PRELIMINARY ASSESSMENT OF CLAY DEPOSITS IN SELECTED AREAS OF THE WHITEHORSE MAP SHEET AREA (105D) FOR THE MANUFACTURE OF CLAY BASED PRODUCTS

REPORT

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1.0 Introduction

1.1. Objectives

This project is an initiative of the Yukon-Canada Co-operation Agreement for Small Business Development, whose mandate is to support expansion and diversification of the Yukon economy. The possibility of extracting suitable clayey sediments for the purpose of locally producing bricks, tiles or pottery has never been investigated. The high costs of transportation and the high breakage risk during shipping makes locally produced clay products an economically attractive and practical alternative. Fine-grained Quaternary deposits in the vicinity of Whitehorse have favourable physical characteristics for clay products, however this potential has never been investigated. This project is the first effort to map, sample, analyze and evaluate the potential of clay deposits in the Whitehorse area for industrial applications.

The report provides a summary of the project and delineates the analytical procedures necessary to determine the physical properties of clay necessary ceramic potential. It also includes a discussion on the fine-grained deposits within the study area (Figure 1) and on the results of the ceramic clay tests with recommendations for future work.

Accompanying the report (in back pocket) are maps at a 1:50,000 scale showing potential clay deposits with a legend showing suitable geological units and their suitability as economic industrial mineral. All analytical data obtained during this study are found in Appendix 1.

1.2 Study Area

The study area includes the valley bottom and valley wall settings in the vicinity of the Whitehorse area (Figure 1). The Takhini River Valley, the Yukon River Valley and the Carcross Valley are accessible via either the Alaska Highway or the Klondike Highway and several other secondary roads and/or tote trails. The M'Clintock Valley however is largely inaccessible via road.

1.3 Project Methodology

For ease and clarity, in this report, the term "ceramic clay" will be used to describe a clay body suitable for use in the ceramics industry. The term clay is defined in a variety of ways, however it is generally related to a grain size range between 2 um and 4 um. In the ceramics industry, clay is also defined in terms of plasticity and workability.

Plasticity and workability are related to both sediment grain size and sediment mineralogy. For example, fine grained feldspar particles may technically be classified as a clay particle from a geological perspective, however these minerals lack plasticity and as a result are not suitable as a ceramic clay. Plasticity is defined as the ability of a material to be deformed under pressure and retain that form. Workability is defined as the ease with which material can be molded without cracking or sticking. Both of these physical characteristics are dependent on grain-size, clay mineralogy and ion arrangement within the clay structure. Thus, the first step to classify suitable clay bodies for ceramic potential involves the organization of geological deposits into predictable and mappable units of specific grain-size and clay mineralogical families. The testing

Figure 1 Location Map and Physiographic Subdivisions

of clay deposits under fired and unfired conditions determines the potential of a deposit type as a source of commercial ceramic clays. Examples of economically viable clay deposits include: 1. heavy clay, which is used for brickware and structural clay products; 2. refractory or heat resistant clay and 3. whiteware, earthenware or artware which include fireclays and porcelain.

When mapping for ceramic clay deposits, it is essential to recognize the dominant textural and mineralogical properties of fine-grained Quaternary deposits and to make predictions in terms of textural variability and the occurrence of detrital inclusions. Both are directly linked to the paleoenvironment of deposition and as a result an understanding of Quaternary geological processes is essential when mapping for ceramic clay. Clay mineralogy is a property usually expressed at a regional scale. For example, the clay mineralogy of a particular sediment type can be quite consistent within a specific drainage system however this may change dramatically in a different valley as a result of varying bedrock provenance for the clayey sediment.

Preliminary field maps were completed utilizing interpretations from published surficial geology and soils maps and through air photo interpretation. A series of black and white air photos at the 1:20,000 and 1:40,000 scale were used to draft preliminary maps of fine-grained deposits in the study area.

The physical characteristics of glaciolacustrine deposits within the study area such as grain size distribution and clay mineralogy were used to develop a legend which relates the genesis of the Quaternary geological unit to ceramic clay potential. Potential clay bodies must have a suitable grain-size distribution, favourable clay mineralogy and a reasonably large volume of predictable quality. The legend developed for this project (Table 1) includes: 1. grain size or textural range; 2. probable clay mineralogy; 3. deposit thickness and 4. types of possible detrital inclusions within the clayey deposits. Each map unit is rated for it's potential as a ceramic clay source as either unsuitable, marginal or of untested potential. For example a thin clay body with sandy sediment inclusions is evaluated as unsuitable or less desirable than thicker clayey deposits of higher quality. Several other valleys in Yukon have a similar geological history as the Takhini River Valley, the Yukon River Valley and the Carcross Valley and as result the potential for significant sources of ceramic clay deposits is high.

A short period of field work was designed to test the integrity of the preliminary maps and legend with a sampling strategy to evaluate the most promising clay deposits within the study area. Five large samples were shipped to the Alberta Research Council Ceramic Clay Laboratory for a series of analyses. Grain-size distribution, clay mineralogy and fired and unfired tests were performed on four samples. A minimum of 6 kilograms of unweathered sample is required for the complete series of test which requires 6 to 8 weeks of laboratory time.

Table 1 PRELIMINARY ASSESSMENT OF CLAY DEPOSITS IN SELECTED AREAS OF THE WHITEHORSE MAP SHEET AREA (105D) FOR THE MANUFACTURE OF CLAY BASED PRODUCTS

LEGEND

ALL MAP UNITS ARE GLACIOLACUSTRINE DEPOSITS

EXPECTED CLAY FAMILY and CALCITE CONTENT	ESTIMATED THICKNESS RANGE IN M.	EXPECTED SIGNIFICANT INCLUSIONS	EXPECTED DOMINANT TEXTURE
A West Takhini, high calcite %	1 0-10	B- Boulders	C Clay
B East Takhini, mod. calcite %	2 10-20	G- Sand and gravel	CL Clay Loam
C North Yukon, high Calcite	3 20 +	R- Bedrock	SICL Silty Clay Loam
D South Yukon, unknown		Z- Known Permafrost	SIL Silt Loam
E Carcross, unknown			SL Sandy Loam
F M'Clintock, unknown			
H Developed Land			
S Saline Soil			

2.0 Quaternary Geology

2.1 Physiographic Subdivisions

For ease of discussion, the study area is divided into three subareas which includes the Takhini River Valley, the Yukon River Valley and the Carcross Valley (Figure 1). The Takhini River Valley is a broad low relief undulating surface which dissected by the Takhini River. It is approximately 6 kilometers wide, at elevations between 700 metres to 715 metres above sea level (a.s.l.) and is composed of thick deposits of glaciolacustrine silt and clay. A series of intermediate to low lying terraces are found in the valley bottom setting. Several groundwater discharge areas in the Takhini valley are suspected to be the cause of salt contaminated soils, which would also have an undesirable impact on the ceramic clay potential. Three samples were collected in the Takhini Valley and includes samples CC1, CC2 and CC3, (Figure 2). All of the samples were collected in clayey glaciolacustrine deposits which have a high potential for ceramic clays. In addition, these samples were collected in areas not visibly affected by salt contamination.

The Yukon River Valley, as defined in this study, runs from the southern end of Lake Laberge to Marsh Lake and is characterized as a broad plain which is dissected by the Yukon River. This valley is composed of low relief areas of glaciolacustrine deposits to hummocky kame and kettle or stagnant ice areas which are chiefly sand, gravel and diamicton. Overlying both the glaciolacustrine deposits and ice stagnant deposits are wind blown sand dunes. Elevations in the Yukon River Valley ranges between 660 metres to 690 metres a.s.l. Exposed bedrock is more frequent toward the Marsh Lake area. The M'Clintock River Valley is a small tributary valley of the Yukon River and is a low relief, poorly drained flat comprised of glaciolacustrine deposits and a variety of alluvial deposits. The elevation of the valley floor ranges between 685 metres and 730 metres a.s.l. Samples CC4 and CC5 were collected at the intersection of the Takhini River and the Yukon River and CC6 was collected near the intersection of the M'Clintock River and the Yukon River (Figure 2).

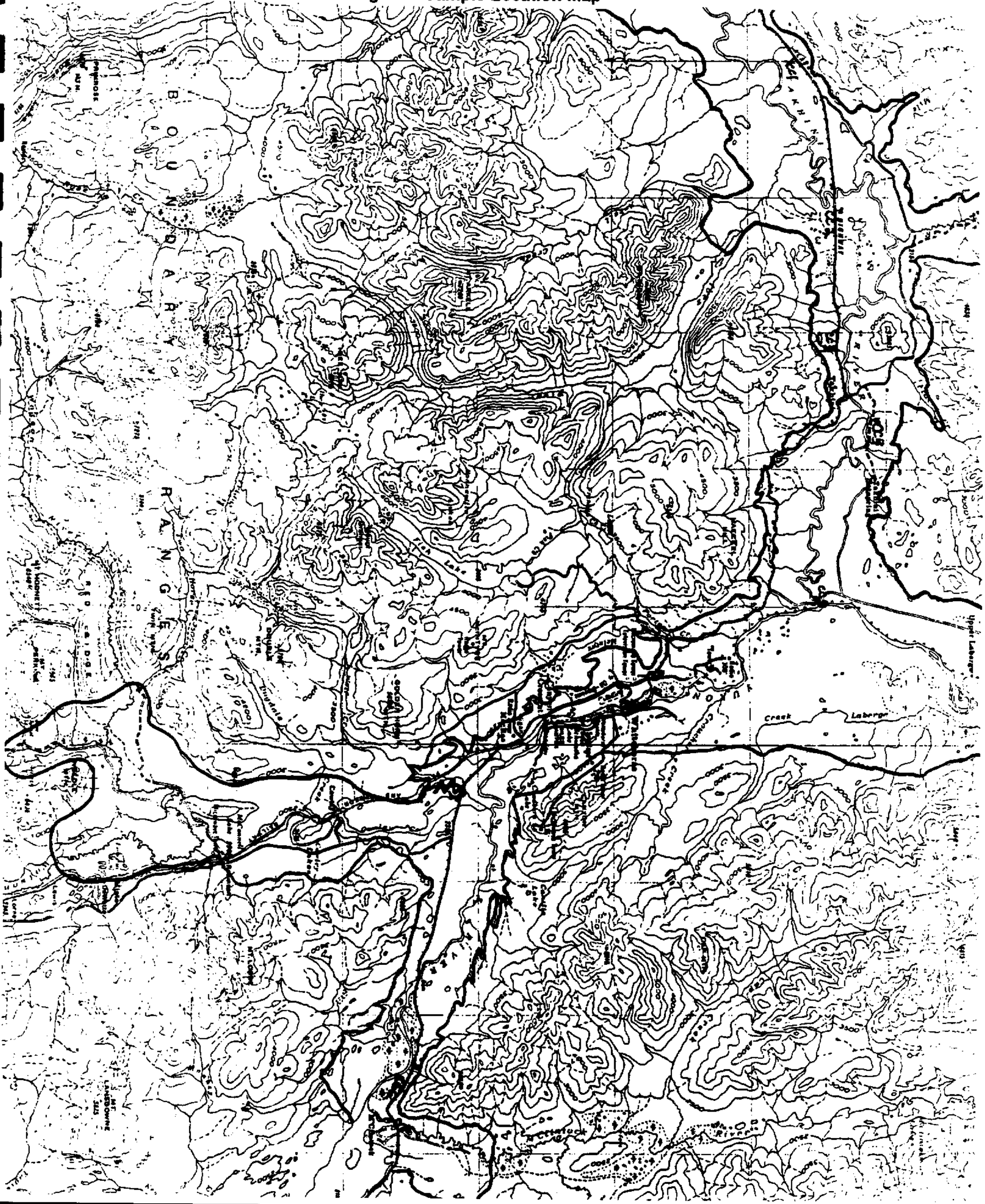
The Carcross Valley is composed of a complex assemblage of glaciofluvial sand and gravel and morainic deposits with small pockets of glaciolacustrine deposits, aeolian sand and bedrock outcrops. The topography is varied and consists of ridges, hills, hummocks and incised channels. The valley floor ranges in elevation from 730 metres to 810 metres a.s.l. No samples were collected in this valley as the Quaternary deposits described above are unsuitable for ceramic clay potential.

2.2 Quaternary History

Glaciolacustrine deposits are found within the entire study area, however the distribution, quality for ceramic potential, and thickness varies considerably according to the Quaternary history and the paleoenvironment in each of the major valleys. During with the last two millions years four major glaciations have significantly modified the landscape of southern and central Yukon. These glaciations are termed Nansen and Klaza which are collectively termed pre-Reid (oldest), Reid and McConnell (youngest, Bostock, 1966, Hughes et al. 1968). Each of these glaciations moved in a northerly direction into central Yukon, with the pre-Reid glaciations as the most extensive ice advance. As the glaciers slowly receded, their thickness decreased and their configuration was changed from a large, thick ice sheet to a complex assemblage of ice tongues, controlled by the local valley topography.

McConnell glacial ice was in the study area between 14,000 and 35,000 years ago, reached an elevation of 1830 metres a.s.l., and as a result covered the majority of the high elevation summits in the area. As the McConnell ice retreated and downwasted, a complex network of ice tongues dammed drainage systems and created a series of proglacial lakes in main valleys and tributary valleys. In the Whitehorse area, the McConnell ice front retreated in a southeastern direction which indicates that the western portion of the Takhini River Valley and the north area

Figure 2 Sample Location Map



of the Yukon River Valley were ice free prior to the Carcross Valley area and the eastern portions of the Yukon River Valley.

In the Takhini River Valley and the Yukon River Valley a large volume of melt water was dammed which formed the extensive Glacial Lake Champagne (Figures 3a to 3d), until approximately 10,000 years ago. This lake is believed to have reached an elevation of 822 metres to 853 metres a.s.l., as indicated by raised beach lines on valley walls in the Tahkini River Valley. The modern day surface of the Takhini River Valley is composed of Glacial Lake Champagne fine-grained sediments at an elevation of 700 metres (Plates 1a, b). The thickness of the Glacial lake Champagne sediments is in excess of 60 metres as shown by the thick exposures which have been created by downcutting of the Takhini River and the Yukon River. These deposits are the most probable source of ceramic clay.

2.3 Glaciolacustrine Deposits

Glacial lakes often form in front of advancing or retreating glaciers as a result of damming by stagnant ice blocks, damming by glacial drift deposits such as moraines and/or by a reversal of the regional slope due to isostatic depression. Glaciolacustrine deposits may cover extensive areas as a glacier retreats with fine-grained sediment being deposited from suspended load from glaciofluvial (e.g. stream) sources (Figure 4). Coarser grained sediments (e.g. sand, silt, gravel) are deposited from rafted ice blocks, from glaciofluvial and deltaic sedimentation and from mass wasting in valley wall positions and from the glacier terminus.

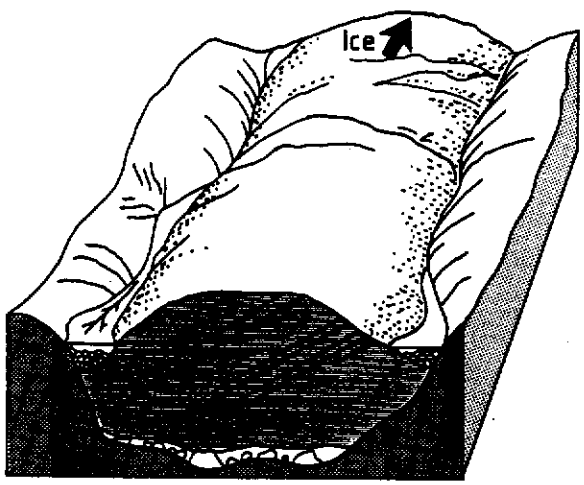
Glaciolacustrine sediments are dominantly composed of well sorted, well stratified laminae of clay, silt and fine sand in various proportions (Plate 1). In general, the sand content in such deposits increases closer to the source of the sediments (e.g. wasting glacial ice) and the clay content increases in the deeper portion of the lake basin as well as with distance from the glacier terminus (Figure 4). If the ice snout or margin is retreating in a consistent manner with no re-advance and retreat cycles, the location and composition of fine-grained deposits is predictable. Glaciolacustrine deposits are often characterized by alternating beds of finer-grained clayey sediments and coarser-grained silty sediments, termed varves which are the result of cyclic sedimentation.

Icebergs calving at a glacier terminus have the potential to shed their load of coarse-grained debris anywhere within the lake basin. This coarse-grained debris forms pockets of coarse gravel with occasional boulders within the well sorted fine-grained lacustrine sediments (Plate 2). Such inclusions involve a small volume of sediments and have an unpredictable distribution. Although inclusions of this type do not affect the mineralogical characteristics of the surrounding sediments, they will obviously add small quantities of sand and gravel to the host lacustrine deposit and as a result lower the overall quality for ceramic potential.

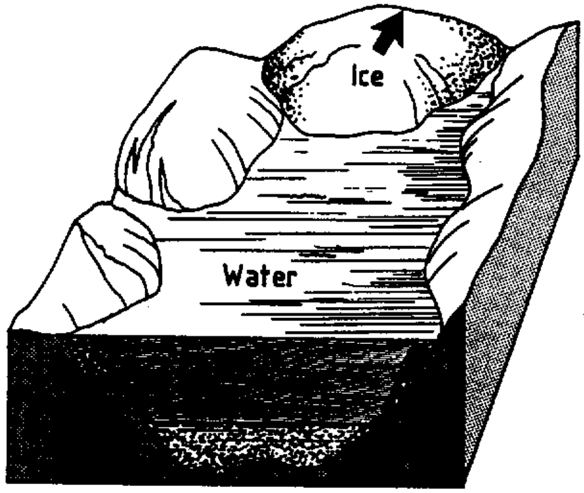
Incoming streams from the valleys sides also add coarse-grained sediments in a lacustine setting depending upon the hydrological characteristics of the stream environment and the lake basin configuration.

South of City of Whitehorse in the Yukon River Valley, glaciolacustrine deposits are found in more restricted depositional settings and as a result are mixed with sand and gravel deposits. The McConnell ice front in the Carcross Valley probably fluctuated with multiple advances and retreats and as a result glaciolacustrine sediments are either mixed or partially covered by coarser glaciofluvial and morainic deposits.

