Final report for YMEP Focused Regional Project 21-062

THE ASTROLABE EXPLORATION PROJECT

GEOCHEMICAL REPORT

Cover image: typical MD520 landing site.

By and for Jack Milton, Ph.D.

31st January 2022

Dates of fieldwork 8th Sep to 13th Sep 2021

NTS 115J10; 115J11; 115J12; 115J13; 115J14; 115J15

Latitudes 62.641° to 62.771° N

Longitudes 138.922° to 139.409° W

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EXECUTIVE SUMMARY

Samples of stream sediments were taken in the Home Creek area (25 km SW of the Coffee deposit), and Doyle Creek area (20 km S of Coffee), Dawson Range, Yukon. Silt samples were analyzed for geochemistry, and bulk stream sediment samples were collected for heavy mineral concentration. Soil samples were taken during prospecting. Mineral concentrates were logged for porphyry indicator minerals, and zircon separates were produced. Zircons were analyzed by LA-ICP-MS for geochronology and geochemistry in an effort to detect Late Cretaceous zircons with fertile indicator geochemistry, associated with concealed and unmapped Casino suite intrusive rocks.

Casino Suite and Prospector Mtn age zircons were detected in several bulk stream sediment samples that all occur in drainages with no known or mapped occurrences of such rocks. The number of zircons detected suggest that a significant size porphyry could be present in at least two of the sampled drainages. Follow-up of these anomalous drainages with more detailed sampling is recommended to try and trace these anomalous signatures back to bedrock sources that may potentially host Cu-Au-Mo mineralization related to Casino Suite rocks.

INTRODUCTION

A paucity of outcrop and deep oxidation has challenged the traditional methods of early-stage exploration for porphyry Cu-Au-Mo deposits in the Dawson Range, Yukon: stream sediment sampling, soil sampling and prospecting. A method here is proposed and tested within this project to detect Casino Suite intrusive rocks over large areas of the Dawson Range, at relatively low-cost, by dating zircons contained within stream sediments. The small volume ~78-72 Ma Casino Suite intrusive rocks are intimately associated with porphyry Cu-Au-Mo mineralization across the SW Yukon and these granitoids are difficult to distinguish from the granitoids of the Dawson Range Batholith, particularly given the lack of outcrop providing little control on regional geological maps. Late Cretaceous porphyry mineralization occurs in a belt parallel to the Big Creek fault, from Klaza to Casino. A conspicuous gap is present from Casino 150 km NW to the late Cretaceous Taurus and Bluff deposits in eastern Alaska, and within this gap are large areas of Dawson Range Batholith that have not seen much previous exploration activity, with no known late Cretaceous porphyry deposits.

Dating zircon grains in large numbers has until recently been prohibitively expensive, but with the advent of LA-ICP-MS, the cost of doing systematic large-n sampling has come down substantially to levels where it may be deemed feasible for use in mineral exploration (e.g., Lee et al., 2021). Trace element chemistry is measured during the LA-ICP-MS process in addition to the U-Pb dating at little additional expense. The trace element signatures of zircon have recently been linked to predicting porphyry fertility and provide another layer for exploration targeting (Dilles et al., 2015; Lee et al., 2020). Porphyry indicator minerals have been developed to detect porphyry deposits in nearby surficial sediments such as tills, stream sediments and sands (Averill, 2011; McClenaghan et al., 2020).

The Astrolabe project uses stream sediment zircon U-Pb geochronology, zircon trace element geochemistry, porphyry indicator mineralogy of stream sediments, and fine-fraction stream sediment geochemical sampling to explore for porphyry deposits at the headwaters of creeks in the Dawson Range, west of the Casino deposit.

LOCATION

The Astrolabe project is located within the traditional territories of the Selkirk and Tr'ondëk Hwëch'in First Nations, on crown land. A 18 x 12 km area was investigated around Home Creek, ~24 km south-west of the Coffee deposit. Another area was investigated near the old Polaris airstrip approximately 20 km S by E of the Coffee deposit, in the headwaters of Doyle Creek. This project was conducted entirely off-claims, carried out as prospecting in order to locate claims.

ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

The Astrolabe project is located approximately 315 km NW of Whitehorse, and 145 km due south of Dawson City, Yukon, Canada. No year-round roads connect to the project area. Access is best achieved by helicopter from Dawson City or Whitehorse. An old exploration trail crosses the project area, and an old airstrip, named Polaris, is located adjacent to the project area but is overgrown. There is an airstrip at Casino and Boulevard.

The project area covers part of the Dawson Range from elevations between 550 and 1500 metres. The Dawson Range is characterized by rounded rolling hills with sparse cover of scrubby vegetation in the alpine and more thickly vegetated and forested, moderately to steeply incised valleys. The Yukon River is 25 km to the north of the project where it flows to the west. The cold, long and dark winters of the Yukon make the most comfortable and practical season for exploration run from approximately June through to September.

HISTORY

The project area has a few scattered minfile locations based on the location of the DOYLE, CC, PRINCESS, DUCHESS, and GEP claims that were staked and explored around 1969-1975 immediately after the discovery of porphyry mineralization at Casino in 1969. The BID and VINA claims were also worked in Home Creek for porphyry potential, finding minor molybdenite vein mineralization, later reworked as the HOME and HUMMER claims. Historic work includes geological outcrop and float mapping, stream sediment silt geochemistry, soil sampling for Cu-Mo, IP surveying and very limited reconnaissance drilling. A total of 4 vertical holes for a combined length of 600 m were drilled on the CC claims to the east of the project area, and one 150 m hole was drilled just to the south of the project area on the DOYLE claims.

In 2011 Ryan Gold Corp. ran a ridge line of soils on the BAILEYS claims on the north side of the project area. In 2012, Canadian Dehua International Mines Group Inc. flew a magnetic-radiometric survey over a significant portion of the project area on the HOME and HUMMER claims.

No significant mineralization has been located to date.

GEOLOGICAL SETTING

The project area is mostly underlain by Devonian-Permian metamorphic rocks of the Yukon-Tanana terrane; and intrusive and volcanic rocks, mostly of Cretaceous-Palaeogene ages (Fig. 1).

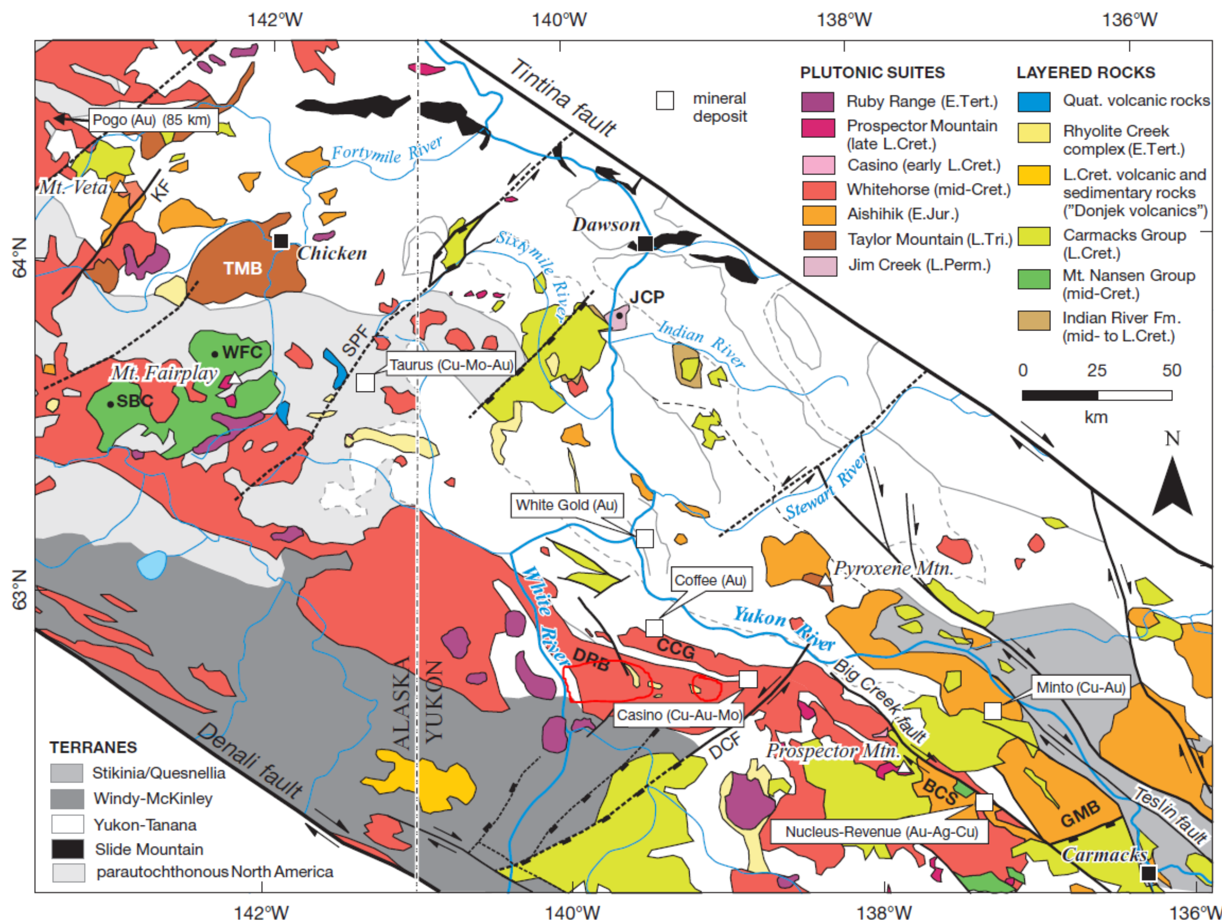

Figure 1 Regional Geology of project area, approximately outlined in red around Home Creek and the headwaters of Doyle Creek (from Allan et al., 2013).

The plutonic rocks of interest to this project include the Casino (early L. Cret.); Prospector Mountain (late L. Cret.); Whitehorse (mid-Cret.); Ruby Range (Palaeogene); Aishihik (E. Jur.); and Pyroxene Mountain (L.Tri) suites (Allan et al., 2013; Fig. 2). The volcanic rocks of interest include the Rhyolite Creek complex (Palaeogene); Carmacks Group (L. Cret); and Mt. Nansen Group (mid-Cret.) (Allan et al., 2013; Fig. 2). The ages of these intrusive suites are summarized in Figure 3 and a comprehensive update and review of Jurassic magmatism is given by Sack et al. (2020). The key ages relevant to this project are the Casino Suite (~72-79 Ma) (Allan et al., 2013), Prospector Mountain Suite and Carmacks Group (70-68 Ma) (Joyce et al., 2015; Yukon Geological Survey, 2020), Rhyolite Creek Assemblage (~64-54 Ma) (Yukon Geological Survey, 2020). The mid-Cretaceous Whitehorse Suite in this area occurs as: the Dawson Range Batholith (~107-100 Ma, Figure 1), which can show local evidence of deformation; and the undeformed, smoky-quartz bearing Coffee Creek granite (~100-99 Ma) (Godwin, 1975; Ryan et al., 2013; Allan et al., 2013).

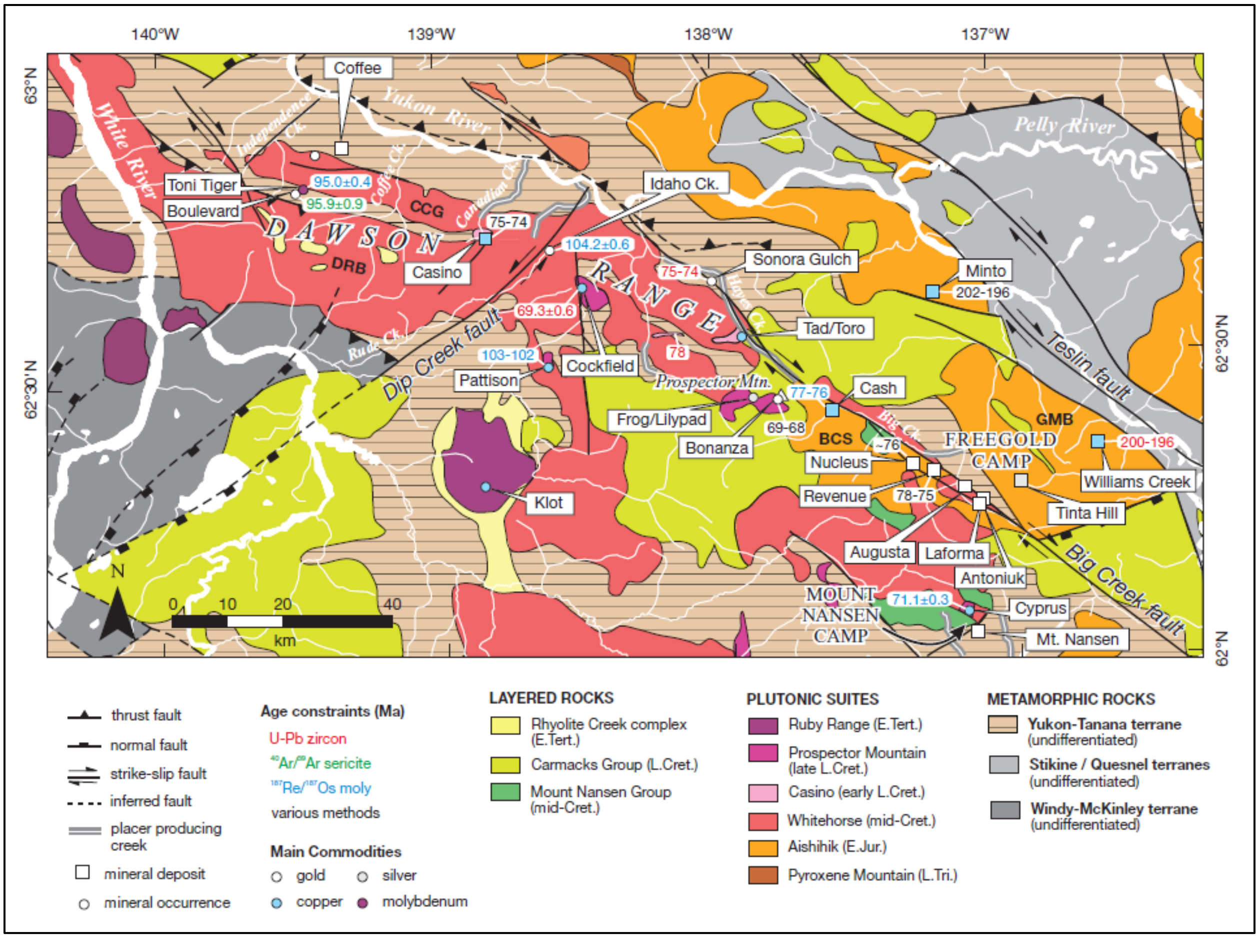

Figure 2 Volcanic and plutonic rocks of interest within the Dawson Range, significant mineral deposits and ages of mineralization (from Allan et al., 2013).

