NOTES

The Artillery Lake map area consists of part of the western margin of the early Proterozoic Thelon Tectonic Zone of the northwestern Churchill Province with its linear trends, strongly foliated granitoids and high grade gneisses and schists which has been juxtaposed against the Archean Slave Province with its curvilinear structural trends, relatively massive plutonic bodies and mainly low to intermediate metamorphic grade metasediments and metavolcanic rocks (Fig. 1). The east half of the area was mapped previously by Fraser (1972) and various aspects of the geology have been discussed in brief reports on the current mapping program following successive field seasons (Henderson and Macfie, 1985, 1986; Henderson et al., 1987). Geologically and for purposes of discussion the area can be divided into four structurally bounded domains (Figure 2).

Western Domain

The western domain is typical of much of the Slave Province in that it consists of steeply dipping Archean Yellowknife metasediments and metavolcanics ranging in grade from greenschist to amphibolite that have been intruded by a variety of Archean, mainly massive, equidimensional, bulbous plutons of varied composition.

A major unit of dominantly mafic Yellowknife volcanic rocks occurs along the northeastern side of Clinton-Colden Lake to east of Ptarmigan Lake. It is interrupted by plutonic intrusions between the two lakes. The unit consists mainly of mafic pillowed and massive flows that are locally amygdaloidal with lesser amounts of carbonate cemented mafic breccias and finer volcaniclastic sediments. Small felsic domes and volcaniclastic units are present locally within the mafic sequence (Wodicka, 1987). One felsic centre has a U-Pb zircon age of 2671 +2/-4 Ma (van Breemen and Henderson, 1988). Most of the volcanics are at amphibolite grade although the volcanics on the large island in Clinton-Colden Lake are mainly at greenschist grade.

Yellowknife metasediments underlie a large area south and west of Clinton-Colden Lake. They consist of metamorphosed interbedded greywacke mudstone turbidites that are typical of the Yellowknife elsewhere in the Slave. With the exception of bedding and local grading, primary sedimentary structures are not well preserved. Most of the metasediments are at amphibolite grade and contain assemblages of the following minerals: quartz-plagioclase-biotite-muscovite-andalusite-sillimanite-staurolite-cordierite-garnet. Staurolite is more abundant than cordierite, in contrast to most other areas of the province. Greenschist grade rocks occur on islands in Clinton-Colden Lake and west of Ptarmigan Lake.

Supracrustal rocks of the Yellowknife Supergroup are intruded by members of several plutonic units. The Tarantula plutons are part of a widespread igneous suite that ranges in composition from granodiorite in the northern part of the Healey Lake area to the north (Henderson and Thompson, 1982) to tonalite and diorite in this area. They have U-Pb zircon ages of 2622 + 1.4/-1.2 Ma and 2616 + 7/-6 Ma at localities in the Healey Lake and Artillery Lake areas respectively (van Breemen and Henderson, 1988; van Breemen et al., 1987b). The Charloit granodiorite plutons, with a U-Pb zircon and sphene age of 2617 + /-7 Ma (van Breemen and Henderson, 1988), bear a strong resemblance morphologically, compositionally, texturally and chronologically to the Defeat Plutonic Suite at Yellowknife (Henderson, 1985). Other major plutonic units include the Artillery granite, a coarsely megacrystic unit that occurs mainly west of Artillery Lake but also in the central domain as well as in the Healey Lake area to the north. Ages determined on the Artillery granite include a U-Pb monazite age of 2596 + 3/-6 Ma (van Breemen and Henderson, 1988) and a U-Pb monazite and sphene age of 2595 + /-10 Ma (van Breemen et al., 1987b). The two-mica Ptarmigan granite, which also occurs to the north, has a U-Pb monazite age of 2606 +/-10 (van Breemen and Henderson, 1988). It is similar in many respects to the Prosperous Granite east of Yellowknife (Henderson, 1985). Several small pyroxenite intrusions less than 100 m in size occur in both this and the central domain to the east. They are similar to the line of somewhat larger intrusions north of Clinton-Colden Lake in the Healey Lake area (Henderson and Thompson, 1982). They are inferred to be more abundant than mapped on the basis of local concentrations of pyroxenite boulders in areas without an obvious source. A 3 km body of hornblende gabbro-anorthosite occurs east of the mafic volcanics at the east end of Clinton-Colden Lake (Macfie, 1987). Associated with it but mapped separately from it is a similarly sized diorite to quartz diorite body immediately to the south. A sill-like body of similar anorthositic gabbro occurs east of the mafic volcanics east of Ptarmigan Lake and a small lens of more metamorphosed and recrystallized gabbroic anorthosite occurs within the central domain to the south.

Rock units of early Proterozoic age include the Artillery Lake formation that unconformably overlies Archean granitoid units at Artillery Lake (Gandhi, 1984, 1985; Roscoe et al., 1987). It is a locally stromatolitic dolomite containing, in places, minor lenses of quartz pebble conglomerate. Rare interbedded grey and red shale and dolomite are locally exposed but on the basis of the abundance of red shale blocks down ice from Artillery Lake, much of the lake may well be underlain by shale. In the lake, the chains of islands underlain by dolomite follow the north-northeasterly regional fault pattern of the area and probably represent resistant fault scarps.

