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STRUCTURE AND MINERALIZATION OF THE DRIFTPILE CREEK AREA NORTHEASTERN BRITISH COLUMBIA (94E/16, 94F/14, 94K/4, 94L/1)

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INTRODUCTION

This paper summarizes the preliminary results of a detailed study of the structure, mineralization, and sedimentology of the Driftpile Creek area (Fig. 53-1), carried out during the 1985 field season. The work represents the first stage of a three-year project on the sedimentation, tectonics, and mineralization of the Driftpile area Ba-Fe-Zn-Pb deposits and forms part of an ongoing research program on stratiform sediment-hosted Pb-Zn deposits in the Canadian Cordillera (McClay, 1983a, 1983b). The detailed study of the Driftpile Creek area will form part of a regional mapping program of the Gataga River district (NTS sheets (94E/16, 94F/14, 94K/4, and 94L/1).

The objectives of this project are: to determine the structure of the Driftpile Creek area; to establish a detailed stratigraphy of the area (incorporating a biostratigraphy based on conodonts); and to produce a model for the structural and sedimentological evolution of the Gataga district, and in particular for the distribution of stratiform Ba-Fe-Zn-Pb deposits. In the 1985 field season, detailed structural and stratigraphic mapping at 1:10 000 scale was carried out in the Driftpile Creek area and the results form the basis of this paper.

Previous work in the Driftpile Creek area of the Gataga district has been chiefly concerned with reconnaissance style mapping at 1:250 000 scale by Gabrielse (1962), Taylor and Stott (1973), and MacIntyre (1981, 1983). Work on the Driftpile deposit by Archer Cathro and Associates acting for the Gataga Joint Venture between 1977-1982 involved both detailed and regional mapping together with extensive diamond drilling. Through this exploratory work Carne and Cathro (1982) identified three main mineralized horizons in the Devonian siliciclastics. These strata occur within a 180-kilometre-long complex fold and thrust belt of Ordovician-Devonian sedimentary rocks — the Kechika Trough (Fig. 53-2) which is the southern extension of the Selwyn Basin.

LOCATION AND TOPOGRAPHY

The Driftpile Creek deposit is located at 58 degrees 04 minutes north and 125 degrees 55 minutes west (Fig. 53-1). It lies within the Muskwa Range of the northern Rocky Mountains, between the Kechika River (the northern extension of the Rocky Mountain Trench) to the southwest, and the Gataga River to the northeast. Elevations range from 1 000 metres to over 2 000 metres, and the area is characterized by long ridges and valleys parallel to the dominant northwest-trending structural grain. Tree line reaches up to 1 500 metres with abundant vegetation of mixed woodland in valley bottoms and poplar, pine, and grasses on higher ground. The best outcrop is found in river sections and on the more elevated terrane. Access to the area was via helicopter from Johanson Lake and float plane from Dease Lake. A 640-metre dirt airstrip, at an elevation of 1 340 metres, is suitable for small fixed wing aircraft; it is located approximately 2 kilometres from the camp on Driftpile Creek.

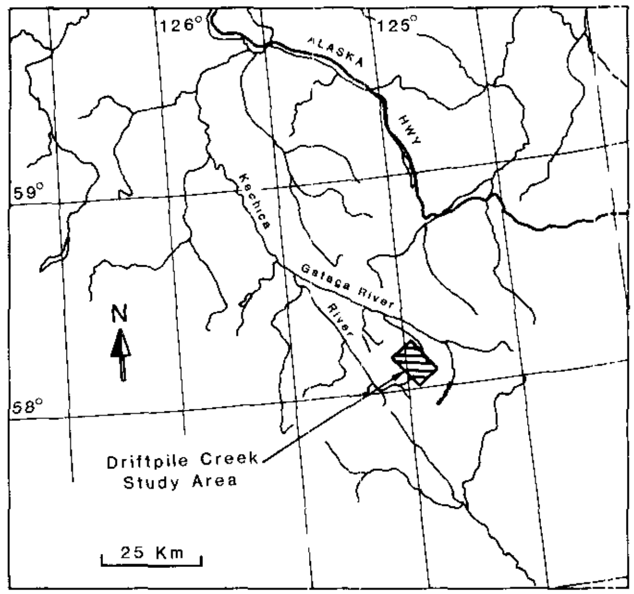

Figure 53-1. Location map of the Driftpile Creek area, northeastern British Columbia.

TECTONO-STRATIGRAPHIC SETTING

The Driftpile Ba-Fe-Zn-Pb deposit is located in the Rocky Mountain Fold and Thrust Belt. Host rocks are part of the long, narrow northwest-trending Kechika Trough — a southern extension of the Middle-Upper Paleozoic Selwyn Basin (Fig. 53-2). Sedimentation is dominated by black, fine-grained siliciclastic rocks reflecting a starved and restricted basin environment. The Kechika Trough also hosts the Cirque, Elf, and Fluke Pb-Zn-Ba deposits (MacIntyre, 1983) south of the Gataga area (Fig. 53-2). These stratiform barite-sulphide deposits are considered to have formed from metalliferous fluids discharged into local basins along contemporaneous faults during block faulting related to crustal extension during Middle to late Devonian time (Gordey, *et al.*, 1982; MacIntyre, 1983; Goodfellow and Jonasson, 1984).