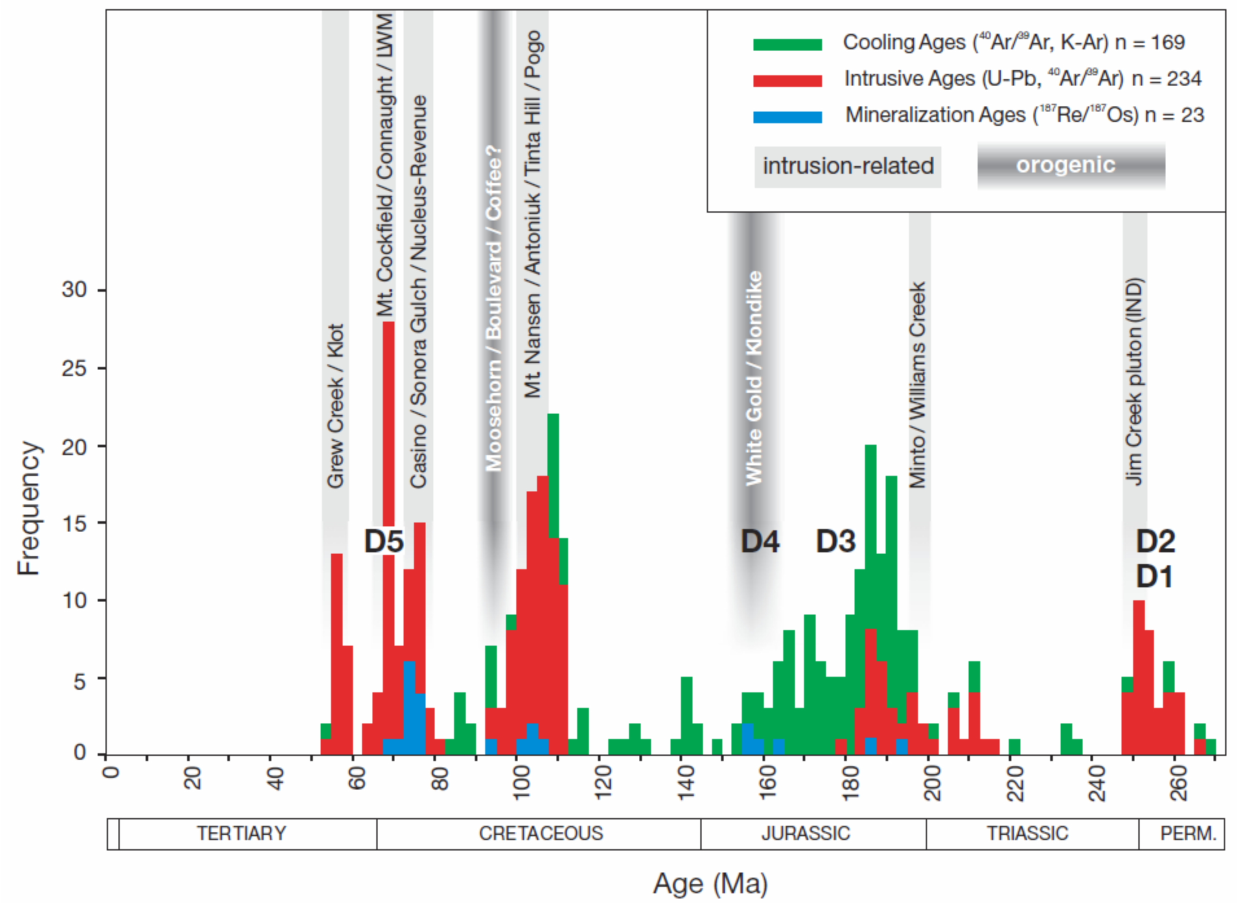

Figure 3 Age summary of intrusive events, mineralization, deformation and cooling ages of the Yukon-Tanana terrane from Allan et al. (2013).

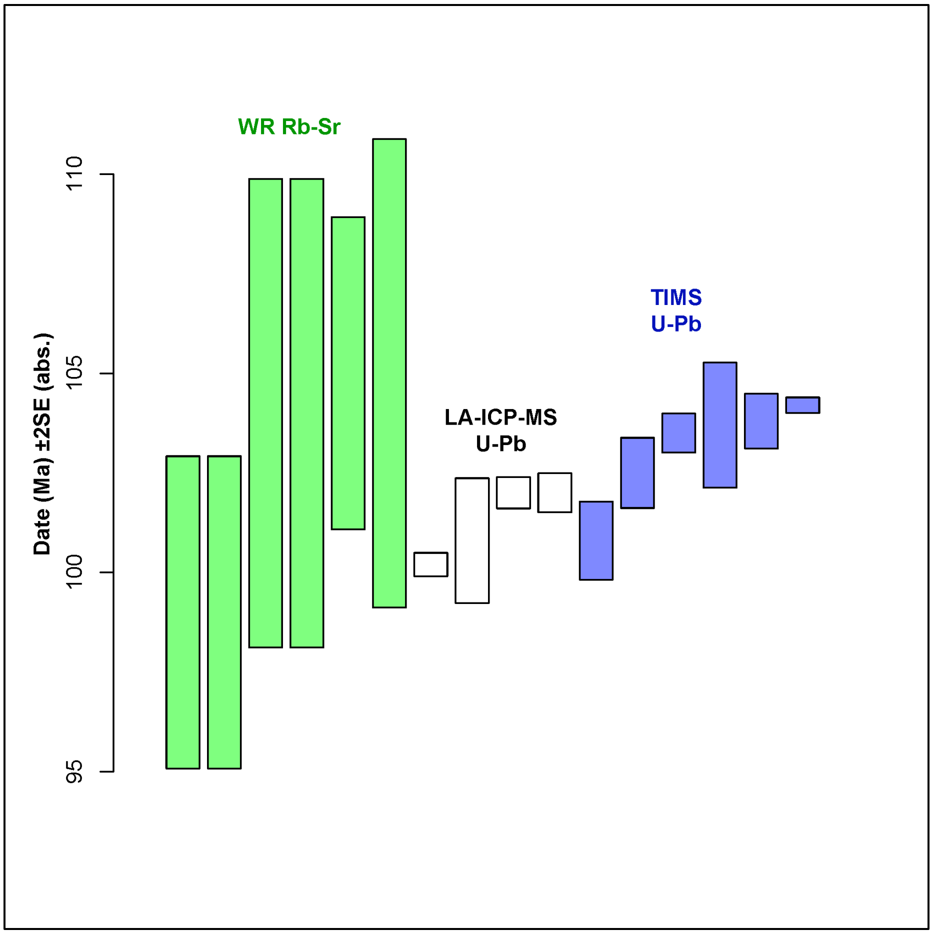

Figure 4 U-Pb zircon dates and whole rock Rb-Sr dates for the Dawson Range Batholith (data from Yukon Geological Survey, 2020).

DEPOSIT TYPES

The area is being targeted for early-Late Cretaceous porphyry Cu-Au-Mo-Ag mineralization associated with the ~78-72 Ma Casino Suite intrusive rocks such as that found nearby at the Casino deposit (Casselman and Brown, 2017). The area is also prospective for gold mineralization similar to that found at the nearby Coffee deposit.

SAMPLING AND EQUIPMENT

Samples of 0.8 to 3.8 kg of fine sediment were collected from the banks of streams or in areas of slack water by hand and placed in pre-labelled Hubco sentry bags, in locations where fine sediment was available for sampling.

Bulk samples were taken from the active channels of streams with a shovel and were screened with a 1/12" metal mesh sieve over a 5-gallon plastic bucket lined with a pre-numbered polyethylene sample bag (Figures

5 and 6; cover photo). Coarse material ranging from coarse sand through pebbles to cobbles was targeted from a selection of point locations at each site to ensure that the full range of grain sizes were sampled equally across different bedforms. Between 2.9 and 14.6 kg were collected in each sample (10 kg was targeted). A plastic gold pan was used to scoop water from the creeks to wet sieve the samples. Excess water was carefully tipped out of the buckets after a brief period of settling, ensuring that no silt to sand sized sediment was lost during the process. Sample locations were recorded using a hand-held GPS (Garmin GPSMAP 64s). Notes, and back-up sample locations were taken with an iPad using the FieldMove app and an external Bluetooth GPS (Garmin GLO). Sample collection procedures were broadly aligned with the GSC protocols for bulk sample collection established by Friske and Hornbrook (1991), described in Day et al. (2013) and implemented in a study of PIMS around the Casino deposit by McClenaghan et al. (2020).

Figure 5 Sample site 21JM014 showing typical sampling environment and equipment.

Sampling was carried out by Jack Milton and Quintom Willms in September, 2021. Access to sampling locations was via Fireweed Helicopters MD520 to within ~200 metres of each sample site, then on foot to the sampling site.

Figure 6 Sampling site 21JM013 with sampling equipment and MD520 helicopter.

Each sampling site was number using the scheme 21JM0XX where XX ranged from 13 to 24. All silt samples were suffixed by an 'S' and all bulk stream sediment samples were suffixed by a 'B'.

Soil samples were numbered 21SXXX where XXX was as three-digit number.

All sample locations are shown on Figures 13 and 14 and can be found in digital appendix 1.

EXPLORATION METHODS

Silt Geochemistry

Silt samples were driven from Dawson City to Whitehorse and submitted to Bureau Veritas preparation laboratory. Samples were dried at 60°C and sieved to -230 mesh (grain size of less than 63 microns). Samples were digested in 1:1:1 aqua regia and analyzed by ultratrace ICP-MS (BV package AQ252). One silt sample 21JM017S did not return a Au value with ICP-MS due to interference from other elements, and this sample was re-run using a fire assay fusion for Au, Pt and Pd by ICP-MS (FA130).

Soil Sampling

Soil samples were taken using a hand-dug pit and targeted B-horizon soils. If no B horizon was present, a sample would be taken from the C horizon. Care was taken to avoid loess or volcanic ash contamination where possible. Samples were placed in Kraft paper bags and sent to BV for drying at 60C, sieving to -80 mesh, aqua regia digestion and ultratrace ICP-MS analysis (BV packages SS80 and AQ252).

Porphyry Indicator Mineralogy (PCIM)

Bulk samples were driven to Whitehorse, packed in to 5-gallon buckets and shipped via Manitoulin Transport to Overburden Drilling Management, Nepean, Ontario where the samples were processed for PCIMs, gold, and zircon (Figure 7). A ~300 g archival split is taken for each sample, then the sample is passed across shaking tables for gravity concentration and dry sieved to 0.25 mm. The heaviest fraction is micro-panned for gold, zircon and metallic grains. The table concentrate is passed through heavy liquids to separate a >2.8, g/cm^3 specific gravity fraction and the >2.8 SG material and the coarse fraction treated with an oxalic acid wash to aid picking and logging then dry sieved to 0.25 mm. The coarse fraction ferromagnetic grains are removed by magnetic separation and the non-ferromagnetic grains are further separated into SG 2.8-3.2 and >3.2 g/cm^3 fractions by heavy liquids. The remaining material is sieved to 0.25-0.5 mm, 0.5-1.0 mm and 1.0-1.7 mm size fractions. The SG >3.2 fraction is further separated into strongly, moderately and weakly paramagnetic fractions and nonparamagnetic fractions by currents of 0.6, 0.6-0.8, 0.8-1.0, and >1.0 amps, respectively. All fractions and splits are vialled and archived or used for picking PCIMS, metallic grains, zircon, and gold grains under a binocular microscope by an experienced picker. Grains of unknown or equivocal composition are checked using a scanning electron microscope (SEM). Representative grains are picked and vialled for PCIMs of interest, and all gold grains.

Only selected samples were run for PCIM. For the samples that were not run for PCIM, a zircon-rich separate was produced for geochronology by tabling and micropanning. This separate was examined for gold grains and gold grains were logged and identified, where present, for every sample.

