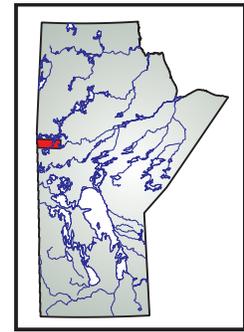


Northern Flin Flon Belt compilation, Manitoba (parts of NTS 63K12, 13) by H.P. Gilbert

Gilbert, H.P. 2010: Northern Flin Flon Belt compilation, Manitoba (parts of NTS 63K12, 13); in Report of Activities 2010, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. 88–93.



Summary

In 1986, the author initiated 1:20 000 scale geological mapping in the northern part of the Flin Flon Belt. The map area extended northward from latitude 54° 48'N to the contact with the Kisseynew Domain, and from the Manitoba-Saskatchewan boundary in the west to Naosap Lake in the east. The results of this mapping, which have been published in a series of preliminary maps and reports, have been compiled in a geoscientific map that will be released in winter 2010–2011. The new 1:30 000 scale map will be accompanied by notes containing descriptions of the geology and geochemistry of the various tectonostratigraphic components. A geochemical database with analytical data from 345 rock samples, together with lithological and textural information, will be released as a data repository item, together with the geoscientific map. Apart from a brief overview of the principal lithotectonic framework of the northern Flin Flon Belt, this report highlights key findings on the economic and structural geology that are presented in the geoscientific map.

Introduction

The Paleoproterozoic Flin Flon Belt (Figure GS-7-1) has been the subject of geological mapping by provincial and federal surveys for more than 60 years. Although reconnaissance and regional mapping has been undertaken across the entire width of the belt and beyond, detailed mapping has focused largely on the central and southern parts of the belt where the main volcanic-hosted massive sulphide deposits have been found. Mapping was initiated by the author in the northern part of the belt (Embury–Wabishok–Naosap lakes area) in 1986, an area that had not been mapped since the 1940s (Tanton, 1941; Bateman and Harrison, 1945). Detailed (1:20 000 scale) mapping was subsequently extended to the northern margin of the volcanic terrane and eastward to the contact with an extensive granitoid terrane at Naosap Lake (Figure GS-7-2). The results of this mapping have been documented in an open file (Gilbert, 1999) and various Manitoba Geological

