Geological Survey of Canada

CURRENT RESEARCH
2006-A1

Documentation of a Holocene volcanic cone in the Tuya-Teslin volcanic field, northern British Columbia

K. Simpson, B. Edwards, and K. Wetherell

2006

CURRENT RESEARCH

Natural Resources Canada Ressources naturelles Canada

Canada

ISSN 1701-4387
Catalogue No. M44-2006/A1E-PDF
ISBN 0-662-42326-7

A copy of this publication is also available for reference by depository libraries across Canada through access to the Depository Services Program's Web site at http://dsp-psd.pwgsc.gc.ca

A free digital download of this publication is available from GeoPub: http://geopub.nrcan.gc.ca/index_e.php

Toll-free (Canada and U.S.A.): 1-888-252-4301

Critical reviewers
Mark Stasiuk

Authors' addresses

K. Simpson (ksimpson@nrcan.gc.ca)
Geological Survey of Canada
605 Robson Street, Suite 101,
Vancouver, British Columbia V6B 5J3

B.Edwards (edwardsb@dickinson.edu)
K. Wetherell (wetherek@dickinson.edu)
Department of Geology,
Dickinson College, P.O. Box 1773,
Carlisle, Pennsylvania 17013 U.S.A.

Publication approved by GSC Pacific, Vancouver

Original manuscript submitted: 2005-09-13
Final version approved for publication: 2005-11-03

Correction date:

Documentation of a Holocene volcanic cone in the Tuya-Teslin volcanic field, northern British Columbia

K. Simpson, B. Edwards, and K. Wetherell

Simpson, K., Edwards, B., and Wetherell, K., 2006: Documentation of a Holocene volcanic cone in the Tuya-Teslin volcanic field, northern British Columbia; Geological Survey of Canada, Current Research 2006-A1, 7 p.

Abstract: A previously unnamed Holocene volcanic cone is herein informally named Gabrielse cone. Gabrielse cone is a subaerial basaltic scoria cone that is one of the few subaerial volcanic features in the Tuya-Teslin area. The cone is approximately 400 m in diameter with a central crater approximately 30 m deep. It consists largely of unconsolidated basaltic scoria some of which show preserved fluidal shapes typical of subaerial bombs. To the northeast the scoria cone appears to be breached and remnants of a lava flow were observed. Mineral compositions as determined by scanning electron microscope–energy dispersive spectometer are consistent with other occurrences of alkali olivine basalts in the area.

Résumé : Un cône volcanique auparavant innommé est ci-après désigné de manière informelle «cône Gabrielse». Le cône Gabrielse est un cône de scories basaltiques subaérien et l'une des rares entités volcaniques subaériennes dans la région de Tuya-Teslin. Il a un diamètre approximatif de 400 m et présente un cratère central d'une profondeur d'environ 30 m. Il se compose en grande partie de scories basaltiques non consolidées, dont certaines présentent des formes d'écoulement caractéristiques de bombes subaériennes. Au nord-est, le cône de scories semble égueulé et on a observé des vestiges d'une coulée de lave. Les compositions minérales telles que déterminées au moyen d'un microscope électronique à balayage muni d'un spectromètre dispersif en énergie sont compatibles avec celles d'autres occurrences de basaltes alcalins à olivine dans la région.

INTRODUCTION

Holocene volcanic activity has occurred at a number of volcanic centres in Canada (Fig. 1) including: Fort Selkirk volcanic complex (Volcano Mountain; e.g. Jackson and Stevens (1992); Trupia and Nicholls (1996)), Hoodoo volcanic complex (e.g. Edwards and Russell, 2002), Iskut River volcanic field (Iskut River lava field, Lava Fork; e.g. Hauksdottir et al. (1994)), Nass volcanic field (Tseax cone; e.g. Symons (1975); Wuorinen (1978)), Nazko cone (e.g. Souther et al., 1987), Mount Edziza volcanic complex (e.g. Souther, 1992), Wells Gray–Clearwater volcanic field (e.g. Hickson and Souther, 1984; Hickson, 1986), Mount Meager volcanic complex (e.g. Clague et al., 1995), Garibaldi volcanic complex (e.g. Green et al., 1988) and the Tuya-Teslin volcanic field (e.g. Gabrielse, 1969). These volcanic centres represent a diverse range of activity from monogenetic cinder cones with associated lava flows to stratovolcanoes and shield volcanoes. Compositions are predominantly mafic, but include phonolite (e.g. Hoodoo volcanic complex; Edwards et al. (2002)) and dacite (e.g. Mt. Meager volcanic complex; Stasiuk et al. (1996)).

