

Figure 1. Composite graphic log for eastern wall of Chasm canyon (see map). Lateral distance covered is approximately 950 m. This stratigraphic sucession includes the following facies: 1) basaltic lava comprising vesicular/amygdaloidal pahoehoe lobes (vIB), 2) aphyric columnar-jointed and sheet-like basalt lava (acB), and 3) fine-grained, red-coloured paleosols (P). M.S. refers to magnetic susceptibility measurements. Representative field photographs of major units, including: a) oblique view of representative section (~30 m in height), b) amygdaloidal pahoehoe lobes (vIB), c) clastic dike in top lava (acB) and below paleosol (P) (approximate scale of clastic dike is 2 m), and d) paleosol (P) with basaltic core stones (~30 cm long rock hammer for scale). Photograph courtesy of Paul Sanborn.

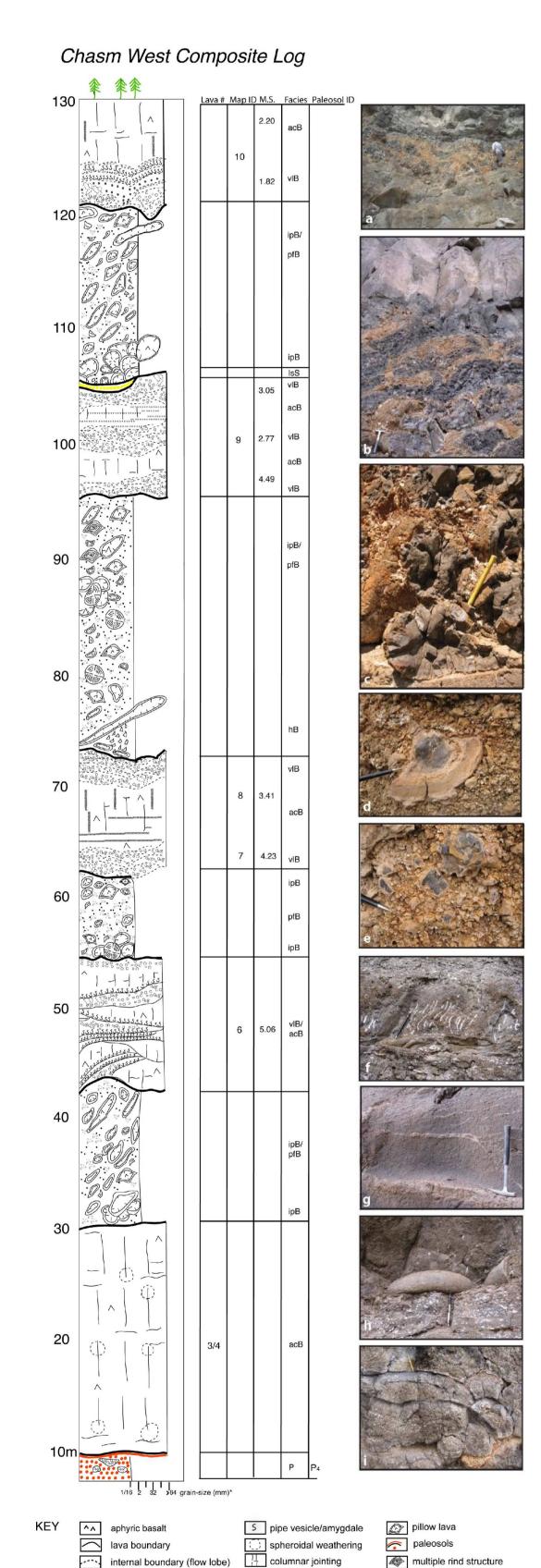


Figure 2. Composite graphic log for western wall of Chasm canyon (see map). Lateral distance covered is approximately 1060 m. M.S. refers to magnetic susceptibility data. The horizontal axis on the graphic log represents the average grain size. Coherent units are illustrated by symbols only and are drawn to the maximum grain size as outlined in McPhie et al (1993). The grain size for units containing variably-sized pillow fragments in a finer-grained matrix was calculated using the average size of the smallest pillow fragments. Intact pillow lobes and larger pillow fragments (> 64 mm) are shown schematically and protrude outside the log where they are abundant within a unit. This stratigraphic sucession includes the following facies: 1) intact pillow lava (ipB); 2) pillow fragment breccia (pfB); 3) lacustrine sedimentary facies; sandstone (IsS); 4) in-situ hyaloclastite (hB); 4) basaltic lava comprising vesicular/amygdaloidal

pahoehoe lobes (vIB); 5) aphyric columnar jointed and sheet-like basalt lava (acB); and 6) fine-grained, red-coloured paleosols

