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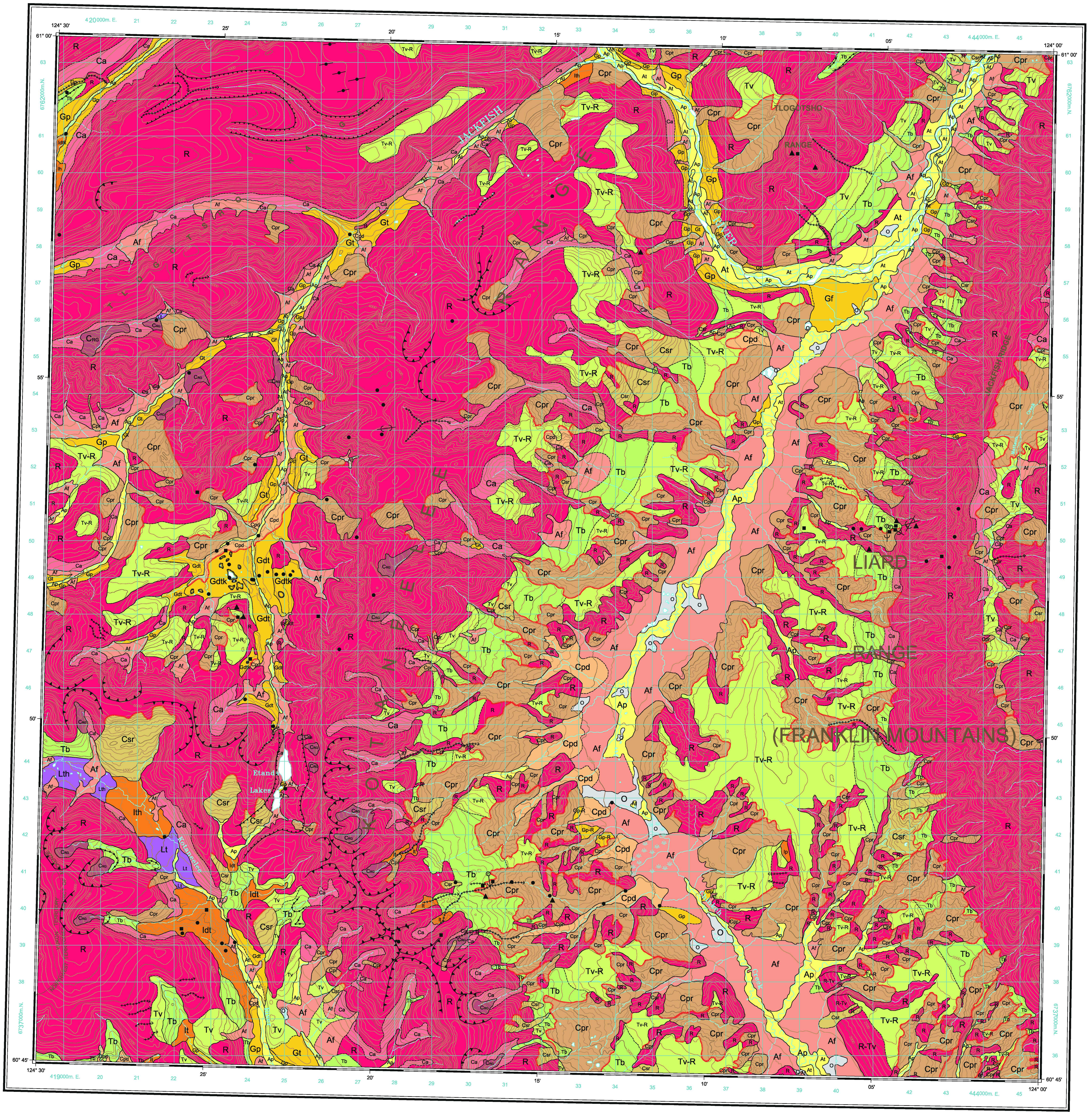
GEOLOGICAL SURVEY OF CANADA / COMMISSION GÉOLOGIQUE DU CANADA

NATMAP CARTNAT

Canada's National Geoscience Mapping Program
Le Programme national de cartographie géoscientifique du Canada



UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 10

LEGEND

Coloured legend blocks indicate units that appear on this map

QUATERNARY

SURFICIAL DEPOSITS

POST LAST GLACIATION

NONGLACIAL ENVIRONMENTS

O — ***ORGANIC DEPOSITS:*** *organic matter; >1 m thick; formed by the accumulation of vegetation in poorly drained depressions (swamps and bogs); usually forms flat terrain*

COLLUVIAL DEPOSITS: *block accumulations and mass wasting debris, 1-50 m thick*

Ca — *Talus (scree): accumulations of blocks; commonly exceeding 2 m in diameter; as much as 50 m thick; forming aprons and fans below cliffs*

CRG — *Rock Glaciers: rock debris deformed by the down-slope flow of buried or interstitial ice, forming pronounced transverse and longitudinal ridges and furrows; largely relict forms, though some active rock glaciers are present*

Cpd — *Debris slump deposits: unconsolidated material; generally smaller blocks or more localized masses, but may include larger masses (>10 m thick) where associated with thick till, glaciolacustrine or glaciofluvial deposits; internal structure of material may be retained; commonly traceable upslope to active scarps; where sufficient moisture is present the slump can become a flow, producing characteristic levees along its lateral margins and a spatulate form at the base of slope.*

Cpr — *Bedrock slump deposits: large rotational blocks in bedrock, shallow to 10's of metres thick; internal structure of material may be retained; commonly traceable upslope to active scarps; where sufficient moisture is present the slump may produce a flow at its base, forming a characteristic spatulate form; prominent in areas underlain by shale, siltstone and sandstone beds of the Cretaceous Fort St. John Group; associated with the largest mass movements in the region*

Csr — *Rock slide deposits: chaotic landscape of irregular and stacked bedrock blocks; associated with moderately dipping, poorly-indurated sandstone and shale-rich beds in the Mattson Formation*

ALLUVIAL DEPOSITS: *gravel, sand, and organic detritus; >1 m thick*

A — *Fluvial deposits: well sorted gravel and sand with detrital organic beds, including concentrations of logs;* **Ap**, *floodplains and mantling valley floors, forming meander scars and point bars;* **At**, *terraces along valley wall sides*

Af — *Alluvial fan: poorly sorted gravel and sand with organic detritus and buried soils; fans are commonly crossed by debris flow channels and levees and subject to shifting stream courses*

POSTGLACIAL OR LATE WISCONSINAN

PROGLACIAL AND GLACIAL ENVIRONMENTS

L — ***GLACIOLACUSTRINE DEPOSITS:*** *coarse to fine sand, silt and clay, with gravel debris flow layers and dropstones; deposited in glacier-dammed lakes; level topography;* **Lp**, *thin discontinous veneers, <1 m thick;* **Lt**, *forming terraces, commonly deeply dissected by postglacial erosion where thick;* **Lh**, *hummocky ice block disintegration terrain*

GLACIOFLUVIAL DEPOSITS: *gravel, sand, minor sandy diamict, usually >1 m thick; deposited on, beneath, or in front of glacier margins*

G — *Proglacial outwash:* **Gd**, *braided outwash deltas;* **Gdt**, *delta terraces;* **Gf**, *fans;* **Gp**, *outwash plains and mantling valley floors;* **Gt**, *level outwash terraces;* **Gk**, *kettle holes*

I — *Ice contact stratified drift: deposited behind or at the ice magin; topography is undulating, irregular, or ridged;* **It**, *lateral kame terraces;* **Idt**, *delta terraces;* **Ik**, *kettle holes;* **Ih**, *hummocky moulin kame fields, or ice block disintegration terrain;* **Ir**, *eskers or crevasse fillings*

TILL: *nonsorted diamict deposited directly by glacial ice; matrix is sandy to clayey and contains striated clasts of various lithologies*

Tb — *Till blanket: > 2 m thick; forming undulating topography that obscures underlying bedrock structure;* Tbk, *distinctly kettled*

Tv — *Till veneer: < 2 m thick and discontinuous; surface mimics underlying bedrock structure*