This paper documents the occurrence of a Holocene volcanic vent in the Tuya-Teslin volcanic field reported by Gabrielse (1969).

PREVIOUS WORK IN THE TUYA-TESLIN AREA

Previous work in the Tuya-Teslin area includes regional mapping by Watson and Mathews (1944) and Gabrielse (1969), and detailed stratigraphic analysis of specific volcanic centres (Mathews, 1947; Allen et al., 1982; Moore et al., 1995; Simpson, 1996; Dixon et al., 2002). Watson and Mathews (1944) informally defined the Tuya formation to include basaltic lava, tuff, and agglomerate in the Tuya-Teslin area. Subsequently, a number of flat-topped, steep-sided volcanoes within the Tuya formation were interpreted by Mathews (1947) to have formed by eruption of lava into lakes thawed through an ice sheet. Mathews (1947) proposed that these subglacial volcanoes be called "tuyas". Since 1947, the Tuya formation has been mapped across the Dease Lake, Jennings River, and Cry Lake map areas (Gabrielse, 1969, 1998) and includes more than thirty individual volcanic features of both subaerial and subglacial origin.

The term 'Tuya-Teslin volcanic field' is used in this paper to describe an area of monogentic volcanic centres of similar age and composition. It includes the 'tuyas' around High Tuya and Tuya lakes, the West Tuya lava field (Wetherell et al., 2005), and centres on the Kawdy Plateau (Fig. 2). It does not include the Level Mountain volcanic complex (Hamilton, 1981) as it is a long-lived volcanic centre that is distinct from the monogentic centres of the Tuya-Teslin volcanic field.

GABRIELSE CONE

Gabrielse (1969) identified an unnamed volcanic cone in the northern part of the Jennings River 1:125 000 map area. The cone was described as "a remarkably fresh, clearly postglacial volcanic vent" and was mapped as part of the Tuya formation (Gabrielse, 1969, p. 30). The volcanic vent erupted through Carboniferous metasedimentary and metavolcanic rocks of the Oblique Creek Formation (Fig. 2; Gabrielse (1969)). This report of a Holocene volcanic vent prompted the present authors to visit the cone in August 2003 to make observations and collect samples. The cone is herein named 'Gabrielse cone' after Hu Gabrielse who first identified it.

Gabrielse cone is located in the Tuya-Teslin volcanic field (Fig. 2; UTM zone 9: 6590072 m N 421835 m E, 1605 m a.s.l.). The cone is approximately 400 m in diameter with a central crater approximately 30 m deep (Fig. 3, 4). It has an unusually low profile (Fig. 4d) and sits on a side hill near the base of a glacial valley. The cone consists of unconsolidated, aphyric, basaltic scoria that weathers to a distinctive red colour (Fig. 4). Clasts range from less than 1 cm to 7 cm and clast shapes vary from fluidal, typical of volcanic bombs, to broken angular shapes.

To the northeast the crater appears to have been breached and a basaltic lava flow can be traced for more than 400 m (Fig. 3, 4c). Basalt from the lava flow is olivine- and plagioclase-phyric (<1 cm in long dimension) with rare troctolitic (plagiclase+olivine) glomerocrysts (Fig. 5). The groundmass is fine grained (generally >50 μm) and consists of olivine, plagioclase, clinopyroxene, magnetite, and ilmenite. Olivine phenocrysts range between Fo83 and Fo59, and olivine in the groundmass range between Fo59 and Fo63. Plagioclase phenocrysts range between An60 and An70 and plagioclase in the groundmass range between An45 and An50. Olivine and plagioclase phenocryst compositions fall within the range for porphyritic alkali olivine basalt (Fo50-80, An50-70) from the West Tuya lava field (Fig. 2; Wetherell (2005)). Zoning in olivine and variation between plagioclase phenocrysts and groundmass is consistent with some fractionation at depth and possibly magma storage.