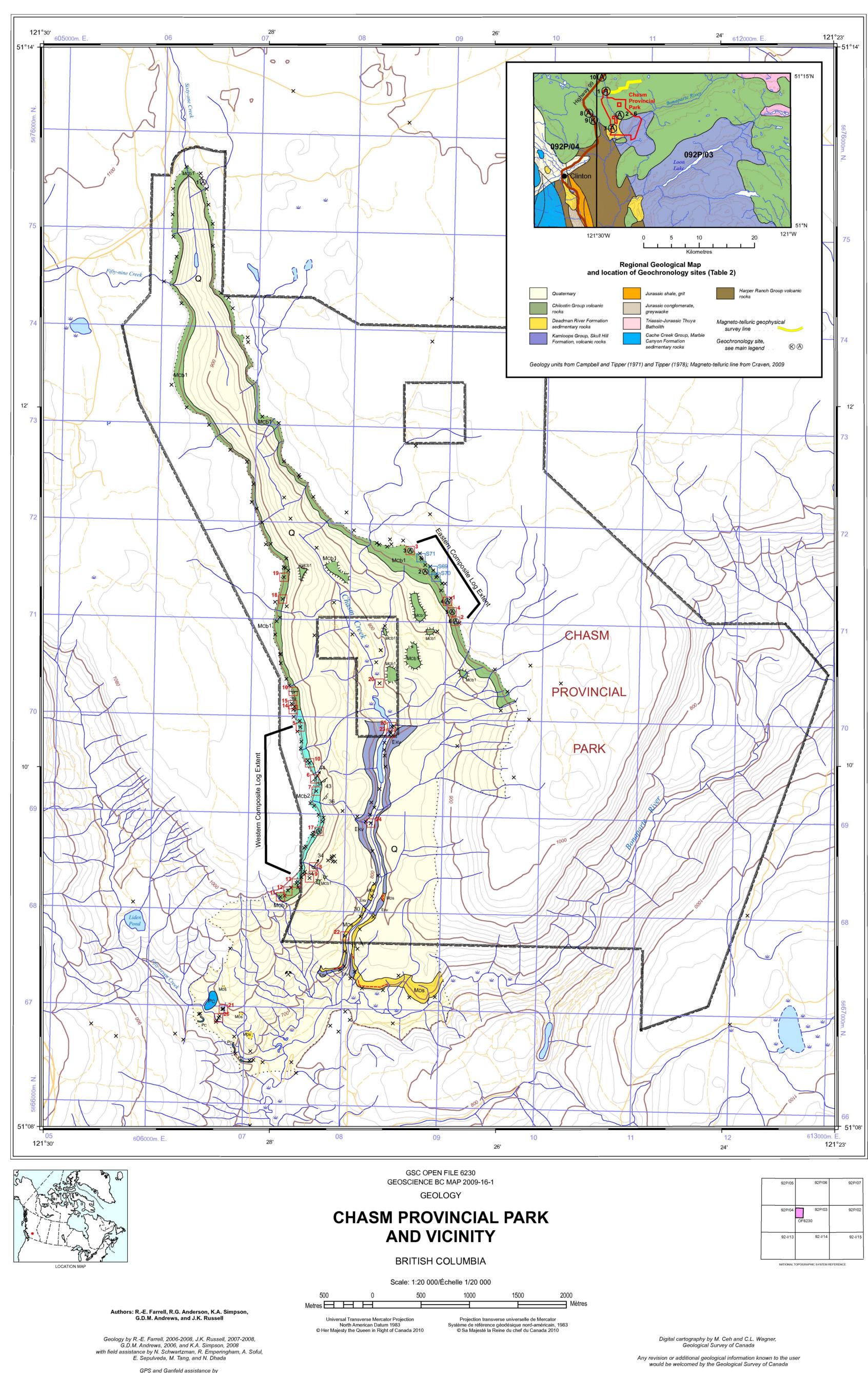
vesicle chimney

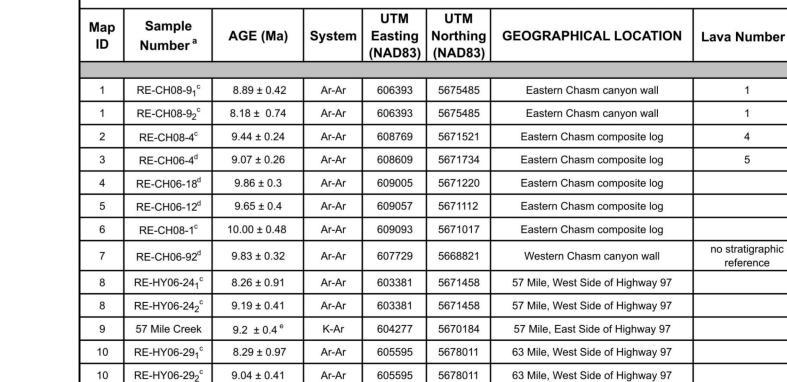
vesicle sheets

lacustrine sandstone

Lava 3/4 and paleosol 4 have been correlated across an area of no exposure. The stratigraphic correlation is made on the basis of colour and texture of the paleosol horizon, the blocky to massive character of the columnar-jointed lava, and the

clear association of the Lava 3/4 to paleosol 4 where there is exposure. Representative field photographs of major units, including: a) Typical view of western log section. Coherent units include: top lava (vIB) and lower lava (acB). Clastic units include: ipB/ pfB. Person for scale (~170 cm); b) Upper lava (acB) with vesicle chimneys underlain by pillow lava (ipB) with dipping pillows to the SE. Hammer for scale; c) Pillow lava with prismatic jointing and tiny normal joints. Hammer for scale is ~40 cm; d) Pillow fragment and associated breccia (pfB). Pencil is 14.5 cm; e) Smaller-sized pillow fragments and breccia (pfB); f) Large pipe amygdales and pahoehoe ropes (vIB). Pencil is 14.5 cm; g) Vesicle sheets. Hammer for scale; h) Large pahoehoe rope (vIB); and i) Cross section through amygdaloidal lobes (vIB).





LEGEND

Very fine-grained, vesicular to amygdaloidal basaltic pahoehoe lavas. Aphyric or