STRATIGRAPHY

In the Driftpile Creek area, Ordovician through Upper Devonian strata are deformed into a northwest-trending fold and thrust belt (Fig. 53-3). These rocks represent the basinal facies of the Kechika Trough and are flanked to the east and west by Cambrian to Early Ordovician platformal carbonates (Fig. 53-2). To the east, the carbonate sequences constitute the western edge of the MacDonald Platform. The western margin of the basin is complicated by large right lateral strike-slip displacements along the Rocky Mountain

Trench during Mesozoic and Cenozoic time (Tempelman-Kluit, 1979; Gabrielse, 1985). The stratigraphy of the Driftpile Creek area is shown on Figure 53-4. A basal sequence of Ordovician through Lower Devonian shales and siltstones has been assigned to the Road River Group; it is overlain with apparent conformability by fine-grained siliciclastics of the Lower Earn Group (Gordey, *et al.*, 1982).

ROAD RIVER GROUP (ORDOVICIAN-LOWER DEVONIAN)

The lowermost strata exposed in the Driftpile Creek area form a 30 to 40-metre-thick sequence of recessive carbonaceous black argillites, cherts, and minor thin limestones that often contain Ordovician graptolites. This is overlain by 130 metres of resistant, distinctly orange-weathering dolomitic micaceous siltstones; locally these contain Silurian graptolites. Two 3-metre-thick cryptalgal-laminated micritic limestone bands are present toward the top of this unit. The Silurian section forms a distinct marker in the Driftpile Creek area. A recessive, silver-grey-weathering package of black argillites, thin-bedded black chert, and locally developed crinoidal limestones with calciferous sandstones of probable Lower Devonian age, overlies the Silurian siltstone and represents the top of the Road River Group in the Driftpile Creek area.

LOWER EARN GROUP (MIDDLE-LATE DEVONIAN)

The Road River Group is conformably overlain by a sequence of black clastics of the Lower Earn Group (Gordey, *et al.*, 1982). In the Driftpile Creek area the base of the Lower Earn Group is characterized by a series of fining upward cycles of thin to medium-bedded laminated siltstones and silt-banded argillites. In the western part of the map-area (Fig. 53-3) these interdigitate with thick-bedded chert pebble conglomerates. This sequence is succeeded by a minimum of 450 metres of recessive, unlaminated to thinly laminated silver-