There is no evidence that Gabrielse cone has been glaciated, whereas the surrounding terrain has been glaciated. The cone is therefore interpreted to have formed postglacially (<11 000 a). Gabrielse cone and the West Tuya lava field (Wetherell et al., 2005) are the only nonglacial volcanic features in the Tuya-Teslin volcanic field.

SUMMARY

Gabrielse cone is a subaerial basaltic scoria cone in the Tuya-Teslin volcanic field and is one of the few subaerial volcanic features in the area. The cone consists of angular to fluidal shaped scoriaceous basalt. A lava flow appears to have breached the northeast side of the cone and can be traced for at

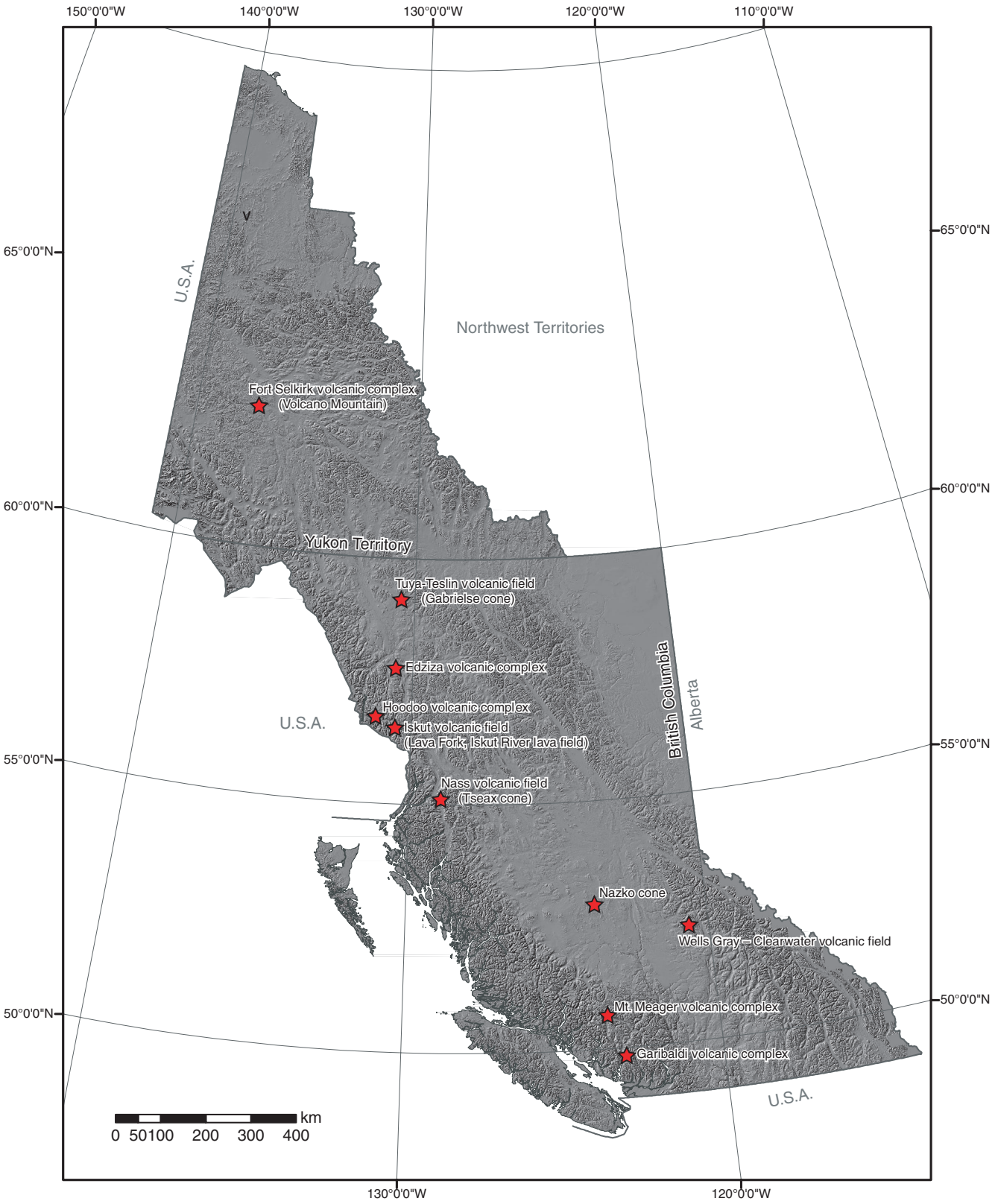

Figure 1. Distribution of Holocene volcanic centres in British Columbia and Yukon Territory.