paleosols with basaltic core stones. Includes the following subfacies: 1) basaltic

aphyric columnar-jointed and sheet-like basalt lava (subfacies acB); and 3)

Basaltic pillow lava, coherent and volcaniclastic, interstratified with fine-grained,

subaerial lavas (60%) versus subaqueous lavas (40%). Subaerial subfacies of the

MCb2 include subaerial lavas similar to subfacies v/B and acB noted above (MCb1,

Subaqueous subfacies include the dominant intact pillow lava (subfacies ipB) and

pillow-fragment breccia (subfacies pfB) facies and rare hyaloclastite (subfacies hB)

Very thick- to medium-bedded, polymictic volcanic breccia and coarse-grained volcanic sandstone. Clasts are predominately plagioclase-phyric volcanic clasts

derived from the Skull Hill Formation of the Kamloops Group. Unit has a characteristic

Western extent of this group has strongly-folded calcareous phyllites. Campbell and

Tipper (1971) describe the Cache Creek Group in this area as a collection of

aphyric, massive to columnar-jointed basalt lavas. Approximate percentage of

----- unconformity ------

EKV massive to blocky coherent lava with domains of breccia. This unit has a distinctive

Fine-grained, plagioclase-phyric, trachytic, weakly vesicular (andesite?) lava;

fine-grained, red-coloured paleosols (subfacies P).

and lacustrine sandstone (subfacies IsS) units.