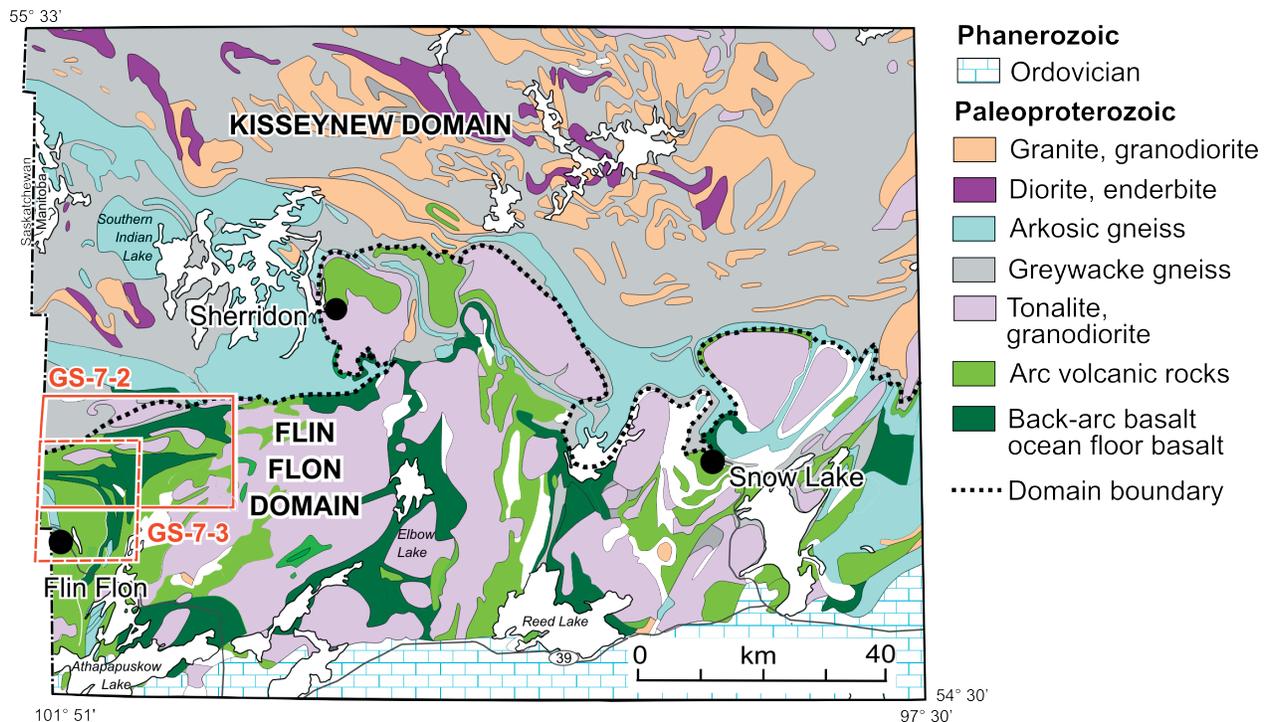


Figure GS-7-1: Regional geology map of part of the Reindeer Zone in the southern Trans-Hudson Orogen. The Flin Flon Domain (Flin Flon Belt) consists of Paleoproterozoic volcanic, sedimentary and intrusive rocks in the Flin Flon–Snow Lake area, south of the Kisseynew Domain and north of the flat-lying Ordovician rocks that extend south from Athapapuskow and Reed lakes. The northern Flin Flon Belt (NFFB) subarea is shown in Figure GS-7-2 (inset); Figure GS-7-3 (inset) shows the lateral extent of tectonically defined components between the NFFB and south-central part of the Flin Flon Belt (Bailes and Syme, 1989).

