THEIR GROUND. SHELL CANADA RESOURCES LIMITED WAS SUFFICIENTLY IMPRESSED WITH INDICATIONS OF TIN AND BASE METAL MINERALIZATION ON THE MILLMOR LICENCES THAT AN OPTION AGREEMENT WAS ENTERED INTO BETWEEN THE TWO PARTIES LATE IN 1976.

RESULTS OF EXPLORATION BY SHELL CANADA RESOURCES ON CLAIMS OF THE MILLMOR SYNDICATE

SHELL CANADA RESOURCES ACTIVELY EXPLORED LANDS OF THE MILLMOR SYNDICATE FROM LATE IN 1976 TO EARLY 1978. INITIALLY WORK WAS DIRECTED TO FINDING THE BEDROCK SOURCE OF BASE METAL AND TIN MINERALIZED BOULDERS FOUND IN THE GRAVEL PITS AT PLYMOUTH. AS SEVERAL OF THESE BOULDERS WERE CONDUCTIVE, THE OPTIONED GROUND AND SURROUNDING AREA WAS SURVEYED WITH AIRBORNE INPHASE-OUT OF PHASE EM AND CONDUCTORS WERE FOLLOWED UP WITH HORIZONTAL LOOP AND

MAGNETOMETER SURVEYS. CONDUCTORS BELIEVED TO BE "UP-ICE", THAT IS, NORTH AND WEST OF THE PLYMOUTH GRAVEL PITS, WERE GIVEN HIGHEST PRIORITY AND WERE THE FIRST TO BE DIAMOND DRILLED. RESULTS WERE DISCOURAGING WITH ONLY WEAK TIN VALUES BEING ASSOCIATED WITH IRON SULPHIDES AND/OR GRAPHITE. DRILLING CONTINUED ON MAGNETIC FEATURES WITHOUT ASSOCIATED CONDUCTIVITY AND AT THE COMPLETION OF 35 HOLES IN NOVEMBER, 1977 A ZONE CONTAINING ERRATIC TIN AND BASE METAL VALUES WAS DEFINED AT DOMINIQUE. THE STYLE OF MINERALIZATION IN CORES WAS SIMILAR TO THAT IN BOULDERS AT PLYMOUTH. FURTHER DRILLING ON THIS ZONE AND TWO OTHER CLOSE-BY ZONES SHOWED THE TIN AND BASE METALS TO BE EPIGENETIC AND TO OCCUR IN A VEIN COMPLEX IN WHICH CONTINUITY FROM SECTION TO SECTION COULD NOT BE ESTABLISHED.

GEOCHEMICAL SURVEYS INITIATED IN THE SUMMER OF 1977 DEFINED THE "UP-ICE" CUTOFF OF TIN-BASE METAL MINERALIZATION AS BEING AT THE DOMINIQUE ZONES. THE PATTERN OF TIN IN THE -10 +100 MESH FRACTION OF TILL AT ARCADIA IS COMPLICATED BY THE PRESENCE OF STRATIFIED SAND AND GRAVEL OF THE TUSKET ESKER COMPLEX OVERLYING TILL ON THE EAST SIDE OF THE DISPERSION PATTERN AND MINOR TIN OCCURRENCES IN GRAPHITIC ARGILLITES WHICH COULD CONTRIBUTE TO THE WESTERN PART OF THE DISPERSION PATTERN. THE SAME ANOMALY PATTERN IS OBTAINED FOR CU AND ZN IN THE WHOLE TILL, AND FOR SN IN HEAVY MINERAL SEPARATES TAKEN FROM THE -10 +100 MESH FRACTION OF TILL. TIN IN HEAVY MINERAL SEPARATES IS UP TO 200 TIMES HIGHER THAN TIN IN WHOLE TILL FROM THE SAME LOCATION.