PRE-QUATERNARY

BEDROCK

R — *Sedimentary bedrock, undifferentiated. The curving, north-south trend of the Kotaneelee and Liard anticlines dominates the map sheet, and are comprised of steep (>60°) to shallow-dipping (<30°), Lower Carboniferous Prophet, Flett, Golata and lower to upper Mattson formation strata (calcareous quartz arenite, siltstone, shale, and mudstone, with minor limestone, dolostone and coal). In the northwestern map area, the Kotaneelee Range merges with the Tlogotsho Range, a region comprised of generally shallow to flat-lying Mattson Formation strata. Shallow-dipping (<30°) Lower Cretaceous formations of the Fort St. John Group (strata include shale, siltstone and sandstone) outcrop extensively in the broad synclinal basin between the Kotaneelee and Liard ranges. Carboniferous Prophet and Golata formations (shale, mudstone and calcareous to dolomitic chert) and Devonian and Carboniferous Besa River Formation strata (mostly shale with some sandstone) is exposed in the west-central map area, north of Etanda Lakes. [see Hynes et al., 2003]*

NOTE: *In areas where the surficial cover forms a complex mosaic, the area is coloured according to the predominant unit and labelled with hyphenated letters in descending order of cover*

MAP SYMBOLS

Geological boundary (defined, gradational)

Scarp

Cirque; peaks and sharp ridges formed by glacial erosion

Moraine

Striae (glacial flow direction known, unknown)

Fluting or drumlinoid ridge parallel to ice flow (direction of flow unknown)

Till fabric (glacial flow direction known)

Proglacial meltwater channel; abandoned or occupied by small underfit stream (wide, narrow with direction of flow inferred)

Kettle hole

Observation

Drift geochemistry sample site

Canadian Shield erratic

NOTE:

Mass Wasting *is the collective term given to the range of processes and resultant landforms that relate to the gravitational downslope movement of rock and/or unconsolidated material without direct conveyance by water, air or ice. Water and ice are, however, often key components in initiating and perpetuating mass wasting by reducing the strength of materials and in their plastic and fluid behaviour.*

Different types of mass wasting are distinguished by the type of materials involved (e.g., bedrock, talus, till), the mode of deformation (e.g., creep, slide, slump, flow), speed of movement, morphology of the moving mass, and water content.

Creep is the slow (mm's to cm's per year), often imperceptible, downslope movement of soil, talus or other unconsolidated material. Creep occurs episodically in response to solutional weathering, seasonal wetting and drying, or freeze-thaw cycles and may include the plastic deformation of clay-rich soils. While more prevalent on steep slopes, creep can occur on slopes <5°. Evidence of creep is seen where tree trunks or structures (e.g., hydro poles) are tilted downslope, soil accumulates upslope of retaining walls, and cracks develop in the soil perpendicular to the dip of the slope. Creep is also responsible for the formation of gelifluction lobes, prominent, small-scale (metres in length, centimetres thick), periglacial landforms found along the upper reaches of local mountain ranges (but not included in the regional surficial geology mapping).

Slides are rapid, downslope movements of bedrock or unconsolidated material. Failure occurs along bedding and/or fracture planes in bedrock, and along bedrock contacts, or structural and sedimentological boundaries within unconsolidated material. Slides can be initiated at shallow or considerable depths.

Slumps involve the rotational movement of bedrock and/or unconsolidated material along failure planes. Slumps may occur as individual blocks or amorphous masses (reflecting water content and structural integrity of the failing material). Slumps commonly extend progressively up-slope through time, and can be associated with active scarp or headwall retreat. Slumps can be initiated by failure along bedding, fracture, or sedimentological planes, by infiltration of surface water, through lateral incision and undercutting of slopes by streams or excavation activities (e.g., road building, pipeline trenching). Slumps are prominent in areas of moderately dipping, poorly-indurated sandstone and shale-rich beds in the Mattson Formation, and in moderate to shallow-dipping shale, siltstone and sandstone beds of the Lower Cretaceous Fort St. John Group. Slumps are associated with the largest mass movements in the map area.

While different earth surface materials and geological settings are often strongly associated with various types of mass wasting, predicting their occurrence, magnitude and rate of deformation is often not possible. Some areas that are prone to mass wasting include regions of steeply dipping bedrock, poorly indurated and shale-rich bedrock, and along stream courses and meandering river channels. Human activities such as road building, pipeline trenching, logging and seismic exploration can also initiate mass wasting, particularly where they undercut slopes, or act to destabilize surficial materials.