Chilcotin Group (undivided subaqueous & subaerial facies)

olivine-phyric, massive to columnar-jointed, flat-lying lavas bracketed by silty to sandy

pahoehoe lava comprising vesicular/amygdaloidal pahoehoe lobes (subfacies vIB); 2)

QUATERNARY

MIOCENE

EOCENE

PERMIAN

Slumped basalt block

Pillow (elongation direction)

MINFILE occurrence

Road, unimproved road, trail

Limit of mapping

Ar-Ar Age determination locality, Map ID

Magnetic Susceptibility locality, Map ID

K-Ar Age determination locality (on inset map)

Station with detailed Paleosol profile, Map ID

Field station location where not indicated by another symbol

MAGNETIC SUSCEPTIBILITY MEASUREMENTS

Field (10)

Field (10)

Field (10)

Field (10)

Field (10)

Lab (3)

Lab (3)

Lab (3)

Field (10)

Field (10)

Field (10)

Field (10)

Field (10)

Field (5)

Field (5)

Lab (3)

5669526

5668138

607422 5668199

607434 5670258

607730 5668821

4.21 607438 5670071

2.79 607431 5670121

2.29 607730 5668821

607730

607730

606782

4.44 608262 5668917

24 07REF137-2 -0.9 608262 5668917 Lab (3)

Chilcotin Group basalt; Deadman Formation volcaniclastic sandstone; Kamloops Group volcanics

608019 5667749

608447 5669850

07REF176 6.1 608457 5669916 Lab (3) Kamloops Group 26 07REF-184 0.13 606735 5666878 Lab (3) Cache Creek Group

GEOCHRONOLOGY OF CHILCOTIN GROUP BASALTS: CHASM CANYON SPECIFIC

607509 5668283

Field (10)

Susceptibility¹ | Easting | Northing |

(lava number) (NAD83) (NAD83)

06REF020q 11.6 (10) 609005 5671220 Field (10)

6.37 (9) 609005 5671220

2.52 (6)

5.99 (4)

7.62 (4)

11.6 (3)

5.18 (2)

5.45 (2)

5.5

0.78

0.72

0.15

Measurements taken with KT-9 Kappameter; Lab measurements on core

Magnetic Susceptibility data is recorded in 10⁻³ SI units

Digital base map from Terrain Resource Information Management Program (TRIM),

BC Provincial Baseline Atlas, under the External TRIM Data Access

Policy Guidelines for BC education institutions.

Modified by GSC

Mean magnetic declination 2010, 17°44'E, decreasing 13.8' annually

Elevation in metres above mean sea level

Contour interval 20 metres

07REF137-3 7.78 608262 5668917

RF-CH08-1

RF-CH06-04

08RFF077

4 RE-CH06-12

5.68 (4) 609006

3.07 (9) 609005 5671220

609005 5671220

609006 56712

609006 56712

609006 5671220

609006 5671220

609006 5671220 609006 5671220

4.97 (2) 609006 5671220

4.2 (1) 609093 5671017

1.75 608609 5671734

3.61 609057 5671112

0.289 609057 5671112

5.06 (3) 607514 5669891

4.23 (5) 607675 5669360

3.41 (5) 607692 5669236

3.05 (7) 607682 5668454

2.77 (7) 607682 5668454

4.49 (7) 607682 5668454

Pillows (planar)

Alluvium, colluvium, till.

Deadman River Formation

red, purple or dark brown colour.

greenstone, argillite, chert and limestone.

