

DESCRIPTIVE NOTES

The Mega River map area (NTS 84 M/SW) is located in northwest Alberta, adjacent to the British Columbia border. The southern third of the map lies within the Fort Nelson Lowlands physiographic region (Bostock, 1970), and comprises the generally flat, low-lying (360–545 metres above sea level (asl)) area that drains southwards into the Hay River drainage basin. The northern two-thirds of the map is situated within the Alberta Plateau physiographic region (Bostock, 1970), and includes the conspicuous Bootis Hill, considered to be a bedrock remnant, that rises to 771 metres asl. The map area is blanketed by Boreal forest (white and black spruce, aspen, lodgepole pine) and extensive bogs and fens. Soils are generally poorly drained, commonly with shallow water tables, reflecting the high clay content of the tills and glacial lake sediments (10–40%) in which they have formed. In raised areas, where soil development is more advanced, gray luvisols predominate. Static and turbic cryosols are found in regions of sporadic discontinuous permafrost.

The surficial geology of the Mega River map area was interpreted from 1:60 000 scale airphotos (Alberta Sustainable Resource Development, 1994). Prior to the field season, preliminary surficial geology interpretations were drawn on the airphotos, and then subsequently ground truthed in the field. Aspects of the regional surficial geology were also interpreted from shuttle radar topography mission (SRTM) imagery (3-arc second, 90 meter resolution). Fieldwork was conducted in summer 2004. Field activities included: 1) inspection, logging and characterization of surficial geology from truck, foot traverse and helicopter field surveys of exposures along roadcuts, cutbanks, borrow and sump pits, as well as from hand-dug and augered holes; 2) sampling of till at a reconnaissance scale (1 sample per 25 km²) for geochemistry, base metal concentrations, particle-size, carbonate content, and kimberlite indicator minerals; 3) measurement of clast fabrics from tills.

The bedrock in the map area consists of horizontally bedded, poorly indurated Shaftesbury Formation shale (Green et al., 1970; Okulitch, 2006). Only a single bedrock outcrop was observed in the map area. This occurred at the east-central margin of the map, near the top of the regional bench dividing the Fort Nelson Lowlands and Alberta Plateau physiographic regions, along a shallow, road-side drainage ditch. Borrow and sump pits situated throughout the eastern and southern regions of the map area reveal a minimum of 3–5 m of glacial drift cover (till and/or lake sediments). The only other region in the map area considered likely to exhibit bedrock close to, or at surface, was along incised stream channels around the periphery of Bootis Hill. However, dense forest cover and an absence of helicopter landing sites negated their possible inspection.

Till within the Mega River map area has a high clay content (10–40 %), reflecting glacial erosion and entrainment of shale-rich bedrock and reworking of advance-phase glaciolacustrine sediment. During glacial advance, eastward draining regional rivers would have been impounded, leading to development of large proglacial lakes. In some localities, a second thinner and distinctly sandier till (30–45% sand in the < 2 mm size fraction of the matrix) overlies this basal clay-rich till. Fabrics in the two tills tend to be very similar, and contacts between them are often diffuse suggesting that it is a second facies relating to deposition of a greater component of more far travelled (Canadian Shield-derived) coarser englacial sediment, rather than a different trajectory of ice. Clast content of the regional till deposits tends to be very low, generally between 1 and 10%, and are dominantly Canadian Shield derived material (e.g., granites and gneisses), but also include local shale and sandstone erratics, as well as limestones, dolomites, quartzites, Athabasca sandstones, and ironstones. Thicknesses of till in excess of 5 m have been observed in the Mega River map area and > 15 m elsewhere in the northwest Alberta study area. A more detailed reconstruction of the regional drift thickness and bedrock topography in the 84M map area is provided by Pawlowicz et al. (2007a, b). Tills in the area are largely considered to have been deposited through basal lodgement processes. In the southwest part of the map area, a checker-board pattern of “islands” of hummocky till separated by rectilinear bog and fen deposits that parallel deglacial ice margins and what may have been linear and transverse crevasse patterns, suggests that ice here may have stagnated during retreat, allowing the uppermost till deposits to largely accumulate by meltout processes.

Rare occurrences of a generally thin (< 1 m), pink to maroon coloured till were observed in the Mega River map area. This same uniquely coloured till has been found elsewhere in the northwest Alberta and northeast British Columbia study area. It has been observed in various stratigraphic positions, including at the till bedrock contact, but was most frequently observed within upper till deposits. Clasts within this till are largely Shield-derived, and though somewhat sandier, it is not broadly dissimilar from the regional tills, other than its striking colour. It is speculated that this pink/maroon till represents glacial rafts of till derived from unknown deposits northeast (up-ice) of the study area.

