STRUCTURE AND MINERALIZATION OF THE DRIFTPILE Ba-Fe-Zn-Pb DEPOSIT NORTHEASTERN BRITISH COLUMBIA (94E, 94F, 94K, 94L)

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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. 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 on-going research programme on stratiform sediment hosted Pb-Zn deposits in the Canadian Cordillera (McClay 1983 a & b). The detailed study of the Driftpile Creek area will form part of a regional mapping programme of the Gataga River District (NTS sheets 94 E/16, 94 F/14, 94 K/4, 94 L/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 Gataga District has been chiefly concerned with reconaissance 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 180km long complex fold and thrust belt of Ordovician - Devonian sediments - the Kechika Trough (fig. 2) which is the southern extension of the Selwyn Basin.

LOCATION AND TOPOGRAPHY

The Driftpile deposit is located at 58 04' N and 125 55' W (fig.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 1100m to over 2000m, and the area is characterised by long ridges and valleys parallel to the dominant northwest trending structural grain. Treeline reaches up to 1500m 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 terrain. Access to the area was via 206 helicopter from Johanson Lake and single engined Beaver from Dease Lake. A 640m dirt airstrip, at an elevation of 1340m is suitable for small fixed wing aircraft, and is located approximately 2km from the camp on Driftpile Creek.

TECTONO-STRATIGRAPHIC SETTING

The Driftpile Ba-Fe-Zn-Pb deposit is located in the Gataga Fold and Thrust Belt. This forms part of the northwest trending long, narrow Kechika Trough - the southern extension of the Mid-Upper Palaeozoic Selwyn Basin (fig. 2). Sedimentation is dominated by black, fine-grained siliciclastics 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. 2). These stratiform barite-sulphide deposits are considered to have formed from metalliferous fluids discharged into local basins along contemporaneous block faulting related to crustal extension during the Middle to Late Devonian (Gordey et al. 1982; MacIntyre, 1983; Goodfellow & Jonasson, 1984).

STRATIGRAPHY

In the Driftpile Creek area, Ordovician through Upper Devonian strata are deformed into a northwest trending fold and thrust belt (fig. 3). These rocks represent the basinal facies of the Kechika Trough and are flanked to the east and west by Cambrian - Early Ordovician platformal carbonates (fig 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 the Mesozoic and Cenozoic (Tempelman-Kluit, 1979; Gabrielse 1985). The stratigraphy for the Driftpile Creek area is shown in figure 4. A basal sequence of Ordovician through Lower Devonian shales and siltstones has been assigned to the Road River Group and this 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 are a 30-40m thick sequence of recessive carbonaceous black argillites, cherts and minor thin limestones, often containing Ordovician graptolites. This is, in turn, overlain by 130m of resistant, distinctly orange weathering dolomitic micaceous siltstones. These contain occasional Silurian graptolites. Two 3m thick cryptalgal laminated micritic limestone bands are present towards the top of this unit. The Silurian 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 sequence of fining upward cycles of thin-medium bedded laminated siltstones and silt banded argillites. In the western part of the map area (fig. 3) these interdigitate with thick- bedded chert pebble conglomerates. This sequence is succeeded by a minimum of 450m of recessive, unlaminated to thinly laminated silver-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. 3 & 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 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. 3 & 5). The western limit of this belt is marked by the Mount Waldemar Thrust (fig. 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. 3 & 4) indicates the first change in thrust vergence from northeasterly vergence to southwesterly vergence. 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:-

Phase 1 deformation has produced asymmetric folding on northeast trending axes (fig. 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 accomodate at least 30-40% 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), indicates the position of the steep limbs of folds related to Phase 1 deformation.

Phase 3 deformation developed local steep - vertically plunging kink folds 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 & Cathro, 1982). These have been designated units UH, TH1 and TH2 (Archer Cathro and Associates, internal report, 1981). The mineralized intervals are located in poorly exposed panels of highly folded and sheared rocks (figs. 3 & 4) which fact hampers correlation between different thrust bound packages. Data has been collected from detailed examination of surface exposures and 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 - 45m in thickness. They typically consist of beds of fine-grained massive-laminated barite, laminated fine-grained pyrite with subordinate sphalerite and galena, 10 to 100 cms thick and intercalated with un-mineralized black cherty argillite and chert beds 10 to 100 cms thick. The sulphide content of the barite beds varies from almost zero to as much as 30 - 40% by volume with the more sulphide rich beds containing 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. The intense folding and shearing has locally produced strong transposition fabrics in the sulphides and barite.

Detailed logging of drill core and of surface exposures has 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 in figure 6a and is found on all scales from mm thick laminations to metre thick alternating beds of barite / sulphide and interbedded argillite (fig. 7). In general there is an inverse relationship between the thickness of the mineralized beds and the thickness of interbedded argillites (figs.7-9) with the thicker mineralized units occuring at the presumed stratigraphic base of the mineralized intervals. This style of interbedded barite / sulphide and un-mineralized argillites is rhythmic in nature and is 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. 8) 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. 8) 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 of the components described above (fig. 8) may be developed. The concentration 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 in figures 6a-d.

In addition to the features described above, detailed logging has revealed that distinct cycles of mineralization can be identified within any one mineralized interval (fig. 9). These cycles are characterised by thick bedded suphide / barite units at the base and these decrease in thickness toward the top of a cycle. Massive barite and laminated pyrite concentrations also decrease upwards within a cycle and the proportion of laminated and blebby barite increases toward the top of the depositional cycle (fig. 9). This pattern of mineralization is shown in the TH1 horizon in figure 9 where at least 3 distinct chemical depositional cycles have been recognised.

DISCUSSION AND CONCLUSIONS

Preliminary fieldwork in the Driftpile Creek area has established a mappable lithostratigrahy and allowed the determination of the tectonic evolution of the Gataga area. Three phases of deformation has been recognised. The identification of an early fold event with apparent NE - SW 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).

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 erect a lithostratigraphy and biostratigraphy (based on conodont dating), with a special emphasis as to the timing of mineralization and of 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.

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FIGURE CAPTIONS

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

Figure 2. Litho-tectonic map of the Kechika Trough and location of the Gataga area.

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

Figure 4. Stratigraphic column for the Driftpile Creek area.

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

Figure 6. 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 mineralisation 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 highly sheared and transposed pyrite (dark bands) that wraps around competent nodular carbonate and barite.

(d) Blebby barite mineralisation consisting of barite nodules flattened by a pressure solution cleavage in siliceous argillites.

Figure 7. Logged section through TH mineralization from in-situ outcrop in Driftpile Creek

Figure 8. Detailed lithological section through a rhythmite cycle within TH, showing chemical differentiation with laminated sulphides at the base passing upwards into massive barite and nodular carbonate. The top of the unit is characterised by sulphide poor, laminated to blebby barite.

Figure 9. Logged section through TH mineralization showing three rhythmic-cycles. Variations in the relative abundance of the three principal components are also shown.