DISCOVERY OF TIN IN THE DOMINIQUE ZONES WAS CONSIDERED ENCOURAGING ENOUGH TO WARRANT INITIATION OF RECONNAISSANCE SURVEYS FOR OTHER SIMILAR TIN OCCURRENCES IN SOUTHWEST NOVA SCOTIA. BECAUSE OF THE POORLY UNDERSTOOD GENESIS OF THE DOMINIQUE MINERALIZATION AT THE TIME, AREA SELECTION IN 1977 WAS BASED ON IDEAS OF STRATIGRAPHIC POSITION WITHIN THE MEGUMA AND PROXIMITY TO GRANITIC ROCKS. IT WAS DECIDED TO SAMPLE TILL IN THE AREAS SELECTED FOR RECONNAISSANCE AND TO DETERMINE SN, W, CU AND ZN IN THE HEAVY MINERAL SEPARATES FROM THE -10 +100 MESH FRACTION. TAKING INTO ACCOUNT THE SIZE OF DISPERSION "DOWN-ICE" OF THE ANOMALY SHOWN AT ARCADIA AND THAT INDICATED IN THE LITERATURE AT MOUNT PLEASANT IN NEW BRUNSWICK (SZABO ET AL, 1975), IT WAS DECIDED TO COLLECT TILL SAMPLES AT 1 KM INTERVALS ALONG LINES 3 KM APART ORIENTATED NORMAL TO ICE DIRECTION. FURTHER AREAS WERE SELECTED FOR RECONNAISSANCE SURVEYS IN EARLY 1978 AND IN THE EAST KEMPTVILLE AREA IT WAS DECIDED TO PUT THE NORTHERN BOUNDARY OF ONE OF THESE AREAS WELL INTO THE AREA OF GRANITIC ROCKS SO AS TO TEST THE INTRUSIVE CONTACT EVEN THOUGH AT THAT TIME SHELL CANADA RESOURCES LIMITED HELD NO CLAIMS IN THAT AREA.

RESULTS OF 1978 SURVEYS BECAME AVAILABLE IN JUNE OF 1978 AND IT WAS QUICKLY REALIZED THAT THERE WAS A SIGNIFICANT ANOMALY OF SN IN TILL IN THE AREA IMMEDIATELY EAST OF EAST KEMPTVILLE. APPROPRIATE MINERAL CLAIMS WERE ACQUIRED AND EXPLORATION IN THE AREA COMMENCED IN JULY OF 1978.

INVESTIGATIONS BY SHELL CANADA RESOURCES LIMITED IN THE EAST KEMPTVILLE AREA, YARMOUTH COUNTY

INITIAL PROSPECTING IN THE AREA OF RECONNAISSANCE GEOCHEMICAL ANOMALIES EAST OF EAST KEMPTVILLE WAS SUCCESSFUL IN SHOWING THE PRESENCE OF BOULDERS OF GRANITIC ROCKS MINERALIZED WITH CASSITERITE, SPHALERITE, AND CHALCOPYRITE. IT WAS CONSIDERED THAT BOULDERS IN TILL IN THIS AREA WERE OF LOCAL DERIVATION AND THE AREA OF THEIR ABUNDANT OCCURRENCE APPROXIMATELY 2 KM BY 0.5 KM WAS DEFINED. THERE IS NO OUTCROP IN THIS AREA; HOWEVER A GEOLOGICAL MAP WAS MADE BY NOTING THE RELATIVE PORPORTIONS OF LITHOLOGIES. SAMPLING OF MINERALIZED BOULDERS WHERE MASSIVE CASSITERITE VEINS WERE EXCLUDED SUGGESTED THE POTENTIAL FOR THE OCCURRENCE OF A CONSIDERABLE TONNAGE OF TIN MINERALIZATION OF INTERESTING GRADE OF THE GREISEN STYLE LOCALIZED AT THE CONTACT OF LEUCO-ADAMELLITE WITH SEDIMENTARY ROCKS. WORK WAS SUSPENDED IN 1978 AT THIS POINT.