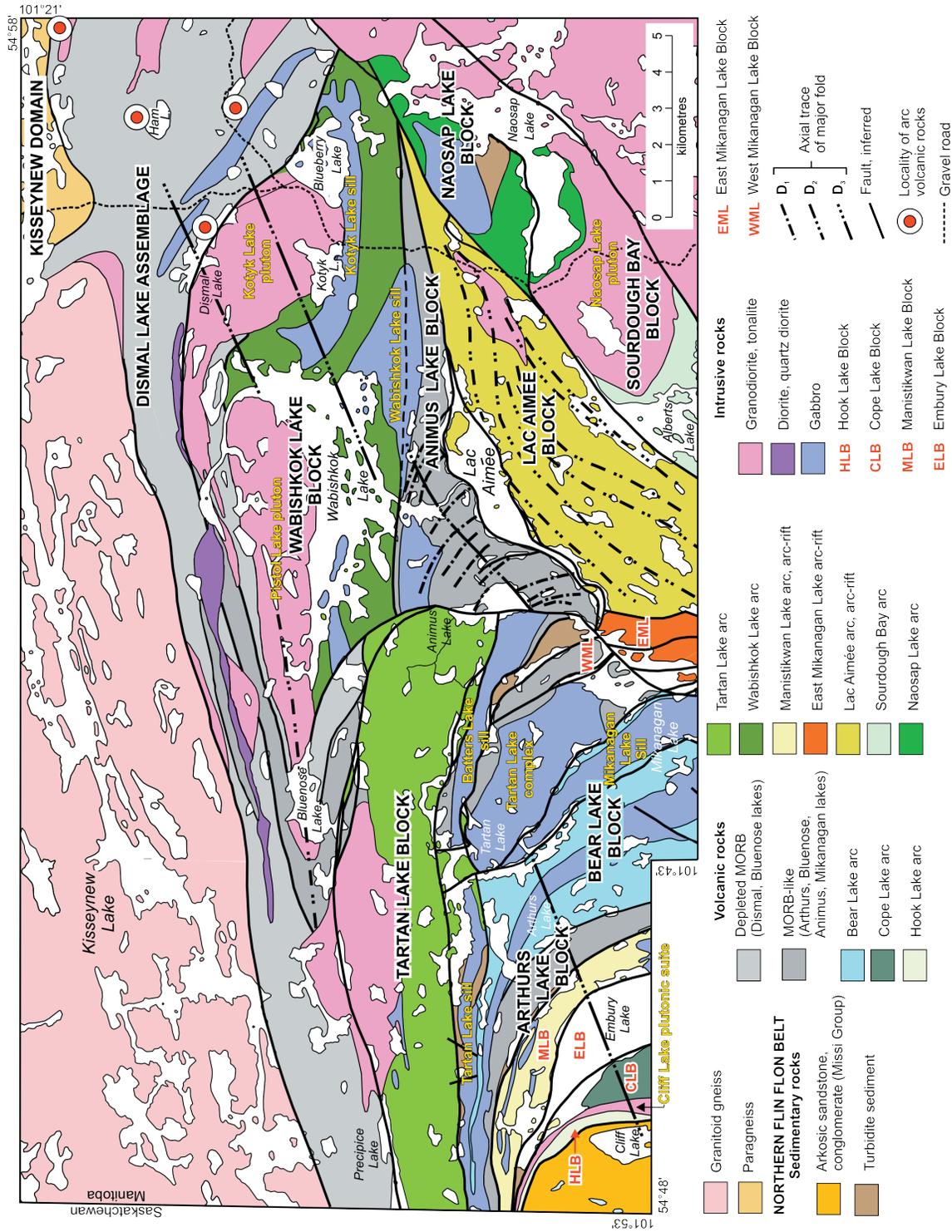


Figure GS-7-2: Geology of the northern part of the Flin Flon Belt, showing the main tectonostratigraphic components and structural features. Animus Lake is bisected by a north-trending fault that is continuous with the Northeast Arm Fault to the south, shown in Figure GS-7-3. Fault blocks southwest of Tartan Lake are deformed by the regional, east-northeast-trending Embury Lake antiform (Stauffer and Mukherjee, 1971). Localities of arc-type rocks within the Dismal Lake assemblage are characterized by base-metal sulphide mineralization.

Survey preliminary maps and reports, most recently, Gilbert 2003a, 2003b, 2004.

The geoscientific map of the northern Flin Flon Belt, to be released in winter 2010–2011 (H.P. Gilbert, work in progress), contains geological and associated geochemical data gathered over the course of eleven field seasons, compiled in a single 1:30 000 scale map that outlines the distribution of compositionally distinctive fault blocks, the main intrusions and the principal geological structures found in the map area. Accompanying notes contain descriptions of the various tectonostratigraphic components, a discussion of their crustal setting and inferred magmatic origin, and sections on the structural and economic geology of the area. Analytical data on the geochemistry of 345 rock samples collected between 1986 and 2004, together with associated lithological and textural information, are compiled in a data repository item to be included with the geoscientific map.

Geology of the northern Flin Flon Belt (NFFB)

The map area in the NFFB is approximately 20 by 33 km in size, and contains over 20 tectonically distinct blocks or fault slices of diverse volcanic, related intrusive and subordinate sedimentary rocks (Figure GS-7-2); most of these are akin to modern oceanic-arc rocks and are part of the Flin Flon arc assemblage (Stern et al., 1995). Mid-ocean-ridge (MORB)-like volcanic rocks are structurally intercalated with juvenile-arc type rocks, and an extensive area of depleted MORB (Dismal Lake assemblage) extends along and across the northern boundary of the Flin Flon Belt, where it is locally in fault contact with the Kiseynew Domain to the north (Gilbert, 2004; Zwanzig and Bailes, 2010).

The pattern of intercalated arc and MORB-type rocks in the NFFB reflects a multiphase deformational history that spanned well over 100 m.y., from the earliest 1886 Ma fold event (Zwanzig et al., 2001), to the latest (<1770 Ma) deformation phase of brittle faulting (Lucas et al., 1996; Gale et al., 1999). Tectonic accretion ca. 1880–1870 Ma juxtaposed different parts of the oceanic-arc system and resulted in low-angle thrusts/regional shear zones that, in some cases, persisted as sites of repeated movement through subsequent episodes of deformation. This study has found that three main, post-accretion deformation events resulted in major fold structures in the NFFB (Figure GS-7-2), with subsequent late brittle deformation, which is consistent with previous structural models for the Flin Flon Belt (e.g., Lucas et al., 1996; Gale et al., 1999).

The Inlet Arm and Northeast Arm faults that flank the Bear Lake Block (Figure GS-7-3) have been interpreted as major accretion-related structures (Bailes and Syme, 1989; Lucas et al., 1996). The Northeast Arm Fault or ‘shear zone’ (Lucas, 1993) juxtaposed arc and

MORB-type volcanic rocks and, during subsequent deformation, was associated with approximately 3 km of sinistral displacement in the NFFB, inferred as a result of oblique-slip movement along the fault (Figures GS-7-2 and -3). The Northeast Arm shear zone is a crustal-scale feature (David and Syme, 1994; Lucas et al., 1996) that divides the NFFB into two structurally distinct subareas: west of the shear zone, major faults and folds trend mainly northwest; whereas to the east, the structural trends are mainly to the northeast and east. The regional structural pattern of the NFFB has also been influenced by late east-northeast-trending open folds, including the Embury Lake antiform (Stauffer and Mukherjee, 1971) and similar structures in the Animus Lake and Wabishkok Lake blocks (Figure GS-7-2).