Kamloops Group

Cache Creek Group

Geological contact (defined, approximate, assumed)

Chilcotin Group (subaerial facies)

^a All samples are whole rocks
^b Number assigned to individual lavas that can be traced laterally along the canyon, see Figures 1 and 2
^c J. Gabites, analyst
^d UBC; T.Ullrich, analyst
^e Mathews, 1988

Table 3.	ble 3. MINFILE ¹							
Map (Minfile) Number	Principal Occurence Name	Status	Easting	Northing	Elevation (m)	Commodities	Mineral Profile Number	Mineral Profile Type
092P 100	CHASM CREEK	Showing	607443	5667349	740	Diatomite	F06	Lacustrine diatomite
http://www.empr.gov.bc.ca/MINING/GEOSCIENCE/MINFILE								

DESCRIPTIVE NOTES

Chasm Provincial Park is located northeast of Clinton, British Columbia, occupies 3067 hectares, and is one of nearly one thousand Marine Parks, Regional Parks, Provincial Parks, National Parks, Ecological Reserves, and Provincial Recreation areas in British Columbia. Within Chasm Provincial Park, which includes the Chasm Canyon, extending approximately 8 km to the south and ranging from 500 - 3000 m wide and 300 m deep, the Chilcotin Group basalt dominates the landscape and bedrock geology. The Chilcotin Group basalt overlies rocks of the Permian Cache Creek Group, Eocene Kamloops Group and Miocene Deadman River Formation. This Open File provides the distribution of these units as well as graphic logs (Figures 1 and 2), georeferenced magnetic susceptibility data (Table 1) geochronology sample locations (Table 2), and location of mineral deposits (Table 3). All of these data are referenced on the map. It provides a summary of interim reports on the area (Farrell et al., 2007, 2008). A main focus of the Open File is the volcanic facies distribution of the Chilcotin Group basalt, which is well-exposed in the Chasm Canyon. The canyon is a late glacial erosional feature. The Permian Cache Creek Group (unit PC) outcrops are located along Fifty-Seven Mile Creek. Three exposures consist of strongly-folded calcareous phyllite. The Chasm Canyon area is considered to be the western extent of the Cache Creek Formation (Campbell and Tipper, 1971). Eccene Kamloops Group rocks (unit Ekv) include plagioclase-phyric coherent and brecciated andesite(?) lava assigned to the Skull Hill Formation and are exposed discontinuously along 3 km of Sixty-One Mile Creek and Chasm Creek. The exposed thickness of the Skull Hill Formation in this area ranges from 3 - 60 m. A bedded sequence of polymictic volcanic breccia and coarse-grained volcanic sandstone of the Deadman River Formation (unit Mds) unconformably overlies the Skull Hill Formation at the junction of Chasm Creek and

the Bonaparte River. The main exposures of the Deadman River Formation occur along Chasm Creek, at the junction of Chasm Creek with the Bonaparte River. At this locality the strata form cliffs averaging 40 m in height. Breccia clasts, rocks derived from the Skull Hill formation, are dominantly angular to subangular and imbricated and set in a sand matrix. Three distinct clast size populations are present (average sizes are 39.1 cm, 8.6 cm, and 1.1 cm). Clast imbrication indicates a northwesterly transport direction, and the angularity of the clasts suggests minimal transport from their source. Post-depositional slumping, observed in places, has displaced these units downslope, and some outcrops are not in-situ (Campbell and Tipper, 1971). The bedded rocks are observed as draping over the paleotopography, which is in agreement with Campbell and Tipper (1971) geologic interpretations. The Chilcotin Group basalt is divided into two main facies (MCb1 and MCb2) described in detail below.

UNIT 6Cb1 'MIOCENE CHILCOTIN BASALT- SUBAERIAL FACIES' This facies consists of subaerial basaltic lavas and paleosol horizons and is subdivisible into three subfacies: 1) basaltic pahoehoe lava comprising vesicular/amygdaloidal pahoehoe lobes (subfacies vIB); 2) aphyric columnar-iointed and sheet-like basalt lava (subfacies acB); and 3) fine-grained, redcoloured paleosols (subfacies P). From a distance, the subaerial lava appears to be thick, 'sheet-like' units with weak lobate shapes and moderately developed columnar-joints (subfacies acB). However, in detail many of the lavas consist of small pahoehoe lobes (subfacies vIB). Post-depositional slumping and landslides are observed in places along the canyon walls. They have displaced the subfacies downslope, therefore the slumped blocks found in the canyon (not on cliffs) are not in-situ (Evans, 1983).