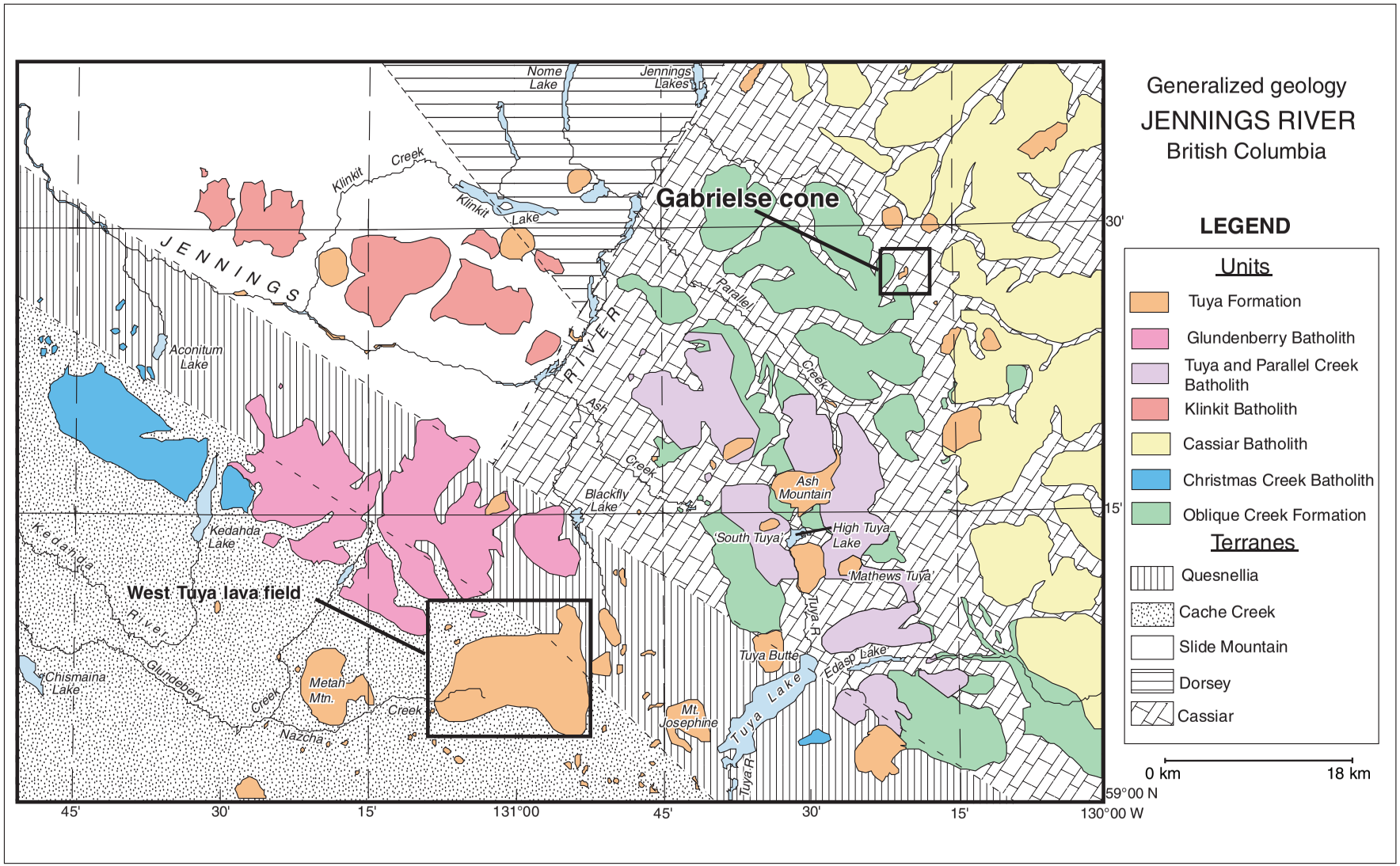

Figure 2. Generalized geology map of part of Jennings River and location of Gabrielse cone (*modified