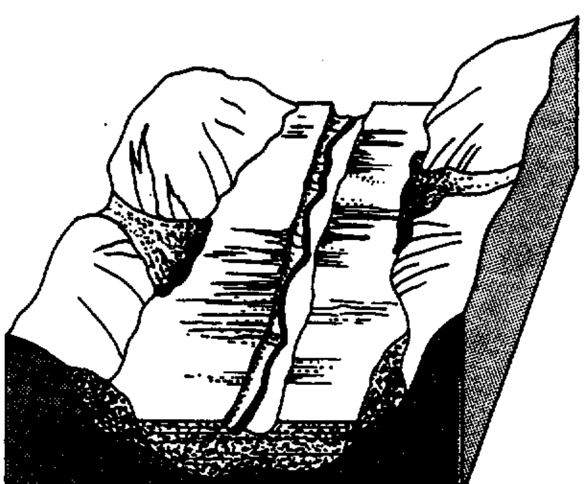
Figure 3 Deglaciation of the Takhini Valley, Glacial Lake Champagne



The McConnel ice retreated. Morainal and glaciofluvial materials were deposited on the margin of the ice.



As the ice melted, large volumes of water were dammed and formed Glacial Lake Champagne. Thick glaciolacustrine silty and clayey deposits covered the bottom of the valley.



After the glacial lake drained, fluvial systems started to erode downward and laterally. Fluvial sands and silts were deposited. Fluvial terraces were formed.

Figure 4 Deposition in a Glaciolacustrine Environment, from Reading

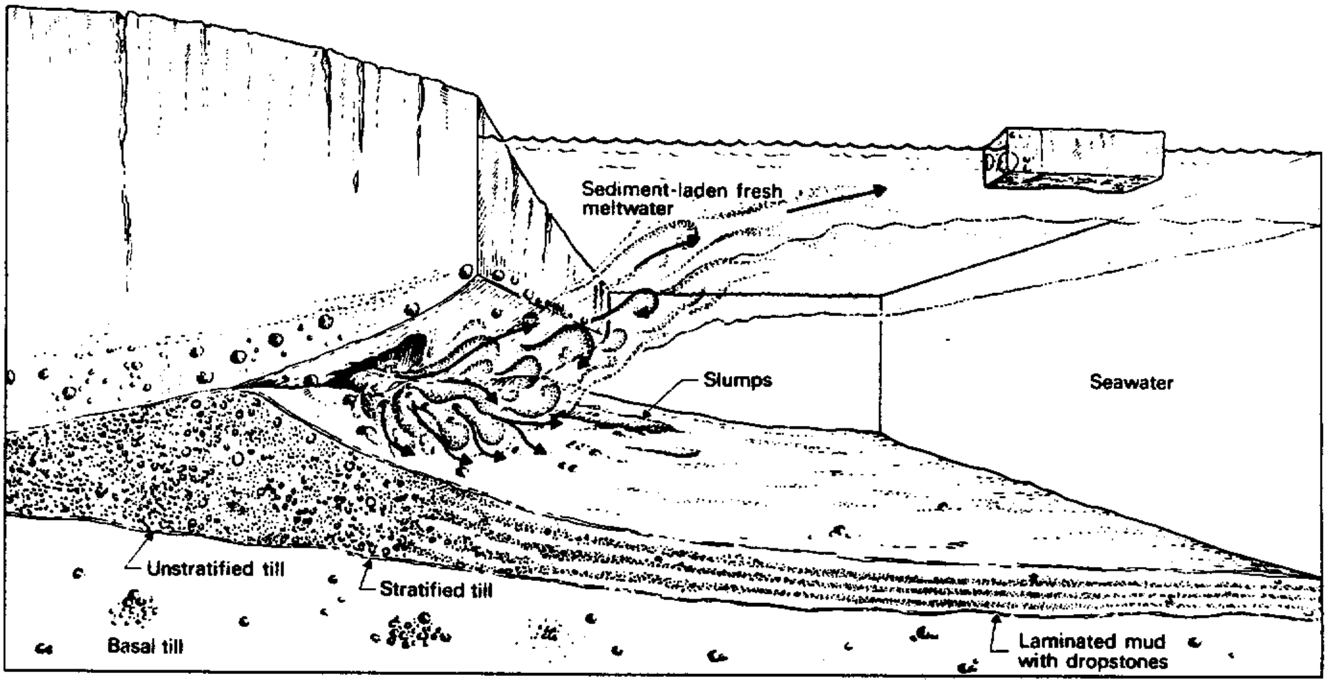


Fig. 13.5. Hypothetical model of glaciomarine sedimentation adjacent to a wet-based tidewater glacier, based on observations of Pleistocene subaqueous outwash and considerations of current dynamics of modern marine deltas. Most of the fresh glacial meltwater rises to the surface of the sea as a low density overflow layer. This layer gradually mixes with sea water while being driven by winds and currents. Silt and flocculated clays gradually fall out of suspension. Rapid mixing of fresh water and sea water adjacent to tunnel mouths may produce a high density underflow capable of transporting sand-grade sediment and occasionally coarser material.

Plate 1 Glaciolacustrine deposits of Glacial Lake Champagne. Well-stratified, well-sorted , planar beds of silt and clay, in the vicinity of Whitehorse

Plate 2 Iceberg deposits within glaciolacustrine deposits. Pockets of gravelly diamicton within well sorted silt and clay beds.

3.0 Laboratory Analysis and Results

This section describes briefly the laboratory tests done on the samples collected, the test results and the resulting rating of potential ceramic clay deposits. Table 2 shows the range of these properties used to evaluation ceramic clay potential. Most of the definitions and background technical information from this section are from Scafe (1991).

3.1 Ceramic Clay Tests

3.1.1 Grain Size Analysis

This analysis is a standard laboratory procedure to obtain the percentage by weight of clay, silt and fine sand. The overall clay content is critical for determining ceramic potential and clay is defined as a particle with a diameter less than 2 um. A minimum of approximately 25. % clay content is required to proceed with further analysis for ceramic potential.

3.1.2 Clay Mineralogy

X-ray diffraction was used to estimate the proportions of illite, montmorillonite, chlorite and kaolinite in the clay fraction of the sample. Further analysis of a clay sample at this stage is dependent upon a desirable combination of clays for ceramic uses.

3.1.3 Unfired Tests

Unfired tests quantify the physical properties of the clay body at room temperature (Table 2). Unfired clay properties include:

Munsell colour: an international color coded color description. Light browns and grays are considered attractive. Greens and yellows may not be desirable, depending on the product.

Tempering water % : the proportion of water required to mix in the clay to obtain optimum workability and plasticity.

Plasticity: the property of a moistened material that allows it to be deformed under pressure then retain the deformed shape after the pressure is removed (Scafe. 1991). For most clay material, maximum plasticity occurs when water content per weight is between 15% and 25%.

Workability: is related to the plasticity and to the ease with which a moist clay material can be molded without cracking or sticking.

Drying properties: as the clay looses its water, the bonding and volume of the material changes. High shrinkage rates are usually accompanied by cracking and wrapping, both of which are undesirable for ceramic clays.

3.1.4 Fired Tests

Fired (also called baked or burned) clays may be divided into soft wares (e.g. scratched by steel), such as building bricks for interior use, unglazed earthenware, or hard wares, such as exterior brick or tiles, stoneware or chinaware (Table 2). Fired test results provide indications of the behavior of the clay body at specific temperatures. These tests include:

Steel hard colour: Colour of the fired clay body, as defined in the international Munsell colour code. Desirable colour depends on the product desired.

Steel hard temperature: Temperature required to obtain hard ware hardness.

Table 2 Criteria Used in Evaluating Selected Clay Products, from Scafe 1991

	Face brick	Sewer pipe	Stoneware	Artware
Unfired Properties				
Workability	good	good	good	good
% water of plasticity	15-40	0-35	not critical	not critical
Drying characteristics	no warping or cracking	no warping or cracking	no warping or cracking	no warping or cracking
% drying shrinkage	0-12	0-8	3-8	0-15
Fired Properties				
Maturing temperature (°C)	980-1200	980-1150	1210-1330	980-1150
Hardness	steel hard	steel hard	steel hard	steel hard
% Absorption (unglazed)	0-15	0-8	0-2	not critical
Color	reds, buffs, creams, etc.	reds, buffs	buffs, grays	variety

Maximum fire temperature: temperature beyond which a body overfires (e.g. at which bloating or fusion will take place).

Firing range: is the temperature range between steel hard temperature and the maximum firing temperature. A range of 5^{0} C to 25^{0} C is considered an extremely short firing range, 30^{0} C to 50^{0} C is a short firing range and 55^{0} C to 100^{0} C is a moderate firing range.

Maximum Fire Shrinkage: during firing, porosity as measured by absorption gradually decreases and shrinkage increases. Firing is terminated when acceptable shrinking is attained.

Comments or concerns: any additional observations relevant to the clay behaviour (e.g. presence of lime specks) are included in these analytical tests.

3.2 Laboratory Results

The summary of the analyses for the samples which were shipped are shown on Tables 3 and 4 and the laboratory data are in Appendix 1. All the samples which were shipped for this study had a sufficient clay content, good plasticity and good workability. The main clay minerals which are present in the submitted samples include kaolinite, illite, chlorite and in one case, montmorillonite in a significant percentage. Other minerals such as quartz, plagioclase feldspar and calcite are also present in all samples (Table 3).

Table 3 XRD SEMI QUANTITATIVE CLAY MINERAL RESULTS

SAMPLE	ILLITE %	MONTMOR. %	CHLORITE%	KAOLINITE%	SAND-SILT%	CLAY(<2U)%
CC1	40	0	10	50	33.6	66.4
CC2	45	0	10	45	58.5	41.5
CC3	45	5	10	40	54.9	45.1
CC6	40	20	15	25	68.5	31.5

Table 4 CHARACTERISTICS OF UNFIRED SAMPLES

Sample	Descrip.	Tempering Water %	Plasticity	Workability	Drying Prop. room T	Drying prop. 105C	Drying shrinkage %, 150C
CC1	light olive gray 5Y6/1	23.36	good	good	initially good, linear cracking appeared several days later	initially good, linear cracking appeared several days later	05.80
CC2	light olive gray 5Y6/1	20.50	good	good	good	good	04.90
CC3	light olive gray 5Y6/1	20.33	good	good	good		4.60
CC6	light olive gray 5Y6/1	19.50	good	good	good	good	6.00

Table 5 CHARACTERISTICS OF FIRED SAMPLES

Sample	Steel Hard Color	Steel Hard Absorp .%	Steel Hard Temp. %	Max. Fire Color	Max. Fire Temp.	Max. Fire Absorp. %	Max. Fire Shrink. %	REMARKS
CC1	Pale Brown, 5YR5/2	1080	-	-	1128+	-	-	Max. fire Temp. not reached. Severe cracks and curving upwards in fired bars, white specks(lime) throughout. Calcite active flux material. Doubtful value
CC2	Pale Brown, 5YR5/2	1102	0.20	Pale Brown, 5YR5/2	1122	0.23	10.92	Extremely short firing range (<25C).Calcite active flux material. White specks (lime) at hot end of bars. Possible structural clay products if firng is accurate.
CC3	Light Brown, 5YR6/4	1101	2.55	Pale Brown, 5YR5/2	1125	.13	10.75	Extremely short firing range (<25C).Calcite active flux material. White specks (lime) at hot end of bars. Possible structural clay products if firing is accurate.
CC6	Pale Brown, 5YR5/2	1150	0.19	Pale Brown, 5YR5/2	1125	0.63	8.16	Max. fire temp. below steel hard. White specks (lime) in bars. Calcite active flux material. Doubtful value

3.3. Summary of Results

CC1 The CC1 sample did not survive the firing due to severe cracking and deformation. This sample was evaluated by the Alberta Research Council as of doubtful value for ceramic use.

CC2 This CC2 sample has potential value, with good colour, good plasticity and good workability. The limitations for ceramic potential include: 1. an extremely short firing range (less than 25 ^{O}C) which would require a specific kiln as well as precise firing procedures and 2. a high calcite content in which white specks of lime may worsen with time and eventually weaken the structural strength of ceramic products. It is likely that this calcite content varies at depth and as a result the potential is uncertain.

CC3 Results very similar to CC2 with the same potential.

CC4 This sample was eliminated very early in the analytical process because of very high calcite content.

CC6 This sample was evaluated as of doubtful value because the maximum fire temperature is below steel hard temperature. In this sample as in all others the presence of lime specks is a concern.

3.4 Ceramic Clay Potential

The map units with ceramic clay potential are shown on Figure 5 and the maps which show areas of fine-grained sediment potential which are classified into textural and mineralogical families, thickness classes and detrital inclusion types are in Figures 6 to 11. The map units are rated as potential source for ceramic clay in either as unsuitable, marginal or of untested potential. Unsuitable clay bodies are eliminated either because of mineralogical reasons, physical reasons, or for land use reasons. Untested potential are map units which contain clay deposits which might possess proper physical and chemical properties but were not sampled and tested during this project because of access problems and financial restrictions. Marginal map units (sampled and analyzed) possess suitable physical properties but marginal mineralogical properties.

3.4.1 Takhini River Valley

The most promising samples were collected in the middle to eastern side of the Takhini Valley. Fine-grained deposits in the valley which are the most promising are highlighted in the summary map (Figure 5). These deposits are estimated to have a thickness of greater than 10 meters with few coarse sediment inclusions, a consistent textural range and are not located in or near areas of groundwater discharge (e.g. excess salinity). The calcite content in these clay deposits may vary slightly with depth and should be verified during with a subsurface drilling program. As shown in the above results section, lime specks are the result of excess calcite in the clay deposit and these specks will ultimately negatively impact the esthetic appeal and long term strength of the final clay product.

Other areas in this valley were eliminated due to: 1. saline seepage (see the map symbol S, Figure 6); 2. bedrock outcrop (see map symbol R, Figure 6); 3. high calcite in the clay mineralogy (see map symbol A, Figure 6) and 4. small to large sand inclusions (see map symbol S, Figure 6).

3.4.2 Yukon River Valley

A few localities in this valley have favourable potential for suitable clay deposits for ceramic uses, however these areas were not sampled due to poor access and budget limitations (Figure 5). Of these areas, the M'Clintock River drainage basin should be considered for future sampling.

Although lime specks were found to be present during analytical tests on sample CC4 which is located just outside of the M'Clintock River drainage basin, it is possible that other clay deposits in the M'Clintock River valley have favourable clay mineralogy and should be investigated.

Others areas in the Yukon River Valley have been eliminated due to: 1. land use conflicts such as the airport and the McPherson and Hidden Lake residential subdivisions; 2. the lack of volume in known clay deposits (see map symbol H, Figure 6); 3. presence of detrital inclusions (see map symbol S, Figure 6), and 4. poor fired behavior as in CC4 (see map symbol E, Figure 6).

3.4.3 Carcross Valley

No samples were collected in this valley due to generally unfavourable geomorphic settings and unfavourable deposit types. Most glaciolacustrine deposits in the Carcross Valley are located on the western side of the valley, are probably thin and are often mixed with morainic and gravelly deposits. Around Lewes Lake, thicker fine-grained deposits are present but are mainly composed of marl which is unsuitable as a fired clay..

4.0 Summary and Recommendations

4.1 Study Methodology for Future Projects

The distribution and potential of clay as an industrial mineral, specifically ceramic potential is directly linked to the physical characteristics of deposit types and the Quaternary history. It is for this reason that surficial geology maps which are designed to show the distribution of clay deposits for industrial use must include the textural data in areas of favourable deposits, the occurrence of detrital inclusions and an interpretation of the deposit thickness and aerial distribution. Air photo interpretation for areas of favourable clay deposits should be followed by ground truthing and sampling of the most promising clay deposits at depth of at least 1 meter from the surface.

Any samples collected in the field will require six to eight weeks of processing to determine their suitability for ceramic uses. Subsurface drilling should be done as a follow up to the surface mapping with the objective of verifying the thickness of the mapped clay deposits and to verify the properties of clay at depth and to collect additional samples. Laboratory analyses, especially the fired tests are crucial to the identification of ceramic clays and should be identified as the most important budget item for future projects.

4.2 Potential Areas for Ceramic Clay Deposits

Several areas in the Takhini River Valley contain clay deposits of significant thickness and appear to have consistent physical properties which are considered to be favourable as a potential source of ceramic clay for industrial use (e.g. CC2 and CC3). However as outlined earlier lime specks and a very short firing range are two limiting factors which may have a significant impact on the potential use of clay deposits in the Takhini River Valley. The short firing range will require special firing conditions as found in tunnel kilns which may impact the overall economic potential of clay deposits in this area for industrial use.

The Yukon River Valley may have suitable clay deposits on the eastern side of the river and north of the City of Whitehorse. These areas were not sampled due to land use issues (e.g. land claims) and access problems and as a result were considered to be of low priority area for the late fall sampling program. The area south of the City of Whitehorse does not have promising clay deposits. In addition the M'Clintock River Valley has favourable clay deposits and should be sampled in future clay mapping programs.

The Carcross Valley as defined in this study was not considered as a promising area for clay deposits, mainly because of great variability of Quaternary deposits which are chiefly sand and gravel. Clay bodies present in this area would probably contains numerous sandy inclusions and would have a small volume.

4.3 Recommendations for Future Work

4.3.1. Sampling

This preliminary study has shown that some clay deposits have suitable physical properties for ceramic potential. Although this is encouraging, the limited number of samples which were analyzed in this study do not allow for a complete evaluation of these favourable clay deposits. Additional sampling should include a short drilling program restricted to the promising areas in the Takhini River Valley (Figure 5). Drilling will also allow for an evaluation of the permafrost conditions at depth which would have a direct impact on the economics of large scale extraction of clay for industrial uses. In addition, sampling of clay via helicopter in the M'Clintock River

Valley and possibly the glaciolacustrine deposits northeast of Whitehorse would delineate other areas which have favourable potential.

4.3.2. Research

Research should include a basic feasibility study of such an industry in Yukon and should include extraction techniques, mixing and firing methods and costs, type of clay products which are most suited to the clay types found in the study area, the volumes of favourable clay deposits in the study area and the potential market. This study could also link other areas in central and southern Yukon which abundant fine-grained deposits and their industrial potential. Research could also be conducted on the possibility of the use of unfired clay in the school or home for craft projects and other similar work.

Finally, it is suggested that a visit to the Medicine Hat brick mill be considered with the objective of scoping out the various aspects of such an industry including mine design, optimum deposit volumes, depths of clay deposits, acceptable ranges of physical and mineralogical properties, types of extracting procedures and the firing technology which is used.

5.0 References

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Appendix 1

ALBERTA RESEARCH COUNCIL

December 17, 1993

Ms. Charlotte Mougeot
RR1, Site 12, Compartment 46
Whitehorse, Yukon
Y1A 4Z6

Dear Ms. Mougeot,

Please find enclosed the results for ceramic testing on four local glacial lake sediments. Semi-quantitative clay mineral estimates with percent sand-silt and percent clay calculations, and ceramic unfired/fired bars have been included.