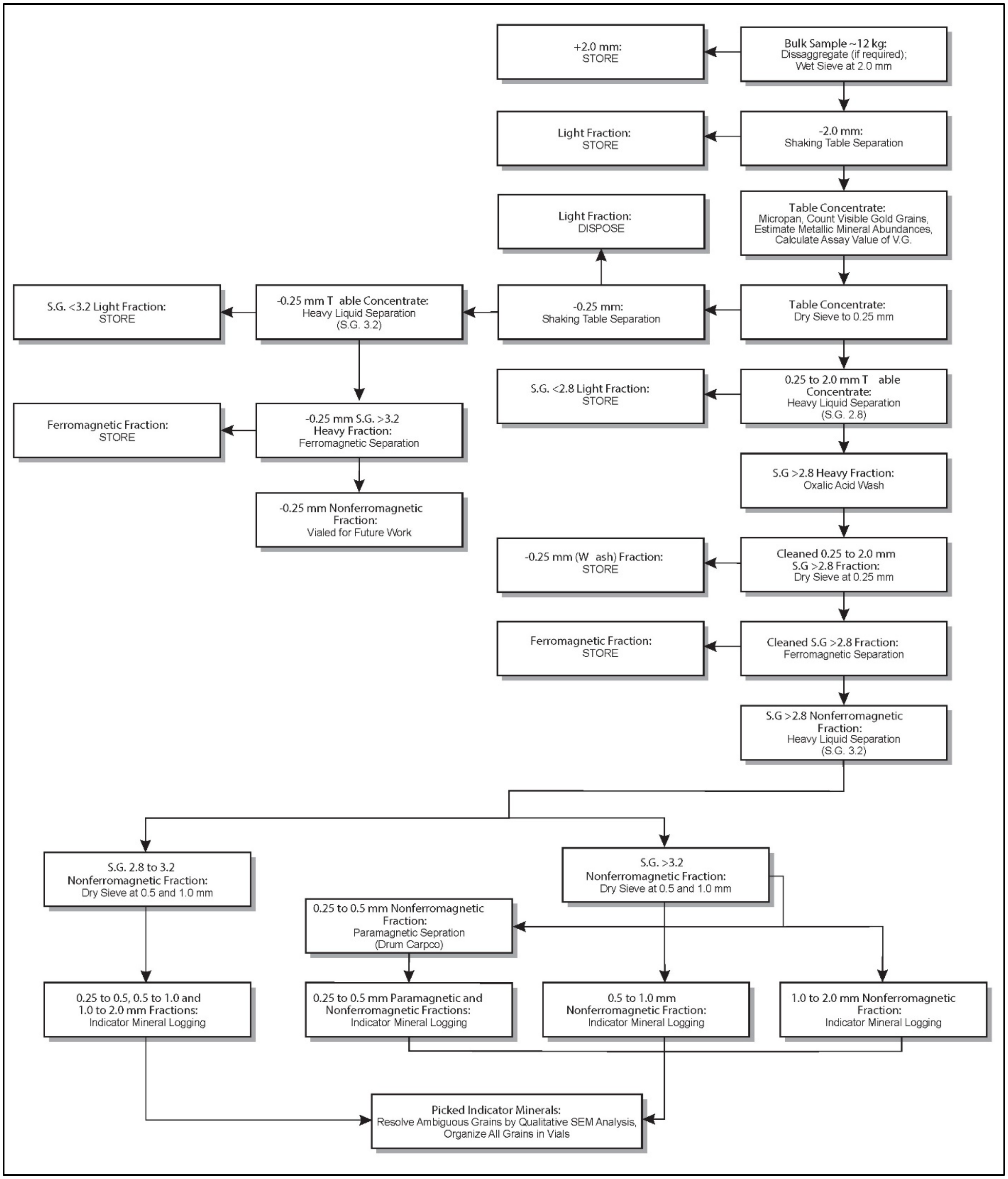

Figure 7 Processing methodology for heavy mineral concentration, gold, metallic and PCIM grain separation (from McClenaghan et al., 2020). Zircons were mostly recovered from the micropanned table concentrate in the <250 micron size fraction. Coarser zircons were recovered in the non-paramagnetic S.G.>3.2 fractions.

Zircon Texture

Zircon grains of interest were examined under the SEM and an electron microprobe mounted cathodoluminescence (CL) system. The CL imaging was employed in order to examine zircon textures, as this has been shown to correlate well with zircon fertility (Bouzari and Hart, 2019; Bouzari et al., 2020). The CL work was carried out at the University of British Columbia Okanagan campus at the Fipke Laboratory for Trace Element Research (FiLTER).

Zircon Geochronology and Chemistry

Zircon rich concentrates <0.25 mm were sent from ODM to FiLTER UBCO for picking, mounting in epoxy pucks, and polishing. The zircon grains were then dated by LA-ICP-MS and simultaneously analyzed for trace element chemistry, including Ti, U, Th, Pb, REE, Ca, P, Zr, Ta, Hf, Y, and Nb. The spot size was 20 microns for regular runs and the instrument used was an Agilent 8900 triple quadrupole ICP-MS equipped with a NWR 193 laser with TV3 sample chamber. Some re-runs were conducted with a 30 micro spot size. Re-runs omitted Nb, Tb, Ho, Tm, and Ta in order to increase integration times on the LREE. Full instrument settings given in digital appendix 4. Standards were measured for trace elements (610 standard), U-Pb dating and trace elements (91500 standard) and U-Pb dating (Plesovice standard).

Re-runs on individual grains refer to grains of interest being re-visited for additional spots after the first round of analyses.

RESULTS

Silt Geochemistry

The gold content of the samples ranged from 1.8 to 40.0 ppb (Figures 8 and 9). The 40 ppb gold sample (21JM017S) is deemed highly anomalous, and is surrounded by two neighbouring drainages (21JM018S and 21JM019S) with elevated gold values of 10.5 and 12.2 ppb. Molybdenum was anomalous (>1 ppm) in sample 21JM014S, 21JM015S, 21JM016S, 21JM018S, 21JM019S, and 21JM020S. No other elements were deemed anomalous including Cu, Ag, Pb, Zn, As, Bi and Sb. Full results listed in digital appendix 2.

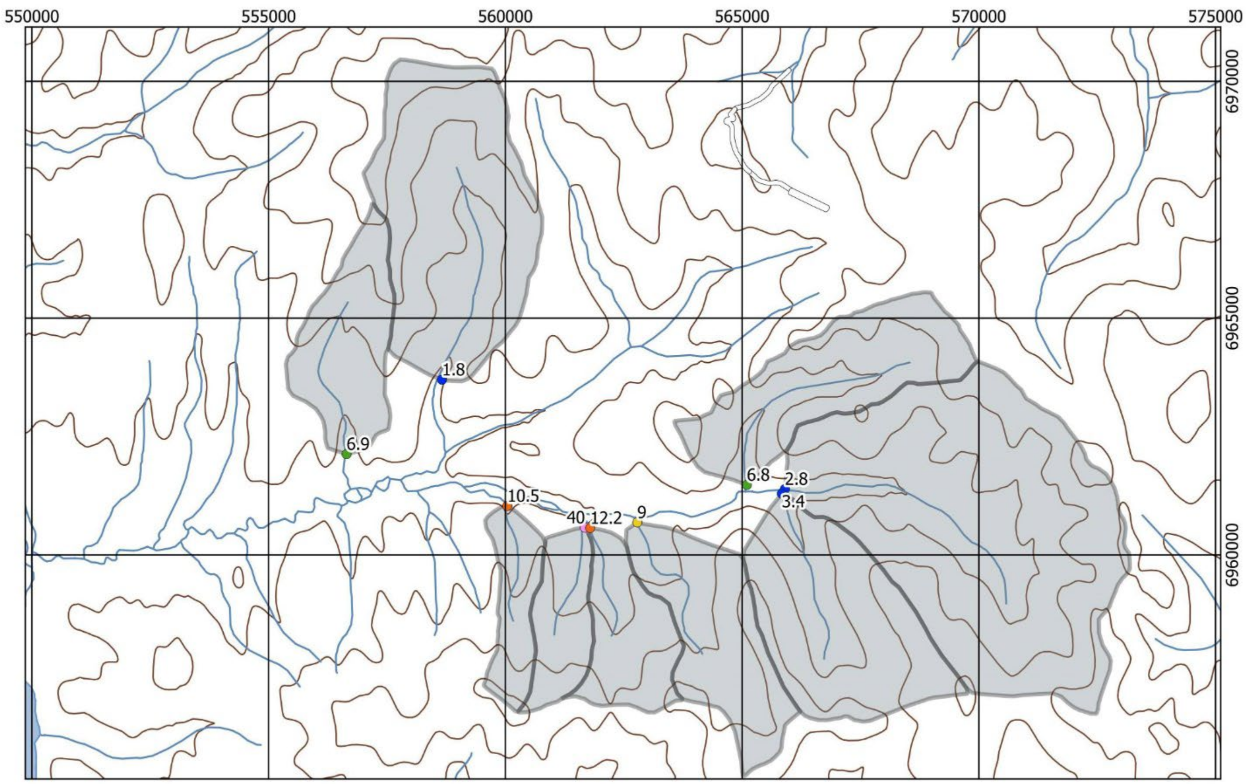

Figure 8 Fine fraction (less than 63 microns) stream sediment aqua regia ICP-MS gold results (ppb). Drainages shown in grey. UTM7 2x2 km grid for scale. 40 ppb Au sample was a fire assay with ICP-MS.

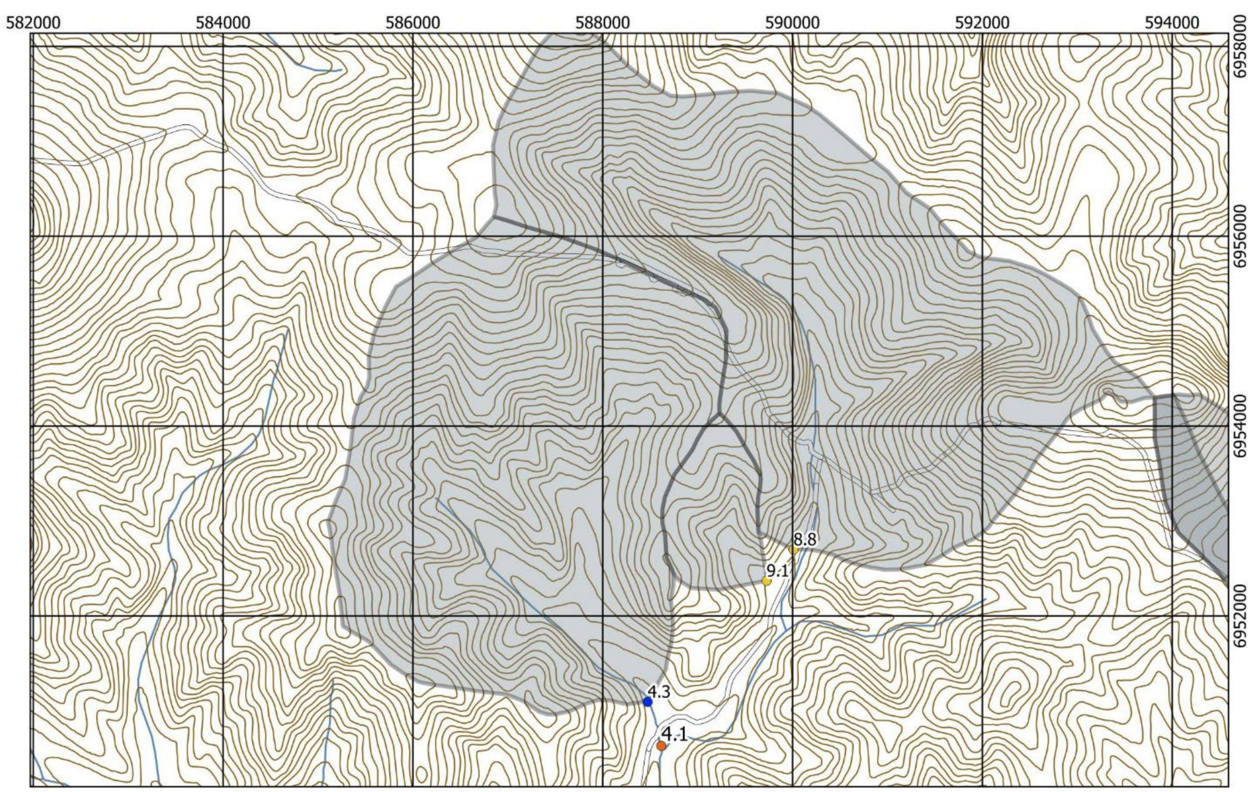

Figure 9 Fine fraction (less than 63 microns) stream sediment aqua regia ICP-MS gold results (ppb). Sample 20JM006S 4.1 ppb Au shown from 2020 program at head of the drainage. Drainages shown in grey. UTM7 2x2 km grid for scale.

Porphyry Indicator Mineralogy

Full data, weights, and picked minerals are listed in digital appendix 3.

All samples were examined for gold grains and some gold grains were detected in a few samples. The most strongly anomalous samples were 21JM017B and 21JM021B, yielding 16 and 22 gold grains respectively, both including pristine shaped gold grains, inferred not to be affected by significant erosion and being located close to their bedrock source. It should be noted that samples 21JM021B and 21JM023B had low weights, so fewer gold grains would be expected in these heavy mineral concentrates, and the 22 and 4 gold grains recovered from each sample, respectively, equate to ~59 and ~14 gold grains when normalized to a bulk sample weight of 10 kg, making sample 21JM021B strongly anomalous for gold.