from* Wetherell et al., 2005).

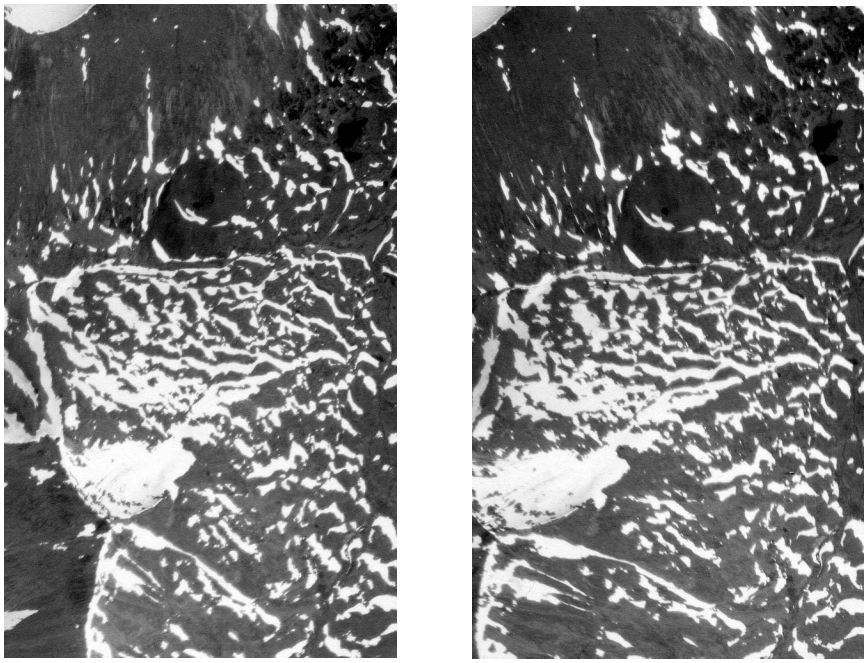

Figure 3. Stereopair of Gabrielse cone. Scale 1:40 000. NAPL A11373-129 and 130.