We trust the enclosed meets with your complete satisfaction.

Yours sincerely,

Dianne Goulet

Dianne Goulet
Encls.

250 Karl Clark Road
Edmonton, Alberta
Canada
403/450-5111
Telex 037-2147
(RESEARCH EDM)

Mailing address:
PO Box 8330
Postal Station F
Edmonton, Alberta
Canada T6H 5X2

CERAMIC TEST

CHARACTERISTICS OF UNFIRED SAMPLES

SAMPLE	DESCRIPTION	TEMPERING WATER (%)	PLASTICITY	WORK-ABILITY	DRYING PROPERTIES ROOM TEMP.	DRYING PROPERTIES 105 C	DRYING SHRINKAGE (%) 150 C
CC1	Light olive gray (5 Y 6/1)	23.36	good	good	initially good - linear cracking appeared several days later	initially good - linear cracking appeared several days later	05.80
CC2	Light olive gray (5 Y 6/1)	20.50	good	good	good	good	04.90
CC3	Light olive gray (5 Y 6/1)	20.33	good	good	good	good - slight surface cracking along edges	04.60
CC6	Light olive gray (5 Y 6/1)	19.50	good	good	good	good	06.00

CHARACTERISTICS OF FIRED SAMPLES

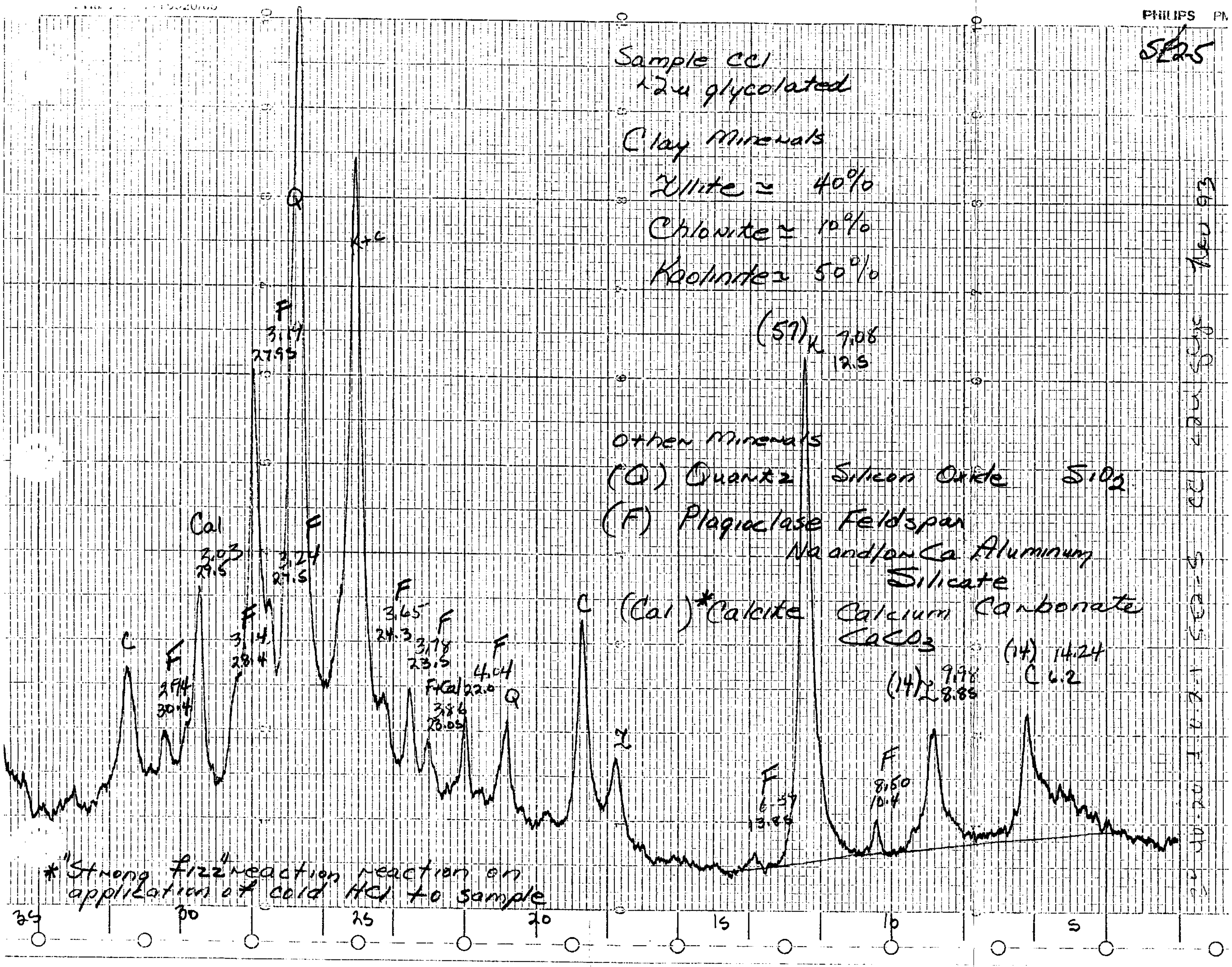
STEEL HARD COLOR	STEEL HARD TEMP. (C)	STEEL HARD ABSORPTION (%)	MAXIMUM FIRE COLOR	MAXIMUM FIRE TEMP. (C)	MAXIMUM FIRE ABSORPTION (%)	MAXIMUM FIRE SHRINKAGE (%)	REMARKS
Pale brown (5 YR 5/2)	1080	-	-	1128+	-	-	Maximum fire temp not reached. Severe cracks and curving upward in fired bars, white specks (lime) throughout. Calcite active flux material. Doubtful value.
Pale brown (5 YR 5/2)	1102	0.20	Pale brown (5 YR 5/2)	1122	0.23	10.92	Extremely short firing range (<25 C). White specks (lime) at hot end of bars. Calcite active flux material. Possible structural clay products if firing is accurate.
Light brown (5 YR 6/4)	1101	2.55	Pale brown (5 YR 5/2)	1125	0.13	10.75	Extremely short firing range (<25 C). White specks (lime) at hot end of bars. Calcite active flux material. Possible structural clay products if firing is accurate.
Pale brown (5 YR 5/2)	1150	0.19	Pale brown (5 YR 5/2)	1125	0.63	8.16	Maximum fire temp below steel hard. White specks (lime) throughout bars. Calcite active flux material. Doubtful value.

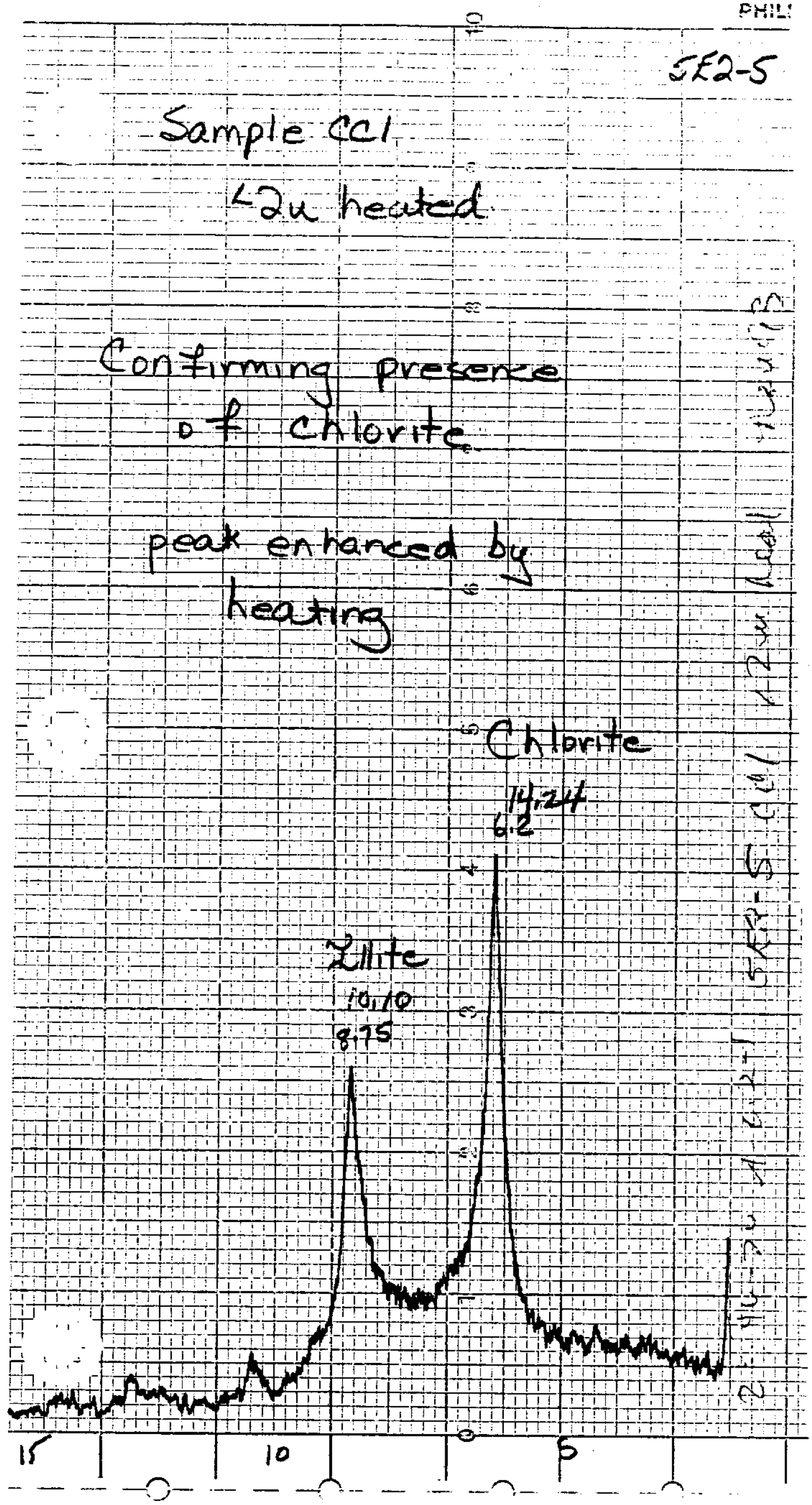
XRD SEMI-QUANTITATIVE CLAY MINERAL RESULTS

SAMPLE	ILLITE	MONTMORILLONITE	CHLORITE	KAOLINITE	% SAND-SILT (>2u)	% CLAY (<2u)
CC1	40%	0%	10%	50%	33.6%	66.4%
CC2	45%	0%	10%	45%	58.5%	41.5%
CC3	45%	5%	10%	40%	54.9%	45.1%
CC6	40%	20%	15%	25%	68.5%	31.5%

OTHER MINERALS PRESENT IN ALL FOUR SAMPLES:

Quartz
Plagioclase Feldspar
Calcite


PHILIPS
SE25
Sample CCl
<2µ glycolated
Clay Minerals
Illite ≃ 40%
Chlorite ≃ 10%
Kaolinite ≃ 50%
(57) K 7.08 12.5
Other Minerals
(Q) Quartz Silicon Oxide SiO2
(F) Plagioclase Feldspar Na and/or Ca Aluminum Silicate
(Cal) *Calcite Calcium Carbonate CaCO3
(14) 14.24 C 6.2
(14) I 9.98 8.85
F 8.50 10.4
F 6.57 13.85
I
C
Q
F 4.04
F+Cal 22.0 3.86 23.05
F 3.78 23.5
F 3.65 24.3
K+C
F 3.24 27.5
Q
F 3.19 27.95
F 3.14 28.4
Cal 3.03 29.5
F 2.94 30.4
C
*"Strong fizz" reaction on application of cold HCl to sample
35
30
25
20
15
10
5



SR2-5
Sample CC1
<2u heated
Confirming presence of Chlorite
peak enhanced by heating
Chlorite
14.24
6.2
Illite
10.10
8.75
15
10
5

AM

SAMPLE # CC1 DATE Nov 23/93

Gm Sample	2100
Ml. Water	640
Total	2740
% H2O	23.36%

Wet Length	10.0
Loss on Drying	.58
7 Bars { 9.4, 9.45, 9.4, 9.4, 9.4, 9.45, 9.45 }	
% Drying Shrinkage @ 150°C	5.8%

PLASTICITY / WORKABILITY } Good

COMMENTS Entire spl moist, large chunks formed when squeezed. Material in extruder exhibited good plasticity {molded into cap/casing - easy to remove} 8 Bars Extruded - Bars fairly straight / fairly firm - slightly plasticene in feel

DRYING @ 105°C Nov 23/93 4:15 pm
AR - Initially Good - several days later linear crack appearing
- 6% Drying Shrinkage

7 Bars: @ Room Temp / 150°C
Initially Good - several days later linear crack appearing on 5 Bars; 2 eventually cracked in half

TEMPERATURE GRADIENT FURNACE
Nov 29/93 150°C Overnite

TEST UNIT TGCA DATE Dec 9/93

CONTROLLER TEMP 250°C - 1200°C with 2½ hr soak at 850°C {≈ 7.0 hrs}

REAR	READINGS	FRONT	READINGS	
0 (7.5")	1150.1	0 (7.5")	1147.2	— severe cracking + curving up of bars
(6.0")	1112.8	1 (6.0")	1125.2	
(4.5")	1034.0	2 (4.5")	1042.2	
(3.0")	908.3	3 (3.0")	928.8	
(2.0")	786.8	4 (2.0")	821.0	
(1.0")	613.1	5 (1.0")	649.1	

Slight curving up of bars at 1120°C

SAMPLE NO CC1

	LENGTH		WIDTH			TEMP	SHRINKAGE	ABSORPTION			
FRONT	DRY	FIRED	DRY	FIRED	DIFF.	°C	%	WET WT.	DRY WT.	DIFF	% AB.
1	.45	.45	.937	.937	0	517	0				
2	.95	.95	.939	.939	0	633	0				
3	1.46	1.46	.943	.942	+.001	727	+0.11				
4	1.95	1.95	.944	.941	+.003	812	+0.32				
5	2.46	2.45	.946	.935	+.011	870	+1.16				
6	2.96	2.95	.946	.935	+.011	922	+1.16				
7	3.46	3.44	.945	.934	+.011	963	+1.16				
8	3.96	3.93	.946	.933	+.013	1000	+1.37				
9	4.46	4.42	.941	.926	+.015	1035	+1.59				
10	4.95	4.90	.939	.904	+.035	1063	+3.73				
11	5.46	5.35	.934	.864	+.07	1080	+7.50				
12	5.96	5.79	.929	.859	+.07	1117	+7.54				
13	6.46	6.23	.923	.835	+.088	1128	+9.53				
14											
REAR											
1	.46		.878								
2	.96		.887								
3	1.46		.897								
4	1.96		.906								
5	2.46		.912								
6	2.96		.918								
7	3.46		.924								
8	3.96		.927								
9	4.46		.933								
10	4.95		.936								
11	5.46		.937								
12	5.96		.936								
13	6.46		.935								
14											

(Absorption columns, bracketed beside front bars 2–12:) Severe cracking of bars - did not proceed with Absorption Test

COMMENTS:

Front Bar Used

Color (unfired bar)

Light Olive Gray 5 Y 6/1

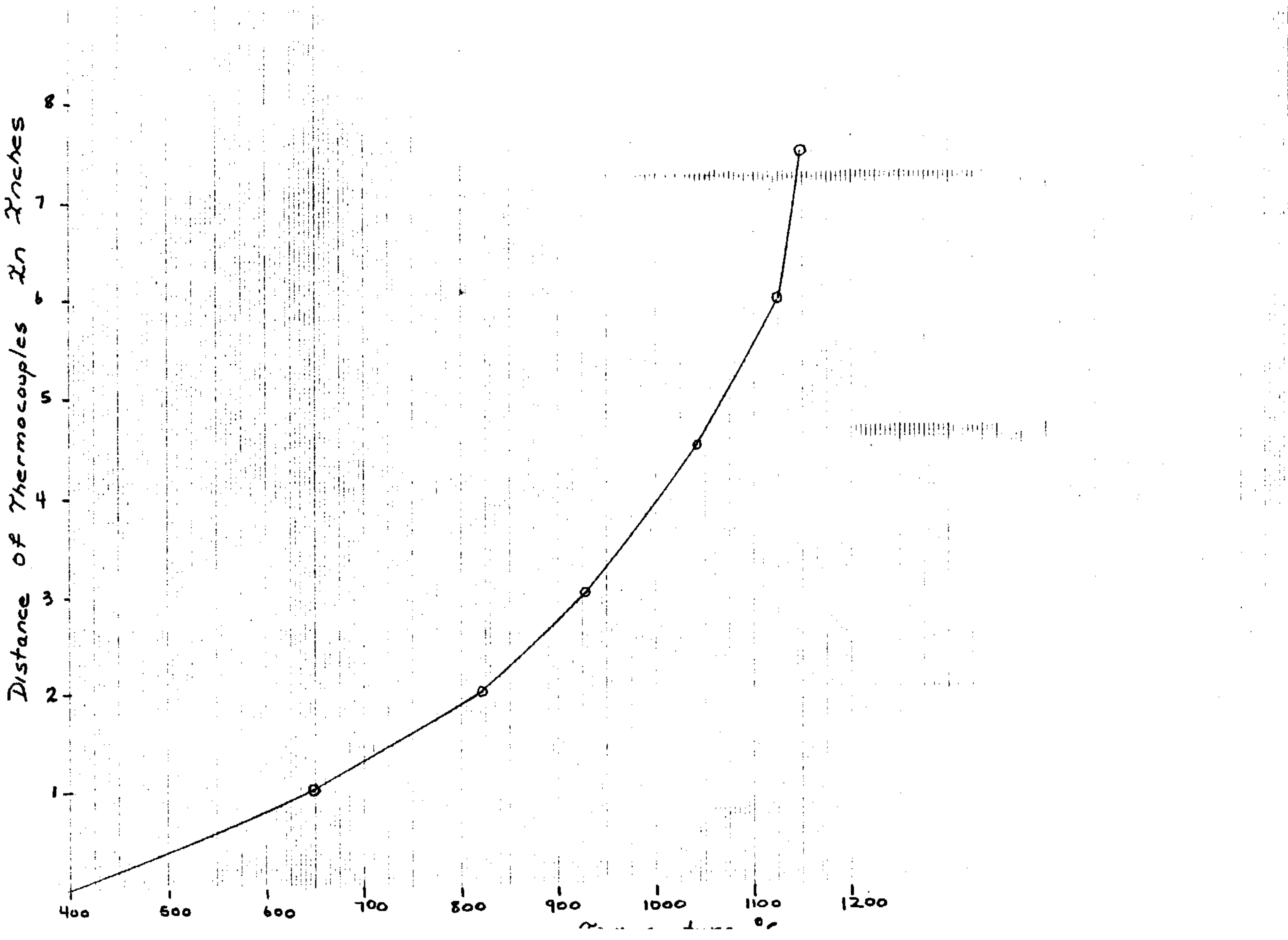
Steel Hardness @ #11 (1080)