Glacial History: *The Etanda Lakes map area was glaciated during the last (late Wisconsinan) glaciation (ca. 25-10 000 years ago) by the continental Laurentide Ice Sheet flowing from the northeast (Keewatin Sector) and by the Cordilleran Ice Sheet flowing from the west. The Laurentide Ice Sheet dispersed distinctive granite erratics, originating from the Canadian Shield, that were found atop the Liard and Kotaneelee ranges (>1200 m above sea level (asl)), and throughout the Chinkeh and Jackfish river valleys. A granite erratic was also found atop the La Biche Range (1620 m asl) southwest of this map sheet, while directly south, sandstone erratics of unknown provenance were found at the crest of the Kotaneelee Range (1850 m asl), establishing a minimum upper limit of glaciation for the region. Cross-cutting ice flow directional indicators (striae and flutings) indicate that glaciers first moved westward across the region. It is speculated that prior to the Last Glacial Maximum (LGM) an independent plateau ice cap existed on the Tlogotsho Range. During the LGM, Laurentide ice subsumed the Tlogotsho plateau ice cap, inundated the entire landscape, and coalesced with Cordilleran ice to the west. Subsequently, Cordilleran ice advanced eastward, displacing the Laurentide ice. Cordilleran ice, however, did not overtop or locally extend eastward of the Kotaneelee Range.*

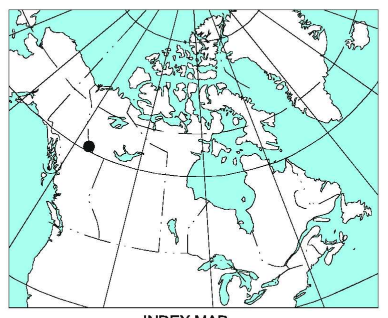
Deglacial landforms associated with the impoundment of regional drainages between the divergently retreating Cordilleran and Laurentide ice sheets are prominent in the map area. Of particular note is the thick (~200 m) ice-contact delta near the head of the Kotaneelee River, which can be directly tied to paleo-drainage northwards through the Etanda Lakes pass and the deposition of an extensive glaciofluvial delta complex in the headwater region of the Jackfish River. Drainage down the Jackfish River was blocked by Laurentide ice. The absence of any granite erratics in the abundant ice-contact deposits south of Etanda Lakes indicates a Cordilleran ice source.

Thick (>30 m) till blankets, with clast fabrics indicating southward flowing ice, are found along the upper, lateral margins of the peneplained Lower Cretaceous strata comprising the synclinal basin between the Kotaneelee and Liard ranges. Valley-ward of these blankets, the surficial geology is till veneer and rock, suggesting that the surface was actively scoured by ice and/or deglacial rivers. Deeply-incised rivers through the Lower Cretaceous strata exhibit a concave pattern considered to reflect lateral and proglacial drainage along a northward-retreating Laurentide ice lobe.

Relict rock glaciers are found in the floors of many cirque basins in the southwest part of the map sheet. Actively flowing rock glaciers were also found in the map area, mainly in Etanda Lakes pass and the west-central map area. It is suggested that their active form relates to thick accumulations of fine-grained talus weathered from shale-rich lower Mattson, Golata and Besa River formation strata.

REFERENCES

Hynes, G.F., Fallas, K.M., and Lane, L.S.
2003: Geology of Etanda Lakes (95C/16), Northwest Territories and Yukon Territory; Geological Survey of Canada, Open File 1676, 1 map, scale 1:50 000.



INDEX MAP

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level

OPEN FILE 1671

SURFICIAL GEOLOGY
ETANDA LAKES
NORTHWEST TERRITORIES - YUKON TERRITORY

Scale 1:50 000/Échelle 1/50 000

Kilometres 1 0 1 2 3 Kilomètres

Universal Transverse Mercator Projection
North American Datum 1983

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

Compilation by I.R. Smith based on fieldwork and studies of vertical air photographs 2000-2002.
THIS MAP IS A PRODUCT OF THE CENTRAL FORELAND NATMAP PROJECT

Surficial geology from field work by I.R. Smith 2000-2002.
Additional data from G.F. Hynes, 2002.

Digital cartography by I.R. Smith.

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada.

Base map at the same scale published by Surveys and Mapping Branch in 1971.

95F/2 no title	95F/1 Clausen Creek	95G/4 The Twisted Mountain
95C/15 Dendale Lake	95C/16 Etanda Lakes GSC OF 1671	95B/13 Sawmill Mountain
95C/10 Tika Creek	95C/9 Chinkeh Creek GSC OF 1615	95B/12 Mount Flett

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2003

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