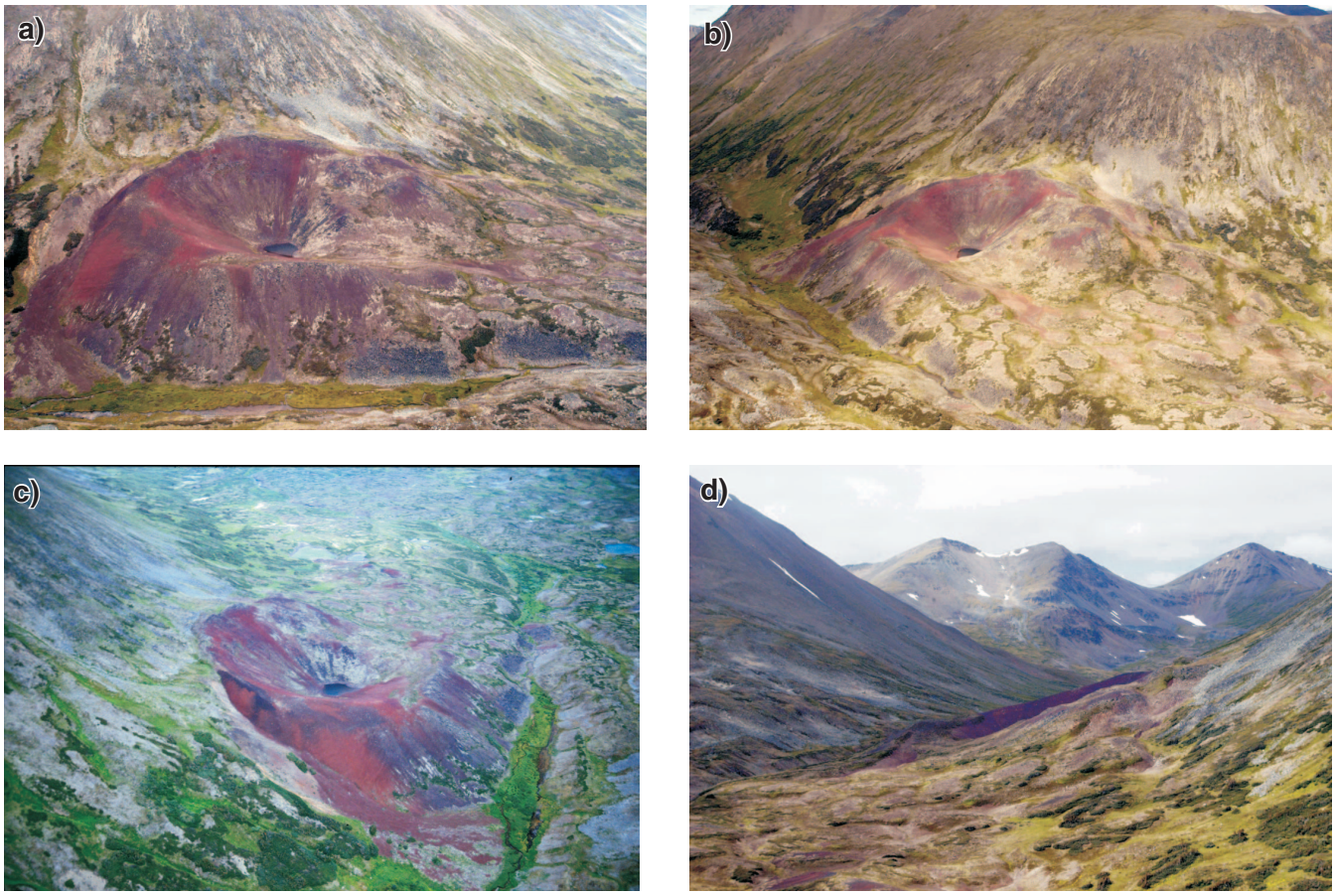

Figure 4. Gabrielse cone. Cone diameter is approximately 400 m. **a)** View looking towards the north-northeast. **b)** View looking towards the west. **c)** View looking towards the northeast. The distinctive red weathering of the volcanic rocks outlines the distribution of the lava flow in the distance. **d)** View to the west-southwest illustrating the low profile of the cone.