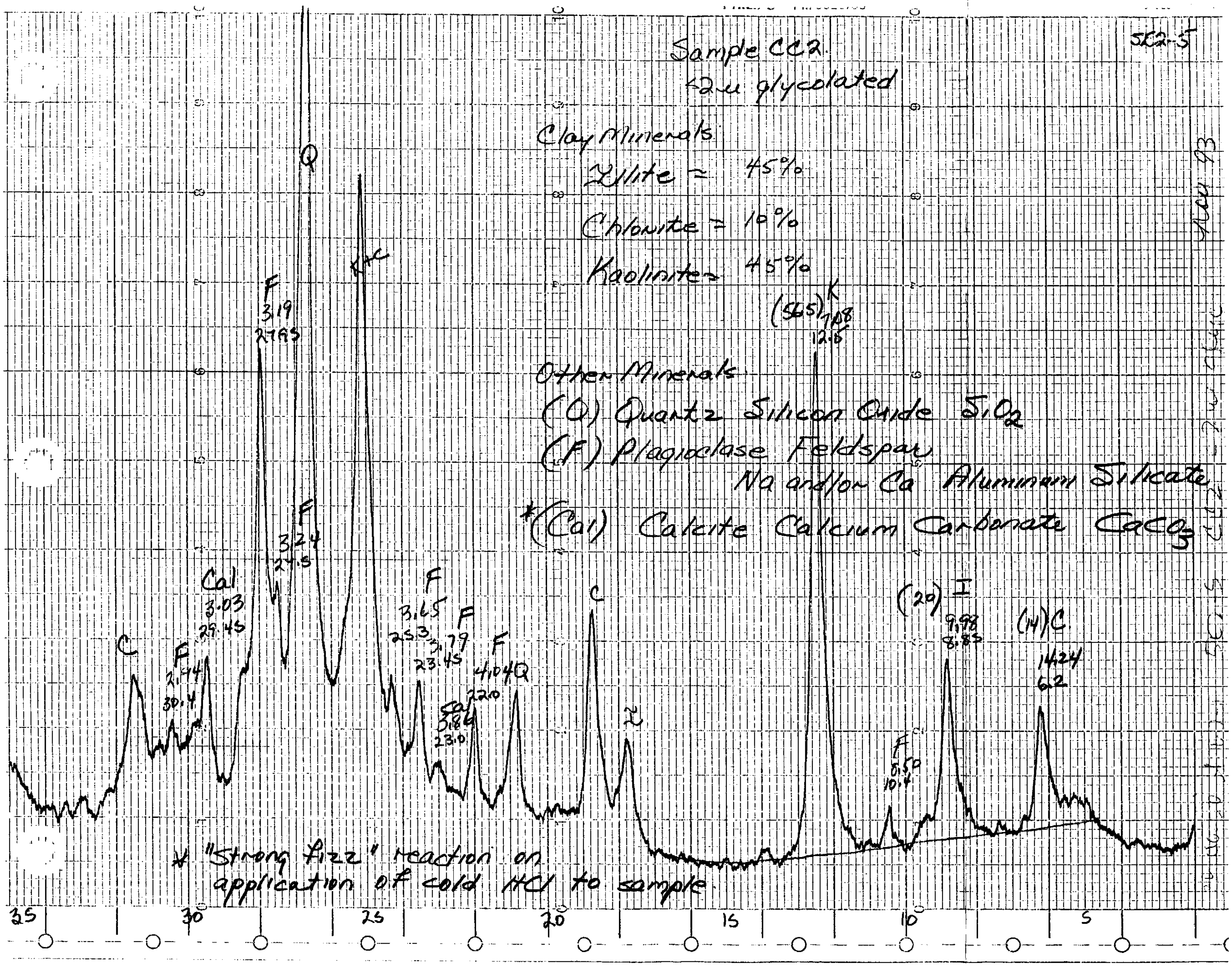
Color (fired) Pale Brown 5YR 5/2

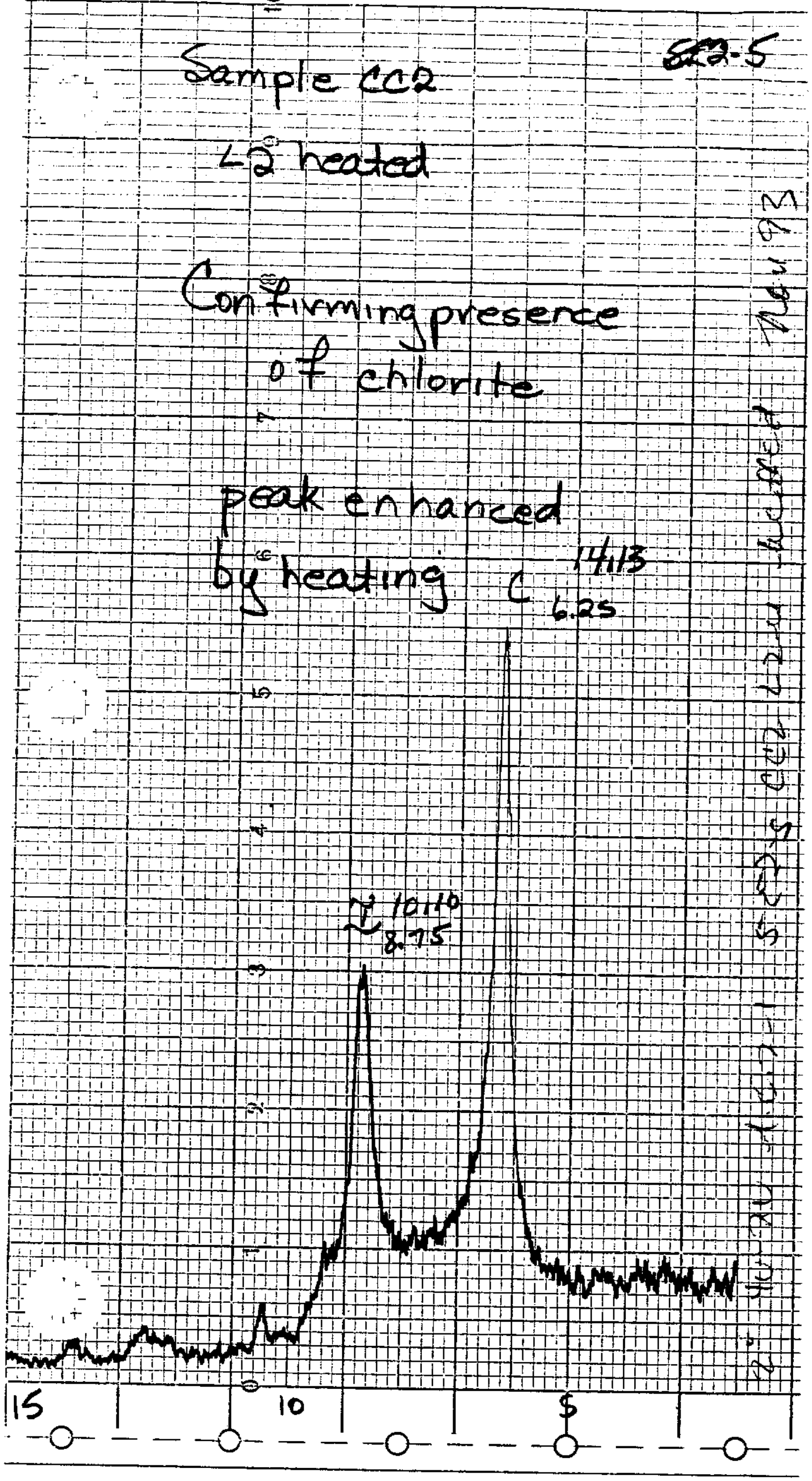
MAX Fire Temp not reached — {bars curving up + cracking in TGF}

CCI

FRONT BAR




SC2-5
Sample CC2
<2u glycolated
Clay Minerals
Illite ≈ 45%
Chlorite ≈ 10%
Kaolinite ≈ 45%
Other Minerals
(Q) Quartz Silicon Oxide SiO2
(F) Plagioclase Feldspar
Na and/or Ca Aluminum Silicate
*(Cal) Calcite Calcium Carbonate CaCO3
* "Strong fizz" reaction on application of cold HCl to sample
Nov 93
Q
K+C
F 3.19 27.95
F 3.24 27.5
Cal 3.03 29.45
F 2.94 30.4
C
F 3.65 25.3
F 3.79 23.45
F 4.04 Q 22.0
Cal 3.86 23.0
C
I
(565) K 7.08 12.5
F 8.50 10.4
(20) I 9.98 8.85
(14) C 14.24 6.2
35
30
25
20
15
10
5


22-5
Sample CC2
L2 heated
Confirming presence
of chlorite
peak enhanced
by heating
C 14.13
6.25
I 10.10
8.75
Nov 93
15
10
5

SAMPLE # CC2 DATE Nov 23/93 Am

gm Sample	2100
Ml. Water	541
Total	2641
% H2O	20.5%

Wet Length	10.0
Loss on Drying	.49
7 Bars {9.5, 9.5, 9.55, 9.5, 9.5, 9.5}	
% Drying Shrinkage @ 150 °C	4.9%

PLASTICITY } Good

WORKABILITY }

COMMENTS. Entire spl moist, large chunks formed when squeezed. Material in extruder exhibited good plasticity & molded onto cap/casing — easy to remove. 8 Bars Extruded — Bars fairly straight / fairly firm — slightly plasticene in feel

DRYING @ 105°C Nov 23/93 — @ Room Temp/150°C

1 Bar — Good — Good

— 5% Drying Shrinkage

TEMPERATURE GRADIENT FURNACE

NOV 29/93 150°C overnite

TEST UNIT TG-CA DATE Dec 3/93

CONTROLLER TEMP 250°C — 1200°C with 2½ hr soak at 850°C (≈ 7¾ hrs)

REAR	READINGS	FRONT	READINGS
0 (7.5")	1164.5	0 (7.5")	1161.9
1 (6.0")	1126.9	1 (6.0")	1138.4
2 (4.5")	1047.6	2 (4.5")	1054.6
3 (3.0")	920.5	3 (3.0")	939.0
4 (2.0")	798.0	4 (2.0")	828.0
5 (1.0")	621.3	5 (1.0")	654.3

slight curving up of bars at 1130°C

SAMPLE NO CC2

	LENGTH		WIDTH			TEMP	SHRINKAGE	ABSORPTION (FRONT)			
FRONT	DRY	FIRED	DRY	FIRED	DIFF.	°C	%	WET WT.	DRY WT.	DIFF	% ABS
1	.47	.47	.947	.947	0	521	0	7.5675	6.4263	1.1412	15.08
2	.97	.97	.951	.951	0	647	0	6.7663	5.6888	1.0775	15.93
3	1.47	1.47	.954	.952	+.002	737	0.21	9.2574	7.7183	1.5391	16.63
4	1.97	1.96	.955	.952	+.003	823	0.31	6.1025	5.1009	1.0016	16.41
5	2.47	2.46	.956	.950	+.006	880	0.63	6.9937	5.8457	1.1480	16.42
6	2.97	2.96	.956	.949	+.007	933	0.73	6.0914	5.0824	1.009	16.56
7	3.47	3.45	.956	.948	+.008	977	0.84	6.4897	5.3538	1.1359	17.50
8	3.96	3.94	.954	.945	+.009	1014	0.94	7.7169	6.4666	1.2503	16.20
9	4.47	4.45	.952	.934	+.018	1050	1.89	7.0498	6.0272	1.0226	14.51
10	4.97	4.93	.950	.895	+.055	1077	5.79	7.5165	6.9822	0.5343	7.11
11	5.47	5.39	.947	.845	+.102	1102	10.77	5.3897	5.3741	0.0156	0.29
12	5.97	5.78	.943	.840	+.103	1122	10.92	5.2047	5.1930	0.0117	0.23
13	6.47	6.24	.939	.850	+.089	1140	9.48	8.6199	8.5954	0.0245	0.28
14											
REAR											
1	.46		.914								
2	.96		.918								
3	1.46		.922								
4	1.96		.925								
5	2.46		.926								
6	2.97		.928								
7	3.47		.929								
8	3.96		.929								
9	4.47		.928								
10	4.97		.927								
11	5.47		.923								
12	5.97		.919								
13	6.47		.915								
14											

COMMENTS:

Front Bar Used

Color (Unfired bar)
Light Olive Gray
5 Y 6/1

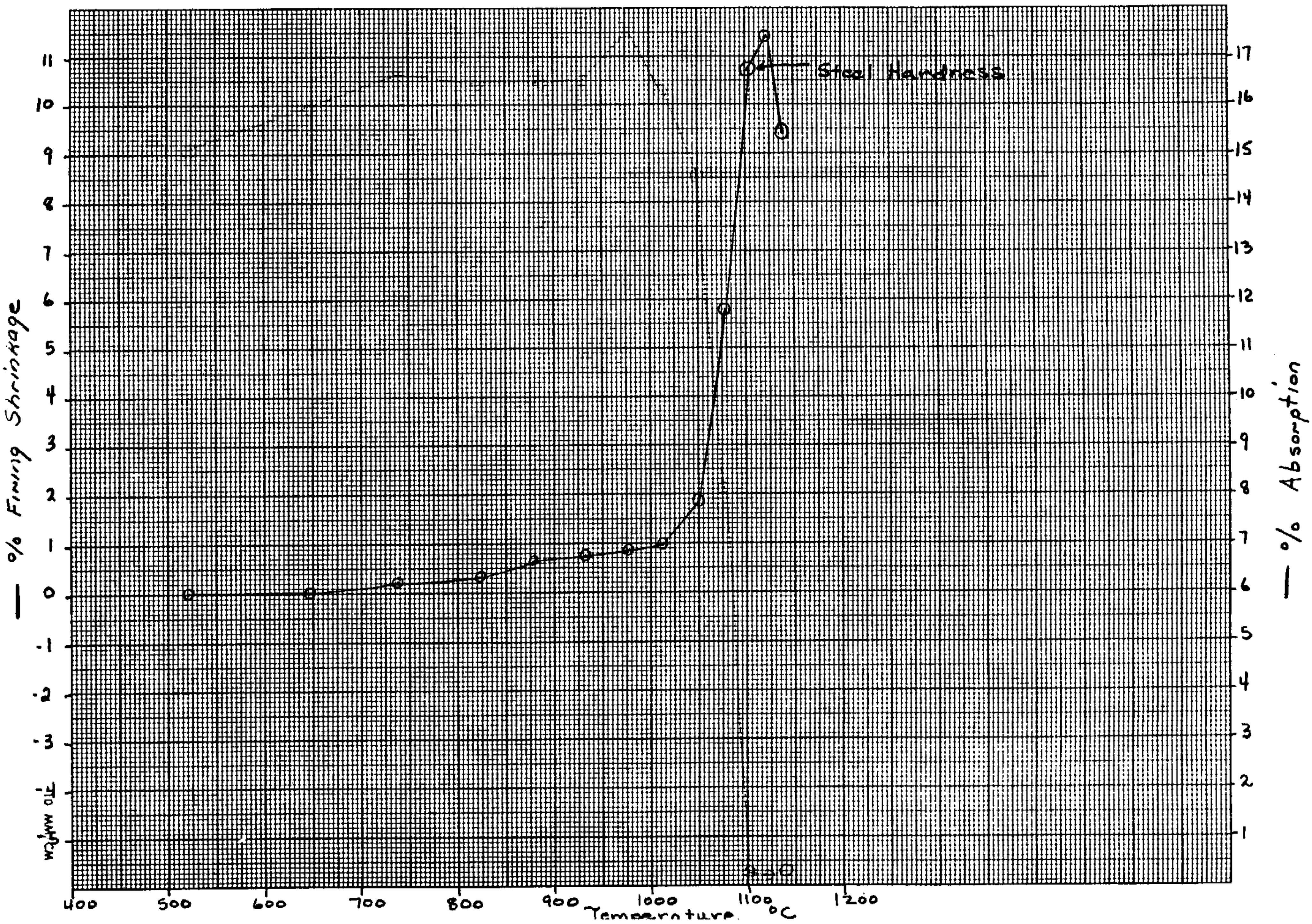
Steel Hardness
@ #11

Color (fired)
Pale Brown
5YR 5/2

Max Fire Temp @ #12
Color Pale Brown 5YR 5/2

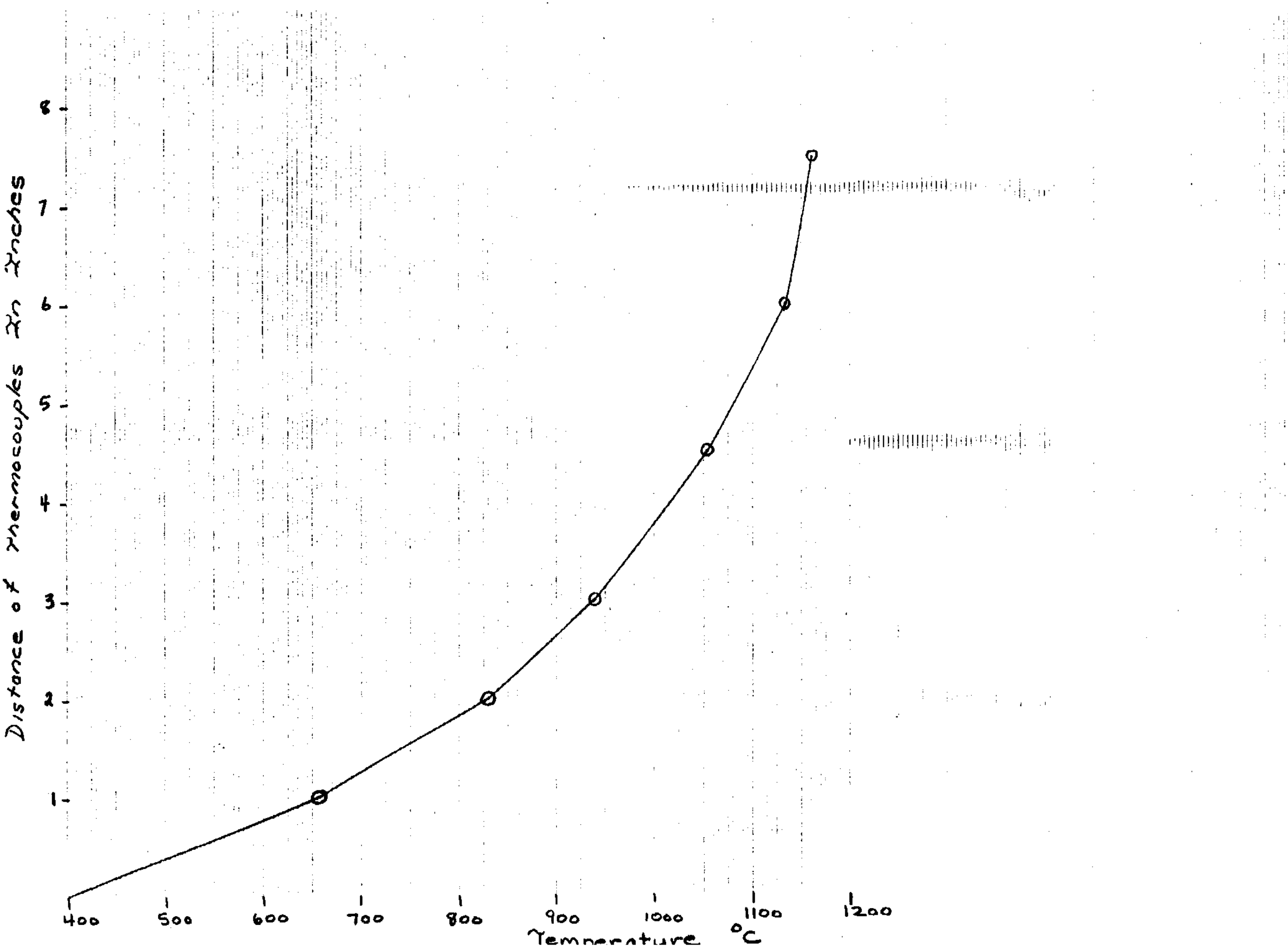
CC2

FRONT BAR



CC2

FRONT BAR



5E2-5

Sample CC 3
<2u glycolated

Clay Minerals

Illite 45%

Montmorillonite = 5%

Chlorite = 10%

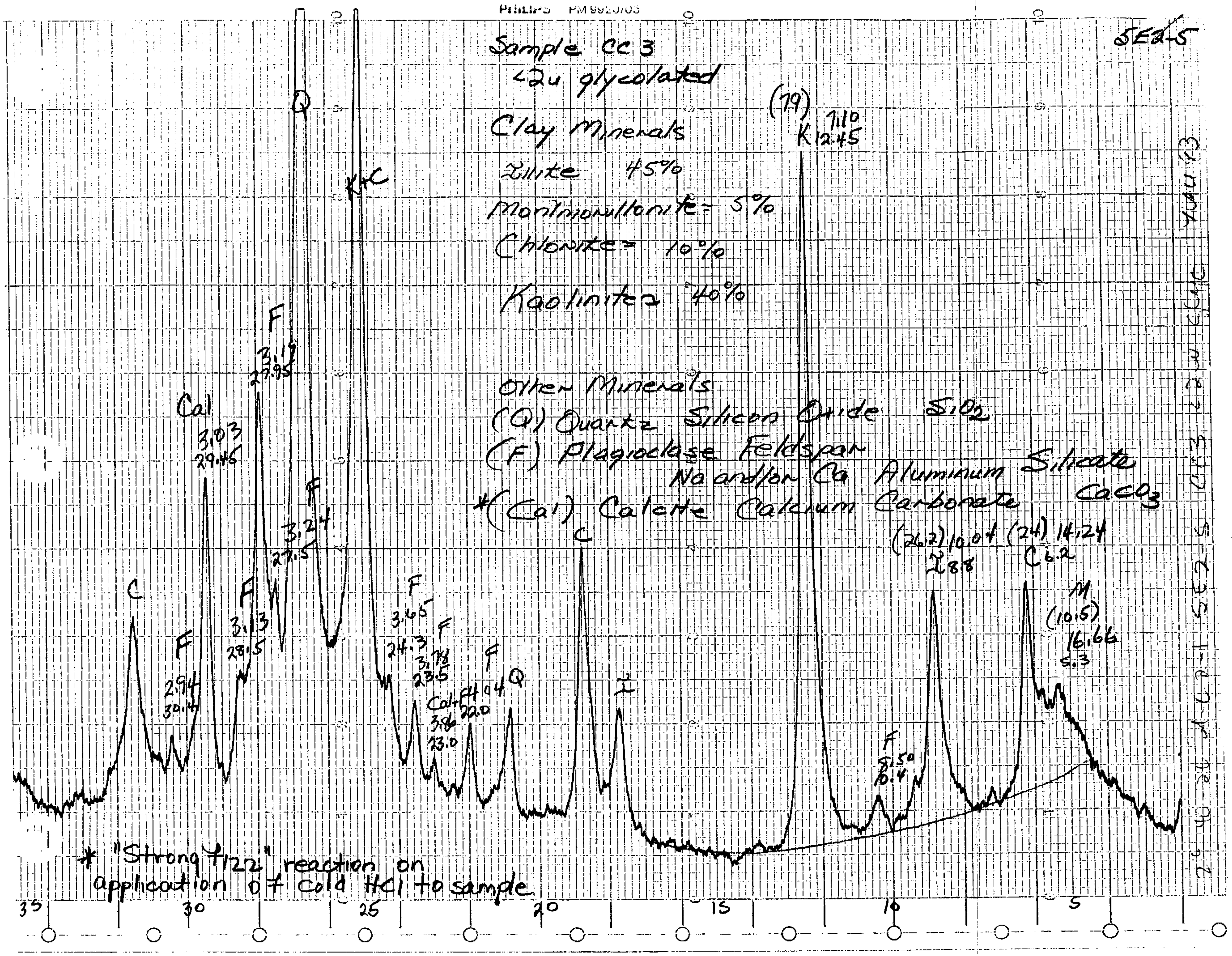
Kaolinite = 40%

Other Minerals

(Q) Quartz Silicon Oxide SiO_2

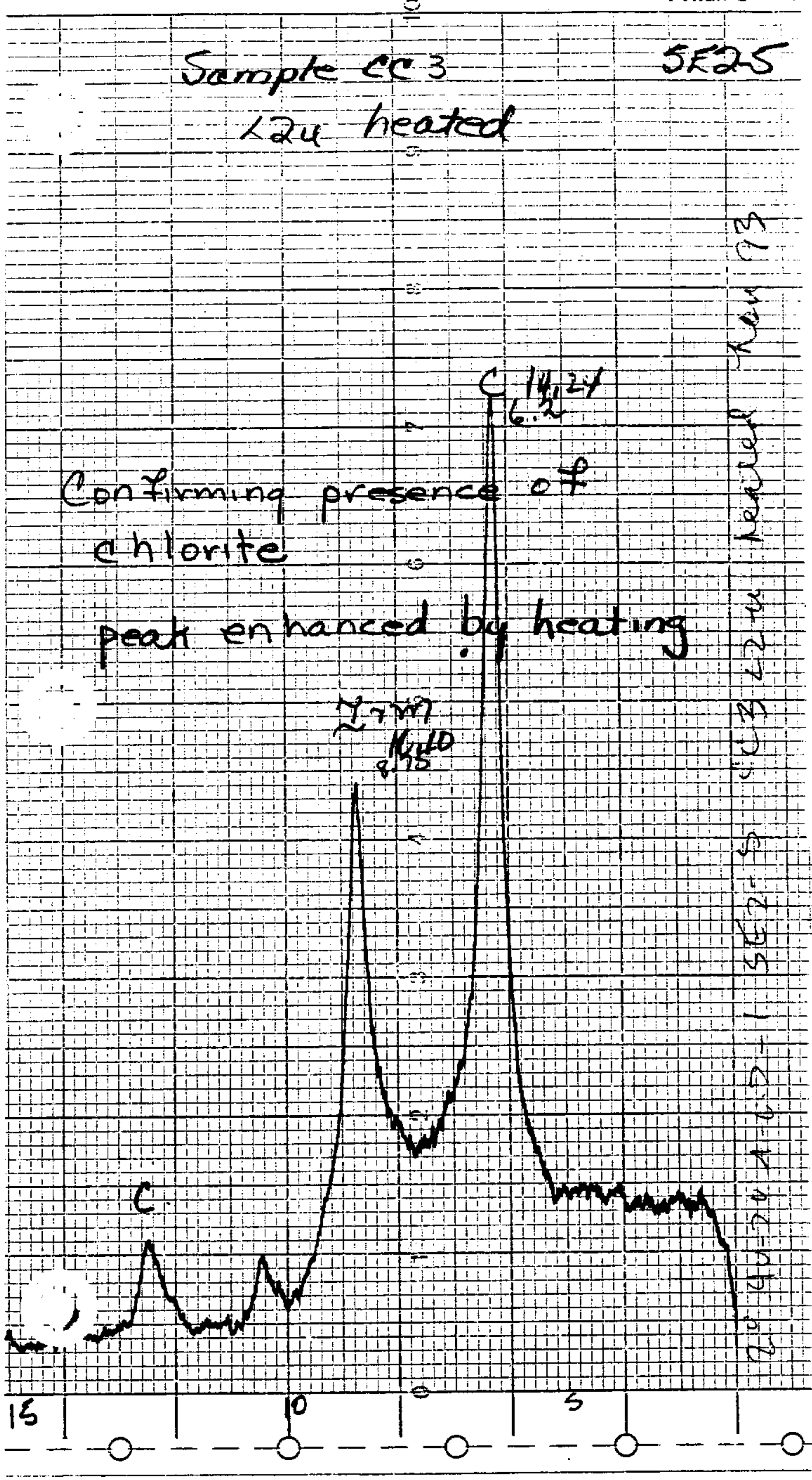
(F) Plagioclase Feldspar
Na and/or Ca Aluminum Silicate

*(Cal) Calcite Calcium Carbonate $CaCO_3$



* "Strong fizz" reaction on application of cold HCl to sample

PHILIPS



Sample CC 3
<2u heated
5E25
C 14.24
6.2
Confirming presence of
chlorite
peak enhanced by heating
C
15
10
5

AM

SAMPLE # CC3 DATE Nov 24/93

Sample	2100
Ml. Water	536
Total	2636
% H_2O	20.33%

Wet Length 10.0

Loss on Drying .46

6 Bars → {9.6, 9.5, 9.55, 9.5, 9.5, 9.6}

% Drying Shrinkage @ 150 °C 4.6%

PLASTICITY } Very Good

WORKABILITY }

COMMENTS Entire spl moist; large chunks formed when squeezed. Material in extruder exhibited good plasticity {molded onto cap/casing - easy to remove; peeled off}

7 Bars + 1 spl - Bars {very plasticene in feel - soft}

DRYING @ 105 °C Nov 25/93 8 AM
1 Bar Good
5.5% Drying Shrinkage
on 1 Bar

@ Room Temp/150°C
Good - slight
surface cracking
along edges

Dec 1/93 pm 150°C overnight (6 Bars)

TEMPERATURE GRADIENT FURNACE

TEST UNIT TG-CA DATE Dec 6/93

CONTROLLER TEMP 250°C - 1200°C with 2½ hr soak at 850°C (≈ 7¼ hrs)

REAR	READINGS 2nd	FRONT	READINGS 1st
(7.5")	1161.9	0 (7.5")	1158.8
(6.0")	1123.6	1 (6.0")	1136.0
(4.5")	1045.9	2 (4.5")	1053.5
(3.0")	919.0	3 (3.0")	938.1
(2.0")	797.3	4 (2.0")	829.5
(1.0")	619.7	5 (1.0")	654.6

slight curling up at 1135 °C

SAMPLE NO CC3.

FRONT	LENGTH DRY	LENGTH FIRED	WIDTH DRY	WIDTH FIRED	WIDTH DIFF.	TEMP °C	SHRINKAGE %	ABSORPTION (FRONT) WET WT.	DRY WT.	DIFF	% AB.
1	.44	.44	.922	.922	0	520	0	10.4751	8.9026	1.5725	15.01
2	.93	.93	.925	.926	-.001	635	-0.11	9.6148	8.0378	1.5777	16.40
3	1.44	1.44	.928	.928	0	733	0	4.8924	4.0849	0.8075	16.51
4	1.93	1.93	.929	.929	0	818	0	6.7618	5.6481	1.1137	16.47
5	2.45	2.44	.930	.930	0	876	0	8.2390	6.8726	1.3664	16.59
6	2.94	2.93	.930	.930	0	928	0	6.6362	5.5180	1.1182	16.85
7	3.44	3.43	.928	.928	0	973	0	7.1454	5.9483	1.1971	16.75
8	3.94	3.93	.926	.924	+.002	1010	+.22	7.2028	6.0117	1.1911	16.5[illegible]
9	4.44	4.43	.923	.917	+.006	1047	+.65	7.9476	6.7177	1.2299	15.48
10	4.95	4.92	.919	.895	+.024	1076	+2.61	6.7401	5.9745	0.7656	11.36
11	5.45	5.39	.915	.848	+.067	1101	+7.32	5.9848	5.8322	0.1526	2.55
12	5.95	5.81	.911	.813	+.098	1125	+10.75	5.2342	5.2272	0.0070	.13
13	6.45	6.26	.906	.819	+.087	1141	+9.60	10.2284	10.1993	0.0291	.29
14											

REAR	LENGTH DRY	WIDTH DRY
		.934
1	.45	.939
2	.95	.945
3	1.45	.949
4	1.94	.952
5	2.45	.955
6	2.95	.958
7	3.45	.961
8	3.95	.963
9	4.45	.963
10	4.95	.961
11	5.45	.958
12	5.95	.955
13	6.46	
14		

COMMENTS.

Front Bar Used

Color (unfired)
Light Olive Gray
5 Y 6/1

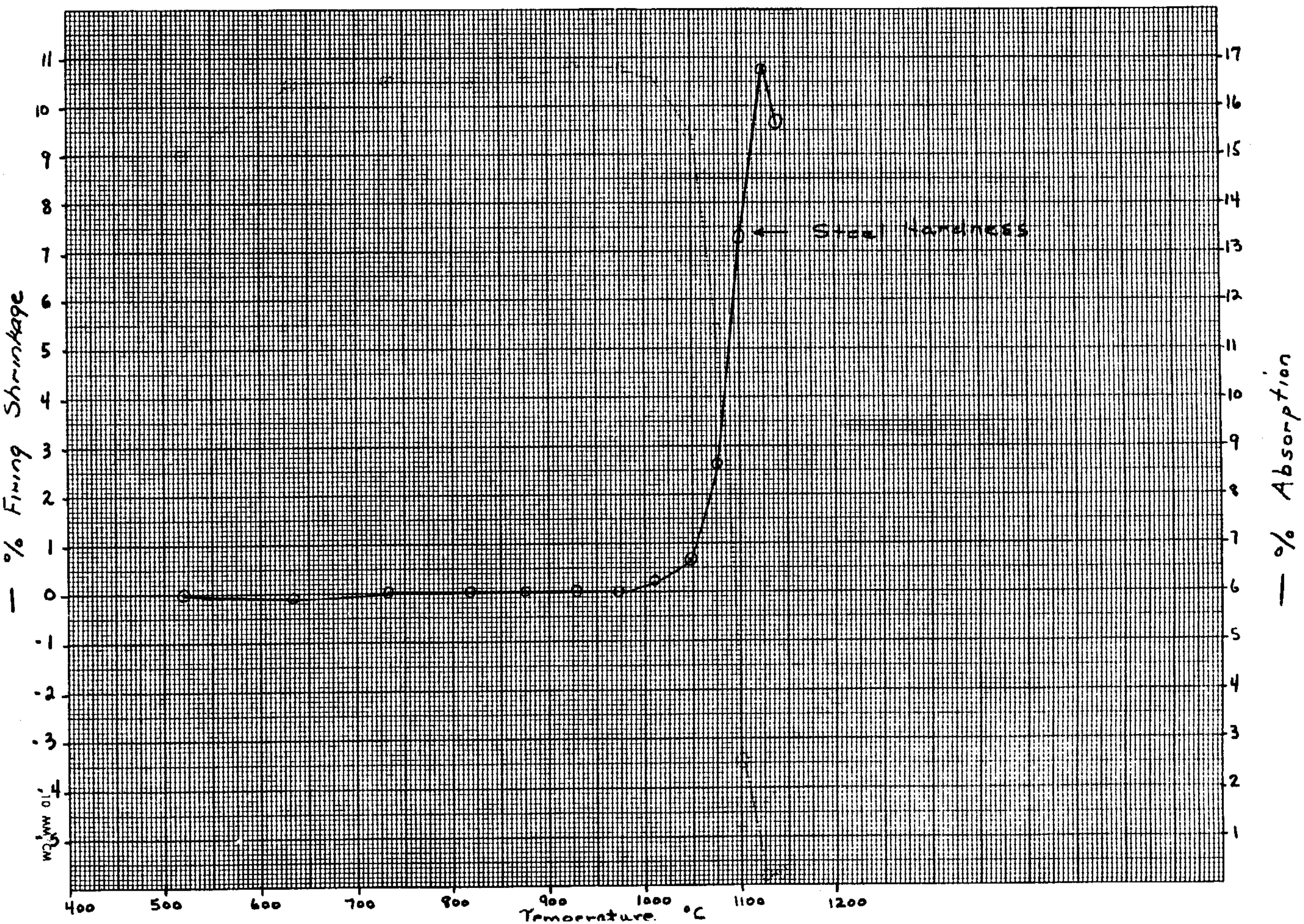
Steel Hardness
@ # 11.

