GS-28

CRETACEOUS BLACK SHALE INVESTIGATIONS IN THE NORTHERN PART OF THE MANITOBA ESCARPMENT (PARTS OF NTS 62J/W, 62K/N, 62N/E AND 63C/W)

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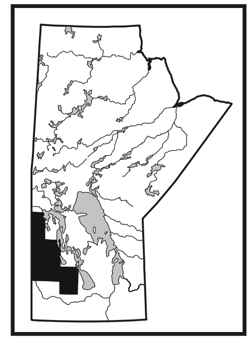

Bamburak, J.D. 1999: Cretaceous black shale investigations in the northern part of the Manitoba Escarpment (parts of NTS 62J/W, 62K/N, 62N/E and 63C/W); *in* Report of Activities, 1999, Manitoba Industry, Trade and Mines, Geological Services, p. 120-122.

SUMMARY

Structures within the Superior Boundary Zone (which includes the Thompson Nickel Belt) in Manitoba have been shown to be active during the Paleozoic. The fractures produced by these long-term movements produced channel-ways for deep fluid migration that may have originated in the buried Precambrian basement. These channel-ways may have also penetrated the overlying Mesozoic rocks in southwestern Manitoba. The fluids may have left their signature by depositing minerals at structural and lithological traps within the Mesozoic section. The purpose of this summer's field work was to determine if unique mineralization is present along the trend of the Superior Boundary Zone situated within the Porcupine Hills/Duck Mountain/Riding Mountain area, and if this mineralization has economic potential.

INTRODUCTION

Basement reactivation

McCabe (1967) suggested that Paleozoic strata straddling the Superior Boundary Zone (SBZ) in Manitoba was differentially affected by basin subsidence and uplift during deposition. Support for this interpretation was provided by Green et al (1980), who concluded that the Precambrian eastern Proterozoic basement block exhibited distinctly different tectonic and lithostratigraphic patterns and different crustal thickness and composition than the western Proterozoic block. Bezys and McCabe (1996) stated that basement control of the Paleozoic depositional framework was due to these crustal blocks reacting with slight differences to imposed tectonic forces. They concluded that the Superior craton underwent greater subsidence during depositional episodes and greater uplift during erosional episodes than the Trans-Hudson Orogen.

Northwest of Lake Winnipeg, McCabe (1967) noted a northeast-trending flexure in the Paleozoic structure contours within the SBZ, the Moose Lake syncline. Bezys (1996a) provided evidence that tectonic movements were active during Lower Paleozoic time in the William Lake area, on strike with the Moose Lake syncline. She described the 17 km long Reedy Lake lineament that coincides with the trend of lakes and streams, as well as basement magnetic signatures. Sub-vertical fractures in outcrop and in drill core were also documented.

In southwestern Manitoba, McCabe (1971) associated the Birdtail-Waskada axis, the site of numerous, sharply defined structural and isopach anomalies, with post-Middle Devonian salt collapse. Bezys (1996a) concluded that faults and fractures, propagating from the basement, allowed for circulation of brines that dissolved the Prairie Evaporate and caused collapse of overlying strata. The presence of a complex mosaic of crustal belts, plutons, faults and fault-bounded blocks in southwestern Manitoba was indicated by Lyatsky et al. (1998) and Dietrich and Bezys (1998). Evidence for the deep groundwater flow penetrating Paleozoic limestone within the outcrop belt is provided by solution chimneys in the Mafeking quarry (Fedikow et al., 1996, Bamburak et al., 1997), by the Ochre Lake structure (Bezys, 1996b), and by modern salt springs (Bezys et al., 1997).

Bezys et al. (1996) recognized accretionary lapilli within Cretaceous channel fill in core from a hole drilled south of Easterville. She concluded that the presence of accretionary lapilli suggested a proximal volcanic source possibly related to the SBZ. Such activity during the Cretaceous suggests that basement reactivation along the SBZ continued during the Mesozoic.