Zircons in the panned concentrated were abundant in all samples and ranged from an estimated 1,500 to 20,000 grains.

Porphyry copper indicator minerals were logged for 21JM017B, 21JM018B, 21JM020B, 21JM021B, 21JM022B, 21JM023B, and 21JM024B. Counts were generally low for all samples, however traces of scheelite were identified in 21JM020B, 21JM021B and 21JM024B. Pyrite was also found in 21JM020B. Scheelite is a favourable indicator, as tungsten minerals ferberite and scheelite are found in the Canadian Creek placer immediately below the Casino deposit (Bostock, 1959). Grossular was recovered in substantial quantities (~3000 grains) from samples 21JM024B; these high garnet concentrations are likely sourced from Yukon-Tanana schists and gneisses, and such rocks were noted to be abundant at this bulk sample site. Owing to the presence of these metamorphic rocks, garnet is not a useful indicator of porphyry mineralization in this district. There is likely a higher portion of metasedimentary rocks present in this drainage, consistent with the original mapping by Cairnes (1912).

No mid density porphyry copper indicator minerals were found in any samples. The mid density particles consist mainly of coarse-grained hornblende and hornblende with attached plagioclase, epidote-altered plagioclase and minor goethite.

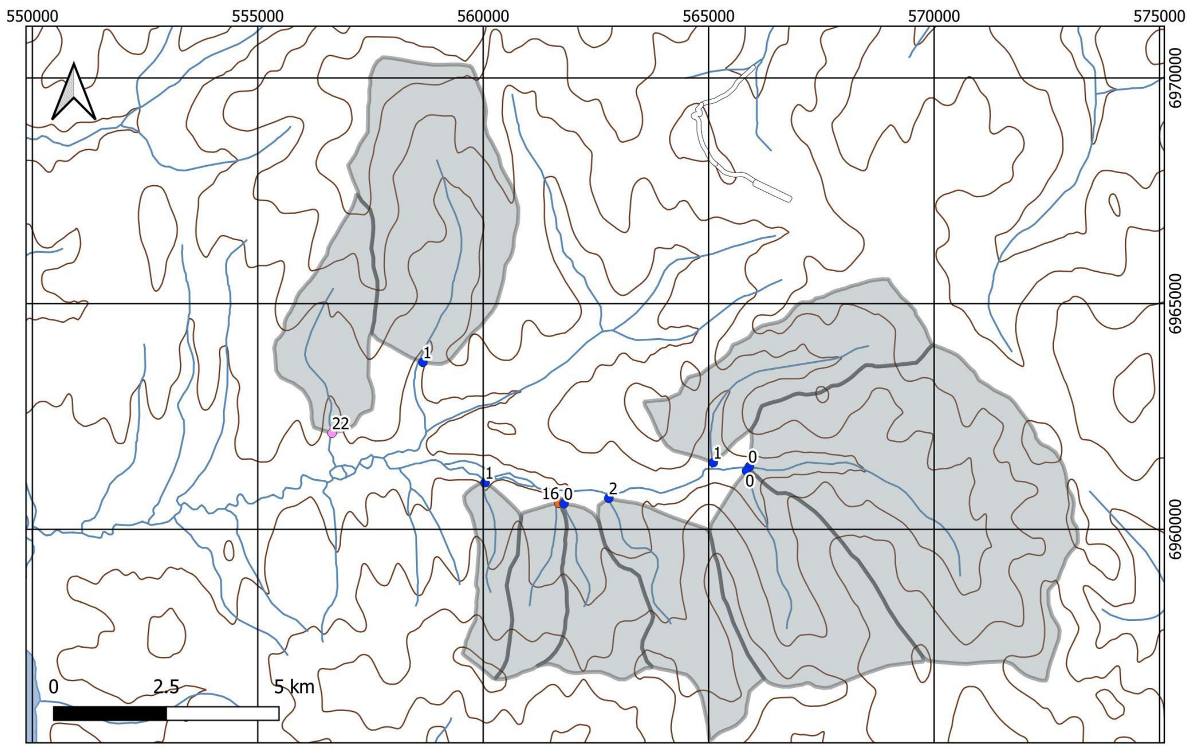

Figure 10 Total number of gold grains logged in bulk samples for each drainage (grey polygons), Home Creek.

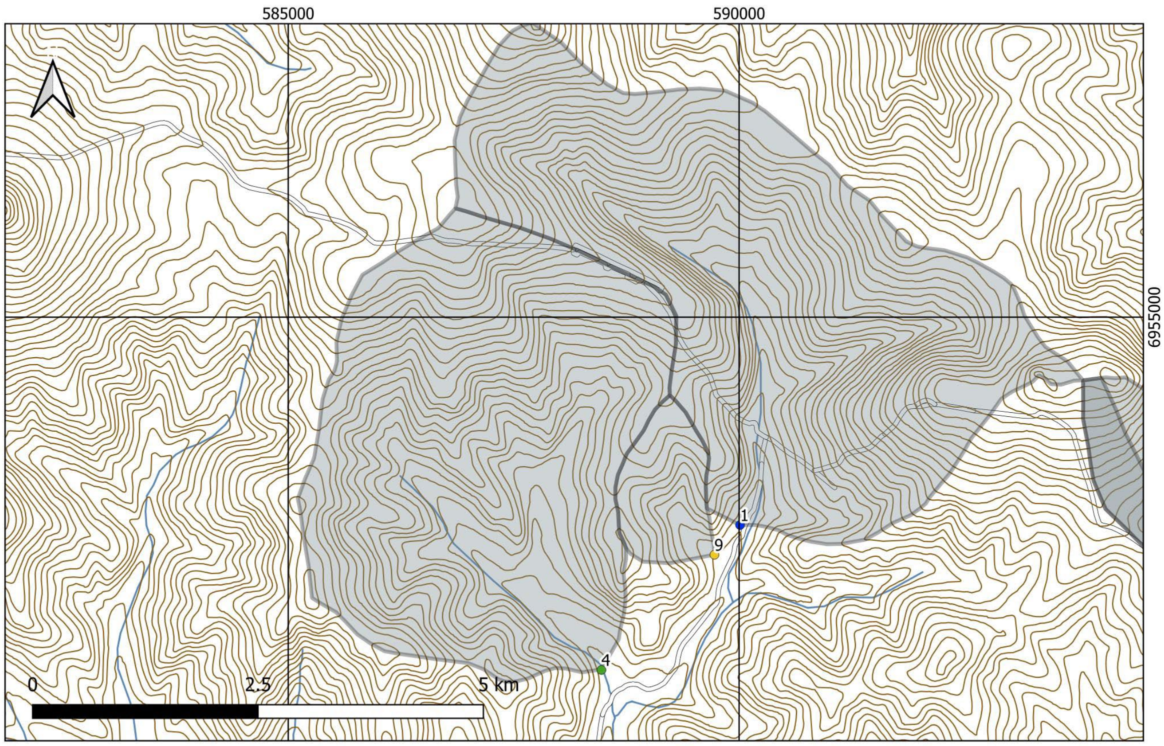

Figure 11 Total number of gold grains logged in bulk samples for each drainage (grey polygons). Polaris area.

Soil sampling

A total of 11 soil samples were taken opportunistically whilst prospecting. Good soils were developed but no anomalous results were returned.

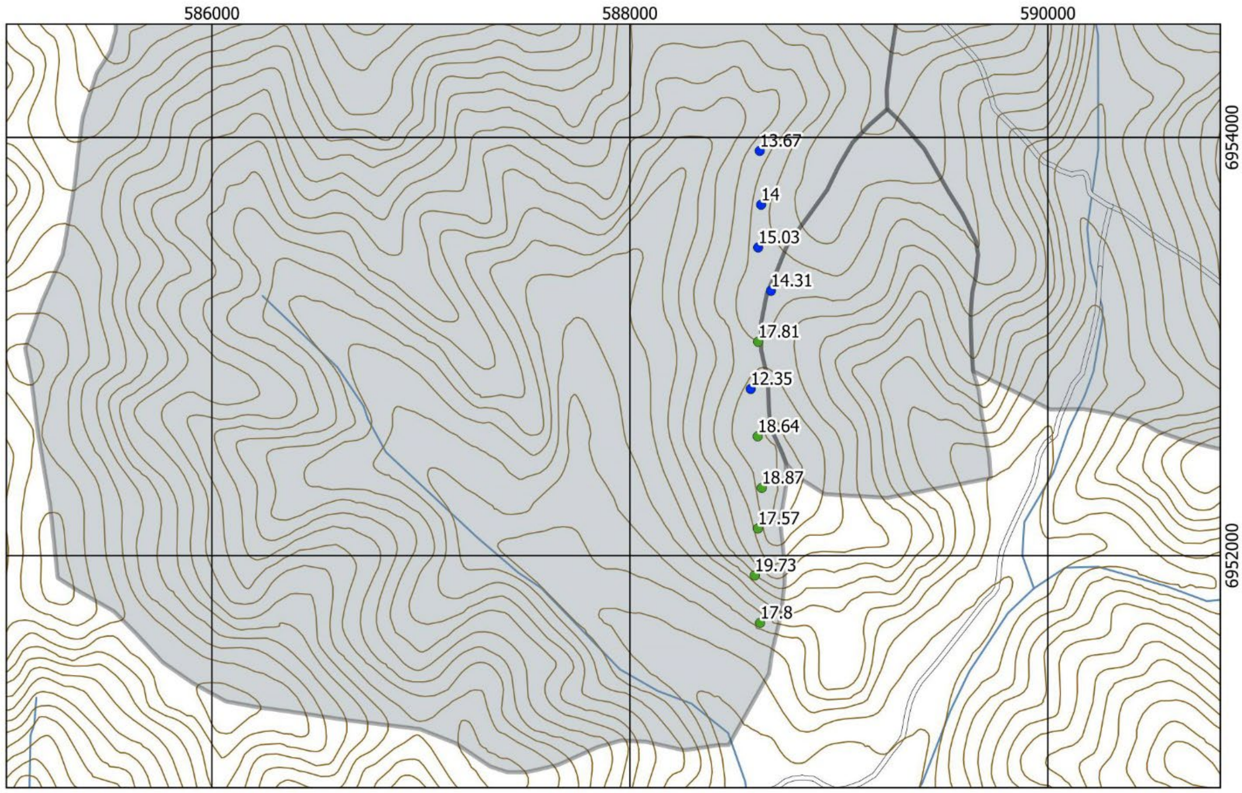

Figure 12 Copper in soil results (ppm aqua regia ICP-MS). 2x2 km UTM7 grid for scale. North is up.

Zircon Geochronology

Zircons were dated from each bulk sample. All dates reported in the text are $^{206}Pb/^{238}U$ dates corrected for common lead by the Stacey and Kramers method and errors are reported as absolute two standard errors of the mean dates. A total of 1,001 analyses were carried out, including single spots and multiple spots on each grain. Full sample data can be found in digital Appendix 4. Unless otherwise stated, all spots were aimed at the centre of the zircon grain. Spot locations for re-analyses are shown in Appendix 4. Weighted mean ages are presented in Figures 15 to 26, however these do not represent crystallization ages of the rock suites from which they are derived. The intrusive suites and volcanic rocks considered are likely comprised of a range of different intrusions that may have crystallized throughout a prolonged span of magmatic or volcanic activity, and within each igneous phase there may be antecrystic or xenocrystic zircons that yield dates older than the age of magmatic crystallization or volcanic eruption. Detrital zircons in recent stream sediments are a mix of all zircon-bearing lithologies contained within the drainage, and therefore may represent a mix of different age igneous rocks. At best, the weighted means should be considered an average of the intrusive age of rocks within the considered fraction of the zircon sample population, but the precision is not meaningful. Weighted mean plots show ages included in the mean as green, outliers not included in the mean as blue or open boxes, and potential Casino Suite zircons in red. All ages are shown with 2SE and only zircons between 50 and 300 Ma are plotted for clarity. All zircon data can be found in Appendix 4.

Attempts are made to trace zircons back to bedrock sources within each drainage, by relating zircon dates to intrusive suites and other rock types that are well known across SW Yukon (for reviews see Allan et al., 2013; Sack et al., 2020). In many cases, suggestions are put forth for occurrences of unmapped units within each drainage, however it is recognized that any of the zircons could have a xenocrystic origin and may not indicate the presence of the suggested unmapped rock units in the drainage.

All bulk sample locations and the areas of drainages are shown on Figures 13 and 14.