Stratigraphic and geochemical data for representative volcanic rock suites in the NFFB, together with a brief discussion of the economic geology of arc-type rocks in the northeast part of the study area, are summarized in Gilbert (2009). In addition to a comprehensive discussion of these data, the notes accompanying the new 1:30 000 scale geoscientific map will include discussions on the magmatic origin and tectonic significance of the various volcanic rock suites, in light of the large amount of information published on the Flin Flon Belt over the last 25 years.

Economic considerations

The Flin Flon Belt is one of the largest Paleoproterozoic volcanic-hosted massive sulphide (VMS) districts in the world, with over 162 million tonnes of Cu-Zn-(Au) ore (combined reserves and production to 2007) in 27 past and currently active mines (Manitoba Innovation, Energy and Mines, 2010). VMS-related mineralization in the Flin Flon Belt typically occurs in one or more of the following settings: 1) rifted arc-type sequences, 2) felsic magmatic rocks in arc-type sequences, and 3) faulted contacts between contrasting stratigraphic components or juxtaposed fault blocks (Bailes and Syme, 1989; Syme and Bailes, 1993; Syme, 1998; Syme et al., 1999).

Prospective targets and the main occurrences of VMS-associated base-metal and gold mineralization in the NFFB are as follows:

- Two rift-related panels that extend across the Flin Flon Belt and include evidence for arc-rift tectonic components: 1) Manistikwan Lake Block–Arthurs Lake Block–Grassy Narrows Zone, and 2) Lac Aimée–East Mikanagan Lake–Scotty Lake blocks (Figures GS-7-2 and -3). Both panels contain numerous prospects for mineralization and have been explored periodically for over five decades.
- Rhyolite-hosted base-metal mineralization at Trout Lake mine (Figure GS-7-3), a Cu-Zn ore deposit of over 20 million tonnes (Ordóñez-Calderón et al., 2009) that occurs at the faulted contact between a