Current investigations

In 1996, Cretaceous black shales were sampled along the southern portion of the Manitoba Escarpment for industrial mineral evaluation (Bamburak, 1996). Some of these samples were analyzed along with oil well core and chips by Fedikow et al. (1997) to provide new metallogenetic concepts relevant to mineral exploration on Phanerozoic sequences. The results of these analyses were published as a series of data files (Fedikow et al., 1998). Additional black shale samples were collected in the Porcupine Hills area as part of the Prairie-type microdisseminated mineralization study centred on the Mafeking area (Bamburak et al., 1997). These samples were analyzed early in 1999.

To determine if unique mineralization is present within Mesozoic shales along the trend of the SBZ, and if this mineralization has economic potential, Cretaceous bedrock exposures situated within the Porcupine Hills/Duck Mountain/Riding Mountain (PDR) study area (Fig. GS-28-1) were sampled during the summer of 1999. The exposures, many of which were described in detail by McNeil and Caldwell (1981), are found mainly along stream valleys at the edge of the Manitoba Escarpment. Two holes were drilled on the north slope of the Porcupine Hills (Bamburak and Bezys, GS-27, this volume).

STRATIGRAPHY

The stratigraphic succession of deposition and erosion of formations in southern Manitoba is shown in Figure GS-28-2. The Upper Cretaceous stratigraphy of the PDR study area is shown in more detail in Table GS-28-1. For the most part, the marine shales and thin limestone beds were removed by erosion east of the Manitoba Escarpment (Fig. GS-28-1).

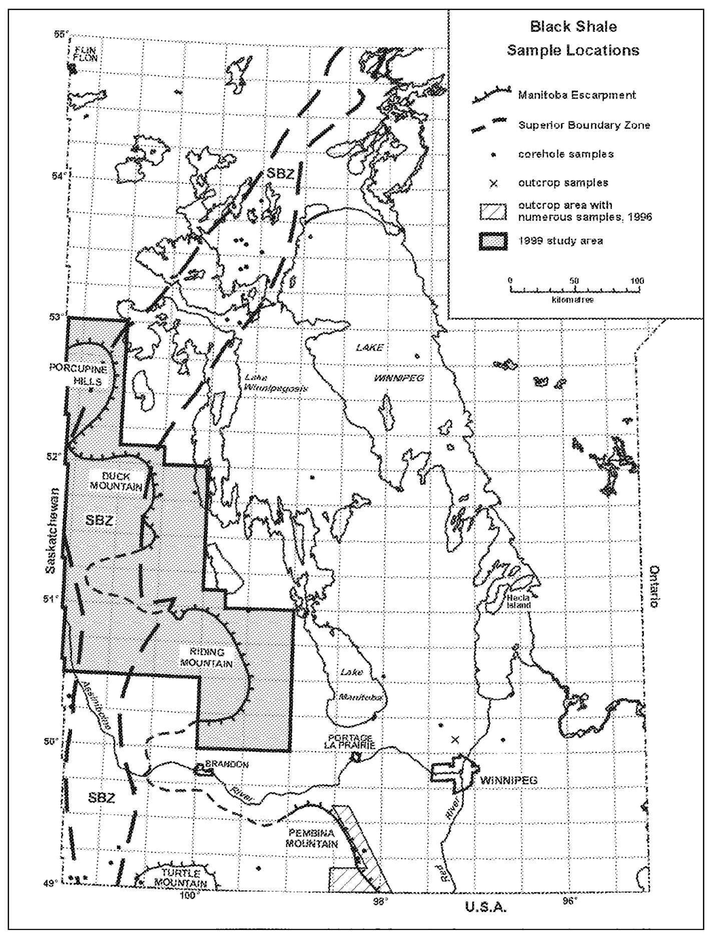

Figure GS-28-1: Location of the Porcupine Hills/Duck Mountain/Riding Mountain (PDR) study area; Manitoba Escarpment and Superior Boundary Zone (SBZ) in southern Manitoba. Sampling sites for outcrop, drill core and well chip samples in Manitoba (after Fedikow et al., 1997).