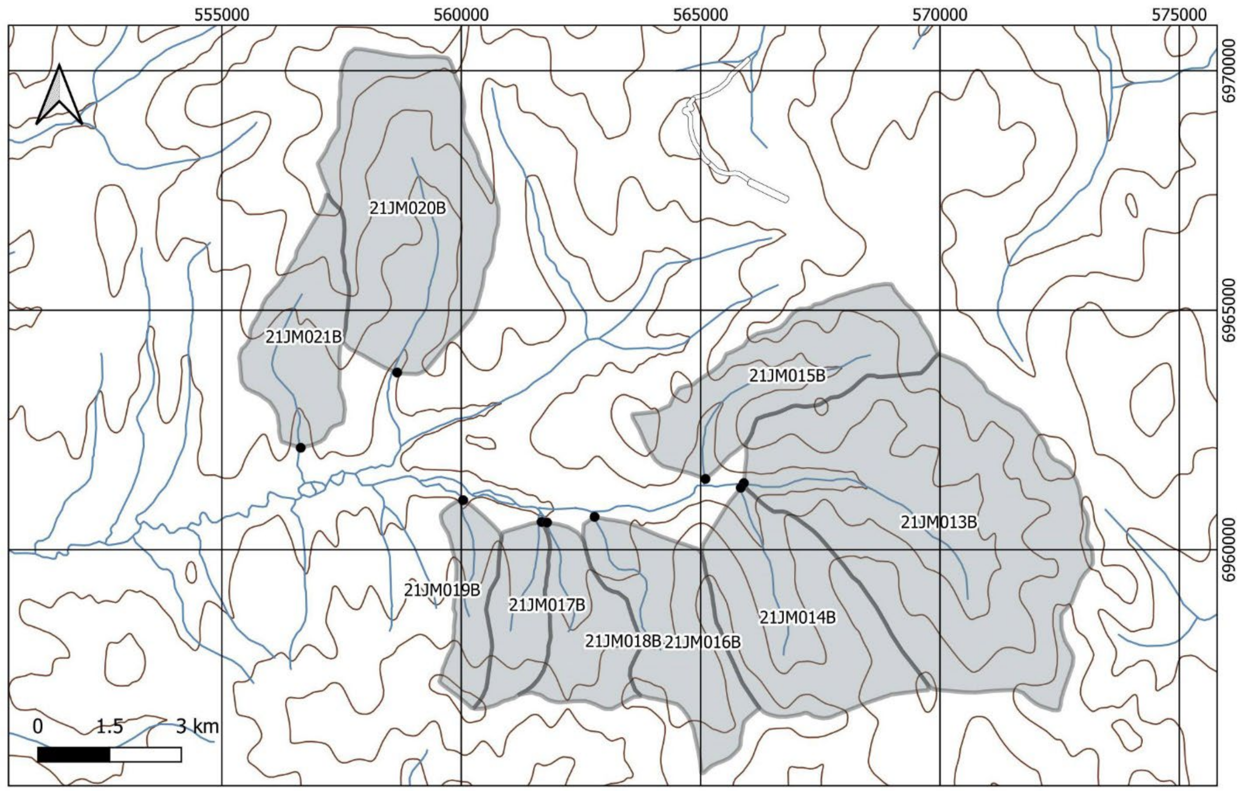

Figure 13 Locations of Home Creek bulk sample drainages and sample sites.

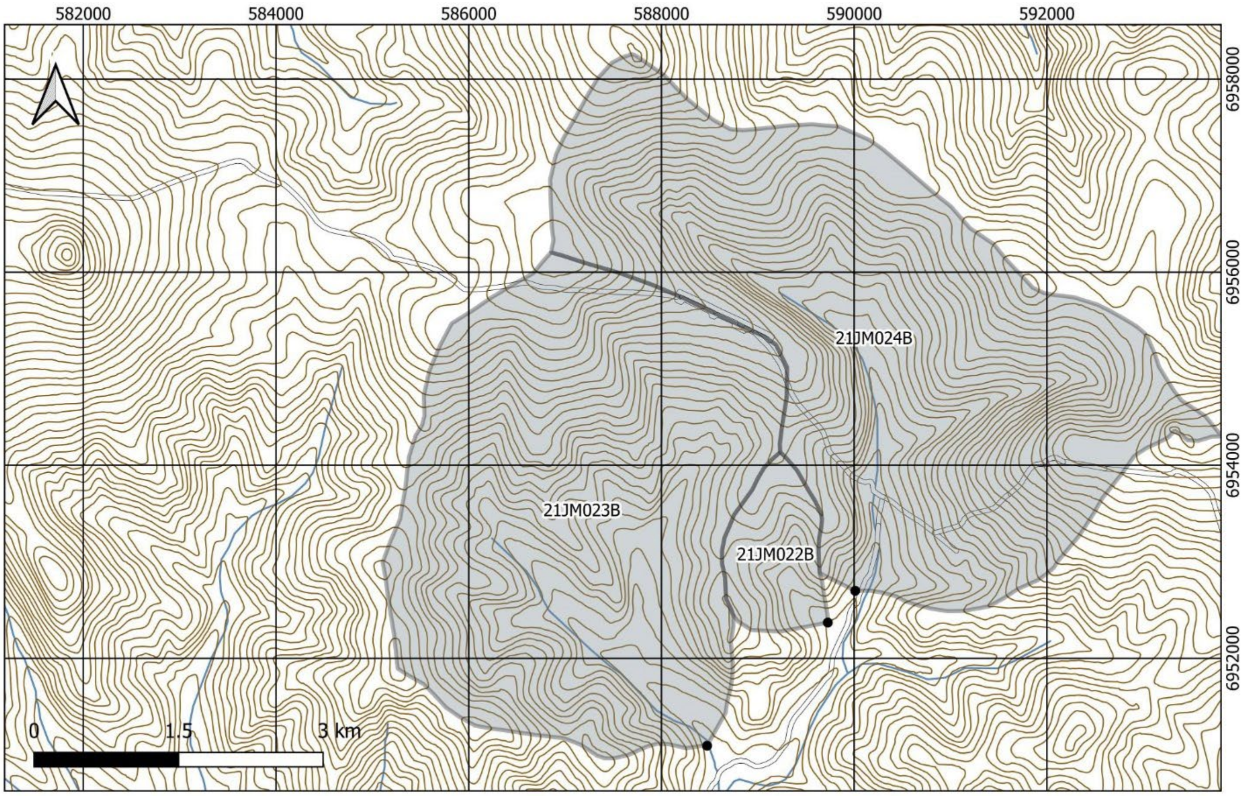

Figure 14 Locations of Polaris bulk sample drainages and sample sites.

EXPLORATION BULK SAMPLE DETRITAL ZIRCON RESULTS

The vast majority of the zircons dated in this exploration project yielded ages associated with the Dawson Range Batholith ~110 Ma or Coffee Creek Granite ~100 Ma, as this is the dominant bedrock lithology in the area. Some zircons are older, particularly where zircons are being eroded from Yukon-Tanana metasedimentary rocks, and some older zircons may be inherited within igneous rocks. These ages are not further considered here, as they are not associated with the exploration target. Younger zircons (<~90 Ma) are considered, particularly those potentially derived from Casino Suite rocks (~80-70 Ma) and Prospector Mountain Suite rocks (~69-66 Ma) as either of these suites may be associated with porphyry Cu-Au-Mo mineralization. There is temporal overlap between Casino Suite and Prospector Mtn suite rocks. The Casino Suite is thought to be more highly prospective than the Prospector Mtn suite, so zircons yielding ages of ~80-72 Ma are considered better follow-up targets than those of a crossover, ~72-69 Ma age, or those from the Prospector Mtn suites ~69-66 Ma.

<u>21JM013B</u>

This drainage is 32.76 km^2 in area and 208 zircons were dated (Figure 15). One ~65 Ma and one ~62 Ma zircon were found within the drainage but no Casino Suite zircons were identified.

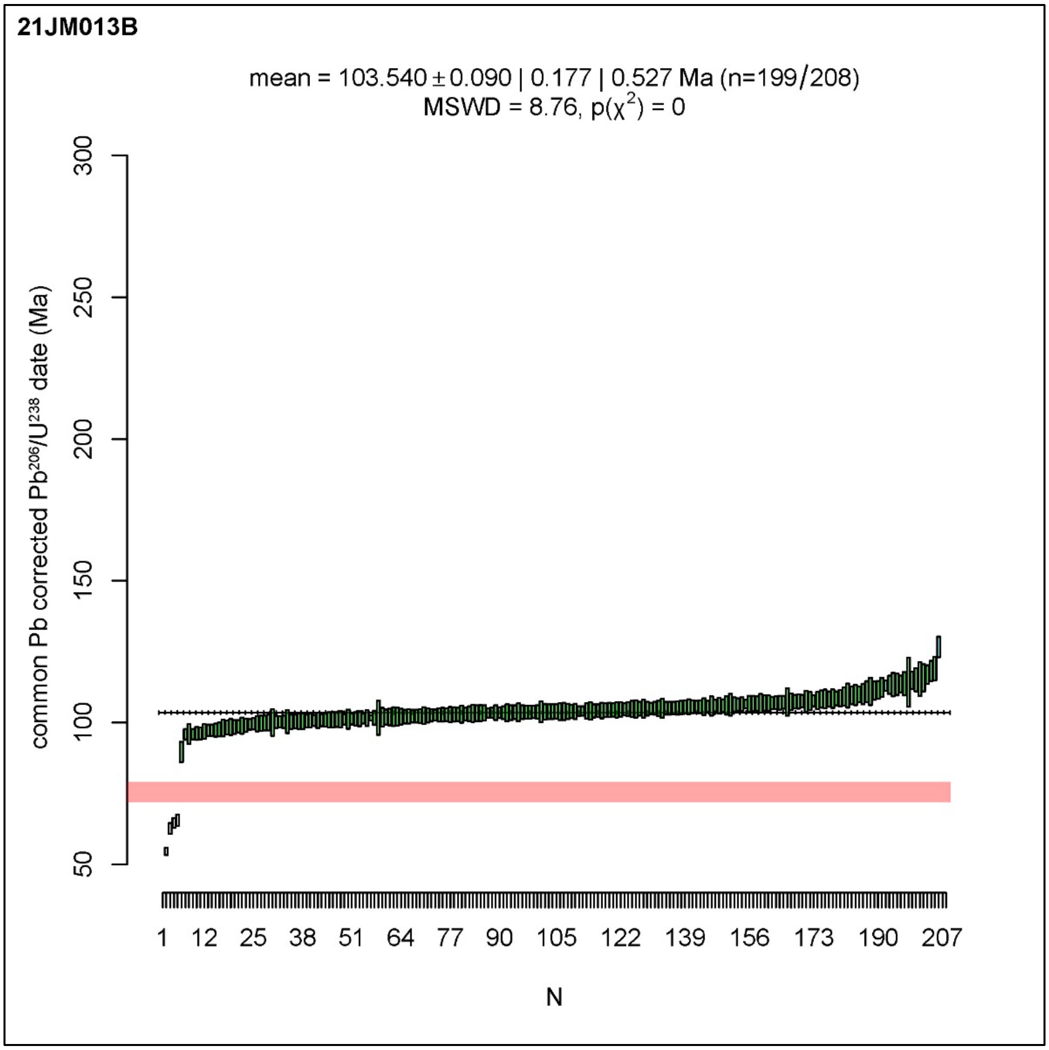

Figure 15 Weighted average age of Dawson Range batholith zircons detected in sample 21JM013B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013)

<u>21JM014B</u>

This drainage is 13.19 km^2 in area and 88 zircons were dated (Figure 16). One zircon with a date of ~70 Ma (from 3 spots) yielded a crossover age between Casino and Prospector Mtn Suites.

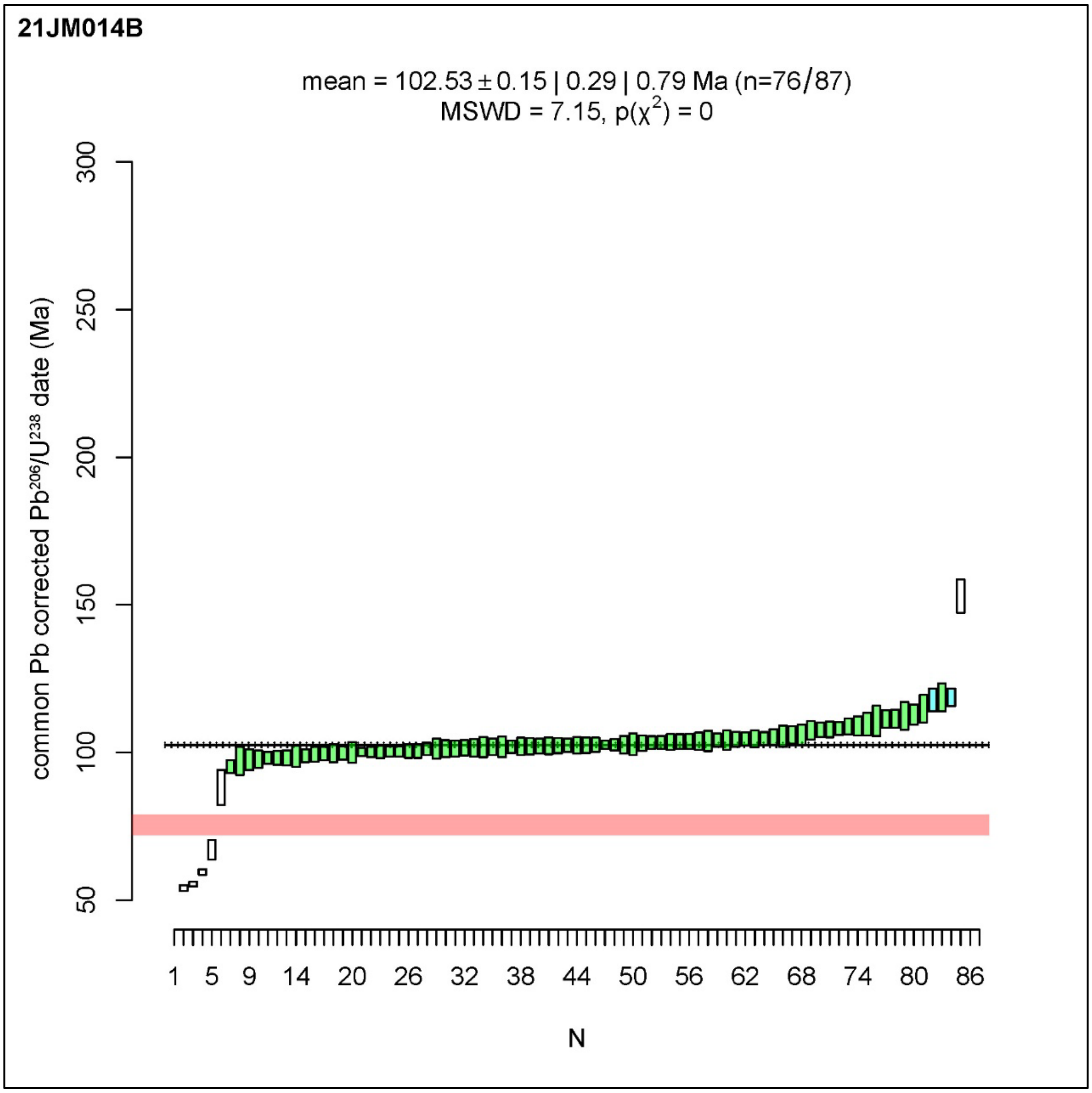

Figure 16 Weighted average age of Dawson Range batholith zircons detected in sample 21JM014B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013)

<u>21JM015B</u>

This drainage is 10.82 km^2 in area and 66 zircons were dated (Figure 17). No Casino Suite age zircons were detected.