Two sets of early Proterozoic diabase dykes are present in the domain; the dominant set has an easterly trend while the second set trends east northeasterly to northeasterly. Both sets occur in the Healey Lake area to the north where they become progressively metamorphosed towards the Thelon Tectonic Zone (Henderson and Thompson, 1982). The youngest unit in the area is the north northwesterly trending, middle Proterozoic Mackenzie diabase dyke swarm. Only locally exposed, their mapped distribution is based on their strong magnetic expression.

At the map scale, structural trends are northerly in the central and eastern parts of the domain whereas in the northern part of the domain, trends follow the generally northwesterly structural trend of the eastern Slave. At more detailed scales the trends are commonly more irregular. In the low-grade rocks west of Ptarmigan Lake a pronounced horizontal crenulation is common. The relatively weak foliation becomes more intense with more consistent trends towards the eastern margin of the domain. Several north northeasterly trending faults and narrow shear zones that are parallel to the domain boundary structures and the abundant shear zones of the eastern domain, are present within the western domain.

Central Domain

The central domain differs from that to the west in that a moderate to strong foliation with a more consistent, generally north-northeasterly trend is ubiquitous. As well, parts of the domain have been variably affected by Proterozoic metamorphism. The Archean metamorphic grade is significantly higher than to the west on the basis of migmatite grade in the Yellowknife metasediments. The boundary with the western domain is a series of shear zones that in general become narrower to the north. Moderate to steep, down-dip, easterly plunging lineations occur locally in these zones. The northern half of the domain is also expressed by a background magnetic intensity at least 100 nanoteslas higher than that to the west (Geological Survey of Canada, 1968). An asymmetric paired gravity anomaly characterizes the area between the Bathurst and McDonald faults (Fig. 1) and is influenced to some extent by the central domain. The negative component occurs on the Slave Province side while the somewhat smaller positive anomaly is centered over the Thelon Tectonic Zone to the east but to some extent laps over the Slave Province to the north and south (Henderson et al., 1987). Within the map area the anomaly is sensitive to the central domain in that the general trend of the line of inflection between the positive and negative anomalies follows the western boundary of the domain in the southern part of the area before crossing over to the eastern boundary (Observatories Branch, 1969). The central domain can be defined by the shift of the gravity anomaly pattern, the relatively higher background magnetic intensity, and the high metamorphic grade of the Yellowknife metasediments within it in contrast to the presence of similar but lower grade metasediments immediately to the north in the Healey Lake area. The domain as defined by these criteria does not continue far beyond the northern boundary of the map area although the bounding shear zone can be traced 40 km north to Healey Lake. This would suggest that if the central domain represents an uplifted crustal block exposing Slave Province rocks at a deeper structural level, the amount of uplift was greater in the south. Many of the Archean rock units recognized in the western domain, as well as others that are not present to the west, occur in the central domain.

The oldest rocks in the domain are believed to occur in the heterogeneous granitoid gneiss complex west and northwest of Sifton Lake. It contains compositionally layered, recrystallised granitic gneiss to mafic amphibolitic gneiss as well as foliated granitoid plutons that could be significantly younger. This complex is considered as a probable correlative with the Healey complex in the Healey Lake area to the north (Henderson and Thompson, 1982). There a meta-quartz diorite has a U-Pb zircon age of 2679 +/-3 Ma which falls between the zircon ages on Yellowknife volcanics in the region (2671 +2/-4 Ma at Clinton Colden Lake and 2692 +/ 2 Ma 70 km to the northwest on the Back River (van Breemen and Henderson, 1988; van Breemen et al. 1987b)). Two zircon dates from younger granitic phases of the Healey complex to the north suggest ages close to 2.6 Ga (van Breemen et al., 1987b).

The metasediments within the domain are quartz-plagioclase-biotite-(muscovite-sillimanite-garnet) migmatites with varied proportions of leucosome, grading locally into areas of diatexite with only wisps and diffuse patches of relict metasediment. The major zone of metasedimentary rocks near the eastern boundary of the domain continue to the north through the Healey Lake area to the Beechey Lake-Duggan Lake area (Frith, 1982) where it extends into a large area of Yellowknife supracrustal rocks. The metasediments of the domain are thus part of the Yellowknife Supergroup which supports the interpretation that the central domain is part of the Slave Province. The large concentration of metasediments in the vicinity of Douglas Lake may represent the disrupted extension of the southeasterly trending zone of metasediments from the central Slave Province into the Artillery Lake area. Within the eastern belt of metasediment, megascopic kyanite occurs both in the area to the north (Henderson and Thompson, 1982; James, 1985) and as far south as Sifton Lake. The kyanite is inferred to be of Proterozoic age since kyanite indicates higher-pressure metamorphic conditions than normal for the Archean low-pressure, high-temperature facies-series typical of the Slave Province, its growth outlasted presumed Proterozoic shear structures (James, 1985) and it is close to the very high grade Proterozoic metamorphic rocks of the eastern domain. Within the major shear zone in the eastern belt of metasediment, migmatite layering becomes completely disrupted to form a relatively homogeneous porphyroclastic rock.

A major zone of amphibolite up to 3 km wide occurs within the eastern belt of Yellowknife rocks north of Sifton Lake. The rocks consist of compositionally and texturally layered amphibolites to migmatitic amphibolites with variably-developed, white, biotite-bearing leucosome. Thin metasedimentary layers and lenses are present but rare. Although no primary textures or structures are preserved, this unit, because of its thickness, mafic composition and association with the metasedimentary migmatites, is thought to be derived from a volcanic unit. West of Sifton Lake the metasedimentary migmatites contain abundant thin, sill-like amphibolite bodies that may represent more or less syn-volcanic mafic intrusions into the sediments as is seen elsewhere in the Slave Province. Other small mafic units along with rare carbonate lenses occur to the south within this supracrustal belt.

