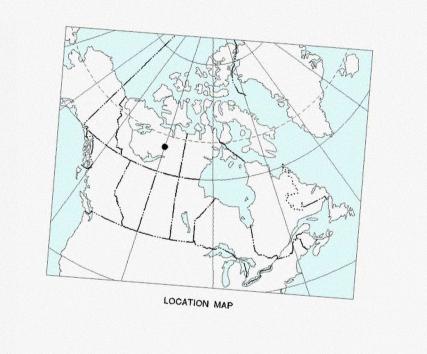
The Lac de Gras map area was originally mapped at 1" to 4 miles by Folinsbee (1949) and the Aylmer Lake area was mapped at the same scale by Lord and Barnes (1954). They noted numerous REFERENCES Proterozoic diabase dykes in the region, but did not distinguish individual swarms or assign a relative Bowring, S.A. and Grotzinger, J.P. 1992: Implications of new chronostratigraphy for tectonic evolution of Wopmay orogen, northwest Canadian age to dykes of different orientation. Since 1992, new mapping in the Lac de Gras area has covered the west half at 1:250 000 scale (Thompson et al., 1993; 1994; 1995; Thompson and Kerswill, 1994), and the northeast part of the area has been mapped at 1:50 000 scale (Kjarsgaard and Wyllie, 1993; Buchan, K.L., Mortensen, J.K., and Card, K.D. 1993: Northeast-trending Early Proterozoic dykes of southern Superior Province: multiple episodes of Mapping and sampling of dykes in eastern parts of the Lac de Gras area and along the adjacent GEOLOGICAL SURVEY OF CANADA western edge of the Aylmer Lake area was undertaken in 1992 and 1993. The field work, combined emplacement recognized from integrated paleomagnetism and U-Pb geochronology; Canadian Journal of Earth Sciences, v. 30, 1286-1296 with regional analysis of air photographs, LANDSAT and aeromagnetic data (cf. Rencz et al., 1993), indicates there are at least four, and likely five, major Proterozoic diabase dyke swarms in the area. The dykes have well-preserved chilled margins and centers are medium- to coarse-grained gabbros with Cadman, A.C., Heaman, L., Tarney, J., Wardle, R., and Krogh, T.E. ophitic to subophitic textures. The dykes are not deformed and have undergone only weak deuteric 1993: U-Pb geochronology and geochemical variation within two Proterozoic mafic dyke swarms, Labrador; Canadian Journal of Earth Sciences, v. 30, 1490-1504 alteration or low-grade metamorphism. Many of the dykes are recessive and form well-defined linears. They are typically 20-50 m wide, although a few large gabbroic dykes of the Mackenzie swarm are >100 m wide. Dykes <5 m wide are rare, except as discontinuous satellite dykes parallel to nearby master dykes. The Mackenzie dykes are the youngest swarm in the map area. Numerous Mackenzie 1992: Evidence from magnetic fabric for the flow pattern of magma in the Mackenzie giant radiating dyke dykes cut 010°-striking Lac de Gras dykes, 080°-striking MacKay dykes and 045°-striking Malley dykes. A few, poorly exposed, thin 305°-striking dykes (Kjarsgaard and Wyllie, 1993) can be traced on aeromagnetic maps. Their age relative to the other swarms is uncertain, but the age may be close to Fahrig, W.F., Christie, K.W., Eade, K.E., and Tella, S. the Mackenzie dykes, since they are not altered and carry a paleomagnetic direction similar to the 1984: Paleomagnetism of the Tulemalu dykes, Northwest Territories, Canada; Canadian Journal of Earth Mackenzie diabase (K.L. Buchan, pers. comm., 1994). Cross-cutting relationships indicate that Lac de Gras dykes are younger than Malley dykes and aeromagnetic maps show that magnetic Lac de Gras dykes cut weakly magnetic MacKay dykes. Dykes from the Mackenzie, Lac de Gras and Malley Fahrig, W.F. and West, T.D. swarms are strongly magnetic and the location of many dykes can be accurately determined from Diabase dyke swarms of the Canadian Shield; Geological Survey of Canada, Map 1627A, scale aeromagnetic maps (Geological Survey of Canada, 1969a; 1969b). MacKay dykes are characterized 1949: Lac de Gras, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Map 977A, Malley and MacKay dyke swarms The Malley diabase, named after the Malley Rapids on the Back River by Frith (1987), occurs