DIAMOND DRILLING COMMENCED ON THE EAST KEMPTVILLE TIN PROSPECT IN MARCH, 1979 AND DURING THE YEAR A TOTAL OF 8,220 METRES OF BQ DRILLING WAS COMPLETED. INITIAL DRILLING ESTABLISHED THE PRESENCE OF TIN IN GRANITIC ROCKS IN BEDROCK IN THE AREA WHICH WAS SUGGESTED BY 1978 WORK AND EARLY IN THIS YEAR IT WAS POSSIBLE TO ESTIMATE FROM DRILLING A RESERVE OF 25,000,000 TONNES OF 0.20% SN TO A DEPTH OF UP TO 100 METRES.

DESCRIPTION OF THE EAST KEMPTVILLE TIN DEPOSIT

TIN MINERALIZATION AT EAST KEMPTVILLE OCCURS IN GRANITIC ROCKS AT THEIR CONTACT WITH SEDIMENTARY ROCKS. THE GRANITIC ROCKS ARE PART OF THE EXTENSIVE SOUTH MOUNTAIN BATHOLITH COMPLEX AND THE SEDIMENTS BELONG TO THE MEGUMA GROUP.

PERTINENT ASPECTS OF REGIONAL GEOLOGY

IN SOUTHWEST NOVA SCOTIA THE OLDEST ROCKS ARE SEDIMENTS OF THE MEGUMA GROUP WHICH HAVE BEEN DIVIDED INTO THE HALIFAX AND GOLDENVILLE FORMATIONS. THE GOLDENVILLE FORMATION IS THE OLDEST OF THE TWO BUT PROBABLY ITS BOUNDARY WITH THE HALIFAX FORMATION IS DIACHRONOUS. THE GOLDENVILLE CONSISTS OF ALTERNATING LAYERS OF SANDSTONE AND FINER GRAINED BEDS AND IS INTERPRETED AS A SUB-MARINE MID-FAN DEPOSIT WHILE THE HALIFAX FORMATION CONSISTS OF SLATE, SILTSTONE, AND MINOR SANDSTONE (SOME WITH FE-MN NODULES) AND PROBABLY REPRESENTS DISTAL TURBIDITE FAN, BASIN PLAIN, CONTINENTAL RISE AND SLOPE, AND OUTER SHELF ENVIRONMENTS OF DEPOSITION. FOSSILS IN HALIFAX SLATES HAVE BEEN DATED AS EARLY ORDOVICIAN BUT THE AGE OF THE GOLDENVILLE IN UNKNOWN. AT EAST KEMPTVILLE SEDIMENTARY ROCKS DO NOT OUTCROP AND ARE KNOWN ONLY FROM DRILL CORE WHERE THEY ARE SEEN TO BE DOMINANTLY SANDSTONES BEARING BIOTITE PORPHYROBLASTS WHERE THEY WERE SUFFICIENTLY ARGILLACEOUS (KEPPIE, 1977a; HARRIS AND SCHENK, 1976; SCHENK, 1970).

THE WHITE ROCK FORMATION OVERLIES THE MEGUMA GROUP IN THE YARMOUTH AREA WHERE IN ADDITION TO SEDIMENTARY ROCKS THERE IS A CONSIDERABLE THICKNESS OF MAFIC TO FELSIC VOLCANIC ROCKS DEVELOPED (KEPPIE,1977a).

THE BRENTON GRANITE IS FOLIATED AND IS INTERPRETED TO HAVE BEEN INTRUDED PRIOR TO OR DURING THE FIRST EVENTS OF THE ACADIAN OROGENIC CYCLE WHEN IT WAS DEFORMED (O'REILLY, 1976) AND IS IN DISTINCT CONTRAST TO THE GRANITIC ROCKS OF THE SOUTH MOUNTAIN BATHOLITH WHICH WERE EMPLACED AFTER THE IMPORTANT PHASES OF ACADIAN FOLDING. MOST OF THE SOUTH MOUNTAIN BATHOLITH WHICH OUTCROPS FROM EAST KEMPTVILLE TO HALIFAX IN GRANODIORITE. THE BATHOLITH IS COMPOSITE HOWEVER, AND ADAMELLITES ARE KNOWN AT CHESTER-NEW ROSS-HALIFAX, AYLESFORD, DALHOUSIE EAST, MILFORD-NEW ALBANY, PORT MOUTON, AND NOW AT EAST KEMPTVILLE. MORE HIGHLY EVOLVED ROCKS SUCH AS ALASKITE NEAR HALIFAX, AND PORPHYRITES AND PEGMATITES AT MILFORD AND IN THE NEW ROSS AREA ARE KNOWN AND IN A GENERAL WAY, IN THE SOUTH MOUNTAIN BATHOLITH, MORE HIGHLY EVOLVED ROCKS ARE YOUNGER WITH A RANGE OF 395 ±15 M.Y. TO 336 ±9 M.Y. (RB-SR WHOLE ROCK ISOCHRON AGES FROM GEOLOGICAL MAP OF NOVA SCOTIA, 1979).