Granitoid intrusive rocks make up a major proportion of the domain. All contain a variably developed but pervasive foliation. The Smart granitoid migmatite in the east-central part of the domain is a grey, medium-grained to sparsely-megacrystic, biotite granodiorite to tonalite with varied proportions of lensesto veins of pink to white, mafic-poor, generally coarser-grained leucosome that is commonly gradational with the grey phase. The grey tonalitic phase has a U-Pb age of 2602 +/-2 Ma (van Breemen and Henderson, 1988). To the north the Musclow granite forms a large, homogeneous, foliated, pink and black megacrystic granite that has a U-Pb zircon age of 2603 +5/-4 Ma (van Breemen and Henderson, 1988). Both the Smart and Musclow granites have close but typically more deformed lithological analogues in the eastern domain although U-Pb geochronological data indicate that they are distinctly younger. More strongly foliated equivalents of the megacrystic Artillery granite and two-mica Ptarmigan granite of the western domain extend across the boundary faults into the central domain. The remaining granitoid rocks have been left in an undifferentiated unit that consists of an heterogeneous assemblage of foliated granite to tonalite and includes diatexite derived from the Yellowknife metasediments. Indeed, where the rocks of the domain are strongly deformed, it is commonly difficult to differentiate between porphyroclastic gneisses derived from Yellowknife migmatites and biotite rich meta-tonalites.

The same sets of Proterozoic diabase dykes present in the western domain also occur in the central zone. The northeasterly to east-northeasterly set tends to have a more northeasterly trend and dominates in this domain. The trend of the easterly trending set is constant, however, suggesting that the more northeasterly trend of the other set is not due to rotation by internal deformation of the domain but may be more a response to the pre-existing foliation in the domain. Both dyke sets become metamorphosed and foliated to some degree toward the Thelon Tectonic Zone, as was seen to the north in the Healey Lake area (Henderson and Thompson, 1982). Dykes in the southern part of the central zone are less metamorphosed than those to the north suggesting that there is also a north-south Proterozoic metamorphic gradient as well.

Eastern Domain

The eastern domain, representing part of the Thelon Tectonic Zone, has little in common with the western and central domains of the Slave Province. Despite this, the boundary with the central domain is the most poorly defined of any of the domain boundaries, being a shear zone between the somewhat more heterogeneous, deformed granitoids and gneisses on the Slave side and the somewhat more homogeneous, deformed granitoid gneisses of the Sifton gneiss of the Thelon Tectonic Zone. It is best defined near the northern border of the map area where James (1985), on the basis of detailed mapping, placed the boundary about 1.5 km east of the zone of Yellowknife supracrustal rocks.

The eastern domain consists of a heterogeneous assemblage of severely deformed granitoid and supracrustal gneisses, most of which are at, or have been retrograded from, granulite metamorphic grade. Mylonitic shear zones occur throughout the domain, resulting in a generally much more linear map pattern relative to the domains to the west. The domain has been divided into several subdomains, that are commonly bounded by pronounced, NNE striking, shear zones. The subdomains may have differing lithological proportions, locally contrasting structural trends and style and, more rarely, contrasting geophysical expression. These shear zones are similar in trend to those that bound the central domain and form the major shear zone on the east side of the central domain (the 'straight zone' (Henderson and Thompson, 1982), and are parallel as well to faults and narrow shear zones that occur within the western domain.

The eastern domain is divided into five major units: two gneiss units of presumed supracrustal origin, a heterogeneous layered gneiss and two granitoid gneiss units. In many cases the rock packages are totally gradational such that the unit designation indicates the probable dominant rock type present in the region with all or any of the other rock types also possibly present. Both the supracrustal and granitoid gneisses are commonly migmatitic with highly varied proportions of in-situ leucosome together with introduced granitoid phases. The common occurrence of orthopyroxene indicates that much of the domain is at granulite metamorphic grade, a major exception being the terrane immediately north of Mary Frances Lake where the occurrence of orthopyroxene in rocks of appropriate composition is rather sporadic. Reconnaissance geothermobarometric measurements in the domain suggest a pressure of 7.4 kbar at 785°C for a relatively undeformed sample while several protomylonitic samples gave significantly lower values between 4 and 5 kbar at 700°C (Haggart, 1987).

Migmatite consisting of biotite-rich paleosome and white quartz-plagioclase leucosome of presumed metasedimentary parentage dominates in the southern part of the domain. An introduced pink granitic phase is commonly present at all scales. Rarely do the migmatites contain sillimanite but where it is present, the migmatites resemble the Yellowknife metasedimentary migmatites of the central domain. More commonly however, hornblende and clinopyroxene are present in the biotite-rich rocks, suggesting a more calcic parent. As a result, previous correlations of this unit with the Yellowknife (Fraser, 1972; Henderson and Macfie, 1985) is in some doubt. A possible correlative occurs at lower grade south of the McDonald fault, 150 km WSW of the most westerly occurrence of the biotite migmatites in the Artillery Lake area. There the 'external paragneisses' of Hanmer and Needham (1988) consist of 'micaceous meta-arenite, rhythmically interlayered meta-arenite and metapelite, calc-silicate and amphibolite' of which the calcsilicate forms a major component. Associated with the biotite-rich migmatites of the eastern domain are extensive units of heterogeneous amphibole-rich rocks ranging from dark amphibolites to amphibolitic gneisses and amphibolitic migmatites that may represent mafic to intermediate volcanics in a supracrustal succession. Like the biotite migmatites, an introduced, concordant granitic component is common. No geochronological data on the supracrustal gneisses are presently available.