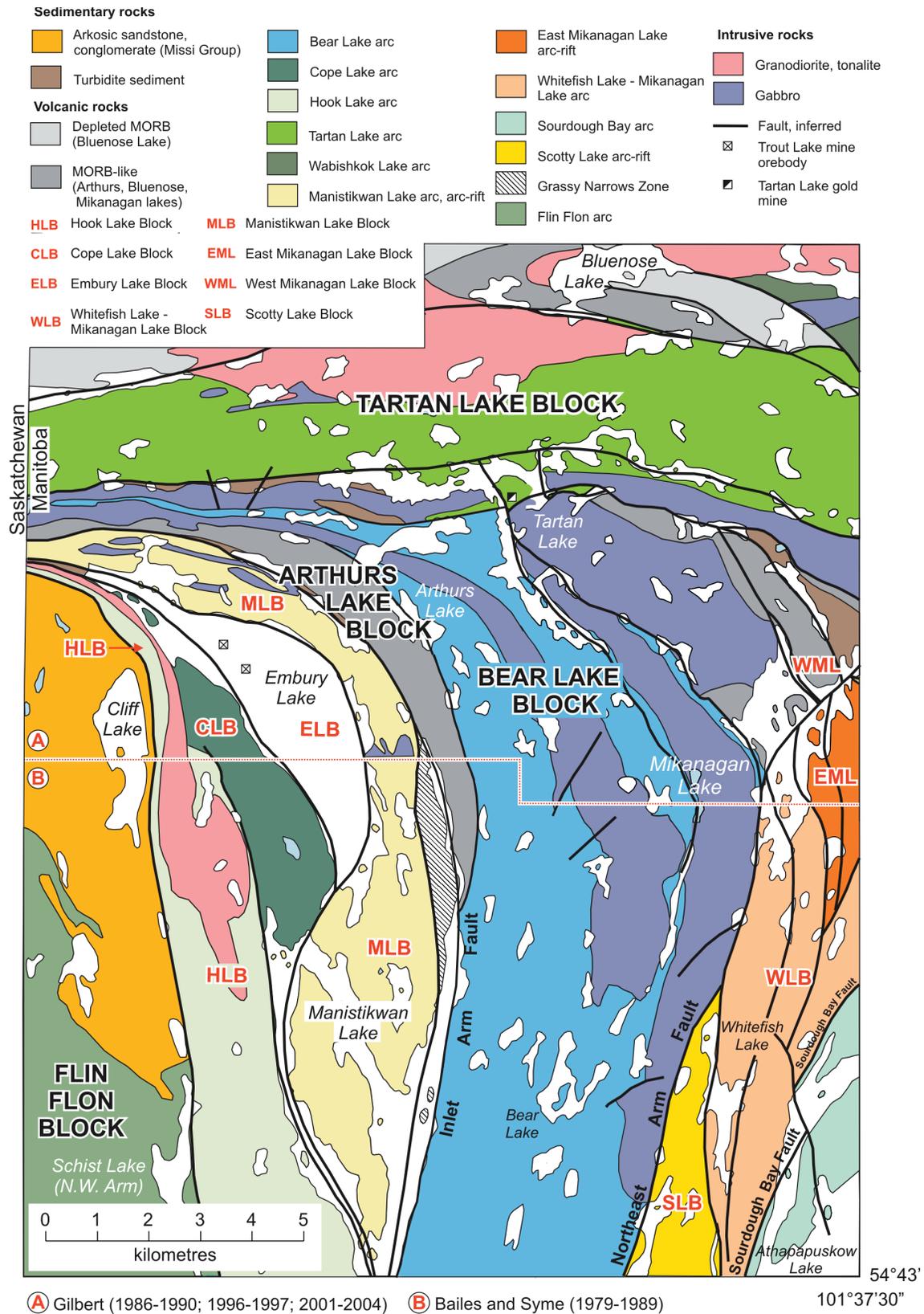


Figure GS-7-3: Geology of the western part of the Flin Flon Belt, showing the lateral extent of tectonically defined components between the NFFB and south-central part of the Flin Flon Belt (Bailes and Syme, 1989). The cumulative displacement on the Northeast Arm Fault is interpreted as approximately 3 km of sinistral movement, based on the various arc, MORB-type and gabbroic rocks on opposite sides of the fault that would be re-aligned when restored to a pre-tectonic configuration.

volcano-sedimentary sequence (to the west) and grey-wacke-argillite (to the east), probably corresponding to the contact between the Cope Lake and Embury Lake blocks (Gilbert, 1988, 1990).

- Rhyolite-associated VMS-type mineralization in 1) arc volcanic rocks close to Kotyk Lake and at north-eastern Blueberry Lake (Gilbert, 2003b), 2) felsic volcanic rocks within the Baker Patton Complex, in the northern part of the Sourdough Bay Block (Figure GS-7-2), and 3) arc-type rocks that occur as enclaves within, or at the margins of the Dismal Lake assemblage. Cu-Zn and precious-metal mineralization in these enclaves is typically hosted by felsic volcanic rocks and is associated with alteration, metasomatism and pervasive deformation.
- The Tartan Lake gold mine (Figure GS-7-3), an approximately 600 000 tonne orebody (Peloquin and Gale, 1985) that is currently under redevelopment by St. Eugene Mining Corporation Ltd. (St. Eugene Mining Corporation Ltd., 2010). The gold mineralization, which is associated with quartz veining and carbonate alteration, is located in shears at the margin of the gabbroic Tartan Lake complex (Figure GS-7-2; Peloquin and Gale, 1985).

Conclusions

Recent mapping in the NFFB has yielded comprehensive lithostratigraphic and geochemical data that has 1) facilitated comparisons between the various tectonostratigraphic components in the Flin Flon Belt and 2) enabled correlations to be made between the Paleoproterozoic rocks and similar successions in modern oceanic arcs. Juvenile-arc and MORB-type volcanic rocks have been shown to be the dominant types in the NFFB, as in the south-central part of the Flin Flon Belt. These rocks extend laterally from north to south across the belt within large fault blocks and smaller fault slices that were intercalated during 1880–1870 Ma tectonic accretion. Whereas some volcanic rocks extend with little change across the Flin Flon Belt (e.g., arc types within Bear Lake Block), in other cases there are sharp contrasts laterally within fault blocks, due to the tectonic intercalation of contrasting types (e.g., arc and MORB types within Manistikwan Lake Block).

The NFFB contains a major Cu-Zn orebody (Trout Lake mine, in production since 1982) and a gold deposit at Tartan Lake mine (operational between 1987 and 1989) that is currently under investigation with a view to renewed production. Numerous prospects exist for the discovery of additional mineral resources in the NFFB, based on the recognition of favourable settings similar to those of ore deposits located in the south-central part of the Flin Flon Belt, within past or currently producing mines. It is noteworthy that some stratigraphic successions in the south-central part of the belt extend laterally, with little

change, into the NFFB. Previous mapping of the NFFB over 60 years ago has become inadequate to support current and future mineral exploration. The detailed mapping and geochemical investigations compiled in the upcoming geoscientific map release will address this need with new data and models for the NFFB.

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