AT EAST KEMPTVILLE THERE IS ONLY ONE OUTCROP OF ADAMELLITE AND MOST OF OUR KNOWLEDGE OF GRANITIC ROCKS IN THIS AREA IS BASED ON DRILL HOLE INFORMATION AND THE MAPPING OF BOULDERS IN TILL. OUR WORK INDICATES THE COMPOSITE NATURE OF WHAT WE HAVE CHOSEN TO TERM THE DAVIS LAKE PLUTON. THE CONTACTS OF THIS PLUTON, ONLY POORLY KNOWN, ON ITS SOUTHEASTERN SIDE, ARE MORE PRECISE ON THE NORTHWEST SIDE AS THERE IS THE ONE OUTCROP ON BIG MEADOW

BROOK, THERE IS DIAMOND DRILLING INFORMATION, AND TILL MAPPING IS FELT TO BE MORE RELIABLE THAN ELSEWHERE. THE PHASES OF THE DAVIS LAKE PLUTON WHICH WE HAVE RECOGNIZED TO DATE INCLUDE:

A. LEUCO-ADAMELLITE HOSTING TIN MINERALIZATION. THIS ROCK IS ESSENTIALLY FREE OF MAFIC MINERALS AND APPEARS TO BE LOCALIZED AT PART OF THE NORTH-WEST CONTACT.

B. BIOTITE-MUSCOVITE ADAMELLITE IS EXPOSED IN BIG MEADOW BROOK AND EXTENDS FROM THESE TO THE SOUTHWEST FOR 5 KM. THIS ROCK TYPE MIGHT OCCUR EAST OF LEUCO ADAMELLITE.

C. BIOTITE GRANODIORITE IS A FIELD TERM NOT YET CONFIRMED BY PETROGRAPHIC STUDY APPLIED TO BOULDERS FOUND IN THE DAVIS LAKE AREA. THESE ROCKS CHARACTERISTICALLY CARRY LARGE K-FELDSPAR PHENOCRYSTS AND ARE SIMILAR TO BIOTITE GRANODIORITE SEEN ELSEWHERE IN THE SOUTH MOUNTAIN BATHOLITH. THEIR TRACE ELEMENT GEOCHEMISTRY IS PRECURSOR TO "TIN GRANITES" IN THE TERMINOLOGY OF TISCHENDORF (1977) AND IT IS DISTINCTLY DIFFERENT THAN THE GEOCHEMISTRY OF OTHER SOUTH MOUNTAIN BIOTITE GRANITE AND BIOTITE GRANODIORITE (CF. MCKENZIE AND CLARKE, 1975; SMITH AND TUREK, 1976).