The largest unit in the domain is a heterogeneous assemblage of undifferentiated layered gneisses. A large component consists of quartzofeldspathic amphibole-bearing gneisses, possibly of supracrustal origin. Sheets and veins of granitoid gneiss occur within and grade into the layered gneisses. South and east of Moraine Lake is a series of discontinuous layers and lenses of marble to calc-silicate gneisses associated with these gneisses. Immediately north of the area at Moraine Lake, gneisses dated at two localities indicate an age of metamorphism of between 1950 and about 1990 Ma (U-Pb on monazite and zircon), with evidence of the protolith of one of the gneisses being no older than 2400 Ma (U-Pb on zircon; van Breemen et al., 1987a). The age of metamorphic zircon from a granulite-grade amphibolite sill within gneisses on the Hanbury River east of Sifton Lake support an age of less that 2000 Ma for the metamorphism (van Breemen et al., 1987a).

Units dominated by compositionally and texturally heterogeneous granitoid gneisses to foliated plutonic bodies occur in several zones across the domain. The Sifton gneiss along the west margin of the domain is one such unit. It is typically a pink and grey layered gneiss with locally developed coarse feldspar and finer black hornblende porphyroclasts; where best preserved it can be seen to be derived from a granitoid migmatite not unlike the Archean Smart granitoid migmatite of the central zone. However, a fairly concordant U-Pb zircon age of about 1975 Ma has been interpreted as a maximum age of metamorphism and minimum age of igneous intrusion (van Breemen and Henderson, 1988) with no hint of an Archean component. Particularly common within the granitoid gneisses in a zone between Moraine Lake and the Hanbury River but occurring elsewhere as well are a series of narrow bodies ranging in composition from black gabbro through anorthositic gabbro to rarely white anorthosite. These bodies have been illustrated on the map as lenses but may well be more extensive along strike than indicated.

Two granitic units differ from the previously discussed major units of the domain in that they form discrete bodies that are significantly younger and do not appear to have undergone granulite grade metamorphism. The Critchell granite forms a succession of narrow elongate bodies of strongly foliated pink and black megacrystic granite that occur in several locations adjacent to subdomain-boundary shear zones. It has a U-Pb zircon age of 1950 +/-5 Ma (van Breemen and Henderson, 1988); therefore, despite its lithological similarity to the Archean Musclow granite of the central zone, there would appear to be no temporal relationship. The Hanbury granite, a strongly foliated, fairly homogeneous, biotite-poor granodiorite occurs as a single pluton on the Hanbury River at the east boundary of the area. It has a U-Pb zircon and monazite age of 1920 +/-4 Ma (van Breemen et al., 1987a). Similar rocks occur throughout the eastern part of the domain as unmapped, thin, layer-parallel, sheets and veins in the older gneisses.

Southern Domain

The southern domain is separated from the three northern domains by the dextral McDonald fault. It is almost completely out of context with them owing to the more than 70 km of displacement along the fault (Thomas et al., 1976). The domain then is considered to be a displaced fragment of the eastern Thelon Tectonic Zone.

The McDonald fault bifurcates to form a strike-slip duplex between Campbell Lake and Ford Lake. The rocks within the duplex and in the immediate vicinity of the fault are extensively oxidized to the extent that identification of the original lithology is commonly difficult. Locally, however, the lithology within the duplex is similar to that immediately to the south suggesting that most of the displacement along the McDonald was along the north side of the structure.

Most of the supracrustal gneisses within the domain occur in the vicinity of Mary Frances Lake. They bear a strong resemblance to the supracrustal gneisses of the eastern domain and are distinguished to emphasize their physical separation across the McDonald fault. Their structural style differs, however, in that the southern supracrustal gneisses commonly have moderately-dipping to flat-lying foliation. Amphibolite, amphibolitic gneiss and amphibolitic migmatite are the dominant rock types and are presumably derived from a mafic volcanic protolith. Biotite-garnet migmatites derived from a metasedimentary protolith are generally less abundant, but locally dominate. Varied proportions of concordant veins and sheets of intrusive granitoid are ubiquitous within these gneisses. Of interest is the occurrence at the east end of Mary Frances Lake of a narrow zone of carbonate, calc-silicate gneiss and rusty sulphide-bearing silicate and oxide iron formation at the contact between amphibolitic gneisses and biotite-garnet gneisses. This is similar to the local occurrence of carbonate and iron formation between metavolcanics and metasediments at several localities in the Yellowknife Supergroup of the Slave Province (Henderson, 1975) and supports the interpretation that these gneisses were derived from a supracrustal succession.

The Campbell granite is a large, relatively homogeneous body of megacrystic to porphyroclastic granite with a prominent positive magnetic expression that occurs southwest of Campbell Lake. Its contact relations with the granitoid rocks to the west are unknown but its eastern contact is a major, finely layered glassy mylonite locally up to a kilometre wide. The granite has a northerly to northeasterly foliation with moderate to steep dips to either west or east. In places the only structural element is a horizontal to gently plunging, N-S stretching lineation. Preliminary U-Pb zircon and monazite geochronological data (W.D. Loveridge, pers. comm., 1988) have been interpreted to indicate an emplacement age of about 1.9 Ga and a strong memory component at about 2.5 Ga.