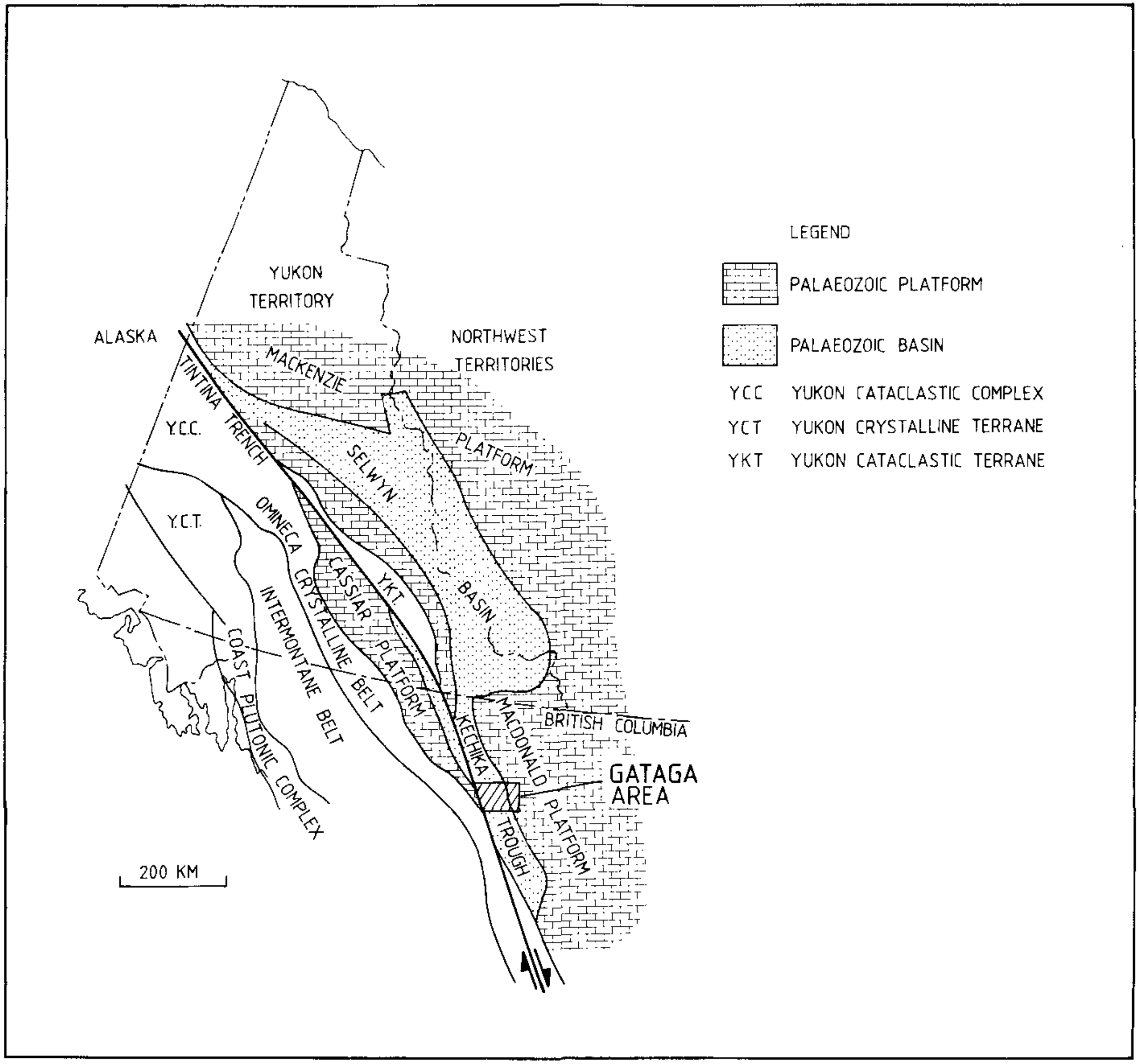

Figure 53-2. Lithotectonic map of the Kechika Trough and location of the Gataga area.

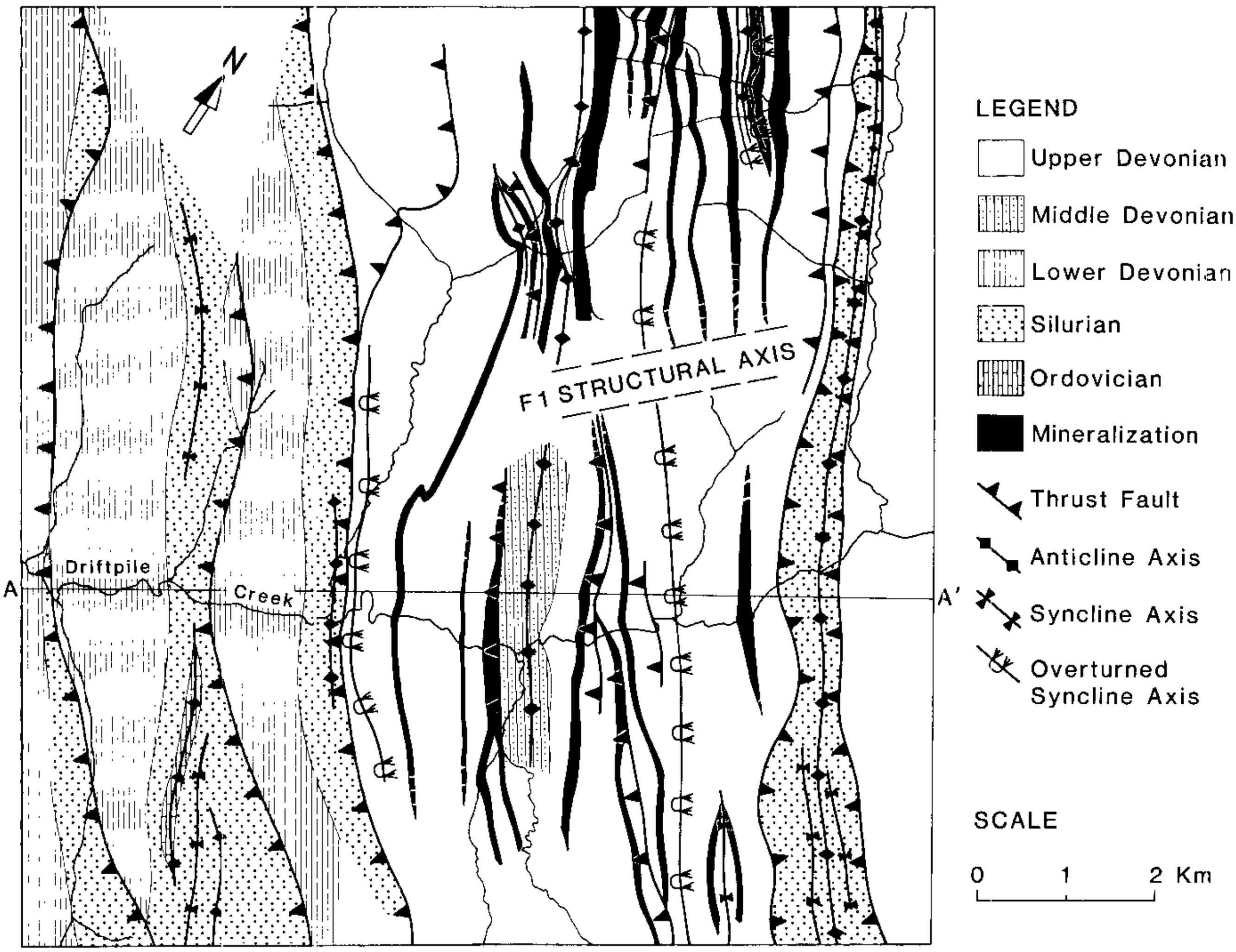

Figure 53-3. Preliminary geological map of the Driftpile Creek area.