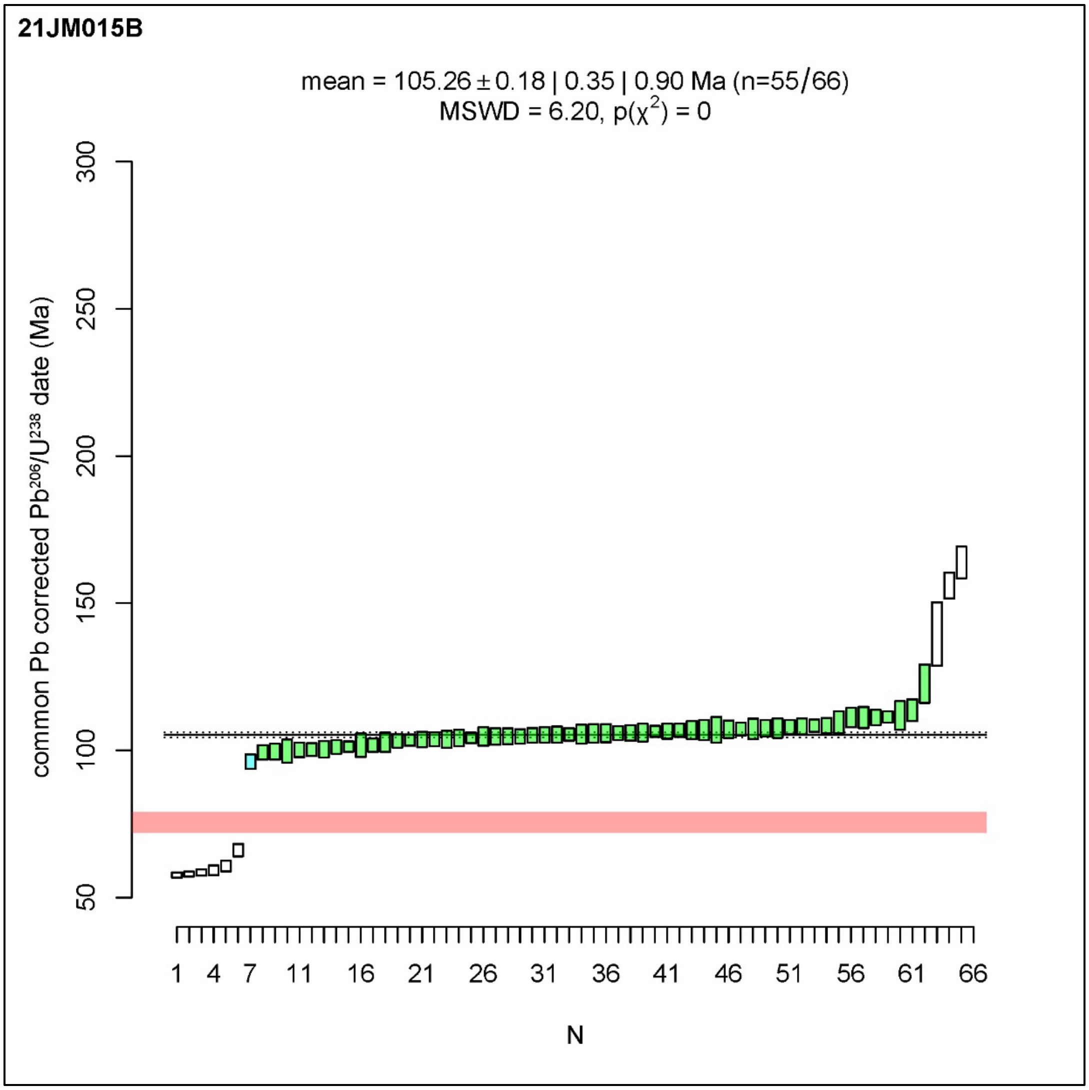

Figure 17 Weighted average age of Dawson Range batholith zircons detected in sample 21JM015B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM016B</u>

This drainage is 8.91 km^2 in area and 60 zircons were dated (Figure 18). One zircon was dated with three spots to give a date of ~84 Ma, possibly representing an Early Casino Suite age, or a late phase of the Home Creek granite. One zircon with two concordant spots yielded a date of 68 Ma representing Prospector Mtn age. One zircon was dated with two discordant rim spots as ~72 Ma with a concordant core date of ~79 Ma, representing a Casino Suite age. The average age of the "Dawson Range Batholith" from this sample is significantly younger, and likely represents significant input from the Home Creek pluton, with an approximate ~100 Ma date that matches a U-Pb TIMS date of 102.5 ± 0.9 Ma (Mortensen 99M-106b in YGS Geochronology database), located approximately 3.5 km E of the drainage.

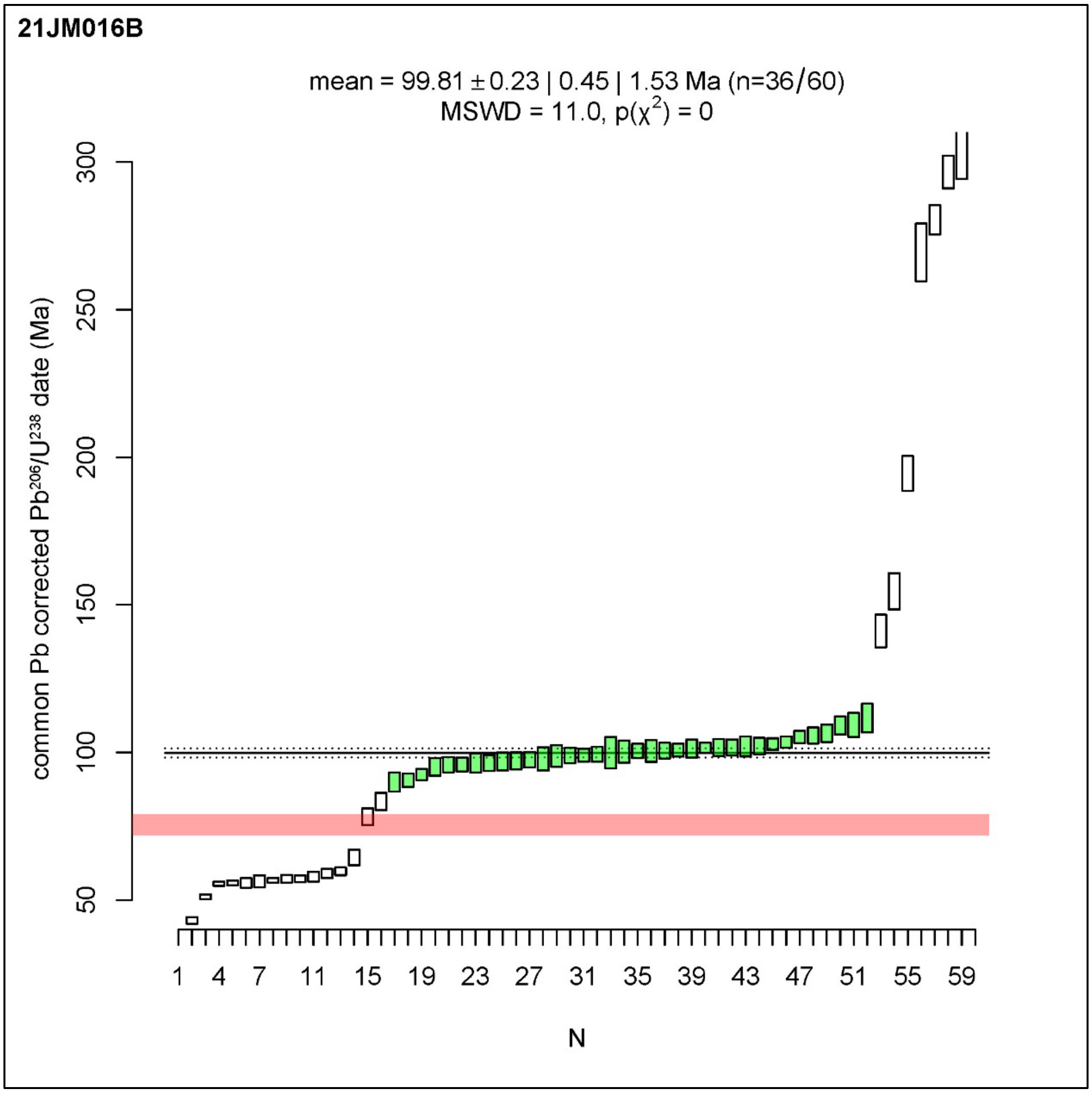

Figure 18 Weighted average age of Dawson Range batholith zircons detected in sample 21JM016B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM017B</u>

This drainage is 4.07 km^2 in area and 33 zircons were dated (Figure 19). A single Casino Suite zircon was identified with possibly a ~72 Ma core with a ~69 Ma rim. Similar to 21JM016B, this sample has a younger average age of "Dawson Range Batholith" of ~100 Ma, likely representing the Home Creek pluton.

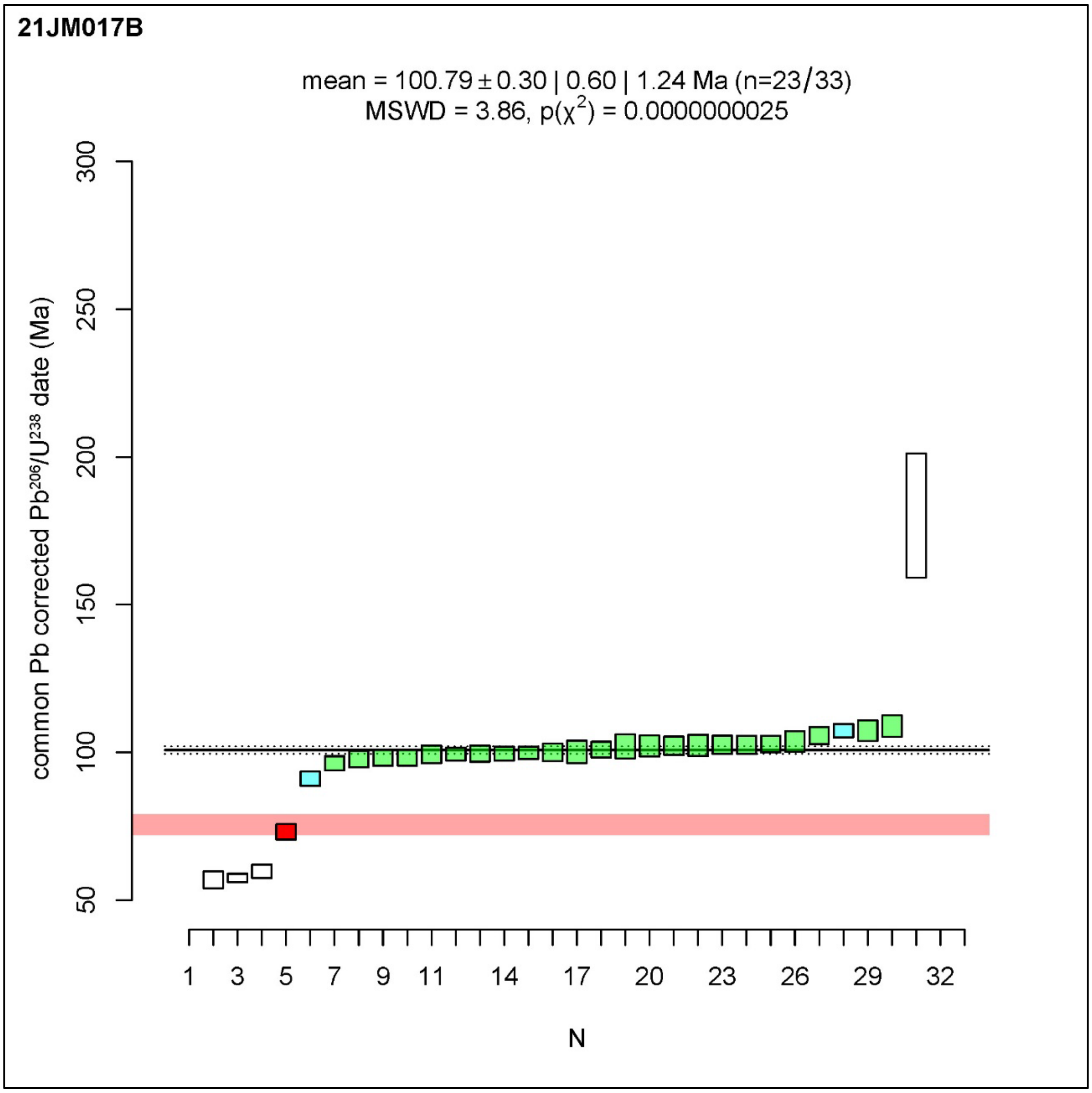

Figure 19 Weighted average age of Dawson Range batholith zircons detected in sample 21JM017B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM018B</u>

This drainage is 5.51 km^2 in area and 40 zircons were dated (Figure 20). Two Casino Suite zircons were detected, one with a single spot 76 ± 4 Ma discordant analysis, and another with five spots showing a range of dates from 80 to 65 Ma, tentatively representing either a Casino Suite or Prospector Mtn age. Two grains with single spot analyses returned dates of ~67 and ~69 Ma, representing Prospector Mtn age. A ~100 Ma age of most zircons in this sample is likely due to a significant contribution of Home Creek pluton zircon to the sample population.