At the southwest corner of the domain occurs part of a narrow, elongate body of strongly foliated, highly magnetic, pink and black granite that resembles the Critchell granite of the eastern domain and is tentatively postulated to represent an extension of a body of Critchell granite 85 km to the east at the east boundary of the area immediately north of the McDonald fault.

The main part of the domain consists of undifferentiated granitoid gneisses and foliated to massive granitoids of varied composition. Migmatitic amphibolite gneisses and biotite-rich gneisses of presumed supracrustal origin are present locally but are typically minor relative to the granitoid sheets that intrude them at all scales. Several wide zones of mylonite to ultramylonite occur in this mainly granitoid terrane. Overall the fabric in the heterogeneous gneisses and granitoids have a northeasterly trend but individual measurements are highly varied. Dips range from vertical to flat. Orthopyroxene was not recognized in the course of field work, suggesting that granulite grade metamorphic conditions were not reached.

Faults and Shear Zones

The Artillery Lake area is dominated by an older set of mainly north northeasterly trending shear zones and younger east northeasterly trending faults.

The north northeasterly shear zones occur throughout the area and indeed define the boundaries of the various domains and subdomains discussed above. They are most important within the Thelon Tectonic Zone (only the most prominent have been shown on the map) but occur as well in the adjacent Slave Province, the most westerly known one apparently defining the course of the Hoarfrost River, 40 km northwest of Artillery Lake. The structures are ductile shear zones up to several kilometres wide with a well developed penetrative foliation that grades into the adjacent country rock. In general, the shear zones become fewer in number and narrower with steeper deformational gradients towards the west. An important exception is the major shear zone within the belt of Yellowknife metasediments near the eastern margin of the central domain. In the west, the occurrence of down dip lineations and the lack of any significant horizontal displacement of lithological units suggest movement on the shear zones is dominated by dip-slip components. In the east the situation is less clear as lithological trends parallel the shear zones and both down-dip and strike-parallel lineations are present (Miller, 1987). Within the eastern domain kinematic indicators suggest a dextral sense of movement. That these are major structures in many cases is indicated by the variation in geophysical expression between domains or subdomains separated by these structures. For example, the northern part of the central domain is at least 100 nanoteslas higher in its background magnetic susceptibility relative to the west. In the eastern domain, the easternmost subdomain north of Mary Frances Lake has a very flat negative magnetic expression relative to the highly varied magnetic relief to the west, despite otherwise similar geology. This subdomain also corresponds in a general way to a relatively minor gravity low. These shear zones are a major component in the juxtaposition of the Thelon Tectonic Zone and the Slave Province during the early Proterozoic.

The second and younger set of structures that dominate the map pattern are the faults parallel to the major McDonald fault which separates the northern three domains from the southern domain. These faults are brittle in character, having cataclastic textures within the narrow fault zones and no associated penetrative fabric. In many cases the fault zone and adjacent country rock are extensively oxidized. The sense of displacement of most of these faults is dextral and they have a generally east northeasterly trend. The major structure, the McDonald fault, has a dextral displacement of at least 70 km. Most of the other faults of this set occur north of the McDonald, within the eastern domain, well into the Healey Lake area to the north. The largest of these is the fault through the southern part of Smart Lake with a displacement of up to 12 km; the others having less than 3 km, and commonly only a few tens or hundreds of meters, of displacement. Southwest of the Artillery Lake area, beginning at the east end of the east arm of Great Slave Lake, the main McDonald fault makes a 10° bend, returning to its normal 065° trend on entering the Artillery Lake area (Fig. 1). This geometry, in effect, translates the locus of the fault some 10 or 15 km to the north northwest of its projected trajectory from south of the east arm of Great Slave Lake. In order to accommodate this translation and the returning bend, the strike-slip duplex between Ford and Campbell Lake and the set of short displacement splays and en echelon faults north of the returned main McDonald fault have formed. Many of the splays follow pre-existing shear zones; many begin and almost all converge into the north-northeasterly trending shears while the central part of the fault follows the 065° trend of the McDonald. Also present but much less numerous are northwesterly trending sinistral faults that are parallel to the Bathurst faults to the north (Fig. 1). They are best developed between Sifton and Smart Lakes where the Bathurst-McDonald relationship is shown in microcosm. Others are present as closely-spaced, northwesterly-trending fractures within panels defined by the older shear zones southwest of Moraine Lake.