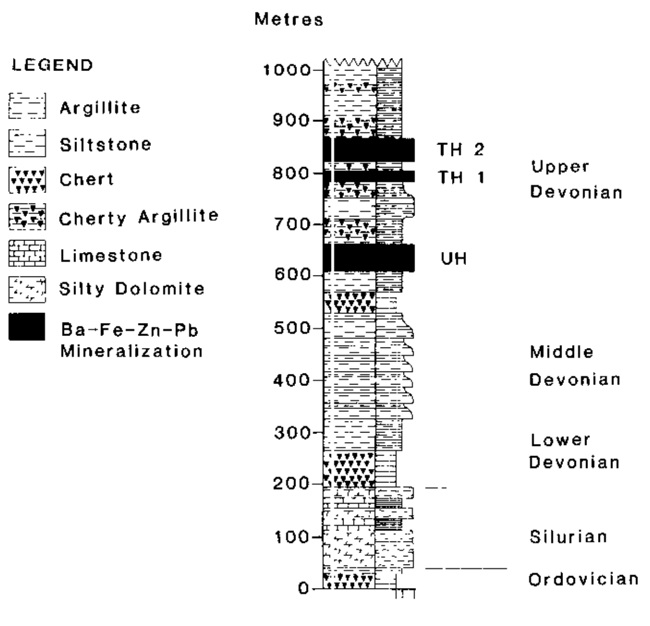

Figure 53-4. Stratigraphic column for the Driftpile Creek area.

grey-weathering black argillites, cherty argillites, and thin-bedded chert. These strata range in age from Frasnian to Famennian (M. Orchard, pers. comm., 1985). The Upper Devonian sequence contains at least three horizons of stratiform barite-pyrite-galena-sphalerite mineralization (Figs. 53-3 and 53-4).

STRUCTURE

The Driftpile Creek Ba-Fe-Zn-Pb deposit lies within a northwest-southeast-striking belt of tightly folded and thrust, recessive weathering Lower Earn Group strata (Fig. 53-3). At Driftpile Creek, packages of generally upright to steeply dipping chevron folds and strongly cleaved strata are bound by steep west-dipping thrust faults (Figs. 53-3 and 53-5). The western limit of this belt is marked by the Mount Waldemar Thrust (Fig. 53-3). West of this, the thrust faults root progressively in deeper and older strata. In the east of the map-area the position of a 'pop up' structure of Silurian siltstone (Figs. 53-3 and 53-4) indicates the first change in thrust vergence from northeasterly to southwesterly. This structure marks the eastern edge of the belt of dominantly Middle-Upper Devonian Lower Earn Group rocks.

Detailed structural studies have enabled three phases of deformation to be established:

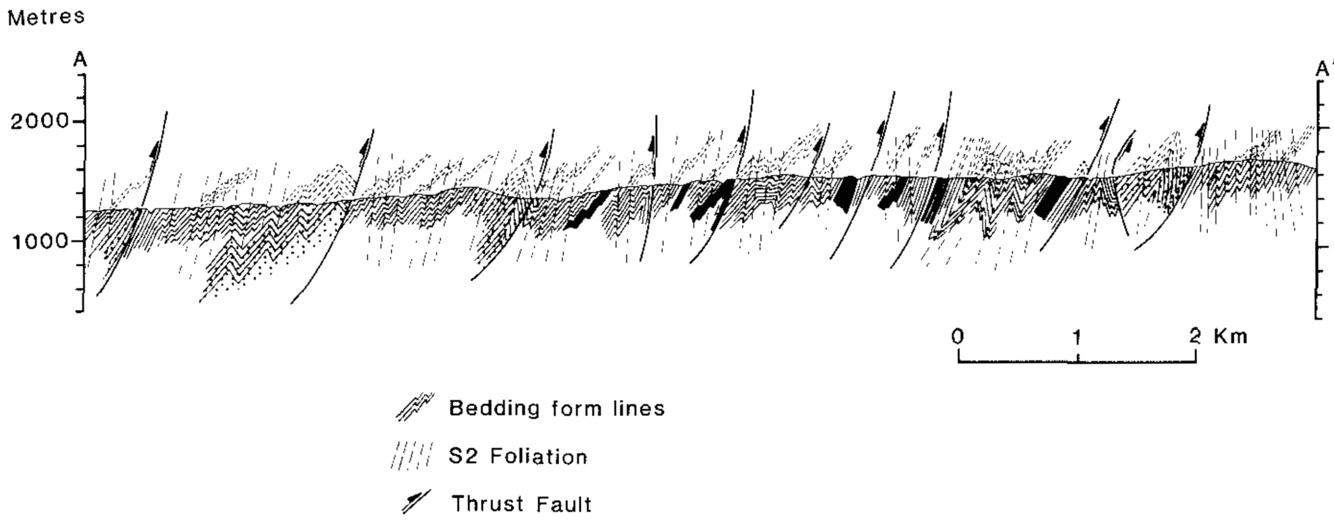

Figure 53-5. Structural section through the Driftpile Fold and Thrust Belt. Silurian siltstone is stippled.

Phase 1 deformation produced asymmetric folding on northeast-trending axes (Fig. 53-3). Phase 1 folds are associated with an early fanning axial planar cleavage that is only locally developed.