Color (fired)
Light Brown
5 YR 6/4

Max Fire Temp
@ #12.
Color Pale Brown 5 YR 5/2

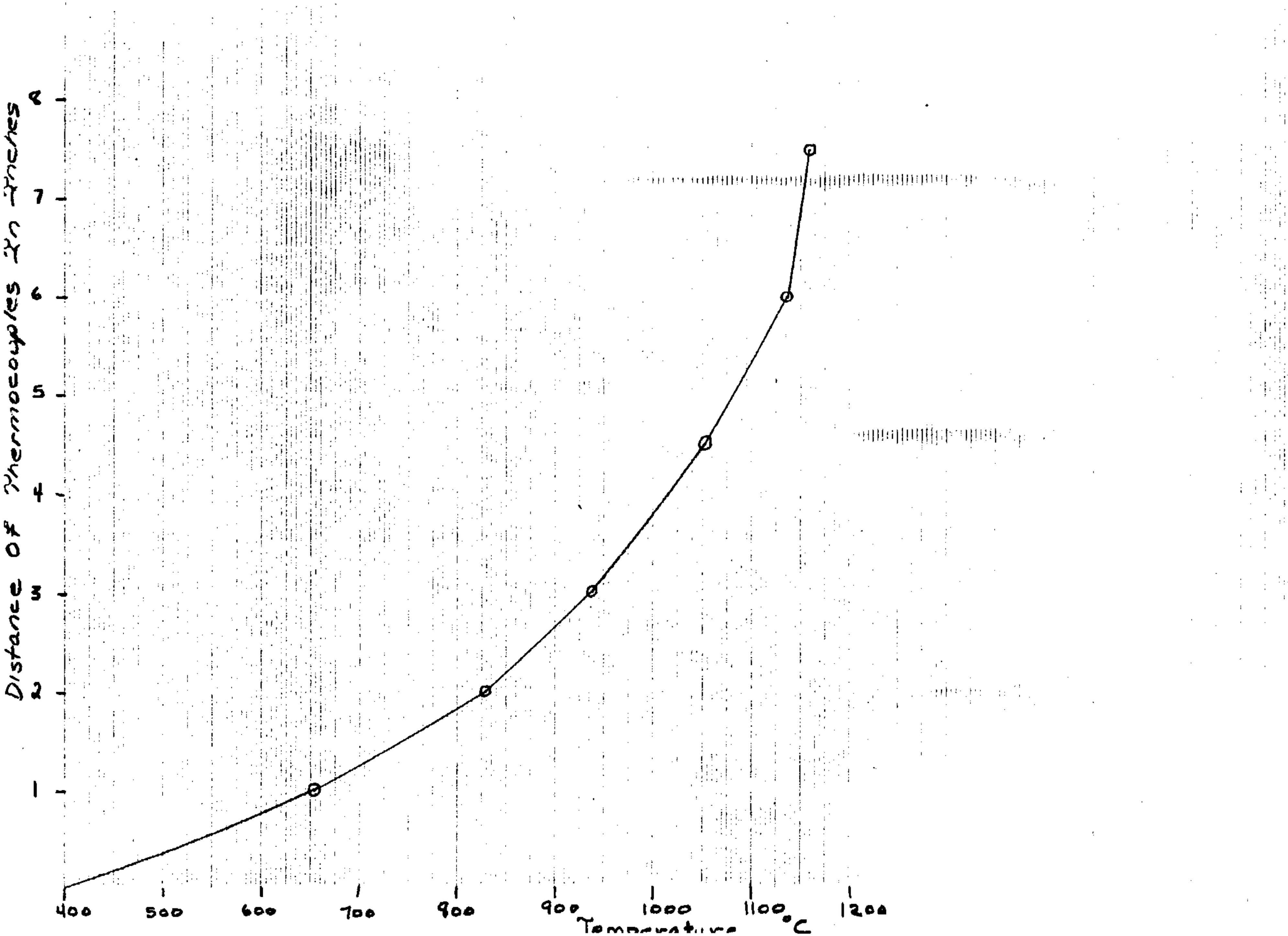
CC3

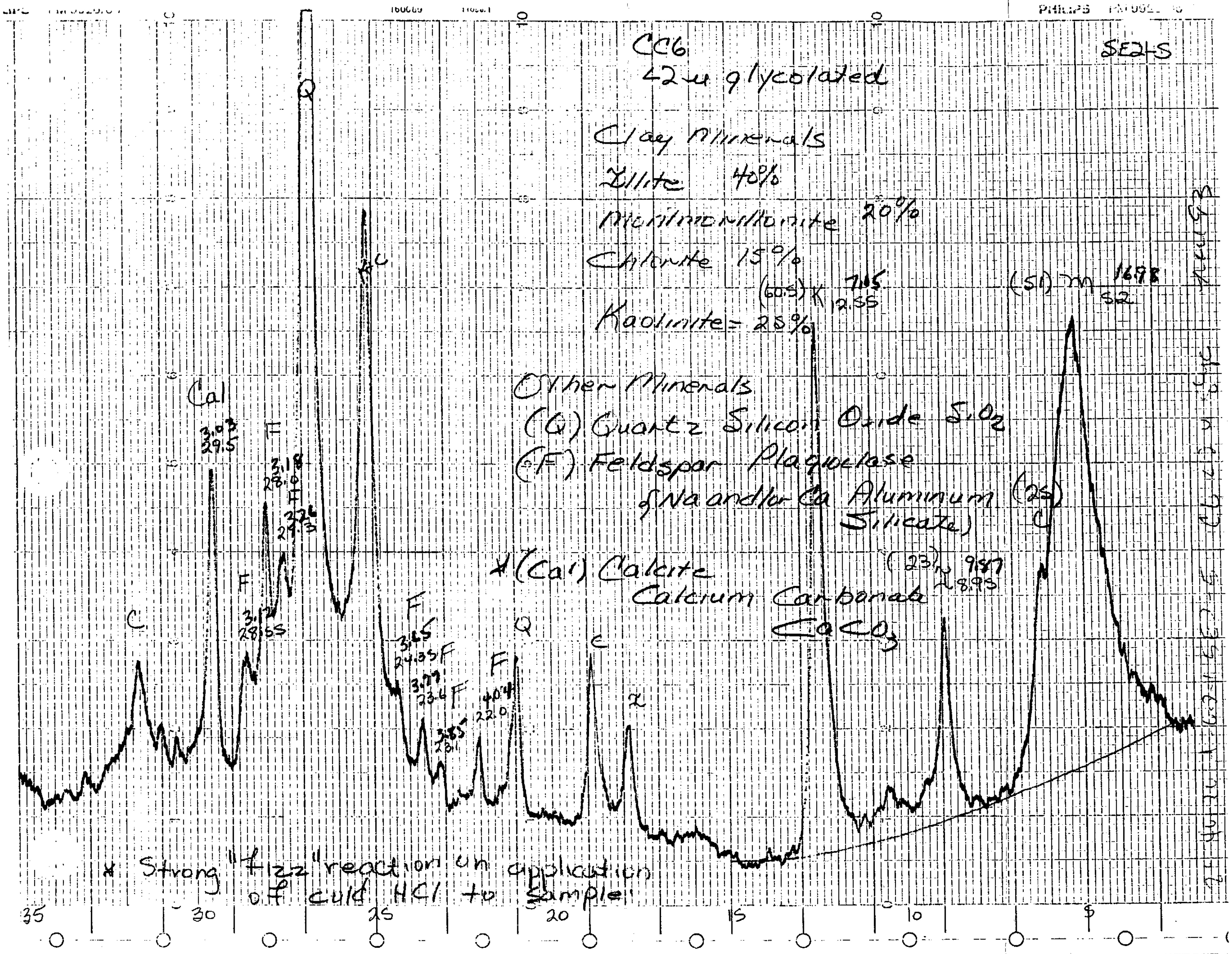
FRONT BAR

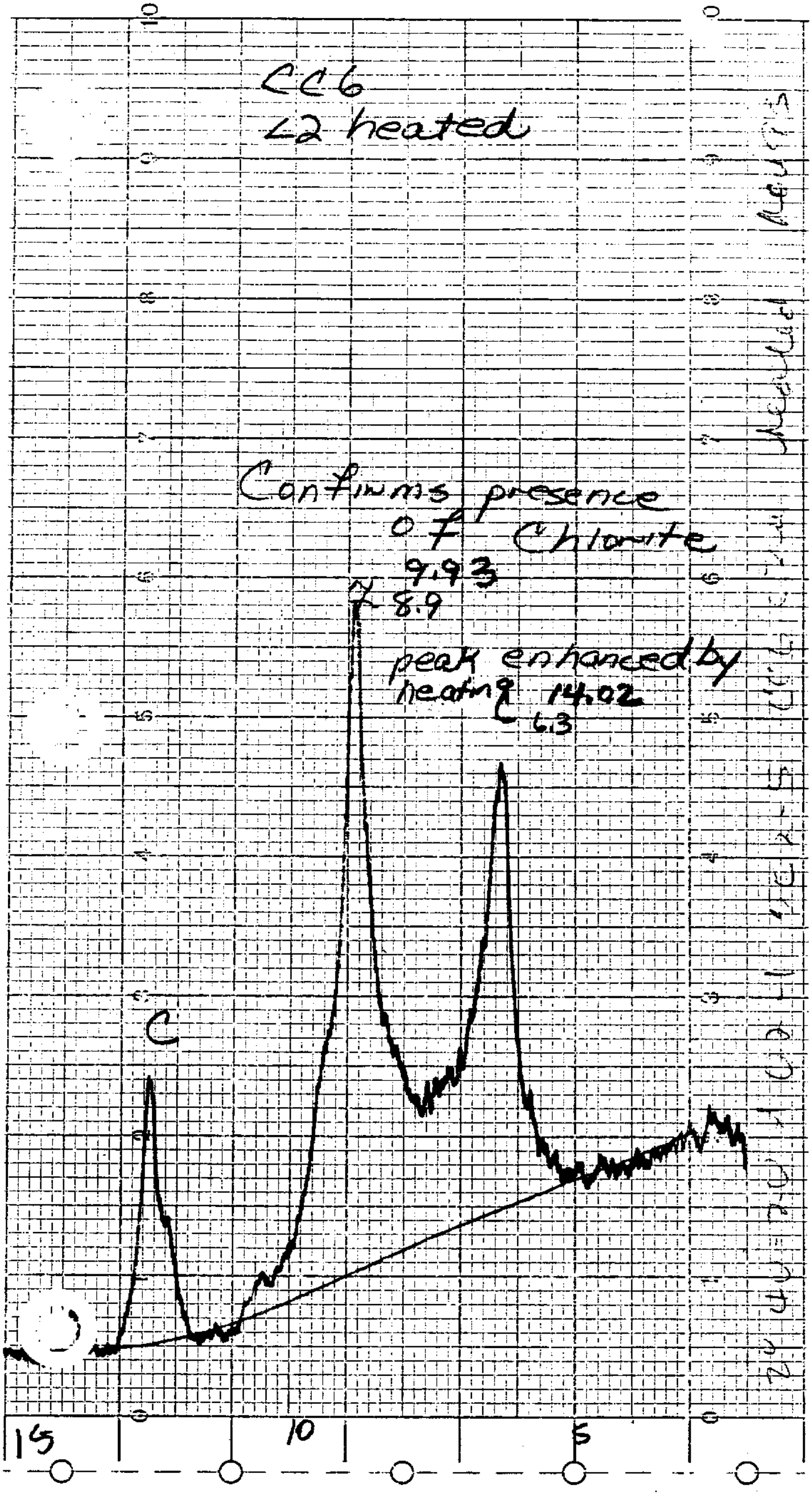


CC3

FRONT BAR




CC6
42u glycolated
SE2-S
Clay Minerals
Illite 40%
Montmorillonite 20%
Chlorite 15%
Kaolinite = 25%
(60.5) K 7.15 / 12.35
(51) m 16.98 / 5.2
Other Minerals
(Q) Quartz Silicon Oxide SiO_2
(F) Feldspar Plagioclase
(Na and/or Ca Aluminum Silicate)
* (Cal) Calcite
Calcium Carbonate
$CaCO_3$
(23) 9.87 / 8.95
Cal 3.03 / 29.5
3.18 / 28.0
3.26 / 27.3
3.14 / 28.55
3.65 / 24.35
3.79 / 23.4
3.85 / 23.1
4.04 / 22.0
* Strong "fizz" reaction on application of cold HCl to sample!
35
30
25
20
15
10
5
PHILIPS


CC6
<2 heated
Confirms presence of Chlorite
9.93
8.9
peak enhanced by heating
14.02
6.3
C
15
10
5

AM

AMPLE # CC6. DATE Nov 24/93

.. Sample	2100
Ml. Water	510
Total	2610
% H_2O	19.5%

Wet Length 10.0
Loss on Drying .6
{9.4, 9.4, 9.4, 9.4)
% Drying Shrinkage 6% @ 150°C

-ASTICITY } Very Good
VORKABILITY }
COMMENTS Entire spl moist; large chunks formed when squeezed. Material in extruder exhibited good plasticity {molded onto cap/casing - easy to remove, peeled off}
5 Bars + 1 spl - Bars {plasticene in feel - firmer than #CC3 Bars}.

DRYING @ 105°C Nov 25/93 8AM — @ Room Temp/150°C
6.0% Drying Shrinkage on 1 Bar — Good - slight warping
or - Severe cracking
Dec 1/93 pm 150° Overnite (4 Bars)

TEMPERATURE GRADIENT FURNACE

TEST UNIT ________ DATE Dec 8/93

CONTROLLER TEMP 250°C - 1200°C with a $2\frac{1}{2}$ hr soak at 850°C {≈ $7\frac{1}{2}$ hrs}

REAR	READINGS	FRONT	READINGS
) (7.5")	1183.3	0 (7.5")	1180.8
(6.0")	1145.4	1 (6.0")	1157.6
(4.5")	1067.8	2 (4.5")	1075.4
(3.0")	939.6	3 (3.0")	957.2
(2.0")	813.6	4 (2.0")	844.3
· (1.0")	632.7	5 (1.0")	667.5

slight curving up at ≈ 1150°C

SAMPLE NO CC6

	LENGTH		WIDTH			TEMP	SHRINKAGE	ABSORPTION			
FRONT	DRY	FIRED	DRY	FIRED	DIFF.	°C	%	WET WT.	DRY WT.	DIFF	% ABS.
1	.46	.47	.919	.919	0	530	0	9.9036	8.6592	1.2444	12.57
2	.97	.97	.927	.927	0	657	0	8.8679	7.6814	1.1865	13.38
3	1.47	1.47	.931	.931	0	752	0	5.5388	4.7391	0.7997	14.44
4	1.97	1.97	.935	.934	+.001	836	.11	7.3326	6.3008	1.0318	14.07
5	2.46	2.46	.940	.939	+.001	898	.11	7.0012	6.0088	0.9924	14.18
6	2.97	2.97	.944	.943	+.001	952	.11	6.7932	5.8185	0.9747	14.35
7	3.47	3.46	.949	.947	+.002	996	.21	7.7430	6.6349	1.1081	14.31
8	3.97	3.96	.950	.947	+.003	1035	.32	6.7612	5.8000	0.9612	14.28
9	4.47	4.45	.953	.943	+.010	1070	1.05	7.6927	6.6960	.9967	12.96
10	4.97	4.95	.956	.921	+.035	1100	3.66	8.2611	7.6678	.5933	7.18
11	5.47	5.39	.957	.879	+.078	1125	8.16	6.6647	6.6229	.0418	.63
12	5.97	5.86	.958	.893	+.065	1150	6.79	5.7902	5.7790	.0112	.19
13	6.47	6.34	.958	.922	+.036	1164	3.76	7.1062	7.0902	.0160	.23
14											
REAR											
1	.45		.924								
2	.95		.928								
3	1.46		.931								
4	1.95		.934								
5	2.46		.935								
6	2.97		.936								
7	3.46		.937								
8	3.96		.937								
9	4.45		.937								
10	4.95		.936								
11	5.45		.934								
12	5.96		.932								
13	6.46		.930								
14											

COMMENTS.

Front Bar Used

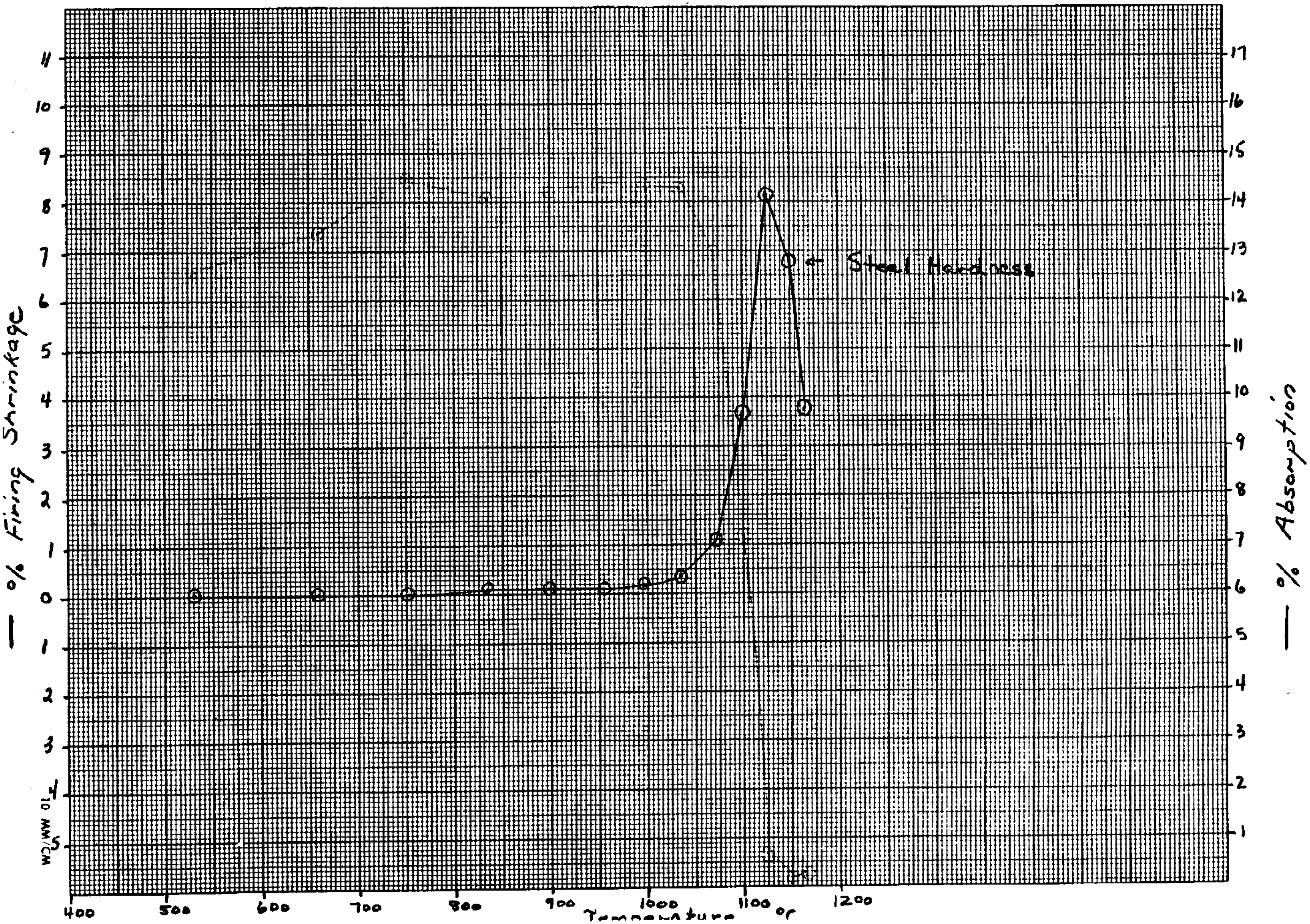
Color (unfired)
Light Olive Gray
5 Y 6/1