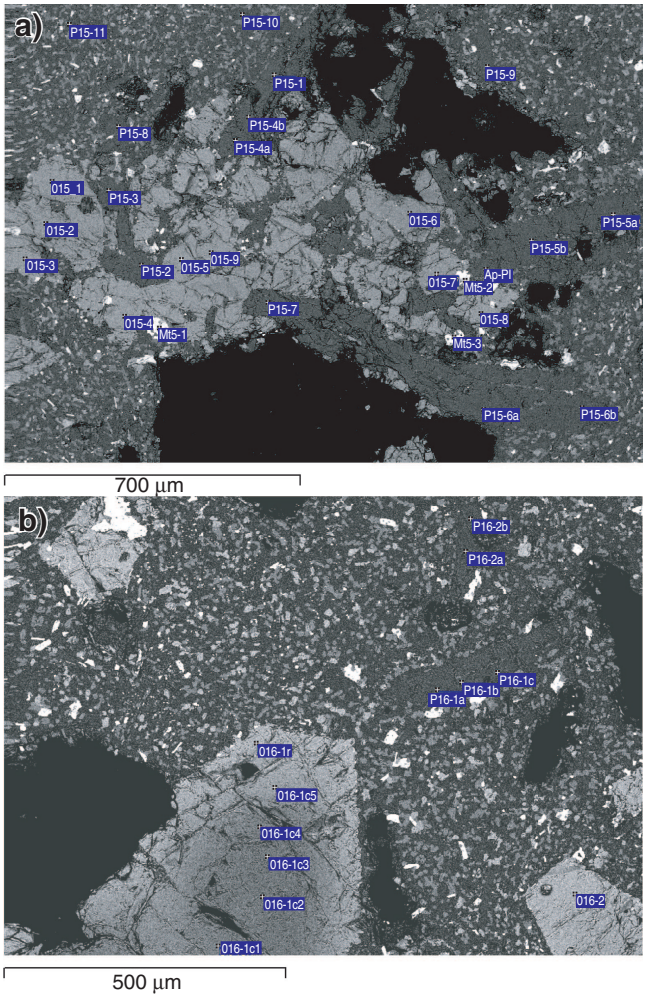

Figure 5. Scanning electron microscope images showing olivine and plagioclase phenocrysts in a fine-grained groundmass of olivine, plagioclase, clinopyroxene, magnetite, and ilmenite. Analyzed points are indicated with labels; Ol = olivine, Pl = plagioclase, Mt = magnetite. **a)** Bright spots are magnetite. **b)** Olivine phenocryst at bottom centre of photograph is zoned.

least 400 m. The cone appears to be unglaciated suggesting a Holocene age. Mineral chemistry is consistent with alkali olivine basalt from the West Tuya lava field.

ACKNOWLEDGMENTS

The authors thank Jim Reed of Pacific Western Helicopters for skilled flying and for fitting the three authors plus gear in one load. Marianne Quat, Stephen Williams, and Carol Wagner are thanked for their support with ArcMap. Hu Gabrielse is an inspiration to all authors and always provides a wealth of information. Dickinson College supported this research through a Whitaker Student-Faculty Research grant. Mark Stasiuk provided a critical review of the manuscript.

REFERENCES

Allen, C.C., Jercinovic, M.J., and Allen, J.S.B.
1982: Subglacial volcanism in north-central British Columbia and Iceland; Journal of Geology, v. 90, p. 699–715.

Clague, J.J., Evans, S.G., Rampton, V.N., and Woodsworth, G.J.
1995: Improved age estimates for White River and Bridge River tephras, western Canada; Canadian Journal of Earth Sciences, v. 32, p. 1172–1179.

Dixon, J.E., Filiberto, J.R., Moore, J.G., and Hickson, C.J.
2002: Volatiles in basaltic glasses form a subglacial volcano in northern British Columbia (Canada): implications for ice sheet thickness and mantle volatiles; *in* Volcano-ice Interaction on Earth and Mars, (ed.) J.L. Smellie and M.G. Chapman; Geological Society, London, Special Publications, v. 202, p. 255–271.

Edwards, B.R. and Russell, J.K.
2002: Glacial influences on morphology and eruptive products on Hoodoo Mountain Volcano, Canada; *in* Volcano-ice Interaction on Earth and Mars, (ed.) J.L. Smellie and M.G. Chapman; Geological Society, London, Special Publications, v. 202, p. 179–194.

Edwards, B.R., Russell, J.K., and Anderson, R.G.
2002: Subglacial, phonolitic volcanism at Hoodoo Mountain volcano, northwestern Canadian Cordillera; Bulletin of Volcanology, v. 64, p. 254–272.

Gabrielse, H.
1969: Geology of the Jennings River map-area, British Columbia (104-O); Geological Survey of Canada, Paper 68–55, 37 p.
1998: Geology of the Cry Lake and Dease Lake map areas, north-central British Columbia; Geological Survey of Canada, Bulletin 504, 147 p.

