

# ST. MARY MAP-SHEET, PURCELL SUPERGROUP, SOUTHEASTERN BRITISH COLUMBIA

By Trygve Höy<sup>1</sup>, Wayne Jackaman<sup>2</sup>, David Terry<sup>3</sup> and Brian Grant<sup>3</sup>

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## INTRODUCTION

The St. Mary sheet (NTS 82F/09) in the Purcell Mountains of southeastern British Columbia (Figure 1) is underlain mainly by the Middle Proterozoic Purcell Supergroup. The Sullivan deposit, a world-class sedex deposit, is located in the eastern part of the map sheet. It closed in 2001 after having mined more than 160 million tonnes of lead-zinc-silver ore. Exploration for sedex deposits continues in the Purcell Supergroup, with at least one company actively drilling targets in the St. Mary map area.

The St. Mary area was mapped initially by Leech (1957). The geology of portions of the sheet has been mapped by Reesor (1958), Höy (1984a) and by a number of exploration companies, including Cominco Ltd., Rio Algom and Kennecott. This project has compiled and reinterpreted this data, as well as data released in numerous assessment reports. Field checks of selected areas and discussions with geologists working in the area have added to the base. The geology of the area will be released as a 1:50 000-scale map in both digital and hardcopy format in early 2004. The map sheet is contiguous with Geoscience Map 1998-3 (Brown, 1998) and overlaps the area of the detailed government airborne geophysical surveys flown over in the late 1990s. Also included in the release is a summary of existing regional geochemical data; these data, including the geophysical surveys, will help in the development of a metallogenic overview that will direct regional exploration.

A second component of the project involves updating all mineral occurrences (approximately 30) in St. Mary map sheet as well as adding new occurrence information.

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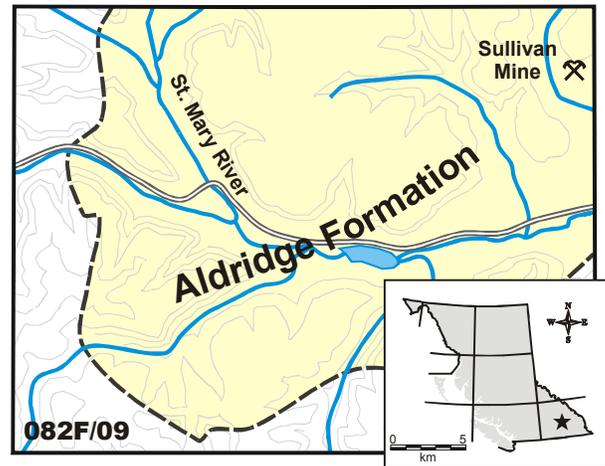


Figure 1: Location and regional geology of the St. Mary map sheet (082F/09).

## REGIONAL GEOLOGY

### *Stratigraphy*

The St. Mary map area is underlain mainly by Middle Proterozoic metasedimentary rocks of Purcell Supergroup. The Purcell Supergroup and its correlative in the United States, the Belt Supergroup, is generally considered to represent the infilling of an intracratonic rift (Hoffman, 1991; and summaries in Höy *et al.*, 2001 and Lydon, 2001). The basal part of the succession, the Aldridge Formation records the early synrift fill and overlying Creston, Kitchener and younger strata, the rift cover succession.

The Aldridge Formation has been divided into three members. The lower Aldridge, generally exposed throughout the central part of the St. Mary map sheet, comprises mainly thin to medium-bedded, pyrrhotite-rich, distal argillaceous turbidites. A prominent quartzitic turbidite sequence, several hundred metres thick, is part of the lower Aldridge stratigraphy in the Sullivan mine area and can be traced westward throughout a large part of the St. Mary map sheet. The Middle Aldridge comprises up to 2400 metres of medium-bedded quartzitic turbidites with prominent intervals of laminated marker siltstones. The upper Aldridge comprises approximately 300 metres of thin-

<sup>1</sup> 2450 Dixon Road, Sooke BC, V0S 1N0

<sup>2</sup> 3011 Felderhof Road, Sooke BC, V0S 1N0

<sup>3</sup> BC Ministry of Energy and Mines

bedded to laminated siltstone and argillite deposited on a shallowing basin plain.

The Creston Formation conformably overlies the Aldridge Formation in the western part of the map area. It comprises green to grey siltstone, argillite and quartzite, with numerous sedimentary structures indicative of shallow water deposition. It is overlain by the Kitchener Formation, metasedimentary rock that is characterized by the presence of carbonate. The Kitchener Formation comprises mainly calcareous and dolomitic siltstone and argillite, some buff-weathering impure dolomite and dark impure limestone. Overlying, mainly metasedimentary rocks, and a thin volcanic succession, are only exposed in the very southeast corner of the St. Mary map sheet.