Steel Hardness
@ #12

Color (fired)
Pale Brown
5 YR 5/2

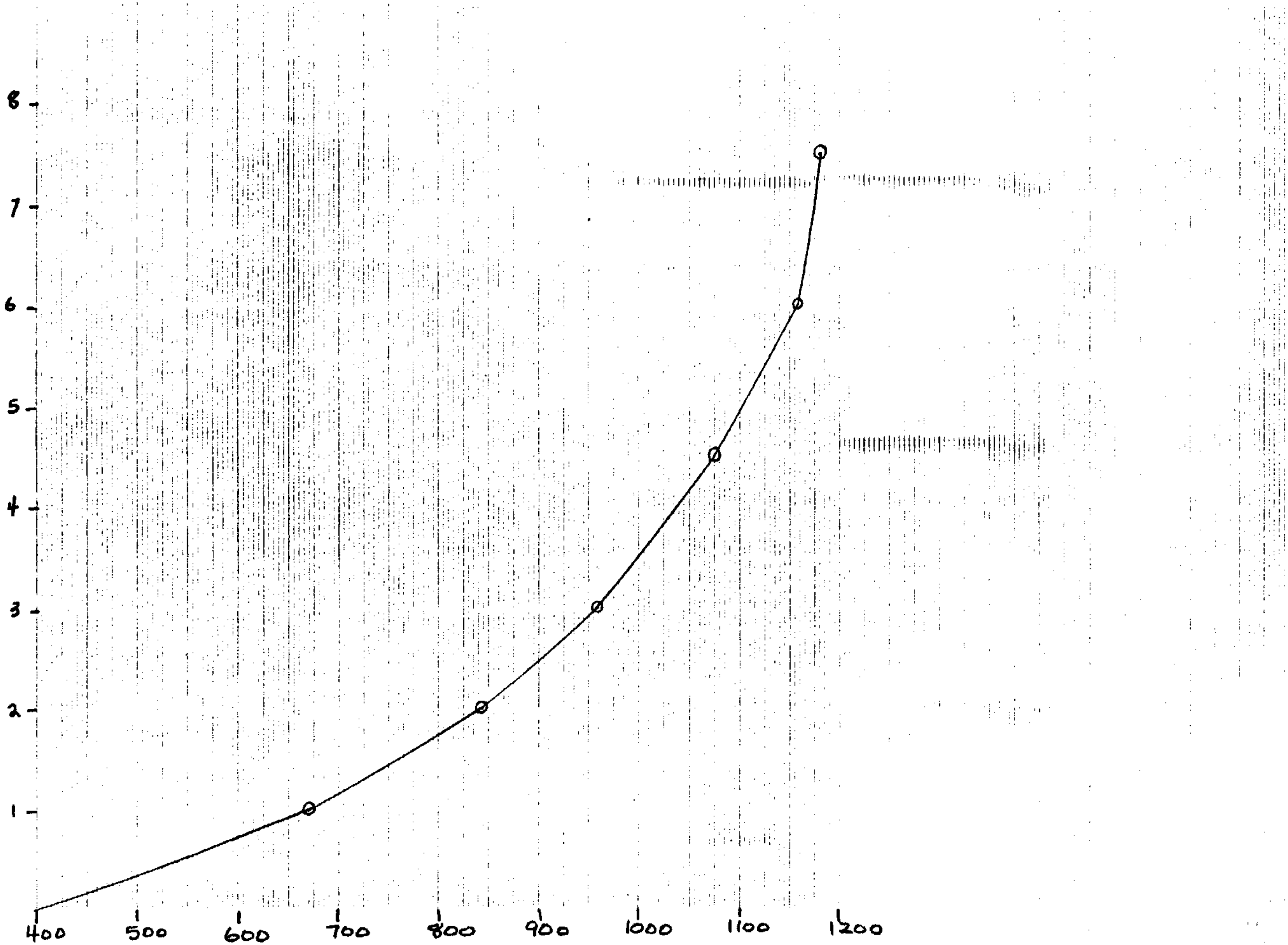
Max Fire Temp
@ #11
Color Pale Brown 5YR

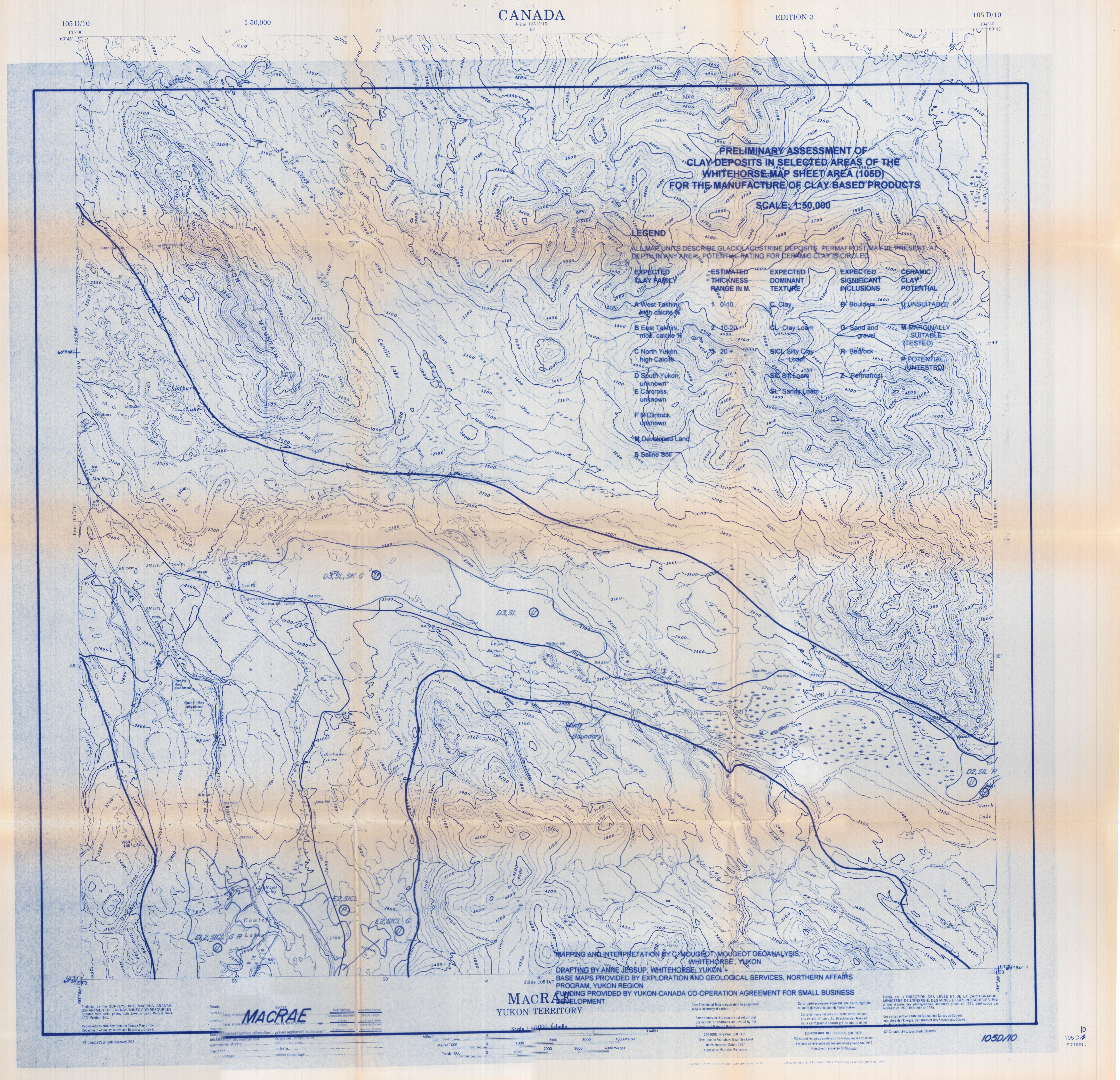
CC6 FRONT BAR



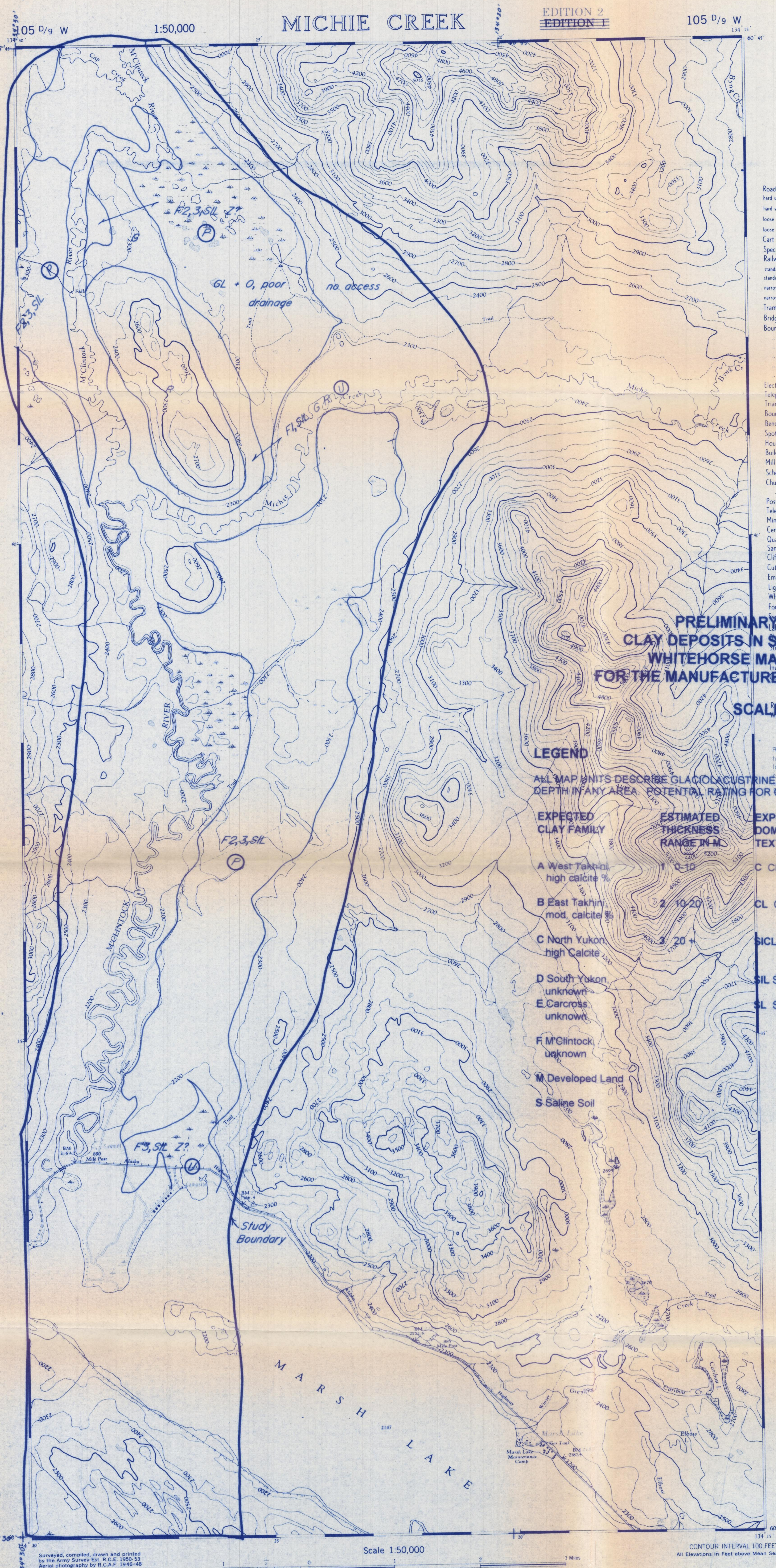
CC6

FRONT BAR





CANADA
105 D/10
1:50,000
EDITION 3
PRELIMINARY ASSESSMENT OF
CLAY DEPOSITS IN SELECTED AREAS OF THE
WHITEHORSE MAP SHEET AREA (105D)
FOR THE MANUFACTURE OF CLAY BASED PRODUCTS
SCALE: 1:50,000
LEGEND
ALL MAP UNITS DESCRIBE GLACIOLACUSTRINE DEPOSITS. PERMAFROST MAY BE PRESENT AT DEPTH IN ANY AREA. POTENTIAL RATING FOR CERAMIC CLAY IS CIRCLED.
EXPECTED CLAY FAMILY
A West Takhini, high calcite %
B East Takhini, mod. calcite %
C North Yukon, high Calcite
D South Yukon, unknown
E Carcross, unknown
F M'Clintock, unknown
M Developed Land
S Saline Soil
ESTIMATED THICKNESS RANGE IN M.
1 0-10
2 10-20
3 20 +
EXPECTED DOMINANT TEXTURE
C Clay
CL Clay Loam
SICL Silty Clay Loam
SIL Silt Loam
SL Sandy Loam
EXPECTED SIGNIFICANT INCLUSIONS
B- Boulders
G- Sand and gravel
R- Bedrock
Z- Permafrost
CERAMIC CLAY POTENTIAL
U UNSUITABLE
M-MARGINALLY SUITABLE (TESTED)
P POTENTIAL (UNTESTED)
D3,SL,SK G
D3,SL
D2,SIL R
E2,SICL
E2,SICL G
E1,2 SICL G R
YUKON RIVER
Cantlie Lake
Marsh Lake
MAPPING AND INTERPRETATION BY C. MOUGEOT, MOUGEOT GEOANALYSIS, WHITEHORSE, YUKON
DRAFTING BY ANNE JESSUP, WHITEHORSE, YUKON
BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION
FUNDING PROVIDED BY YUKON-CANADA CO-OPERATION AGREEMENT FOR SMALL BUSINESS DEVELOPMENT
MACRAE
YUKON TERRITORY
MACRAE
Scale 1:50,000 Échelle
This Provisional Map is equivalent to a standard map in accuracy of content.
Some names on this map are not yet official.
CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection
Cette carte provisoire équivaut une carte régulière au point de vue précision de l'information.
ÉQUIDISTANCE DES COURBES 100 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Système de référence géodésique nord-américain, 1927
Projection transverse de Mercator
© Canada 1975
105D/10



PRELIMINARY ASSESSMENT OF CLAY DEPOSITS IN SELECTED AREAS OF THE WHITEHORSE MAP SHEET AREA (105D) FOR THE MANUFACTURE OF CLAY BASED PRODUCTS

SCALE: 1:50,000

LEGEND

ALL MAP UNITS DESCRIBE GLACIOLACUSTRINE DEPOSITS. PERMAFROST MAY BE PRESENT AT DEPTH IN ANY AREA. POTENTIAL RATING FOR CERAMIC CLAY IS CIRCLED.

EXPECTED CLAY FAMILY	ESTIMATED THICKNESS RANGE IN M.	EXPECTED DOMINANT TEXTURE	EXPECTED SIGNIFICANT INCLUSIONS	CERAMIC CLAY POTENTIAL
A West Takhini, high calcite %	1 0-10	C Clay	B- Boulders	U UNSUITABLE
B East Takhini, mod. calcite %	2 10-20	CL Clay Loam	G- Sand and gravel	M-MARGINALLY SUITABLE (TESTED)
C North Yukon, high Calcite	3 20 +	SICL Silty Clay Loam	R- Bedrock	P POTENTIAL (UNTESTED)
D South Yukon, unknown		SIL Silt Loam	Z- Permafrost	
E Carcross, unknown		SL Sandy Loam		
F M'Clintock, unknown				
M Developed Land				
S Saline Soil				