Phase 2 deformation is related to major Mesozoic compression resulting in a complex array of generally northeast-verging thrusts and folds. An intense penetrative cleavage (S2), is developed throughout the belt. This cleavage may accommodate 30 to 40 per cent shortening due to pressure solution along the cleavage planes. Fold axes and L2 lineations have generally horizontal to shallow plunges, although the presence of steep zones (where the S2 foliation has been superposed on earlier steeply orientated bedding surfaces) indicate positions of steep limbs of folds related to Phase 1 deformation.

Phase 3 deformation developed local steep to vertically plunging kink folds that are superposed on the general northwest Phase 2 structural trend. These folds are interpreted as dextral kinks probably related to late stage movement along the Kechika and Gataga strike-slip faults.

MINERALIZATION

In the Driftpile Creek area three intervals of stratiform Ba-Fe-Pb-Zn mineralization have been identified within the fine-grained black argillites, cherty argillites, and cherts of the Lower Earn Group (Carne and Cathro, 1982). These have been designated units UH, TH1 and TH2 (Archer Cathro and Associates, 1981). The mineralized intervals are located in poorly exposed panels of highly folded and sheared rocks (Figs. 53-3 and 53-4) which hampers correlation between different thrust bound packages. Data have been collected from detailed examination of surface exposures and by logging mineralized intervals in drill core. Preliminary conodont dating has shown that the UH horizon is Frasnian in age whereas TH1 and TH2 appear to be Famennian in age (M. Orchard, pers. comm., 1985).

The Ba-Fe-Zn-Pb mineralized intervals vary from 8 to 45 metres in thickness. They typically consist of beds of fine-grained massive to laminated barite and laminated fine-grained pyrite with subordinate sphalerite and galena interbedded with unmineralized black cherty argillite and chert. Beds vary from 10 to 100 centimetres thick. The sulphide content of the barite beds varies from almost zero to as much as 40 per cent by volume; the more sulphide-rich beds contain the higher Zn and Pb values. The sulphide-rich units are interpreted to be proximal style mineralization deposited in the vicinity of presumed feeder zones. Intense folding and shearing has locally produced strong transposition fabrics in the sulphides and barite.

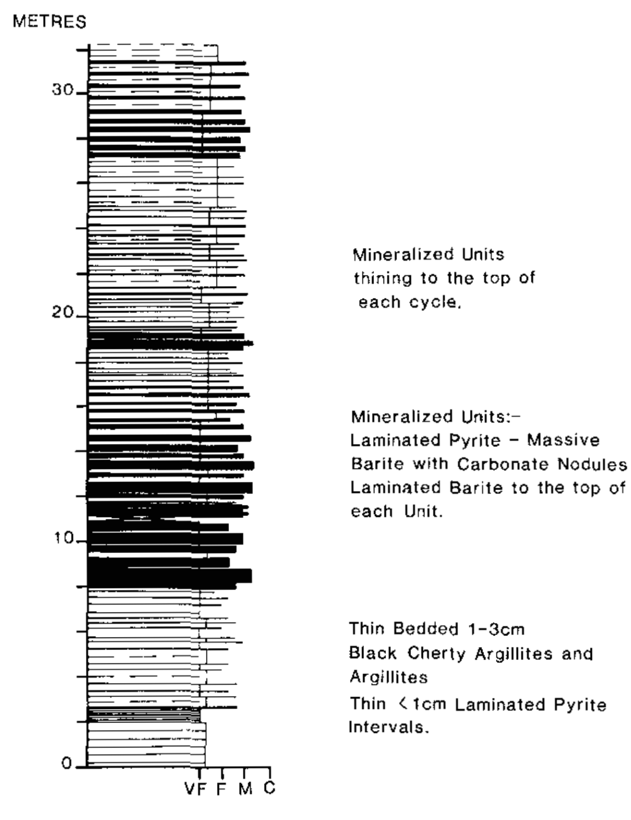

Figure 53-6. Logged section through TH mineralization from *in situ* outcrop in Driftpile Creek.