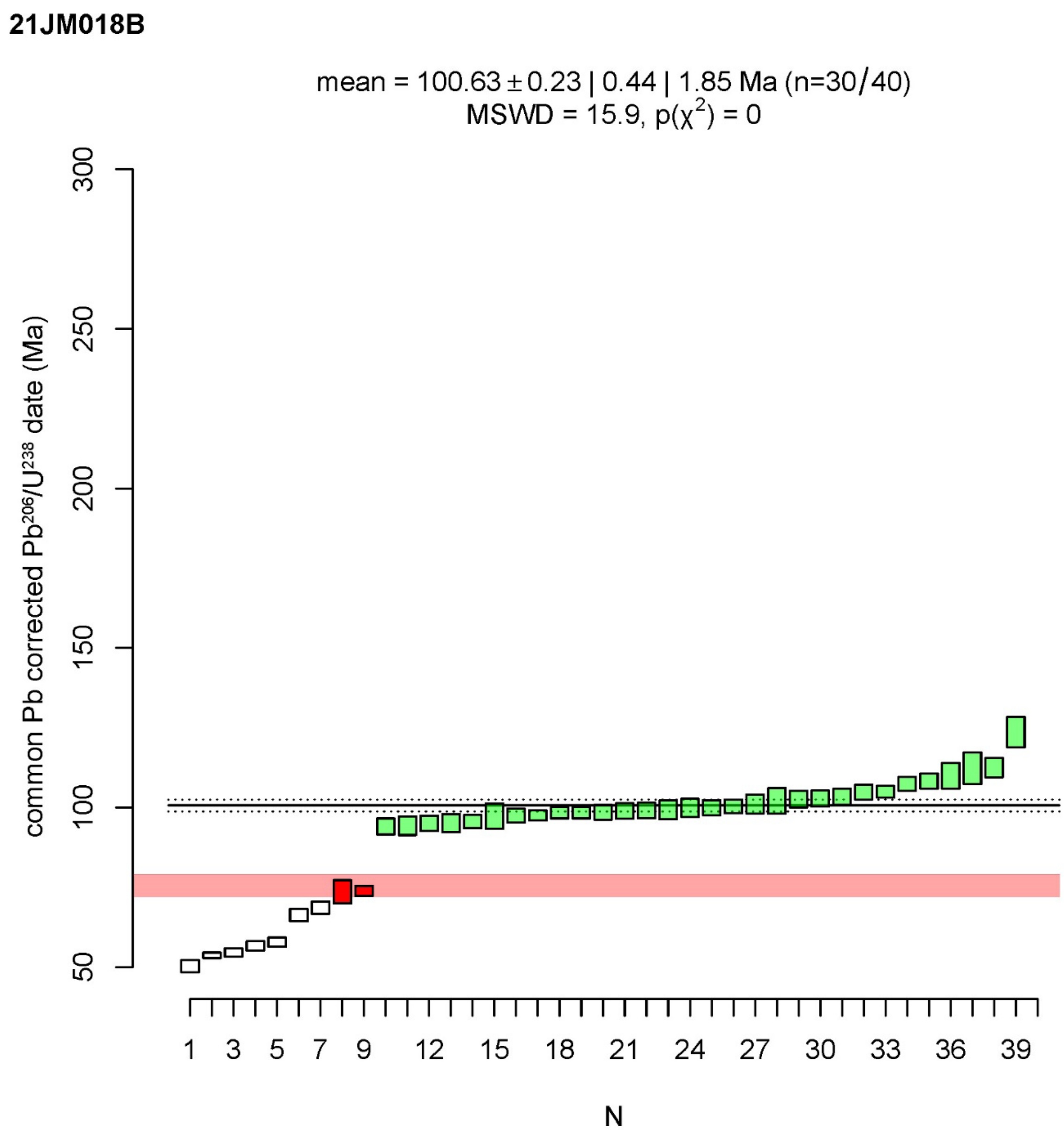

Figure 20 Weighted average age of Dawson Range batholith zircons detected in sample 21JM018B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM019B</u>

This drainage is 3.50 km^2 in area and 34 zircons were dated (Figure 21). No Casino Suite zircon detected. A cluster of zircon around 150 Ma may represent late Jurassic MacGregor suite intrusions. The ~100 Ma age of most zircons in this sample likely represents the Home Creek Pluton.

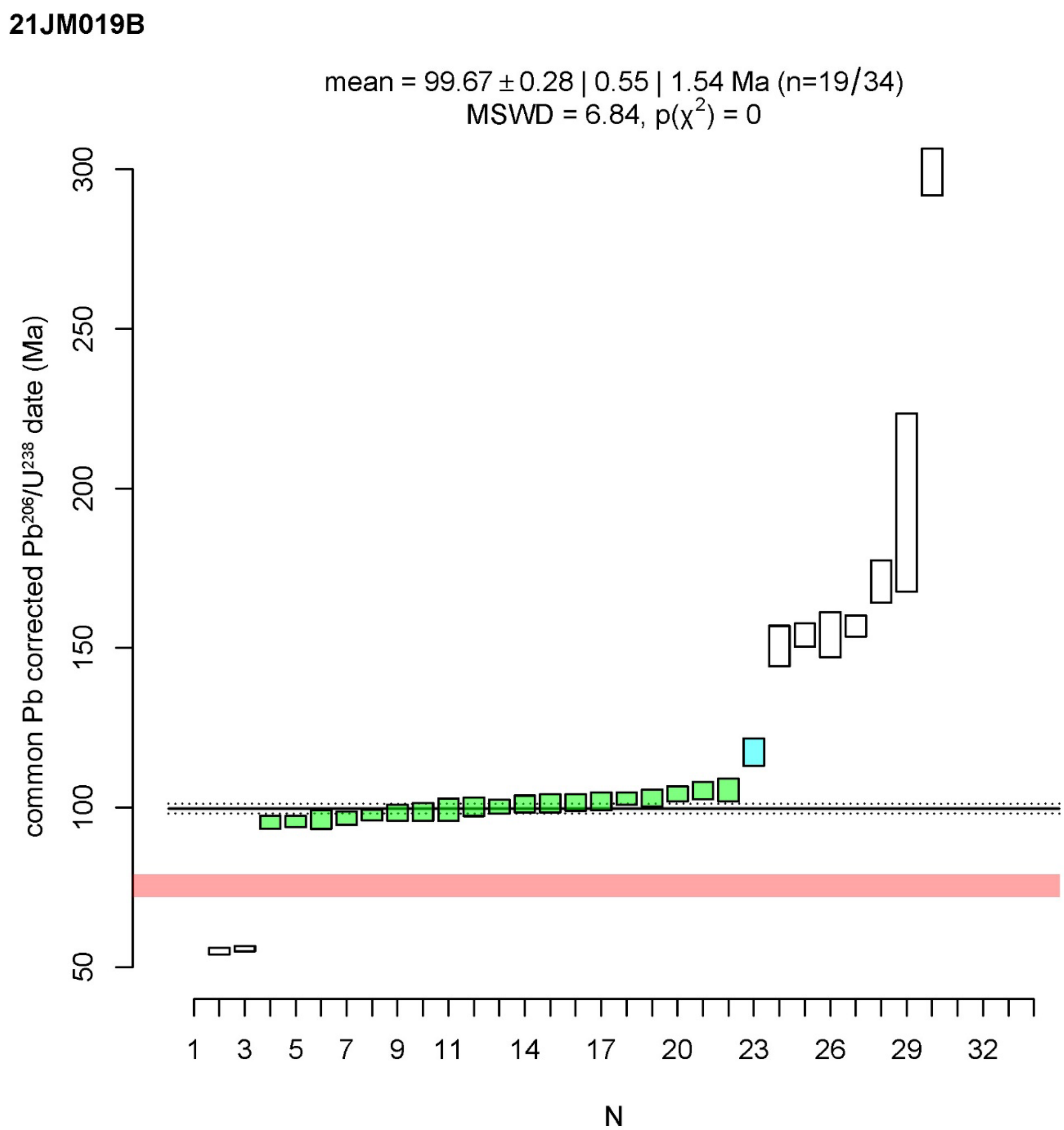

Figure 21 Weighted average age of Dawson Range batholith zircons detected in sample 21JM019B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM020B</u>

This drainage is 18.26 km^2 in area and 84 zircons were dated (Figure 22). No Casino Suite zircons were detected. A population of Palaeocene zircons were detected, including a few grains that are tentatively Prospector Mtn age, or possibly younger.

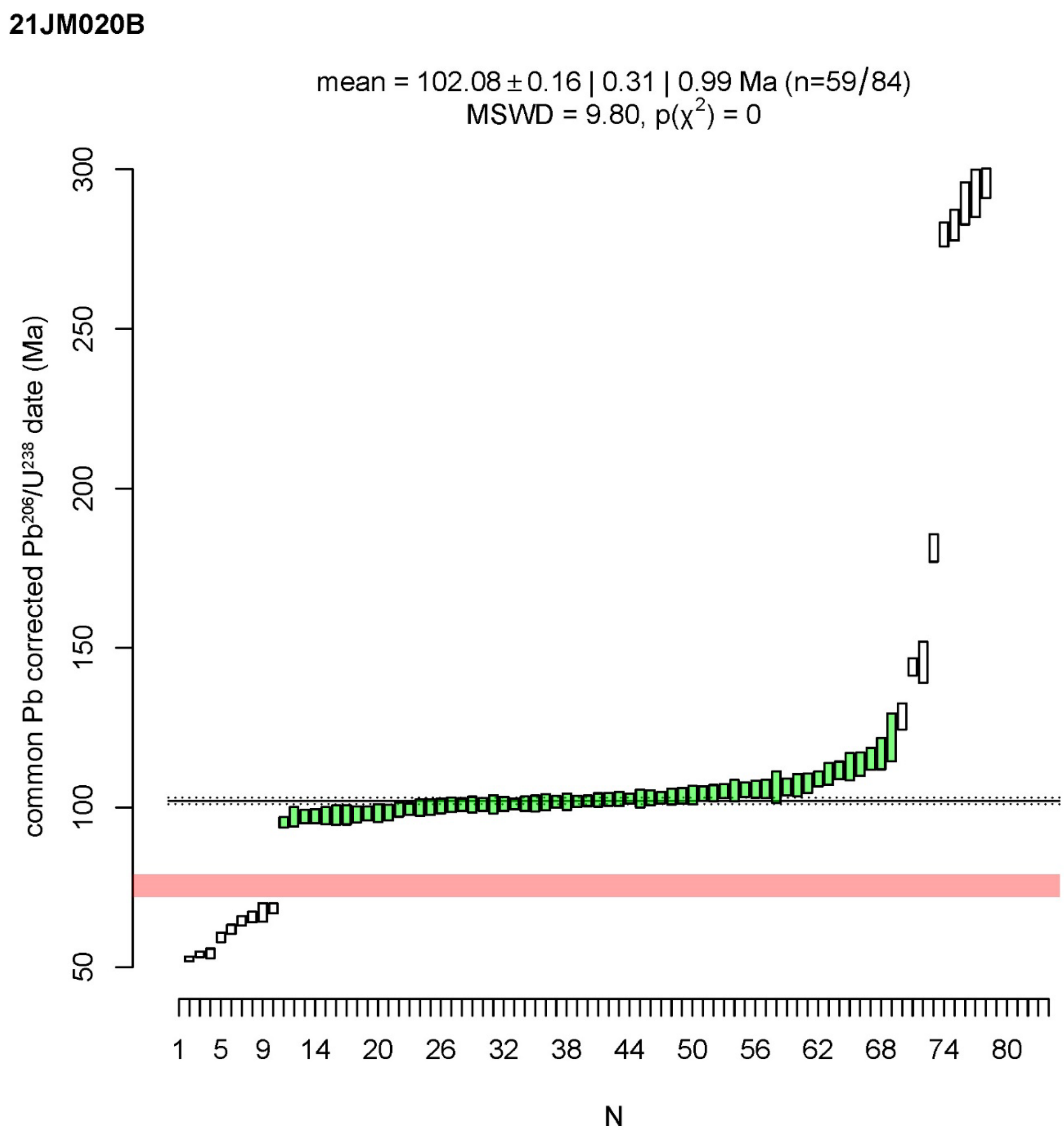

Figure 22 Weighted average age of Dawson Range batholith zircons detected in sample 21JM020B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM021B</u>

This drainage is 7.25 km^2 in area and 49 zircons were dated (Figure 23). A population of 7 zircons yielded a weighted mean date of 67.1 ± 0.3 Ma from the first analysis of each grain, representing a clear Prospector Mtn Suite age in the drainage. Subsequent follow up spots on these grains show three clear Prospector Mtn dates, one grain with a range of Casino Suite dates, two grains with Palaeocene ages, and one with a crossover Prospector Mtn/Palaeocene age. There is also a clear Palaeocene age in the sample population, likely derived from the Rhyolite Creek age volcanic rocks mapped in the drainage.