The southwest-advancing Laurentide Ice Sheet inundated northwest Alberta during the Late Wisconsinan glaciation. Ice-flow direction is recorded in the broader study area by large southwest trending flutings across upland regions as well as by a subsequent set of smaller superimposed and cross-cutting flutings that trend south-southwest. Chronological constraint on the advance of ice is provided by a radiocarbon date of 24400 ± 150 C¹⁴ yr BP on wood recovered from gravel underlying Late Wisconsinan till in the adjacent region of northeastern British Columbia (Levson et al., 2004). Retreat of ice from the area largely occurred between 11.5 and 11 C¹⁴ ka BP (Mathews, 1980; Lemmen et al., 1994; Dyke, 2004).

The pattern of moraines and meltwater channels in the Mega River map area indicates that ice retreated as a series of lobes that were at times topographically confined, and were also punctuated by discrete readvances and/or surges. A spectacular, dense network of > 150 recessional moraines (up to 12 m of relief between ridges and spaced tens to several hundreds of metres apart; Figure 1) plot the retreat of a southward flowing ice lobe across much of central and northwest Bootis Hill. Individual recessional moraines, and regional ice marginal positions can be traced from the valley west of Bootis Hill (~ 580 m asl) obliquely up the western Bootis Hill slope, across its flat upper surface (~ 760 m asl), and then obliquely down its eastern and northern slopes (Figure 2). As the ice retreat pattern does not mirror the ~ 180 m of local topography, it is considered to indicate a period of buttressing by ice to the south, and thus represents the earliest phase of deglaciation in the region when ice began to separate and retreat both north and south around the Cameron Hills.

On the southern slope of Bootis Hill, a series of northwest-trending flutings record a divergent flow from the full-glacial west-southwest trending ice-flow direction. As these flutings occur perpendicular to a well defined series of moraines recording retreat of a northwards flowing ice lobe southwards down the Shekilie River valley (west of the Mega River map area; (Figure 2), it is considered that they relate to a deglacial ice configuration, rather than an early phase of Late Wisconsinan ice advance. Reconstructions of ice-flow history from adjoining map areas suggest that during deglaciation, ice centered in the Hay—Zama lowlands split into two lobes, one flowing west-southwest towards the Fontas River drainage system, and a second, abutting the Etsho Plateau to the west, and flowing northwards up the Shekilie River valley towards the Petitot River drainage system (Figure 2). This northward flowing Shekilie lobe cross-cuts the southernmost set of recessional moraines discussed above. The Shekilie lobe then retreated radially, in a topographically-conformable pattern, southwards off of Bootis Hill while maintaining a somewhat static ice-front position in the upper Shekilie River valley. On the east side of Bootis Hill, drainage channelled between the retreating ice margin and the regional slope led to the creation of a series of kame terraces. Directly east of here, a complex of ice-contact terrace and outwash fan deposits are associated with a prominent moraine deposited along the northern margin of Wally Lake (Figure 2). Northward-trending meltwater channels, and an absence of glacial lake sediments, indicates that ice retreating to the north (linked to the dense network of recessional moraines) must have retreated sufficiently northwards to have allowed free drainage from these ice margins, north and then westward down the Petitot River system. Ice continued to retreat from the low-lying regions south and east of Bootis Hill while continuing to occupy the Hay and Shekilie river valleys to the south and west. This suggests a period of general ice thinning, rather than pronounced marginal retreat. A tightly nested series of moraines, descending westward across the regional slope and up the Shekilie River valley, record a subsequent, progressive, southward lobate retreat of ice. Because the regional drainage is eastward in the Hay River area south of the Mega River map sheet, the retreating ice impounded proglacial Lake Hay, in which was deposited a discontinuous veneer of silty-clay glacial lake sediments. Thicker accumulations of glacial lake sediments and ice contact depositional features are found south of the Mega River map sheet, and elsewhere in the broader study area (cf., Paulen et al. 2005b; Smith et al., 2005).

Continued retreat of ice eastward through the Hay River valley and continuous impoundment of glacial Lake Hay, was punctuated by at least one readvance, possibly a surge event. Sub-parallel sets of flutings in the Mega River map area and surrounding regions record these discrete flow directions. Evidence of the surge event was found immediately to the southwest of the Mega River map area, in a sump pit dug within a prominent fluting. Here, coupled till and overlying lake sediments were intensely deformed into an overturned fold and diapiric structures (oriented down-flow, in a fluting-parallel direction) to a depth of at least 3.5 m (base of pit). Conformably overlying these sediments is a veneer (< 1 m) of horizontally laminated glacial lake sediments. This section thus depicts a sequence of ice advance (till), retreat and impoundment of glacial Lake Hay (lower lake sediments), surge/readvance (deformation of the till and lake sediments; creation of fluting), and final retreat (upper veneer of glacial Lake Hay sediments). The dynamic nature of the retreating ice front and the ice-contact glacial Lake Hay is also demonstrated by the abundance of iceberg scours in the southeast part of the Mega River map.