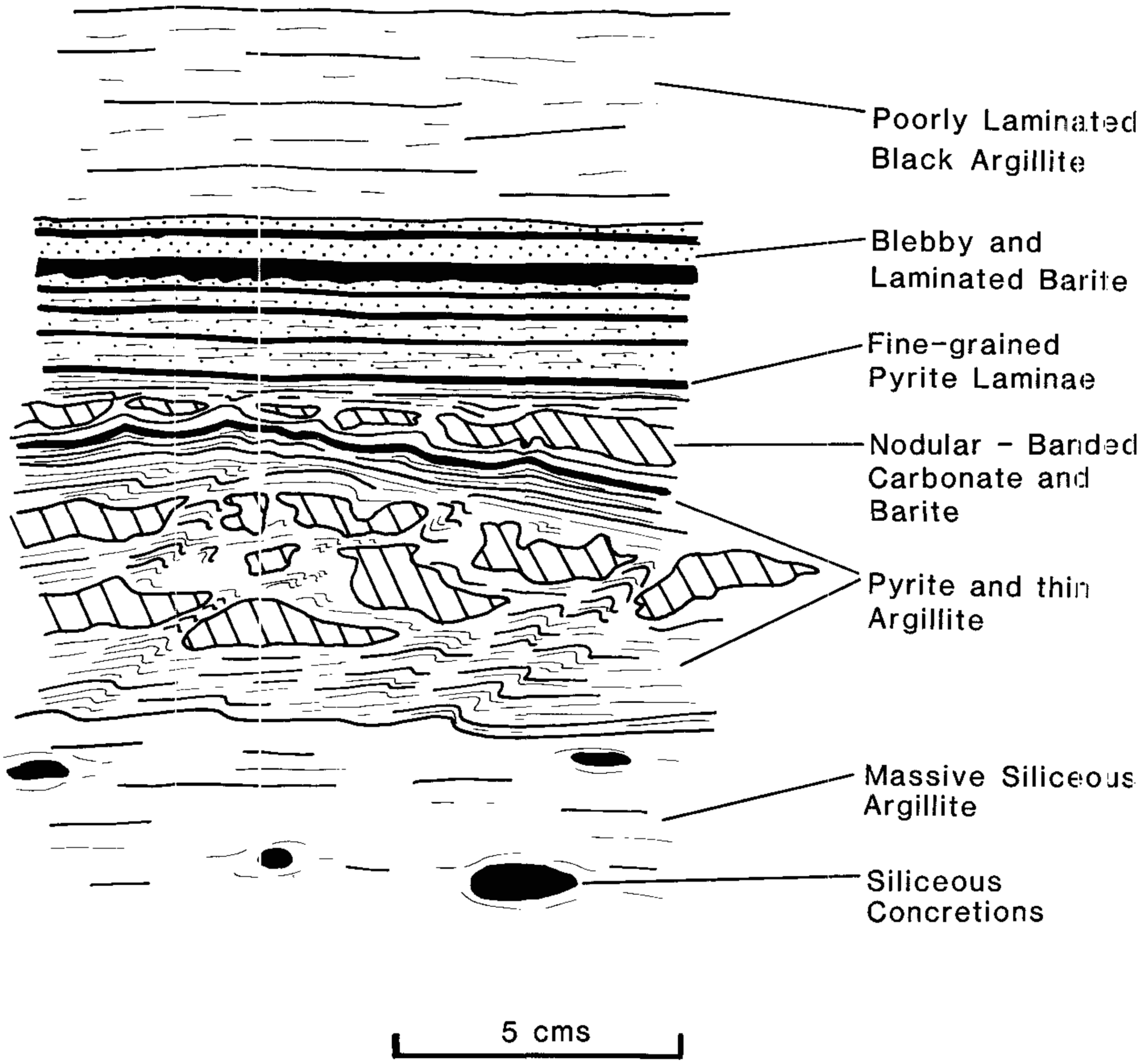

Figure 53-7. Detailed lithological section through a rhythmite cycle within TH, showing chemical differentiation with laminated sulphides at the base passing upward into massive barite and nodular carbonate. The top of the unit is characterized by sulphide-poor, laminated to blebby barite.

Detailed logging of drill core and of surface exposures revealed that the Ba-Fe-Zn-Pb mineralization exhibits a pronounced cyclic pattern of deposition with barite-sulphide beds alternating with chert and cherty argillite beds. This rhythmic pattern of sedimentation and mineralization is shown on Plate 53-1a and is found on all scales from millimetre-thick laminations to metre-thick thick alternating beds of barite-sulphide and interbedded argillite (Fig. 53-6). In general there is an inverse relationship between the thickness of the mineralized beds and the thickness of interbedded argillites (Figs. 53-6 to 53-8); the thicker mineralized units occur at the presumed stratigraphic base of the mineralized intervals. This style of interbedded barite-sulphide and unmineralized argillites is rhythmic in nature and similar to that predicted by Lydon (1983) for sulphide-barite deposition from a cooling brine pool.

In detail, many individual beds within the rhythmically mineralized intervals exhibit an internal chemical stratigraphy (Fig. 53-7) from pyrite-laminated siliceous-cherty argillite in the footwall, laminated sulphides (pyrite + sphalerite and galena) at the base of the mineralized bed, followed by massive barite with coarse-grained recrystallized carbonate nodules (Fig. 53-7) and overlain by laminated to blebby barite at the top of the bed. The carbonate nodules appear to overgrow primary bedding features and are interpreted to be diagenetic in origin. In any one bed not all the components described previously (Fig. 53-7) are developed. The concentration