Economic Geology

Lead mineralization is associated with the unconformity between the early Proterozoic Artillery Lake dolomite and Slave granitoid basement at Artillery Lake. The structurally controlled, epigenetic veins are localized along fractures and faults formed during folding and fracturing of the Artillery Lake formation (Gandhi, 1984, 1985; Roscoe et al., 1987). Rare occurrences of low grade nickel-copper mineralization have been reported in the western Thelon Tectonic Zone in the vicinity of Smart Lake – Campbell Lake (Thorpe, 1972; Padgham et al, 1978). This discovery resulted in the staking of several thousand claims in the region together with considerable airborne and ground EM and magnetometer surveys, geological mapping and some drilling. Although no significant mineralization was found, numerous EM conductors were identified that, for the most part, can be related to graphite bearing shear zones (for example, see McGrath and Henderson, 1985). Silicate-sulphide facies iron formation was recognized at one locality in the southern domain at the eastern end of Mary Frances Lake (63°16.0' 106°04.0'). It occurs at the contact between migmatite grade biotite rich metasediments and amphibole rich metavolcanics in association with thin marble and calc silicate units. Lithium mineral bearing pegmatites occur at two localities west of Clinton-Colden Lake, one at 63°51.3' 107°31.1' and the other just north of the border at 64°01.2' 107°49.7'. These pegmatites may be related to the two-mica Ptarmigan granites which occur in the immediate area and may be similar to the lithium mineral bearing pegmatites associated with the two-mica Prosperous Granite, northeast of Yellowknife. A small zinc-copper showing occurs in the eastern part of the volcanics at Clinton-Colden Lake (Seaton, 1983). Associated with the same volcanic unit but in the Healey Lake area to the north is an occurrence of sphalerite boulders whose source is as yet unidentified (Gibbins et al., 1977).

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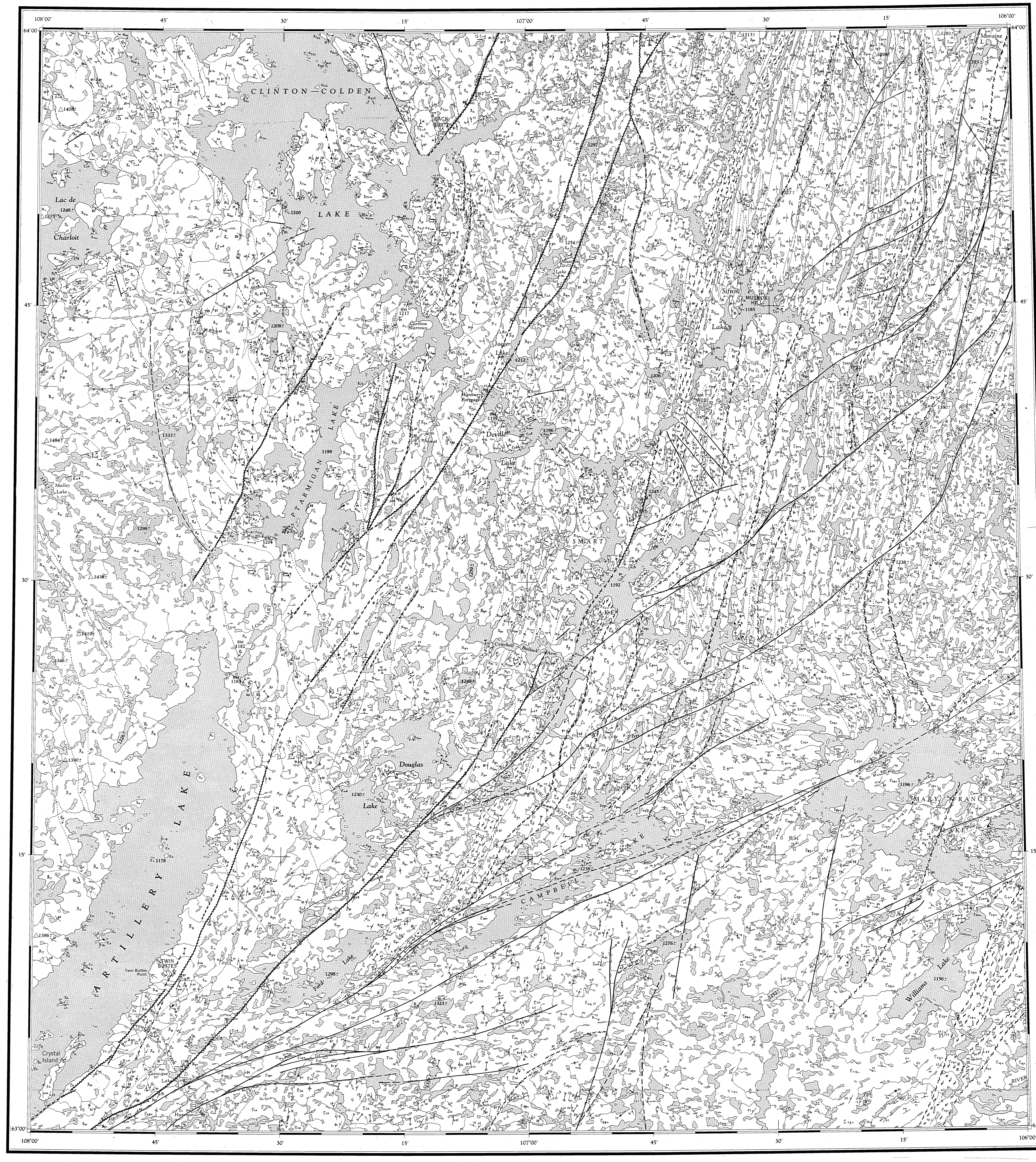

ARTILLERY LAKE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

LEGEND

WESTERN and CENTRAL DOMAINS

Middle Proterozoic

Pm — **Mackenzie Dykes**: diabase, gabbro, in most cases position of dykes defined by aeromagnetic expression, also occur in both eastern and southern domains but extent in part obscured by extreme variation of magnetic pattern in those domains