VESICULAR BASALTIC PAHOEHOE LOBE SUBFACIES (SUBFACIES vIB); Figures 1&2 The dominant subfacies is 'vIB,' and consists of aphyric, vesicular (and/or amygdaloidal) pahoehoe lavas (Fig. 2, photo i). Single pahoehoe lobes range from 6 cm to 3 m across and overlap one another resulting in ~5-10 m thick lava units. The lobe shapes vary significantly, ranging from bulbous ellipses to elongated thin lobes. Lavas are moderately (20%) vesicular. Vesicles are randomly distributed and pipe vesicles (average height 10 cm) commonly occur at lobe contacts and help to differentiate them. Vesicles are <1 mm in size and commonly infilled (amygdales). Pahoehoe lavas have been interpreted to be emplaced on a shallow slope, with the smallest lobes ('toes') at the flow front (Crown and Baloga, 1999). Pahoehoe ropes and wrinkled textures are documented in both vIB and acB.

APHYRIC COLUMNAR-JOINTED BASALT SUBFACIES (acB); Figures 1&2 The 'acB' subfacies are sheet-like lavas, with moderate to well-developed columnar joints. Units are aphyric with sparse olivine microphenocrysts. Vesicle chimneys (1.5 - 5 m) and horizontal vesicle sheets (1-3 cm width, length varies) are a key feature of 'acB'. Vesicularity ranges typically from 30% at the base of the lava, to <5% at the middle, to 30% in the upper portion of the lava. Spheroidal weathering locally masks the columnar jointing. Columnar joints vary in width and preserved chisel marks are rare. Individual emplacement units are ~1 - 10 m thick and the 'acB' subfacies is interpreted to have been emplaced by inflation (SWELL hypothesis; Self et al, 1998).

FINE-GRAINED PALEOSOL SUBFACIES ('P'); Figures 1&2 This subfacies consists of red to buff-coloured paleosols that always occur between lavas on both the eastern and western walls of the canyon. Three paleosol sites were analysed on the eastern canyon wall (Fig. 1). Four to five horizons or zones were identified at each site. A generalized station horizon description would be the following: 1) red fine-grained paleosol material (2.5 YR 6/8) (soil colour values determined using Munsell 1994 colour charts) with an abrupt, irregular boundary that is platy due to weathering; 2) next down-section, very pale brown (10 YR 8/4) and increasingly well-lithified paleosol rock; 3) a lowermost horizon of highly amygdaloidal, weathered basalt, whose colour (10 YR 8/4, 'very pale brown' and 10 YR 4/1 'dark grey') is identical to the surrounding coherent lava in the Chasm, and defines the lower limit of the paleosol. Each horizon consists of rounded weathered basalt fragments, which include highly amyodaloidal varieties and less common dense basalt fragments (up to 10 cm in size). Lower contacts of the paleosol are typically undulating, irregular and gradational to the next horizon. Clastic dikes of identical composition to the paleosols commonly occur at the basal paleosol-

UNIT Mcb2 'MIOCENE CHILCOTIN BASALT- UNDIVIDED SUBAQUEOUS AND SUBAERIAL FACIES' The MCb2 unit is located in the southern portion of the western canyon wall and comprises alternating subaqueous and subaerial lavas. Subaerial lavas make up 60% of the sequence. Subaerial subfacies of the MCb2 include subaerial lavas similar to subfacies vtB and acB described above. Subaqueous subfacies include the dominant intact pillow lava (subfacies ipB) and pillow-fragment breccia (subfacies pfB) facies and rare hyaloclastite (subfacies hB) and lacustrine sandstone (subfacies lsS) units.

lava contact (Fig. 1, photo c). Blocky soil structure is rarely observed in the field, though additional

structures can be identified in thin section. The presence of paleosols suggests many hiatuses in

volcanism during emplacement of the lavas in the Chasmarea.