as a swarm of NE-striking dykes that intrude Archean plutons and supracrustal rocks in the type area, but do not cut 1.90-1.97 Ga strata of the Kilohigok basin to the northeast. The Malley dykes are included in the Contwoyto swarm of Fahrig and West (1986). Both the Malley and MacKay dykes are 1987: Precambrian geology of the Hackett River area, District of Mackenzie, N.W.T.; Geological Survey of metamorphosed in the eastern Slave Province, with metamorphic grade progressively increasing eastward towards the Thelon tectonic zone (Henderson et al., 1990). U-Pb baddeleyite dating indicates a 35 m wide Malley dyke from southeast of Lac de Gras was emplaced at 2.23 Ga (LeCheminant and van Breemen, 1994). Field evidence suggests the Malley dykes are older than the MacKay dykes. At the north end of MacKay Lake, a 45 m wide MacKay dyke is interpreted to cut a 22 m wide Malley dyke. 969a: Aylmer Lake, District of Mackenzie, NWT; Geophysical Series (Aeromagnetic) Map 7199 G Although both dykes are visible within 5 meters of the projected intersection, the actual dyke 1969b: Lac de Gras, District of Mackenzie, NWT; Geophysical Series (Aeromagnetic) Map 7200 G intersection is not exposed; the Malley dyke is offset and the northern margin of the MacKay dyke is not Hanmer, S., Bowring, S., van Breemen, O., and Parrish, R. The plagioclase-phyric MacKay dykes form a widely-spaced, parallel swarm in the central and Great Slave Lake shear zone, NW Canada: mylonitic record of Early Proterozoic continental eastern Slave Province. The 40-50 m wide dykes in the map area can be traced discontinuously for up convergence, collision and indentation; Journal of Structural Geology, v. 14, p. 757-773 to 200 km. The dyke north of Lac de Gras pinches out and is offset at two granite-metaturbidite contacts, where the 080°-striking dyke is deflected to about 125° and pinches out in right-stepping Heaman, L.M. and LeCheminant, A.N. offsets. Elsewhere, left-stepping overlaps and offsets segment the MacKay dykes. These are primary Paragenesis and U-Pb systematics of baddeleyite (ZrO₂); Chemical Geology, v. 110, p. 95-126 emplacement features formed during dyke injection, and suggest the dykes were affected by pre-existing structures in the host rocks (Kjarsgaard and Wyllie, 1993; 1994). The age of the MacKay dykes was estimated at 2.4 Ga (Fahrig and West, 1986), significantly older than the 1.79 Ga age they 1993: Natural diamond occurrences and tectonic setting of "primary" diamond deposits: in Diamonds: assigned to both the Contwoyto (=Malley swarm) and Lac de Gras dykes. McGlynn and Irving (1975) Exploration, sampling and evaluation, in Sheahan, P and Chater, A., eds., Proceedings of a Short suggest there are two distinct easterly trending dyke swarms in the southern Slave Province with K-Ar Course, Prospectors and Developers Association of Canada, p. 1-72 ages greater than 2 Ga. Olivine-bearing Dogrib dykes are distinguished from the olivine-free and slightly altered "X" dykes on the basis of different paleomagnetic signatures. Fahrig et al. (1984) interpret the "X" dykes simply as reversely magnetized Dogrib dykes, which carry a secondary 1994: Geotectonic controls on the formation of diamonds and their kimberlitic and lamproitic host rocks: remanence, and they suggest that the two swarms be referred to collectively as the MacKay dykes. Preliminary U-Pb baddeleyite ages indicate the MacKay dykes in the Lac de Gras area ("X" dykes) Applications to diamond exploration; in Meyer, H.O.A. and Leonardos, O.H., eds., Proceedings of the were emplaced at 2.21 Ga (LeCheminant and van Breemen, 1994). No U-Pb ages are available for the Fifth International Kimberlite Conference, Araxá, Brazil 1991, vol. 2, Diamonds: Characterization, Emplacement of the Malley and MacKay swarms may be linked to rifting events that formed the Henderson, J.B., McGrath, P.H., Theriault, R.J., and van Breemen, O. eastern and southern margins of the Slave Province during break-up of an Archean supercontinent. 