Early Proterozoic

PA — **Artillery Lake formation**: dolomite, pale yellow-brown to orange weathering, locally stromatolitic and brecciated, locally with thin layers to lenses of minor, fine, well rounded quartz pebble conglomerate

Pmd — Mafic dykes: diabase, gabbro to amphibolite, occurs in easterly, northeasterly to east northeasterly and northerly trending sets, dykes in the western domain are massive and only weakly altered while those in the central domain, in particular the northern half, tend to be metamorphosed and foliated to varied degrees

Archean

AA — **Artillery granite**: pink to greyish pink, massive, medium grained, megacrystic, contains moderate amounts of biotite and traces of muscovite

AP — **Ptarmigan granite**: buff to white to pale yellow, massive, medium to coarse grained, generally equigranular, contains moderate amounts of biotite and muscovite in varied proportions; muscovite bearing pegmatite locally present

AS — **Smart granitoid migmatite**: heterogeneous migmatitic granitoid, dominantly grey, fine to medium grained, biotite and/or hornblende granodiorite to tonalite with diffuse to sharply defined lenses to veins of pink to white, coarser grained, leucocratic, granitic leucosome; moderately foliated with local protomylonite zones

AM — **Musclow granite**: pink to red and dark grey to black, homogeneous, weakly to moderately foliated, inequigranular granite with coarse microcline megacrysts in a black, biotite-rich matrix

AC — **Charloit granodiorite**: granodiorite to tonalite, pinkish grey to white, massive, medium grained, equigranular, biotite, locally hornblende bearing

Aum — Pyroxenite: black, massive, medium to coarse grained; occurs as small plugs or lenses

AT — **Tarantula tonalite**: dominantly quartz diorite but ranging from tonalite to gabbro; melanocratic, massive, medium to coarse grained, equigranular, hornblende and biotite bearing

Agu — Undifferentiated granitoid rocks: heterogeneous assemblage of granite to diorite to granitoid gneiss, moderately to strongly foliated, includes in part diatexite derived from associated metasedimentary units

Aag — Anorthositic gabbro: hornblende gabbro to leucogabbro to anorthosite, dark green to grey to white, massive, heterogeneous; extreme grain size variation

Agd — Diorite: diorite to quartz diorite to gabbro, dark grey, massive, medium to fine grained

Yellowknife Supergroup

AYsb — a Greywacke, siltstone, mudstone: greenschist grade, greywacke-siltstone turbidites interbedded with mudstone, primary sedimentary textures and structures locally preserved

AYsc — b Schist, psammitic to pelitic: amphibolite grade equivalent of above, contains various assemblages of quartz-plagioclase-biotite-muscovite-staurolite-cordierite-andalusite-sillimanite (kyanite locally in northeastern exposures)-garnet

AYsm — c Migmatite: migmatitic equivalent of above

AYvf — Felsic volcanic rocks: mainly dacitic to rhyolitic composition, includes massive, featureless, felsic domes to bedded volcaniclastic units of varied grain size

AYvm — Mafic volcanic rocks: mainly massive to pillowed basalt flows and contemporaneous intrusive units with lesser amounts of coarse, commonly carbonate cemented breccia to finer grained volcaniclastic rocks, amphibolite to migmatitic amphibolite in central zone

Agn — Granitoid gneiss complex: heterogeneous assemblage of recrystallized gneisses ranging in composition from granitic gneiss to mafic amphibolitic gneiss and small foliated granitoid plutons, parts but not necessarily all of the complex considered to be possibly older than Yellowknife Supergroup

EASTERN DOMAIN

Early Proterozoic

PH — **Hanbury granite**: pink to grey, homogeneous, strongly foliated, medium grained, even grained, biotite poor; contains inclusions of adjacent metasediments

PC — **Critchell granite**: pink and black, homogeneous, coarse to very coarse, megacrystic, strongly foliated, hornblende-biotite bearing

Pdga — Diorite, gabbro, anorthositic gabbro: small homogeneous pods, lenses, layers, presumably discontinuous; composition varies with location

Pcb — Carbonate: marble, impure carbonate, calcsilicate; thin discontinuous layers and lenses associated with metasedimentary migmatitic gneisses

The following five units represent 'probability' units as opposed to the relatively sharply defined units described above in that the lithology indicated by the unit descriptor is the rock type most probably present at any given locality. However, smaller quantities of the other four units may also be present.

PS — **Sifton gneiss**: relatively homogeneous, pink and grey layered, strongly foliated, commonly porphyroclastic with coarse grey feldspar and black hornblende; derived from a granitoid migmatite (grey granodioritic paleosome with wisps and lenses of pink granitic leucosome) which is locally preserved.

Pegu — Undifferentiated granitoid gneiss: mainly leucocratic layered granitoid gneisses to strongly foliated granitoid rocks

Pgnu — Undifferentiated gneisses: heterogeneous assemblage of layered, dominantly quartzo-feldspathic gneisses of both supracrustal and granitoid parentage but commonly in large part of undetermined origin

Psm — Biotite migmatite: rusty weathering, olive green, moderately to poorly layered with white plagioclase-quartz dominant leucosome and biotite rich paleosome; contains assemblages of hornblende-clinopyroxene-orthopyroxene-garnet-sillimanite (rare)

Pam — Amphibolite: amphibolite, amphibolitic gneiss to amphibolitic migmatite; heterogeneous, melanocratic with local white plagioclase-quartz dominant leucosome where present