One of the primary objectives of the Shallow Gas and Diamond Opportunities study has been an assessment of the nature and genesis of known aggregate deposits, and the identification and characterization of new and/or potential aggregate deposits (Smith et al., 2005). Field observations reveal that till, dug from borrow pits, is the most abundantly used form of aggregate in the map area and is employed to build well pads and most petroleum development and access roads. The high clay content of local tills presents both problems and advantages. When wet, roads constructed from till are treacherously slippery. Areas of high traffic and other roads of importance are top-dressed with gravel, providing an all weather surface. The high clay content of tills is an asset where roads traverse bogs and

fens. As it inhibits water infiltration upwards into the roadbed. This results in the reduction of frost heaving and formation of segregated ice, particularly in areas overlying permafrost. Roads constructed with less clay-rich material quickly become deformed and ridged, requiring constant upgrading. The size and density of borrow pits appears to be largely a function of groundwater seepage (rate of flooding) and logistics (relative travel time for hauling material versus establishing a new pit further down the road). Borrow pits are generally situated in direct proximity to roads being constructed and range in size from 50–150 m x 30–100 m, and 3–10 m deep.

There are no known gravel pits situated within the Mega River map area. The only potential granular aggregate resources identified by the current mapping project pertain to the kame terraces (identified as units Gitk and Git the map) along the eastern margin of Bootis Hill and in the Wally Lake area. Preliminary investigations of the terraces along Bootis Hill, however, suggest they have only thin veneers (< 1 m) of gravely-sand, and are thus likely to be considered unsuitable, and/or uneconomic for development. The kame/glacial outwash deposits (unit Git on map) east of Wally Lake, are a series of 2–5 m high ridges of open-work sandy-gravel. The gravel is largely 1–4 cm sized, angular Shield material. As this site is presently bisected by an existing dirt road, it is likely worthy of more detailed study and assessment.

Given the generally flat-lying terrain, thick till blanket and extensive bog/fen cover in the region, other surface and sub-surface (ice advance) granular aggregate deposits in the map area may well exist, but are obscured from detection. Methods such as those described by Levson et al. (2004) involving the systematic inspection of seismic shothole driller's log records (see also, Smith et al., 2006), auger drilling and even airborne electromagnetic surveys (cf. Best et al., 2004), would be required to identify their existence.

Another central component of the Shallow Gas and Diamond Opportunities study was the sampling and analysis of glacial sediments for the presence of kimberlite indicator minerals (KIMs). Twenty samples of mostly bulk till (25 kg) were submitted for analysis. No significant positive KIM samples were recovered from the Mega River map area. Detailed analytical results of these and other samples from the broader study area are presented in (Plouffe et al., 2006a, 2007). Coincident with the analysis for KIMs, samples were also processed for heavy mineral contents. In addition, the 20 large samples, along with 6 additional smaller grab samples were also subjected to various geochemical analyses. Isolation of the heavy mineral fraction revealed anomalous concentrations of sphalerite grains (> 1000) in the 0.25–2 mm sand-sized fraction from one sample collected in the southeast part of the Mega River map area. Additional samples collected in the vicinity of this sample in adjacent map areas also contained high concentrations of sphalerite grains and secondary galena grains. Results and analysis of this data is presented in Plouffe et al. (2006a), and is considered to record evidence of the glacial dispersal of an unknown, local Cretaceous bedrock-hosted Pb–Zn deposit(s).

ACKNOWLEDGMENTS

This map represents a product of the Shallow Gas and Diamond Opportunities in Northern Alberta and British Columbia project, conducted under the Northern Resources Development Program of the Geological Survey of Canada (Natural Resources Canada). The project involved the collaboration of the Alberta Geological Survey (Alberta Energy and Utilities Board), as part of their Alberta Mineral Strategy, Quaternary mapping initiative, and also the British Columbia Ministry of Energy, Mines and Petroleum Resources. Surficial geology maps adjacent to the Mega River sheet include 84 M/NW (Plouffe et al., 2006b), 84 M/NE (Paulen et al., 2006a), 84 M/SE (Paulen et al., 2006b), 84 M/2 (Kowalchuk et al., 2006), 84 L/NW (Paulen et al., 2005a), and 84 L/NE (Paulen et al., 2005b). Field assistance by Thomas Ahkimmachie, Chris Kowalchuk, Rob Metchooyeah, and Mark Tarplee was greatly appreciated.

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