1990: Intracratonic indentation of the Archean Slave Province into the Early Proterozoic Thelon Tectonic Zone 2.23 Ga Malley dykes are coeval with mafic swarms on other Archean cratons, such as the 2235 Ma Kikkertavak dykes in the Hopedale block, Labrador (Cadman et al., 1993) and 2.24 Ga dykes in the of the Churchill Province, northwestern Canadian Shield; Canadian Journal of Earth Sciences, v. 27, p. Vestfold Hills, an Archean cratonic block within the East Antarctic Shield (Lanyon et al., 1993). The younger 2.21 Ga MacKay dykes are coeval with 2217 Ma Nipissing sills and the 2214 Ma Senneterre Kjarsgaard, B.A., Spark, R.N., and Jakop, Z.J. 1994a: Preliminary geology, Koala, Northwest Territories; Geological Survey of Canada, Open File 2966, 1994b: Preliminary geology, Ursula Lake, Northwest Territories; Geological Survey of Canada, Open File 2967, The 010°-striking Lac de Gras swarm consists of more than 10 dykes, typically 20-40 m wide, Lac de Gras dyke swarm spaced over a width of about 100 km. Medium to coarse-grained gabbros from dyke centers have a characteristic patchy ophitic texture that distinguishes them macroscopically from other dykes in the region. U-Pb baddeleyite ages for two Lac de Gras dykes of 2023 and 2030 Ma (LeCheminant and 1993: Geology of the Paul Lake area (76D/9), Lac de Gras, N.W.T.; Geological Survey of Canada, Open File van Breemen, 1994) are much older than the previously estimated age of 1.79 Ga (Fahrig and West, 1986). Northeasterly trending Hearne dykes on the northwest shore of the East Arm, Great Slave Lake are about the same age as the Lac de Gras dykes. A Hearne dyke preserved within the Great Slave Lake shear zone has an age of 2038 Ma (Pehrsson et al., 1993). The Lac de Gras and Hearne dykes Kjarsgaard, B.A. and Wyllie, R.J.S. 1994: Geology of Paul Lake-Lac de Gras-Lac de Sauvage area, central Slave Province, District of Mackenzie; were emplaced shortly before major collisional events along the eastern margin of the Slave Province that formed the 2.02-1.91 Ga Thelon tectonic zone (Henderson et al., 1990) and the 1.98-1.92 Ga Great Slave Lake shear zone (Hanmer et al., 1992). However, the dyke geometry and age of the Lac de Gras swarm suggests the dykes were emplaced into the central Slave Province from the north and 1993: U-Pb zircon dating of mafic dykes and its application to the Proterozoic geological history of the Vestfold The Lac de Gras swarm diverges slightly from north to south and the dykes can be traced on Hills, East Antarctica; Contributions to Mineralogy and Petrology, v.115, p. 184-203 aeromagnetic maps from MacKay Lake more than 300 km north to a focus beneath Kilohigok basin. The swarm ends in the vicinity of the Booth River intrusive suite, which is largely covered by LeCheminant, A.N. and Heaman, L.M. shallow-marine and fluvial rocks of the Kilohigok basin. The Booth River suite consists of a large 1989: Mackenzie igneous events, Canada: Middle Proterozoic hotspot magmatism associated with ocean layered mafic-ultramafic intrusion associated with granitic rocks dated at 2023 Ma by U-Pb zircon (Roscoe et al, 1987). Therefore, Booth River magmatism was synchronous with emplacement of the Lac de Gras dykes and suggests the swarm was emplaced laterally from beneath Kilohigok basin. The LeCheminant, A.N. and van Breemen, O. development of a west-facing passive margin on the Slave craton (Coronation margin) and 1994: U-Pb ages of