Numerous mafic sills, the Moyie intrusions, form a large part of the lower and middle Aldridge stratigraphic package. They range from gabbro to diorite in composition and have been shown to be intruded, at least in part, into wet, unconsolidated sediments (Höy, 1984b; Höy *et al.*, 2001). Hence, they record a magmatic event during deposition of the Aldridge Formation and provide supporting evidence for a syn-rift model for the basal part of the Purcell Supergroup. A concordant U-Pb zircon date of 1467 $\pm$ 3 Ma for a sill located farther south (Anderson and Davis, 1995) provides a minimum age for early subsidence of the Purcell basin and for synsedimentary deposits such as Sullivan.

### ***Intrusive Rocks and Tectonism***

Several intrusive bodies occur in the St. Mary sheet area. These include the Middle Proterozoic Hellroaring Creek stock and several smaller related intrusion, and Middle Cretaceous intrusions such as the Hall Lake stock.

The Hellroaring Creek stock is a small pegmatitic body exposed in the St. Mary valley south of St. Mary Lake. It has been assessed for its beryllium content and, more recently, for its potential for semiprecious beryls (Legun, 2004). The stock, dated at *ca.* 1360 Ma (J. Mortenson, unpublished data) is interpreted to cut both foliation and folds in the Aldridge Formation (Leech, 1960), and provided some of the evidence for the existence of a Middle Proterozoic compressional event referred to as the East Kootenay orogeny (McMechan and Price, 1982). More recently, however, this event has been interpreted to result from crustal extension associated with deep seated magmatism (Doughty and Chamberlain, 1996).

The Hall Lake stock is a small Middle Cretaceous granitic intrusion near the western edge of the map-area. It cuts the Hall Lake thrust fault and it, and a similar aged intrusion that cuts the St. Mary fault farther east, provide a minimum age for Mid Cretaceous thrust faulting in the Purcell Mountains.

The southern edge of the White Creek batholith is exposed north of the map-area. It is a zoned intrusion with a granodiorite border phases and quartz monzonite central phases (Reesor, 1958).

### ***Mineral Deposits and Exploration***

The Sullivan mine at Kimberley is a classical example of a sedex type of deposit. It was the focus of a collaborative research project involving industry, government agencies and universities that culminated in 2001 with the publication of a comprehensive volume on the deposit and its setting (Lydon *et al.*, 2001). The geology of the Sullivan deposit is dealt with in numerous papers in the "Sullivan volume" and will only be reviewed briefly here.

The Sullivan deposit, largely mined out and closed in 2001, had an initial reserve of approximately 160 million tonnes containing 6.5% Pb, 5.6% Zn, 67 g/tonne silver and 25.9% Fe. The deposit occurred at the transition of the lower and middle Aldridge. It comprised a broadly stratiform, upwardly concave lens, which covered an area of 1.6 x 2.0 km, and consisted mainly of pyrrhotite, sphalerite, galena and lesser pyrite. The western part of the deposit was part of an extensive vent complex, and the eastern part comprised an apron of generally well-laminated sulphides. Several other smaller sedex deposits occurred in the immediate vicinity of the Sullivan deposit, within a south-trending, disrupted geothermal field referred to as the Sullivan-North Star graben.

The lower to middle Aldridge transition, commonly referred to as the Sullivan horizon, has been the focus of considerable exploration in the St. Mary sheet and elsewhere throughout the Purcell basin. At Sullivan, the horizon is marked by an anomalous thickness of sedimentary fragmentals, interpreted as mud volcano deposition, and by cross-cutting discordant fragmentals that appear to record movement along growth faults. Farther west in the St. Mary map sheet, exposures of the Sullivan horizon are also marked by a thick, fairly coarse sedimentary fragmental unit; here the horizon has been tested by several deep drill holes. Exploration continues along this horizon, with Klondike Gold Corp. drilling or extending several holes to the Sullivan horizon in late 2003.

Other deposit types in the St. Mary map sheet include mainly polymetallic vein occurrences. Many of these are considered important as they may target areas that have the potential for discovery of sedex deposits; several occur in the vicinity of the Sullivan deposit.

As noted above, exploration for beryllium and semiprecious gemstones been focused on the Hellroaring Creek stock.

## SUMMARY

The geology of the St. Mary map sheet, despite containing the Sullivan sedex deposit, has not been updated since the mid 1950s (Leech, 1957). The updated 1:50 000-scale geological map, scheduled for release at Roundup 2004, summarizes the results of approximately 50 years of exploration and mapping in the area, mainly by exploration companies but also by provincial and federal government surveys. The data is presented in digital and hardcopy format, on a composite 1:50 000-scale trim base. It includes a compilation of all publicly available geologic maps, RGS data, and exploration data such as drill hole locations. The accompanying BC MINFILE data, scheduled for release late in April, 2004, will update the geology of known mineral occurrences in the map area.

## ACKNOWLEDGMENTS

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