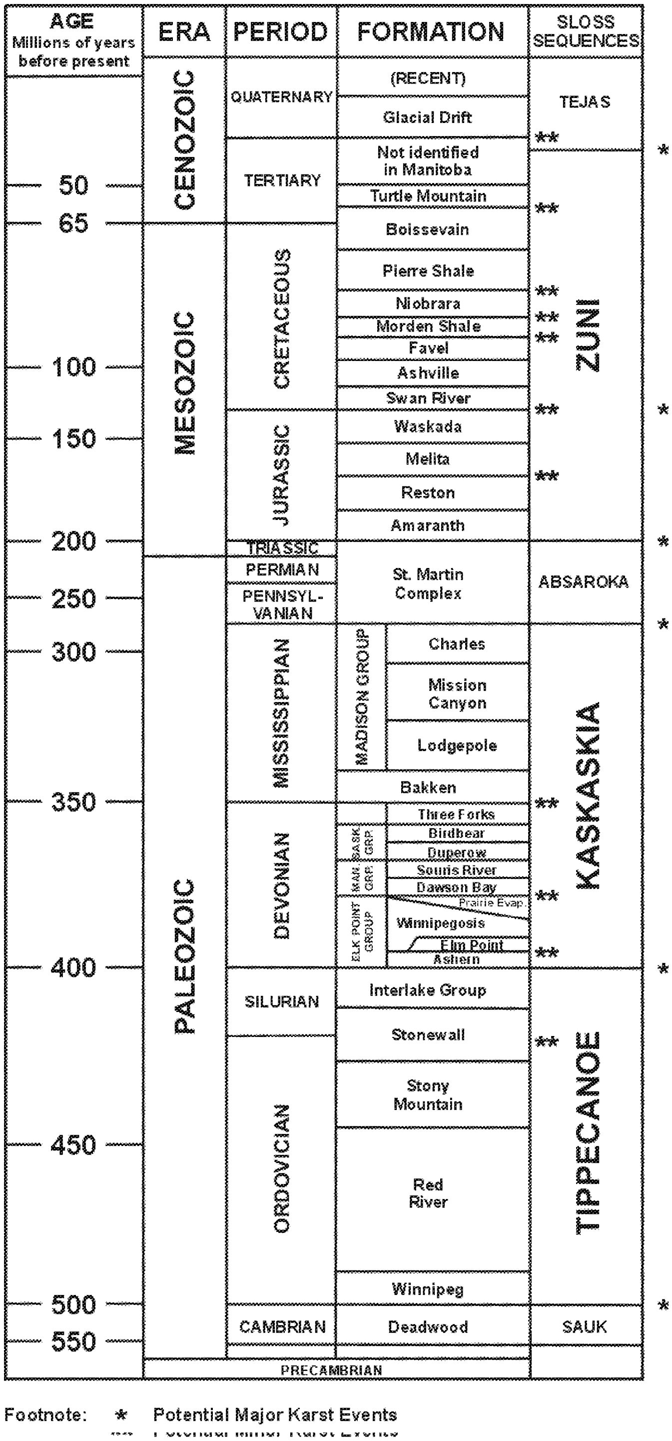

Figure GS-28-2: Generalized stratigraphic section for southern Manitoba with asterisks showing times of karsting events McRitchie, 1991).

The oldest exposed bedrock within the PDR is the Upper Cretaceous Swan River Formation, located east of the Manitoba Escarpment (Fig. GS-28-1). The basal formation of the Escarpment is the Ashville Formation, followed upward in ascending order by the Morden Shale, Niobrara Formation and the Gammon Ferruginous, Pembina, Millwood and Odanah members of the Pierre Shale (Table GS-28-1).

Pleistocene glacial sediments blanket the PDR area.