Proterozoic dyke swarms, Lac de Gras area, N.W.T.: Evidence for progressive break-up synchronous sedimentation in Kilohigok basin lasted from about 1.97 to 1.90 Ga (Bowring and of an Archean supercontinent; in Geological Association of Canada/Mineralogical Association of Canada, Program with Abstracts, v. 19, p. A62 Grotzinger, 1992). A rift assemblage older than the passive-margin sequence has not yet been accurately dated, although a pyroclastic unit, interpreted as erupted during the rift to drift transition, has a U-Pb zircon age of about 2.02 Ga (S.A. Bowring, pers. comm., 1993). This suggests emplacement of the Booth River intrusive suite and injection of Lac de Gras dykes from beneath Kilohigok basin may 1954: Aylmer Lake, District of Mackenzie; Geological Survey of Canada, Map 1031A, scale 1" to 4 miles have been triggered by rifting events that occurred during formation of the western margin of the Slave Paleomagnetism of Early Aphebian diabase dykes from the Slave Structural Province, Canada; Numerous 320°-340°-striking Mackenzie dykes intruded the region at 1.27 Ga. The large dykes Mackenzie dyke swarm occur in arrays of sub-parallel dykes, with dense arrays (about 1-2 dykes/km) separated by zones with only scattered dykes. The Mackenzie swarm is one of the largest giant radiating dyke swarms in the Pehrsson, S.J., van Breemen, O., and Hanmer, S. 1993: Ages of diabase dyke intrusions, Great Slave Lake shear zone, Northwest Territories; in Radiogenic age world; dykes are exposed for more than 2400 km along strike and form a radial array with 100° of arc. They were emplaced laterally from a mantle plume-generated focal point about 700 km to the northwest of the map area (LeCheminant and Heaman, 1989; Ernst and Baragar, 1992). U-Pb studies have determined the precise timing and short duration of the Mackenzie igneous events (LeCheminant and Rencz, A.N., Baril, D., and Thompson, P.H. A.N., Baril, D., and Thompson, P.H. Integrating LANDSAT, aeromagnetic, and geological data for regional bedrock mapping, Winter Lake-Lac de Gras map area, Northwest Territories; in Current Research, Part E; Geological Survey of Heaman, 1989; Heaman and LeCheminant, 1993). The ages are remarkably consistent, with dykes emplaced at 1267-1268 Ma. The geological reproducibility of these results approaches the limit of analytical precision and indicates an exceptionally short duration for the emplacement of large volumes of mafic magma (>230,000 km³) in this single magmatic flareup. Roscoe, S.M., Henderson, M.N., Hunt, P.A., and van Breemen, O. 1987: U-Pb zircon age of an alkaline granite body in the Booth River intrusive suite, N.W.T.; in Radiogenic Age Diabase dykes and kimberlites The recent discovery of diamond-bearing kimberlite pipes in the Lac de Gras area suggests that the and Isotopic Studies: Report 1; Geological Survey of Canada, Paper 87-2, p. 95-100 central Slave Province is underlain by a stable Archean mantle root that has not been destroyed by Proterozoic magmatic events (Helmstaedt, 1993; Helmstaedt and Gurney, 1994). If magma flow was Thompson, P.H., Ross, D., Froese, E., Kerswill, J.A., and Peshko, M. dominantly horizontal during intrusion of the Malley and MacKay dykes, similar to the flow regime Regional geology in the Winter Lake-Lac de Gras area, centrall Slave Province, District of Mackenzie, Northwest Territories; in Current Research, Part C; Geological Survey of Canada, Paper 93-1C, p. 61-70 interpreted for the Mackenzie swarm (Ernst and Baragar, 1992) and suggested above for the Lac de Gras dykes, then the mantle root beneath the central Slave Province should show only limited effects from the four mafic magmatic episodes that originated beneath the craton