Green, N.L., Armstrong, R.L., Harakal, J.E., Souther, J.G., and Read, P.B.
1988: Eruptive history and K-Ar geochronology of the late Cenozoic Garibaldi volcanic belt, southwestern British Columbia; Geological Society of America Bulletin, v. 100, p. 563–567.

Hamilton, T.S.
1981: Late Cenezoic alkaline volcanics of the Level Mountain Range, Northwestern British Columbia: geology, petrology, and paleomagnetism; Ph.D. thesis, University of Alberta, Edmonton, Alberta, 490 p.

Hauksdottir, S., Enegren, E.G., and Russell, J.K.
1994: Recent basaltic volcanism in the Iskut-Unuk rivers area, northwestern British Columbia; *in* Current Research 1994-A; Geological Survey of Canada, p. 57–67.

Hickson, C.J.
1986: Quaternary volcanism in the Wells Gray-Clearwater area, east central British Columbia; Ph.D. thesis, University of British Columbia, Vancouver, British Columbia, 357 p.

Hickson, C.J. and Souther, J.G.
1984: Late Cenozoic volcanic rocks of the Clearwater-Wells Gray area, British Columbia; Canadian Journal of Earth Sciences, v. 21, no. 3, p. 267–277.

Jackson, L.E., Jr. and Stevens, W.
1992: A recent eruptive history of Volcano Mountain, Yukon Territory; *in* Current Research, Part A; Geological Survey of Canada, Paper 92-1A, p. 33–39.

Mathews, W.H.
1947: Tuyas, flat-topped volcanoes in northern British Columbia; American Journal of Science, v. 245, p. 560–570.

Moore, J.G., Hickson, C.J., and Calk, L.
1995: Tholeiitic-alkalic transition at subglacial volcanoes, Tuya region, British Columbia; Journal of Geophysical Research, v. 100, no. B12, p. 24 577–24 592.

Simpson, K.
1996: The geology, geochemistry and geomorphology of Mathews tuya: a subglacial volcano in northwestern British Columbia; B.Sc. thesis, University of British Columbia, Vancouver, British Columbia, 97 p.

Souther, J.
1992: The Late Cenezoic Mount Edziza Volcanic Complex, British Columbia: Geological Survey of Canada, Memoir 420, 320 p.

Souther, J.G., Clague, J.J., and Mathews, R.W.
1987: Nazko cone, a Quaternary volcano in the eastern Anahim Belt; Canadian Journal of Earth Science, v. 24, p. 2477–2485.

Stasiuk, M.V., Russell, J.K., and Hickson, C.J.
1996: Distribution, nature, and origins of the 2400 BP eruption products of Mount Meager, British Columbia: linkages between magma chemistry and eruption behaviour; Geological Survey of Canada, Bulletin 486, 27 p.

Symons, D.T.A.
1975: Age and flow direction from magnetic measurements on the Historic Aiyansh flow, British Columbia; Journal of Geophysical Research, v. 80, p. 2622–2626.

Trupia, S. and Nicholls, J.
1996: Petrology of Recent lava flows, Volcano Mountain, Yukon Territory, Canada; Lithos, v. 37, p. 61–78.

Watson, K. De P. and Mathews, W.H.
1944: The Tuya-Teslin area, northern British Columbia; British Columbia Department of Mines, Bulletin No. 19, 52 p.

Wetherell, K.
2005: Volcanology and Petrology of the West Tuya lava field, northwestern British Columbia, Canada; B.Sc. thesis, Dickinson College, Carlisle, Pennsylvania, 69 p.

Wetherell, K., Edwards, B., and Simpson, K.
2005: Preliminary results of field mapping, petrography, and GIS spatial analysis of the West Tuya lava field, northwestern British Columbia; Geological Survey of Canada, Current Research 2005-A2, 10 p.

Wuorinen, V.
1978: Age of Aiyansh volcano, British Columbia; Canadian Journal of Earth Sciences, v. 15, p. 1037–1038.