PILLOW-FRAGMENT BRECCIA SUBFACIES (pfB): Figure 2

Location

Eastern Log

Eastern Wall

Eastern Wall

Eastern Wall

Western Log

Western Log

Western Log

Western Log

Western Wall

Chilcotin Group Eastern Log

Chilcotin Group

Deadman Fm

Deadman Fm

Kamloops Group

Kamloops Group

INTACT PILLOW LAVA SUBFACIES (ipB); Figure 2 Dark grey, intact pillow lavas are common at the base of the subaqueous sequences. Pillows are packed together with little to no interstitial material. The average pillow size is 70 cm, and they have quenched black glassy rims (1 - 3 cm thick). Intact pillows dip at about 37 degrees and have a rounded, larger plunging 'head' and a narrower 'tail' (Jones and Nelson, 1970). Prismatic jointing and tiny normal joints are commonly preserved.

This facies is monomictic and comprises dark grey angular pillow fragments and orange coarse-grained blocky clasts (Fig. 2, photos d and e). The clasts range in size (\sim 3 mm to 20 cm) and shape (subangular, ragged to curvi-planar). Secondary clay minerals commonly infilled voids in the breccia. This facies is interpreted to have formed by disaggregation of pillow lava as it flowed downslope. HYALOCLASTITE SUBFACIES (hB): Figure 2

Monomictic basalt breccia consisting of angular to subangular fragments, which range in size from about

3 - 10 mm and are weakly vesicular. The matrix is sand-sized and consists of fine basalt fragments. Locally jigsaw-fit textures are preserved, indicating in-situ fragmentation and no transport. More commonly, clasts are rotated relative to one another and randomly distributed, indicating transport postbrecciation. The subfacies is rare and associated with pillow lava (Fig. 2) and is interpreted as hyaloclastite formed by quench fragmentation. Collectively the pillow lava, pillow-fragment breccia, and hyaloclastite subfacies are interpreted to have formed a lava-delta sequence as a result of subaqueous emplacement of basalt lavas (Jones and Nelson, 1970).

LACUSTRINE SANDSTONE SUBFACIES (IsS); Figure 2 A lens of medium-grained buff-coloured sandstone is found locally at the base of a subaqueous section, and overlain by vesicular pahoehoe basalt (subfacies vIB; Fig 2). It is 15 cm thick and not laterally

New whole rock Ar/Ar ages provide the duration of volcanism at the Chasm (Table 2). The youngest lava was analyzed twice, and yielded ages 8.89 ±0.42 Ma and 8.18 ± 0.74 Ma (ages overlap at a 2-sigma level). The durations of volcanism calculated using the two different measured ages for the youngest lava are 1.11 \pm 0.64 My and 1.82 \pm 0.88 My. The weighted average age for the youngest lava is 8.72 \pm 0.37 Ma (2-sigma internal error). Using the weighted average for the youngest lava, the calculation yielded a duration of volcanism of 1.28 ± 0.61 My, which is the authors' preferred estimate for the duration of volcanism at the Chasm.

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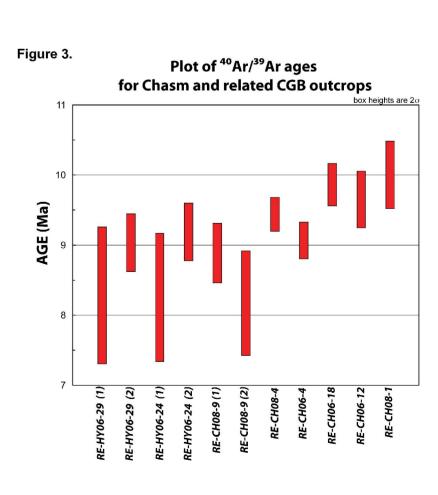
at the Department of Earth and Ocean Sciences, University of British Columbia and funded under the auspices of the Geological Survey of Canada, Targeted Geoscience Initiative 3, Cordilleran Project and Geoscience BC. Dates measured at Pacific Centre for Isotopic and Geochemical Research.

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Pencil is 14.5 cm.

vesicle

amygdale

pahoehoe lobes







in-situ hyaloclastite

pillow fragment breccia

S.P. Williams, Geological Survey of Canada

Paleosol sampling and soil science expertise provided by

P. Sanborn, University of Northern British Columbia

Review of the geochronological calculations

by J. Mortensen, University of British Columbia