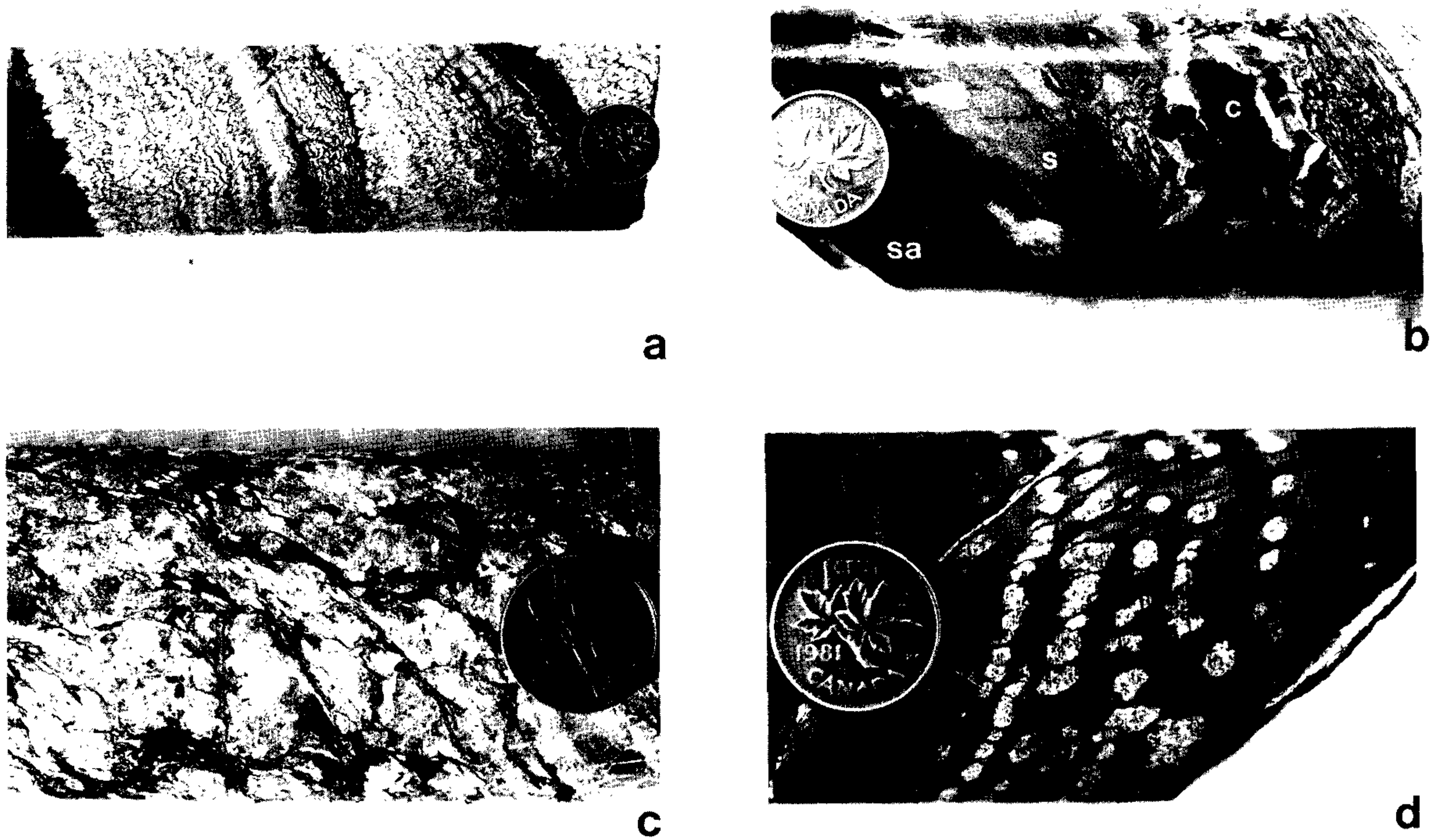

Plate 53-1. Photographs of drill core illustrating styles of mineralization in the Driftpile Ba-Fe-Pb-Zn deposit.
(a) Rhythmic bedding of laminated-blebby barite (white with thin black argillite interbeds. Grey laminated pyrite occurs at the base of the barite beds.
(b) Basal mineralization of a chemical rhythmite unit, TH interval. Base — black siliceous argillite (sa), fine-grained laminated sphalerite (s), coarse-grained carbonate nodules (c), and massive laminated barite (ba).
(c) Barite mineralization comprising dark bands of highly sheared and transposed pyrite that wrap around competent nodular carbonate and barite.
(d) Blebby barite mineralization consisting of barite nodules flattened by a pressure solution cleavage in siliceous argillites.

of pyrite laminations varies throughout the mineralized beds, in general they are more abundant at the base of a rhythmically bedded mineralized interval. Details of each of the types of mineralization are shown on Plate 53- .

In addition to the features described previously, detailed logging has revealed that distinct cycles of mineralization can be identified within any one mineralized interval (Fig. 53-8). These cycles are characterized by thick-bedded sulphide-barite units at the base that decrease in thickness toward the top of a cycle. Massive barite and laminated pyrite concentrations also decrease upward within a cycle and the proportion of laminated and blebby barite increases toward the top of the depositional cycle (Fig. 53-8). This pattern of mineralization is shown in the TH1 horizon on Figure 53-8 where at least three distinct chemical depositional cycles have been recognized.

DISCUSSION AND CONCLUSIONS

Preliminary fieldwork in the Driftpile Creek area has established a mappable lithostratigraphy and allowed determination of the tectonic evolution of the Gataga area. Three phases of deformation have been recognized. The identification of an early fold event with apparent northeast-southwest-trending axes, possibly associated with Devonian extensional faulting, warrants further study as this may have controlled the location of the barite-sulphide deposits and their feeder zones. Superposed upon this earlier deformation event is the main northeasterly directed folding and thrusting of presumed Mesozoic age. Later dextral kink folding is interpreted to be associated with regional dextral strike-slip faulting along the Rocky Mountain Trench (Gabrielse, 1985).