RESULTS

Evidence that fluids from depth left their signature by depositing minerals at structural and lithological traps within the Mesozoic section was noted at several localities in the PDR study area. Two outcrops of altered Marco Calcarenite, contained within the Assiniboine Member of the Favel Formation, were recognized on the south side of the Birch River in Sec. 32, Tp. 29, Rge. 26WPM (Fig. GS-28-3). These locations overlie the SBZ. Alteration of the normally black limestone of the Marco Calcarenite is shown by fracture-bounded halos of buff limestone surrounding black cores. In addition, the calcareous speckled shale underlying the Marco Calcarenite is heavily mineralized with iron oxide along fracture surfaces. The overlying non-calcareous black shale of the Morden is not visibly mineralized, indicating perhaps that it formed a stratigraphic trap against which further upward fluid movement was halted. In contrast to these localities, other outcrops of equivalent strata within the PDR, but outside the trend of the SBZ, appear to be only weakly mineralized.

Chemical analyses of the samples during this summer's fieldwork will be carried out and the results added to the black shale database (Fedikow et al., 1998). Statistical analysis will be done to compare the results of chemical analyses of black shale samples collected along the SBZ and those from outside the area of basement reactivation.

Table GS-28-1: Table of Formations in the Porcupine Hills/Duck Mountain/Riding Mountain area

Formation/Member	Maximum Thickness (m)	Lithology
Upper Cretaceous		
Pierre Shale		
Odanah Member	150	Hard grey siliceous shale
Millwood Member	60	Soft bentonitic clay
Pembina Member	7	Non-calcareous black shale with numerous bentonite interbeds near base
Gammon Ferruginous Member	30	Ferruginous black shale
Niobrara Formation	30	Chalky buff and grey speckled calcareous shale
Morden Shale	30	Non-calcareous black shale with abundant jarosite
Favel Formation		
Assiniboine Member	17	Olive-black speckled calcareous shale with Marco Calcarenite beds near top
Keld Member	17	Olive-black shale speckled shale with Laurier Limestone Beds near top
Ashville Formation	80	Non-calcareous black to dark grey shale, silty; Newcastle sand zone, in places
Swan River Formation	150	Sandstone, sand and silt, quartzose, pyritic shale, non-calcareous

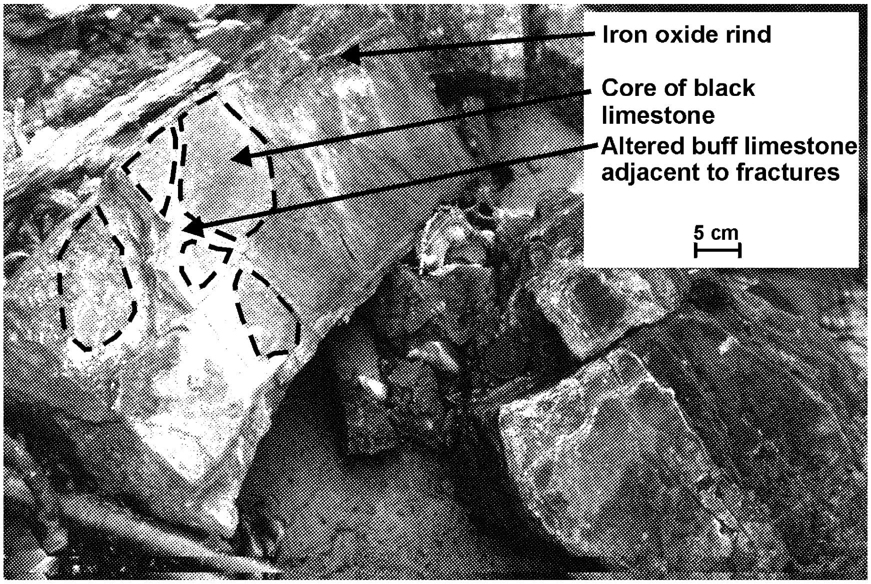

Figure GS-28-3: Altered Marco Calcarenite beds within the Assiniboine Member of the Favel Formation on the south bank of the Birch River in 14-32-39-26W.

ACKNOWLEGEMENTS

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