DESCRIPTION OF TIN MINERALIZATION AT EAST KEMPTVILLE

TIN MINERALIZATION AT EAST KEMPTVILLE IS DEVELOPED FOR 2 KM AT AND NEAR THE NORTHWEST CONTACT OF THE DAVIS LAKE PLUTON. IN THE MINERALIZED AREA THE INTRUSIVE CONTACT IS IN PART FLAT-LYING AND GENTLY DIPPING ALTHOUGH THE WEST CONTACT OF GRANITIC ROCKS IS GENERALLY STEEPLY WEST DIPPING. THE SMALL MINERALIZED ZONE SOUTHWEST OF THE MAIN MINERALIZED ZONE HAS ESSENTIALLY VERTICAL CONTACTS WITH SEDIMENTS BUT IS CONSIDERED TO BE CONTINUOUS AT DEPTH WITH THE MAIN ZONE BECAUSE GRANITIC ROCKS HAVE BEEN OBTAINED BELOW SEDIMENTS IN THE AREA BETWEEN THESE ZONES. WHILE THERE IS AMPLE EVIDENCE OF A FLATTENING IN THE CONTACT OF THE DAVIS LAKE PLUTON WITH SEDIMENTS IN THE AREA OF MINERALIZATION, THERE IS, WITH THE POSSIBLE EXCEPTION OF THE SMALLER SOUTHWEST MINERALIZED ZONE, NO OBVIOUS CUPOLA DEVELOPMENT AS DESCRIBED FOR EAST GERMAN AND RUSSIAN TIN DEPOSITS BY ROGER TAYLOR (1979) IN HIS BOOK ON THE GEOLOGY OF TIN DEPOSITS.

TIN MINERALIZATION OCCURS IN A STOCKWORK OF TIN-BEARING GREISEN ALTERATION ZONES GENERALLY CORED BY GREY QUARTZ VEINS WHICH CUT VARIABLY ALTERED LEUCO-ADAMELLITE. THIS STOCKWORK WHICH IS BEST DEVELOPED WHERE THE INTRUSIVE CONTACT HAS FLATTENED EXTENDS TO AN AVERAGE DEPTH OF 100 M BELOW SURFACE ALTHOUGH OCCASIONAL GREISEN ZONES ARE FOUND AT GREATER DEPTH. TO DATE NO SYSTEMATIC ATTEMPT HAS BEEN MADE TO DEFINE THE ORIENTATIONS OF TIN-BEARING GREISENS; WHILE MOST DIP STEEPLY THE STRONG PREFERRED ORIENTATION OF GREISEN ZONES AS SEEN AT CLIGGA HEAD AND HEMERDON IN CORNWALL IS NOT DEVELOPED AT EAST KEMPTVILLE.

QUARTZ VEINS CORING GREISEN ALTERATION ZONES CARRY IN AVERAGE ORDER OF ABUNDANCE PYRITE, PYRRHOTITE, CASSITERITE, SPHALERITE, CHALCOPYRITE AND RARELY WOLFRAMITE AS FINE TO MEDIUM GRAINED AGGREGATES. THESE MINERALS AND ALSO BISMUTHINITE ARE FOUND IN THE GREISEN ALTERATION ZONES AS FINE GRAINED DISSEMINATIONS WHICH DECREASE IN AMOUNT AWAY FROM THE CENTRAL QUARTZ VEIN. THE ALTERATION OF LEUCO-ADAMELLITE IN THE GREISEN ZONES HAS BEEN INTENSE INCLUDING BREAK-DOWN OF ALL FELDSPARS TO FORM WHITE MICAS AND THE INTRODUCTION OF TOPAZ AND FLOURITE INTO THESE ZONES.

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TRACE ELEMENT GEOCHEMISTRY OF VARIOUS ROCKS

FROM THE DAVIS LAKE PLUTON

ROCK TYPES	ELEMENT CONCENTRATION IN PPM									CLASSIFICATION ACCORDING TO TISCHENDORF (1977)
	Rb	Li	F	Sn	U	Sr	W	Ta	Nb	
LEUCOADAMELLITE (6) (AREA OF MINERALIZATION)	1100	1050	10000	220	31	10	ND	ND	ND	SPECIALIZED
MUSCOVITE-BIOTITE(?) ADAMELLITE (3) (BELOW MINERALIZATION)	910	625	10500	30	25	10	65	ND	ND	SPECIALIZED
UNDIFFERENTIATED ADAMELLITES (6) (EAST OF MINERALIZATION)	833	212	3750	74	16	18	11	13	21	PRECURSOR-SPECIALIZED
BIOTITE GRANODIORITE (6) (FLOAT, DAVIS LAKE AREA)	465	108	1400	15	6	29	5	4	11	PRECURSOR

ND - NO DATA