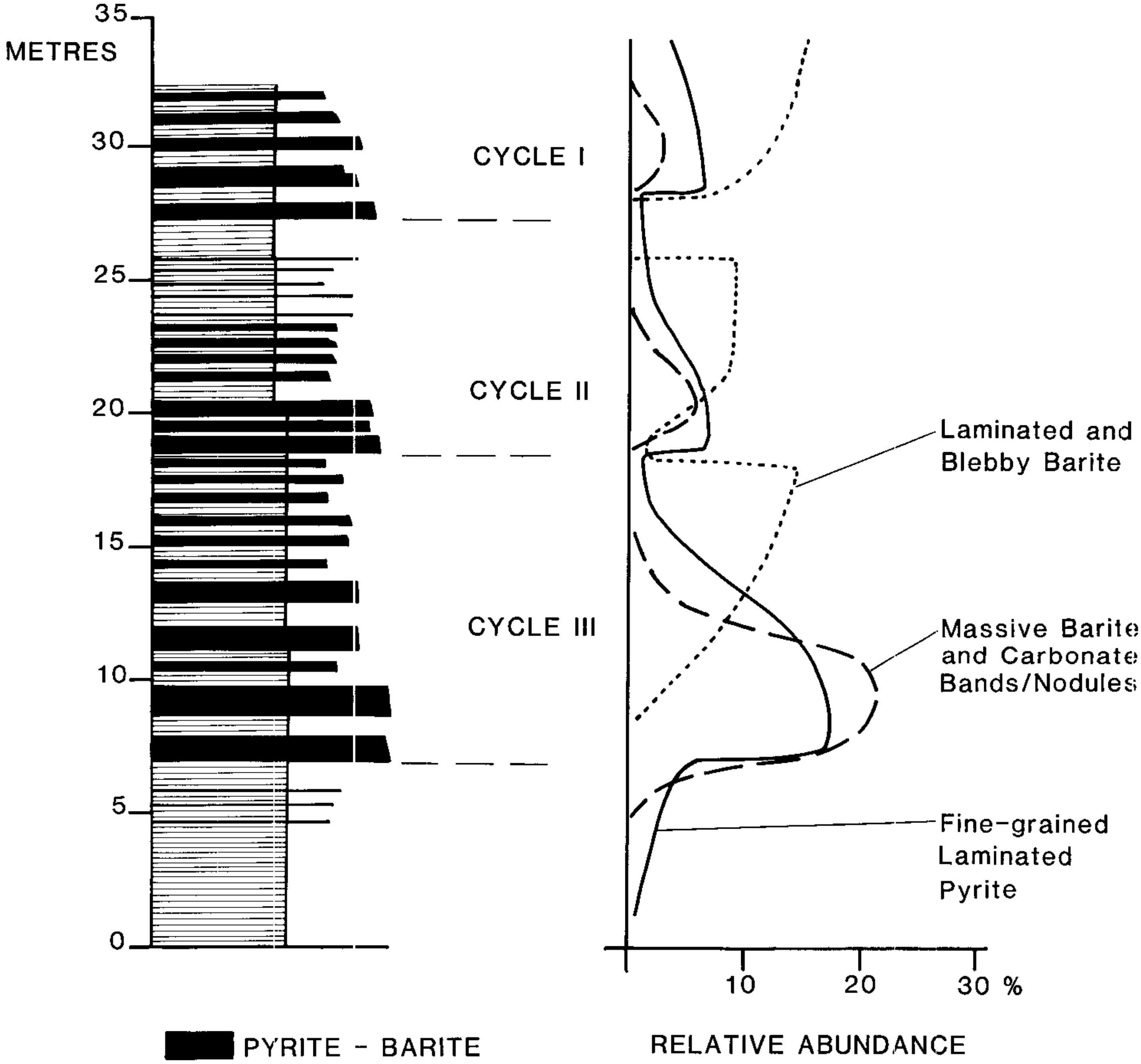

Figure 53-8. Logged section through TH mineralization showing three rhythmic cycles. Variations in the relative abundance of the three principal components are also shown.

The stratiform barite-sulphide mineralization displays distinct cyclic patterns of rhythmic sedimentation. Internal chemical differentiation within individual rhythmite beds has been identified and this can be used to indicate stratigraphic way up. Detailed studies of the mineralization and of its chemistry are continuing.

FUTURE RESEARCH

Future research will be carried out with the following aims:

(1) To define a lithostratigraphy and biostratigraphy (based on conodont dating), with special emphasis on the timing of mineralization and tectonic events controlling the distribution of Devonian basins.

(2) To examine the influence of an early extensional deformation event on controlling the distribution of mineralization within the Gataga area. This aspect will be investigated through further detailed structural and sedimentological research and regional mapping.

(3) To identify a geochemical signature for the Devonian strata in order to locate prospective horizons within the highly deformed black argillites of the Lower Earn Group.

(4) To investigate the mineralization processes using geochemical and isotopic techniques.

ACKNOWLEDGMENTS

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