SOUTHERN DOMAIN

Early Proterozoic

PC — **Critchell granite**: pink and black, homogeneous, coarse to very coarse, megacrystic, strongly foliated, hornblende-biotite bearing

PCA — **Campbell granite**: dark pinkish grey to dark grey, homogeneous, moderately to sparsely megacrystic, moderately to strongly foliated to lineated, biotite-poor

Psgu — Undifferentiated gneisses: heterogeneous assemblage of mainly granitoid gneisses and foliated granitoids with lesser amounts of amphibole-rich and biotite-rich gneisses of presumed supracrustal origin

Pssm — Biotite migmatite: poorly to moderately layered with white plagioclase-quartz leucosome dominant, biotite rich paleosome commonly contains garnet; intruded sheets of foliated granite common

Psam — Amphibolite: amphibolite, amphibolitic gneiss to amphibolitic migmatite; heterogeneous; commonly contains intruded sheets of foliated granite

SYMBOLS

Geological boundary (defined, approximate, assumed)

Bedding, tops known (inclined, overturned)

Bedding, tops unknown (inclined, vertical, dip unknown)

Pillow lava, tops known (inclined, overturned)

Cleavage, schistosity, gneissosity, layering of unknown origin (inclined, vertical, horizontal, dip unknown)

Lineation; mineral, stretching (inclined, horizontal)

Fold hinge (asymmetry unknown, S, Z, M)

Fault trace (inferred, assumed)

Shear zone; narrow (inferred, assumed)

Shear zone; wide

Glacial striae (direction of ice movement known, unknown)

Metamorphic isograd; ornamentation on high grade side (first appearance of cordierite, andalusite or staurolite)

Geology by: J.A. Fraser, 1969 (east of 107°W)
S.S. Gandhi, 1983, 1984 (Artillery Lake)
J.B. Henderson, 1984, 1985, 1986
D.T. James, 1984, 1986
R.I. Macfie, 1984, 1985, 1986
N. Wodika, 1986 (volcanics east of Clinton-Colden L)

Compiled by: J.B.Henderson, 1988

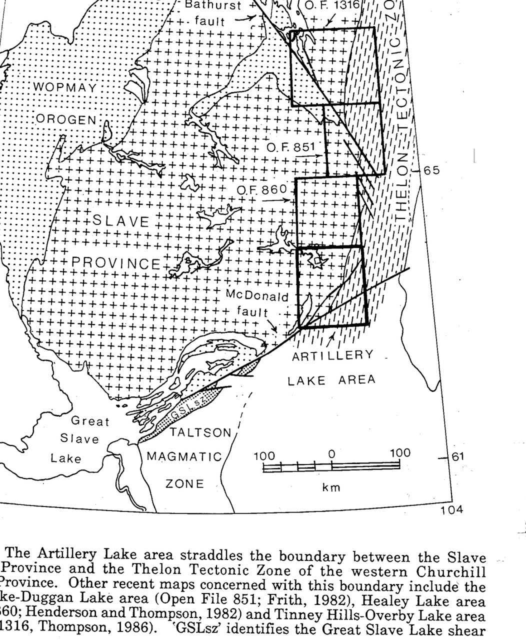

Figure 1 : The Artillery Lake area straddles the boundary between the Slave Structural Province and the Thelon Tectonic Zone of the western Churchill Structural Province. Other recent maps concerned with this boundary include the Beechey Lake-Duggan Lake area (Open File 851; Frith, 1982), Healey Lake area (Open File 860; Henderson and Thompson, 1982) and Tinney Hills-Overby Lake area (Open File 1316, Thompson, 1986). 'GSLsz' identifies the Great Slave Lake shear zone.

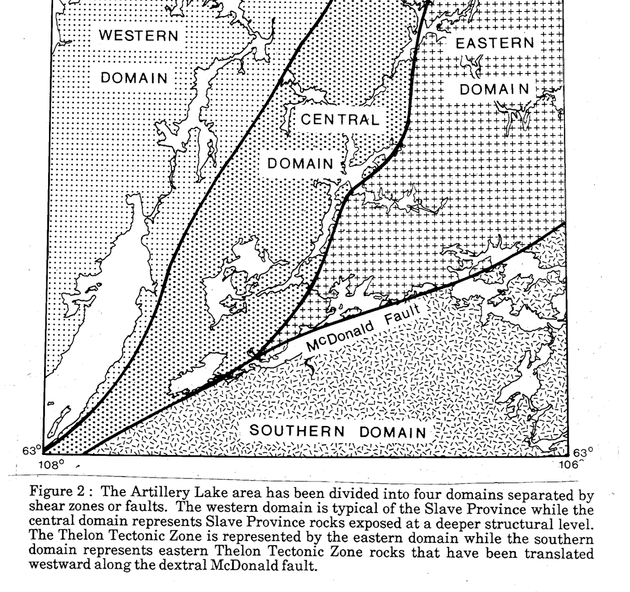

Figure 2 : The Artillery Lake area has been divided into four domains separated by shear zones or faults. The western domain is typical of the Slave Province while the central domain represents Slave Province rocks exposed at a deeper structural level. The Thelon Tectonic Zone is represented by the eastern domain while the southern domain represents eastern Thelon Tectonic Zone rocks that have been translated westward along the dextral McDonald fault.

Scale 1:125 000 Échelle

Miles 5 0 5 10 15 20 Milles

Kilometres 5 0 5 10 15 20 25 30 Kilomètres

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1989

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