MICHIE CREEK
YUKON TERRITORY
105 D/9 W
EDITION 2

CONTOUR INTERVAL 100 FEET
All Elevations in Feet above Mean Sea Level

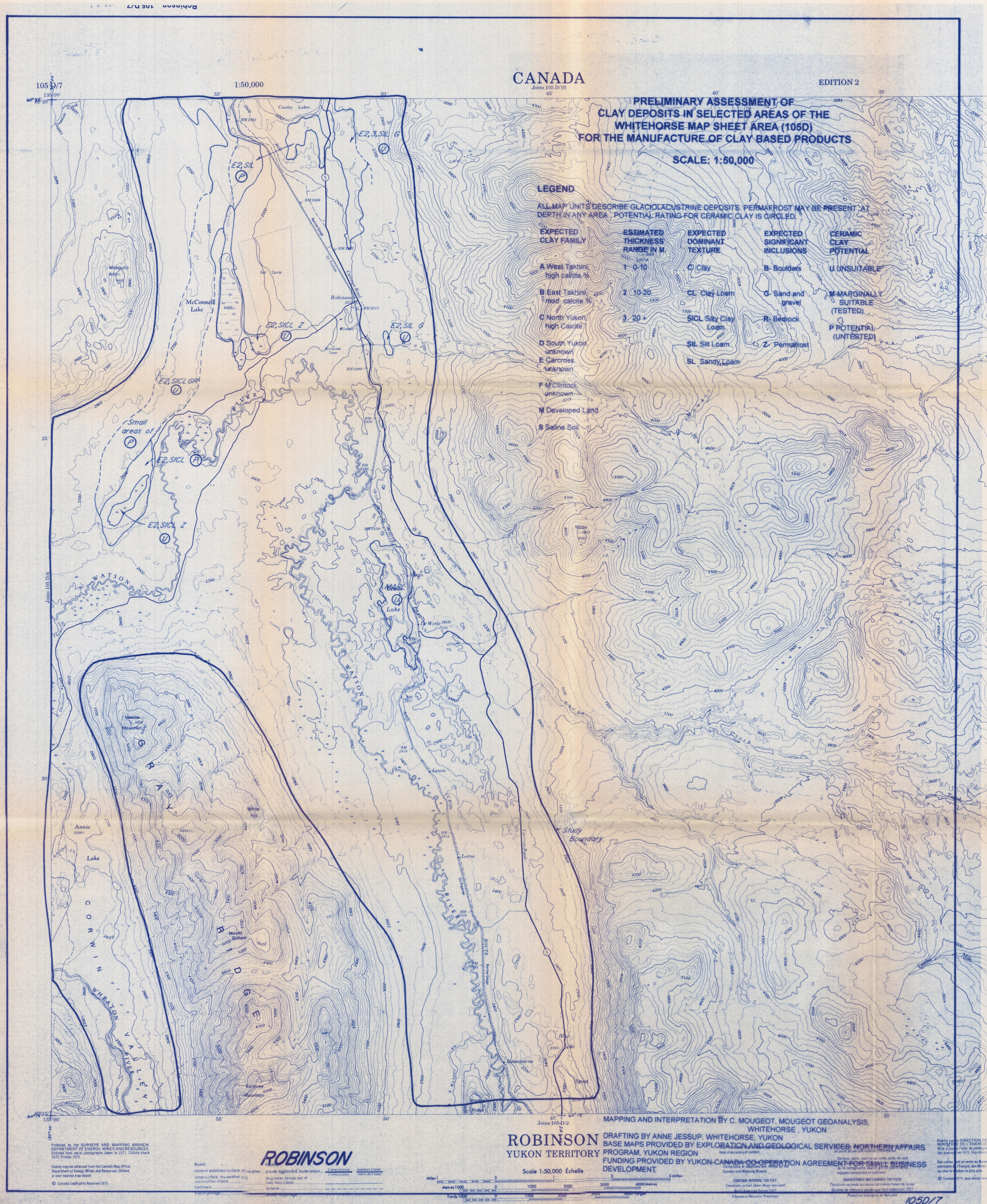
Scale 1:50,000

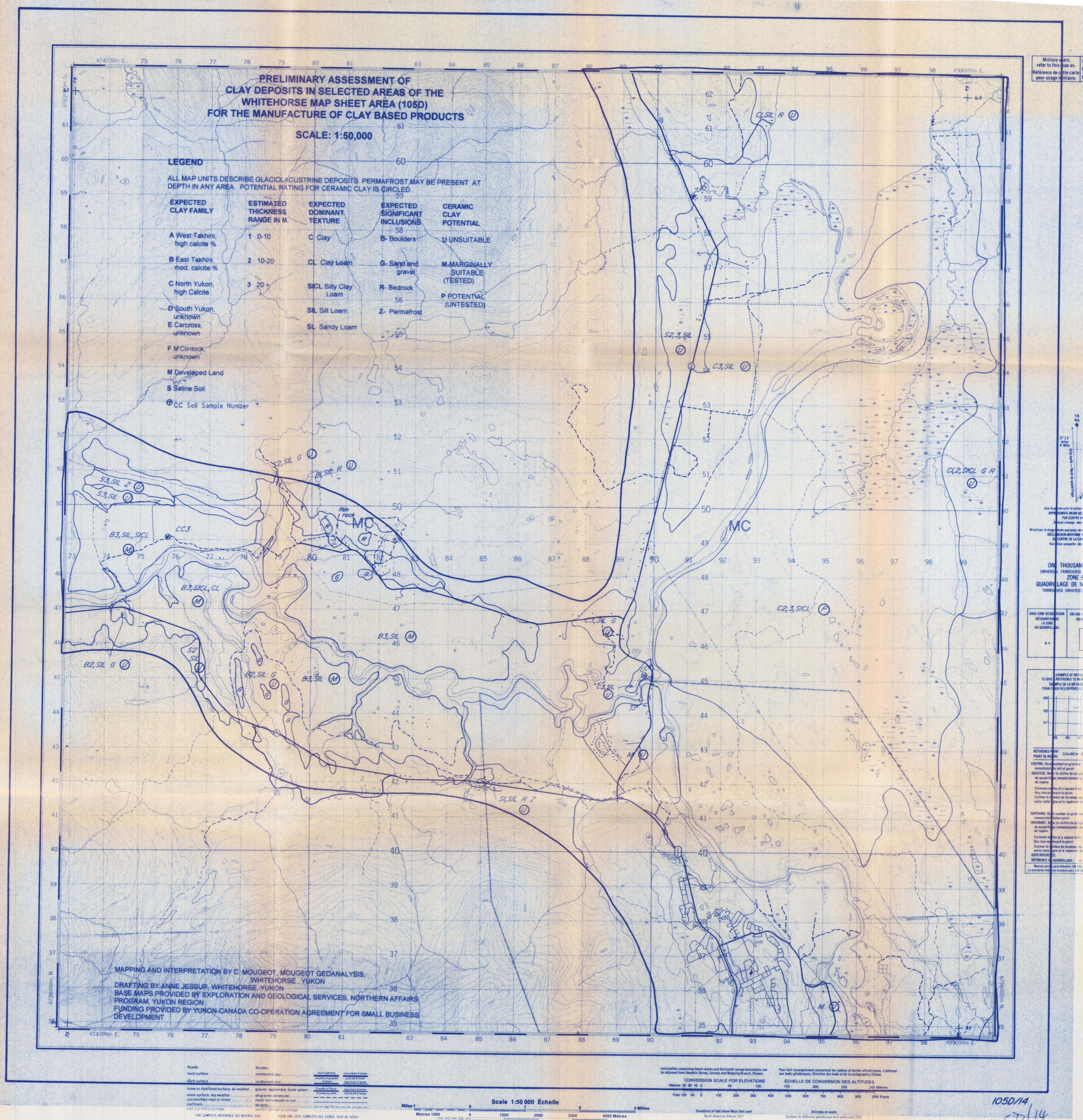
MAPPING AND INTERPRETATION BY C. MOUGEOT, MOUGEOT GEOANALYSIS, WHITEHORSE YUKON
DRAFTING BY ANNE JESSUP, WHITEHORSE, YUKON
BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION

FUNDING PROVIDED BY YUKON-CANADA CO-OPERATION AGREEMENT FOR SMALL BUSINESS DEVELOPMENT

MICHIE CREEK

105D/9 W


CANADA
EDITION 2
105 D/7
1:50,000
Joins 105 D/10
PRELIMINARY ASSESSMENT OF
CLAY DEPOSITS IN SELECTED AREAS OF THE
WHITEHORSE MAP SHEET AREA (105D)
FOR THE MANUFACTURE OF CLAY BASED PRODUCTS
SCALE: 1:50,000
LEGEND
ALL MAP UNITS DESCRIBE GLACIOLACUSTRINE DEPOSITS. PERMAFROST MAY BE PRESENT AT DEPTH IN ANY AREA. POTENTIAL RATING FOR CERAMIC CLAY IS CIRCLED.
EXPECTED CLAY FAMILY
ESTIMATED THICKNESS RANGE IN M.
EXPECTED DOMINANT TEXTURE
EXPECTED SIGNIFICANT INCLUSIONS
CERAMIC CLAY POTENTIAL
A West Takhini, high calcite %
B East Takhini, mod. calcite %
C North Yukon, high Calcite
D South Yukon, unknown
E Carcross, unknown
F M'Clintock, unknown
M Developed Land
S Saline Soil
1 0-10
2 10-20
3 20 +
C Clay
CL Clay Loam
SICL Silty Clay Loam
SIL Silt Loam
SL Sandy Loam
B- Boulders
G- Sand and gravel
R- Bedrock
Z- Permafrost
U UNSUITABLE
M-MARGINALLY SUITABLE (TESTED)
P POTENTIAL (UNTESTED)
E2,3,SIL
E2,SIL
E2,SICL Z
E2,SIL
E2,SICL GP
Small areas of
E2,SICL
E2,SICL Z
McConnell Lake
Robinson
Mosquito
Needle Mountain
GRAY RIDGE
CORWIN
WHEATON VALLEY
Annie Lake
WATSON
Nisutlin Lake
Study Boundary
Lewes
Lorne
MAPPING AND INTERPRETATION BY C. MOUGEOT, MOUGEOT GEOANALYSIS,
WHITEHORSE, YUKON
DRAFTING BY ANNE JESSUP, WHITEHORSE, YUKON
BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION
FUNDING PROVIDED BY YUKON-CANADA CO-OPERATION AGREEMENT FOR SMALL BUSINESS DEVELOPMENT.
ROBINSON
YUKON TERRITORY
ROBINSON
Scale 1:50,000 Échelle
CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection
ÉQUIDISTANCE DES COURBES 100 PIEDS
Élévations en pieds au-dessus du niveau moyen de la mer
Système de référence géodésique nord-américain, 1927
Projection transverse de Mercator
105D/7


PRELIMINARY ASSESSMENT OF
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WHITEHORSE MAP SHEET AREA (105D)
FOR THE MANUFACTURE OF CLAY BASED PRODUCTS
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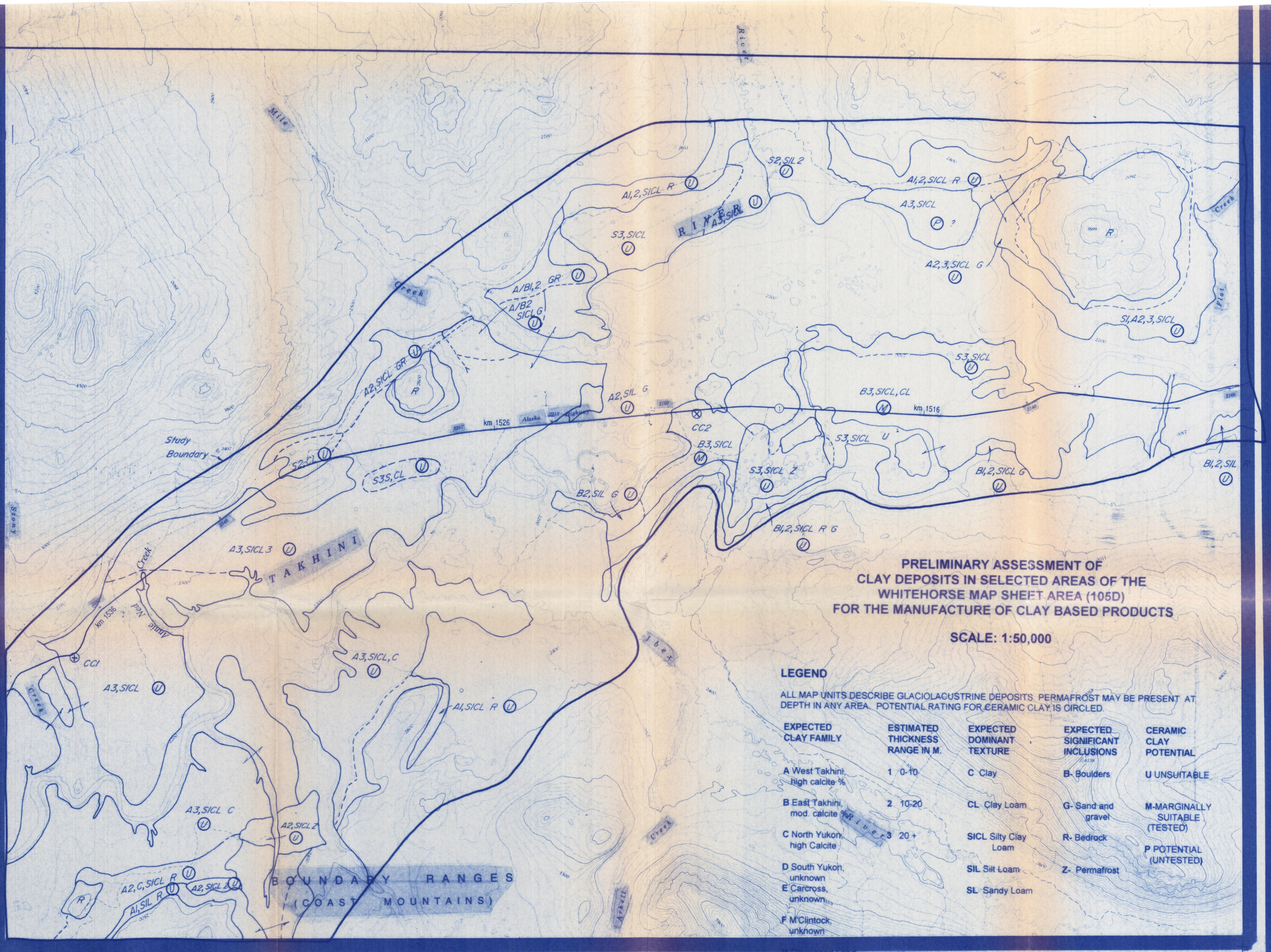
F M'Clintock, unknown
M Developed Land
S Saline Soil
CC Soil Sample Number
ESTIMATED THICKNESS RANGE IN M.
1 0-10
2 10-20
3 20 +
EXPECTED DOMINANT TEXTURE
C Clay
CL Clay Loam
SICL Silty Clay Loam
SIL Silt Loam
SL Sandy Loam
EXPECTED SIGNIFICANT INCLUSIONS
B- Boulders
G- Sand and gravel
R- Bedrock
Z- Permafrost
CERAMIC CLAY POTENTIAL
U UNSUITABLE
M-MARGINALLY SUITABLE (TESTED)
P POTENTIAL (UNTESTED)
MC
MC
C2,3,SICL P
C1,2,SICL G R U
S2,3,SIL
C3,SIL U
C1,SIL R U
B3,SIL M
B3,SIL,SICL M
B3,SICL,CL M
B2,SIL G U
S3,SIL Z U
S3,SIL U
CC3
MAPPING AND INTERPRETATION BY C. MOUGEOT, MOUGEOT GEOANALYSIS, WHITEHORSE, YUKON
DRAFTING BY ANNE JESSUP, WHITEHORSE, YUKON
BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION
FUNDING PROVIDED BY YUKON-CANADA CO-OPERATION AGREEMENT FOR SMALL BUSINESS DEVELOPMENT
ONE THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 8
QUADRILLAGE DE MILLE MÈTRES TRANSVERSE UNIVERSEL DE MERCATOR
Scale 1:50 000 Échelle
105D/14



PRELIMINARY ASSESSMENT OF CLAY DEPOSITS IN SELECTED AREAS OF THE WHITEHORSE MAP SHEET AREA (105D) FOR THE MANUFACTURE OF CLAY BASED PRODUCTS

SCALE: 1:50,000

LEGEND

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D South Yukon, unknown		SIL Silt Loam	Z- Permafrost	
E Carcross, unknown		SL Sandy Loam		
F M'Clintock, unknown				
M Developed Land				
S Saline Soil				
⊗ CC Soil Sample Number				

MAPPING AND INTERPRETATION BY C. MOUGEOT, MOUGEOT GEOANALYSIS, WHITEHORSE, YUKON

DRAFTING BY ANNE JESSUP, WHITEHORSE, YUKON

BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION

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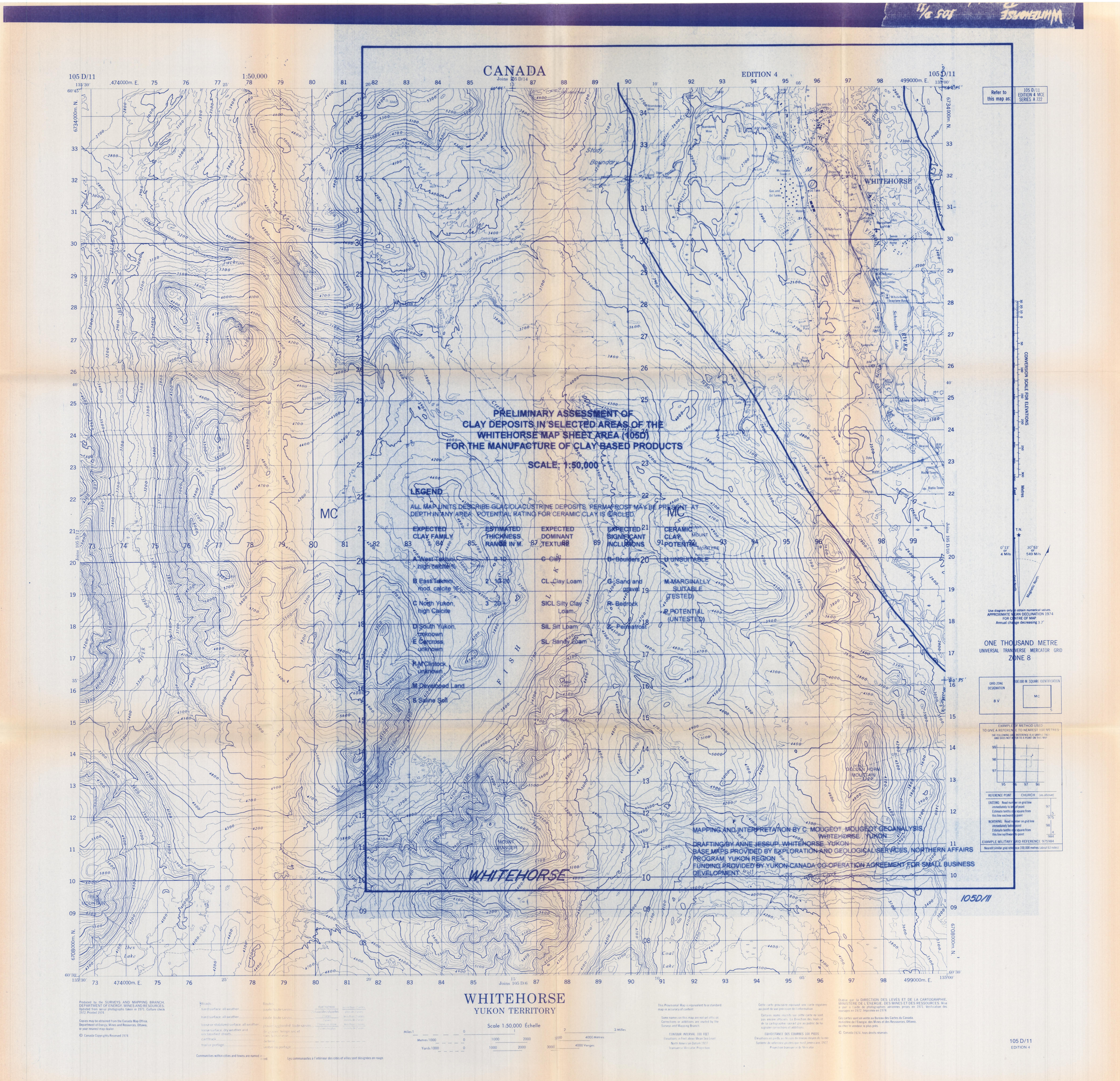
TAKHINI WEST


PRELIMINARY ASSESSMENT OF
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M MARGINALLY SUITABLE (TESTED)
P POTENTIAL (UNTESTED)
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BASE MAPS PROVIDED BY EXPLORATION AND GEOLOGICAL SERVICES, NORTHERN AFFAIRS PROGRAM, YUKON REGION
FUNDING PROVIDED BY YUKON-CANADA CO-OPERATION AGREEMENT FOR SMALL BUSINESS DEVELOPMENT
CANADA
105 D/11
1:50,000
EDITION 4
WHITEHORSE
Study Boundary
FISH LAKE
MOUNT McINTYRE
GOLDEN HORN MOUNTAIN
MC
105D/11
ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 8
CONVERSION SCALE FOR ELEVATIONS
WHITEHORSE
YUKON TERRITORY
Scale 1:50,000 Échelle
105 D/11
EDITION 4