margins between 2.23 Ga and 1.27 Ga. Dyke-parallel fracture sets near the diabase dykes appear to have provided local zones 1994: Preliminary geology of the Winter Lake-Lac de Gras area, central Slave Province, District of Mackenzie, of weakness, at high crustal levels, along which some kimberlites were emplaced. Northwest Territories; Geological Survey of Canada, Open File 2740 (revised), scale 1:250 000 High resolution aeromagnetic maps have been flown by diamond exploration companies over the entire map area. This information, at present proprietary, can provide more precise information about Thompson, P.H., Ross, D., and Davidson, A. the regional distribution of mafic dykes to test proposed magma source directions. Corrections to the 1994: Regional geology of the Winter Lake-Lac de Gras area, central Slave Province, District of Mackenzie, Jolly Lake map, especially information regarding relative dyke ages, displacements and intersection relationships Northwest Territories; in Current Research, 1994-C; Geological Survey of Canada, p. 1-12. would be greatly appreciated and could identify key dykes for additional geochronologic or Thompson, P.H., Russell, I., Paul, D., Kerswill, J.A. and Froese, E. Regional geology and mineral potential of the Winter Lake-Lac de Gras area (76D-W 1/2, 86A-E 1/2), central Slave Province, Northwest Territories; in Current Research, 1995-C; Geological Survey of ACKNOWLEDGMENTS I am grateful to Bruce Kjarsgaard, Tony Peterson and their field assistants Pauline Orr and Tara Sagriff for the hospitality and companionship of their field camp at Lac de Gras in 1992. Mapping at the Lac de Gras camp was partly funded by the 1991-1996 Canada-NWT Minerals Initiatives and DiaMet Minerals kindly made their helicopter available for casual charter. Scott Doehler ably assisted in the field at MacKay Lake in 1993 and Rob Johnstone and crew provided hospitality and assistance from their 1993 base at the MacKay Lake Lodge. Ken Buchan is thanked for extensive discussions in the office and help in the field in 1992 and 1993. Peter Thompson and Bruce Kjarsgaard graciously made results of their 1992-1994 mapping available for this compilation. Otto van Breemen provided key U-Pb Canadä

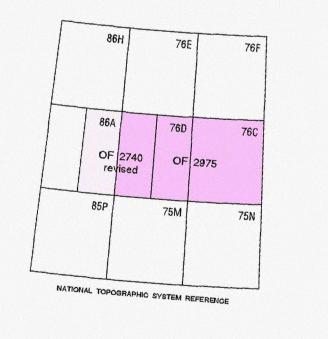
LEGEND MESOPROTEROZOIC PALEOPROTEROZOIC Lac de Gras swarm Dyke (defined outcrop, interpreted) . ..____ Map compilation and interpretation by A.N. LeCheminant, 1993-1994,
Geological Survey of Canada, see descriptive notes for details of bedrock geology sources Digital cartography by P. Arscott, D. Baril, C. Bowie, B. Chagnon, and D. Ross, Geological Survey of Canada Electrostatic plot produced by the Geological Survey of Canada Any revisions or additional information known to the user would by welcomed by the Geological Survey of Canada Digital base map assembled and modified by the Geological Survey of Canada from digital bases compiled by the Surveys, Mapping and Remote Sensing Branch Copies of the topographical edition of this map area may be obtained from the Canada Map Office, Department of Natural Resources, Ottawa, Ontario, K1A 0E9 Mean magnetic declination 1994, 25°40' E, decreasing 20.7' annually.

Readings vary from 23°07' E in the SE corner to 27°55' E in the NW corner of the map

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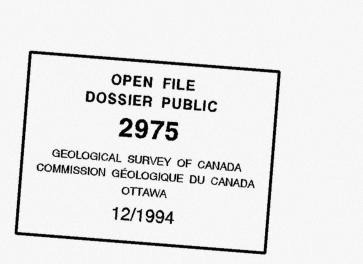
NTWOYTON





PROTEROZOIC DIABASE DYKE SWARMS, LAC DE GRAS AND AYLMER LAKE AREA OPEN FILE 2975

NORTHWEST TERRITORIES Transverse Mercator Projection CM 110°, Scale Factor 1.0 Projection transverse de Mercator © Crown copyrights reserved M.C. 110°, facteur d échelle 1,0 © Droits de la Couronne réservés



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