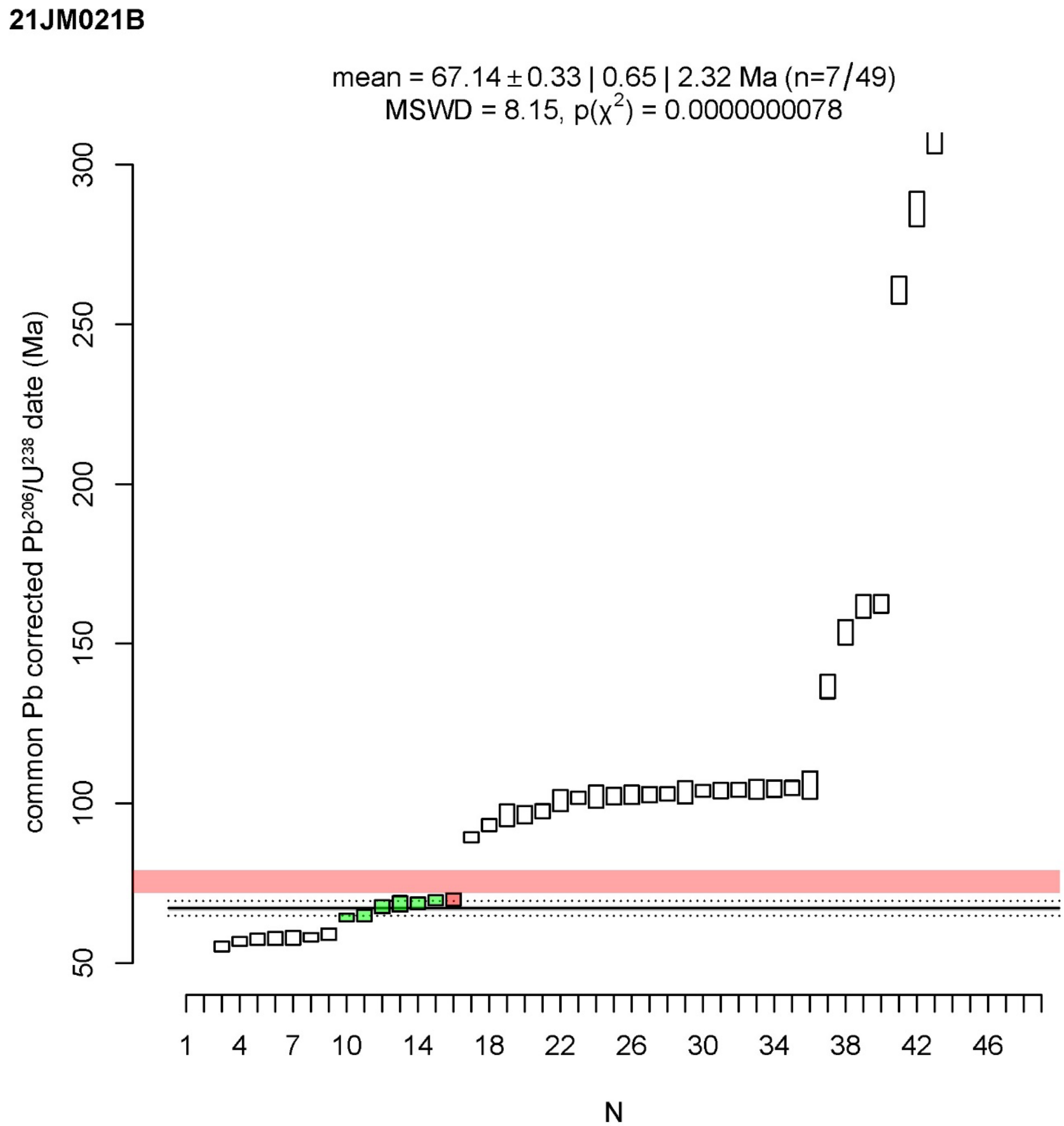

Figure 23 Weighted average age of Prospector Mtn Suite zircons detected in sample 21JM021B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM022B</u>

This drainage is 1.48 km^2 in area and 33 zircons were dated (Figure 24). No Casino Suite zircons detected.

21JM022B

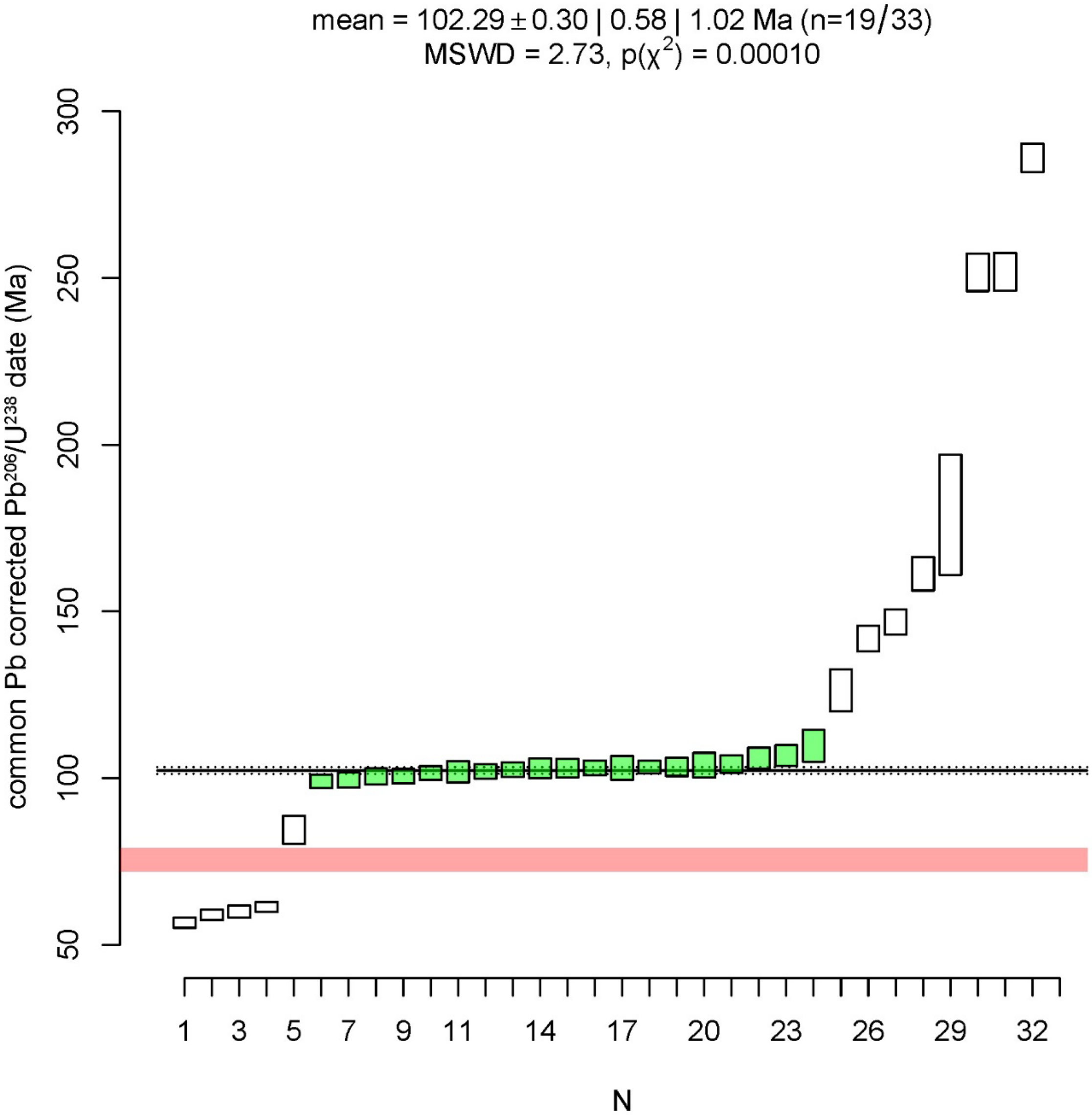

Figure 24 Weighted average age of Dawson Range batholith zircons detected in sample 21JM022B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM023B</u>

This drainage is 16.15 km^2 in area and 107 zircons were dated (Figure 25). A distinct population of Casino Suite zircons are present in the drainage. Re-analyses confirmed one grain at 71.9 ± 0.4 Ma, another at 75.0 ± 0.6 Ma, another at 70.3 ± 0.7 Ma, another with a Casino Suite age core and Prospector Mtn age rim, and two likely Palaeocene but unconfirmed dates.

21JM023B

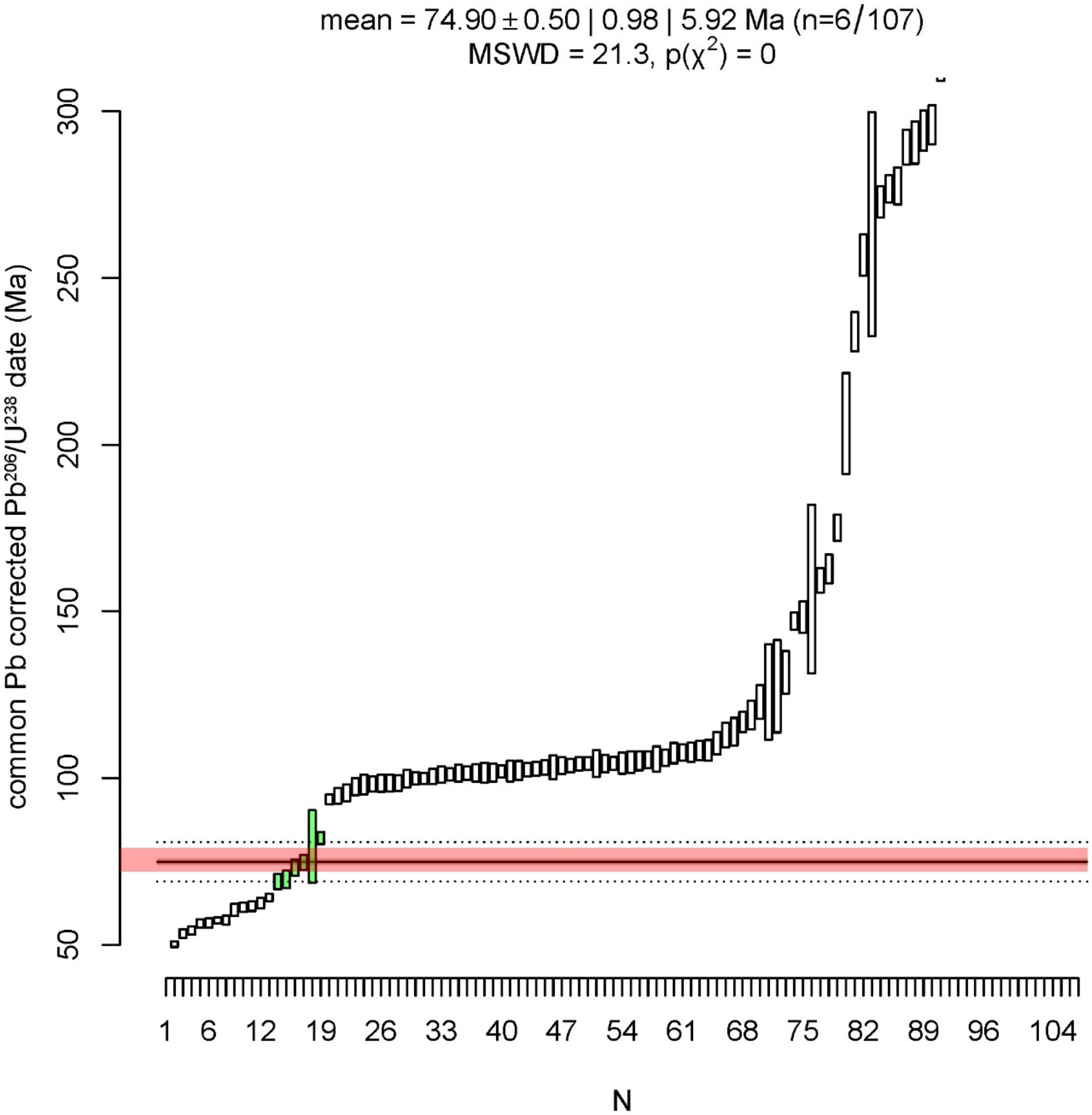

Figure 25 Weighted average age of Casino Suite zircons detected in sample 21JM023B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

<u>21JM0024B</u>

This drainage is 18.45 km^2 in area and 124 zircons were dated (Figure 26). No Casino Suite zircons detected.

21JM024B

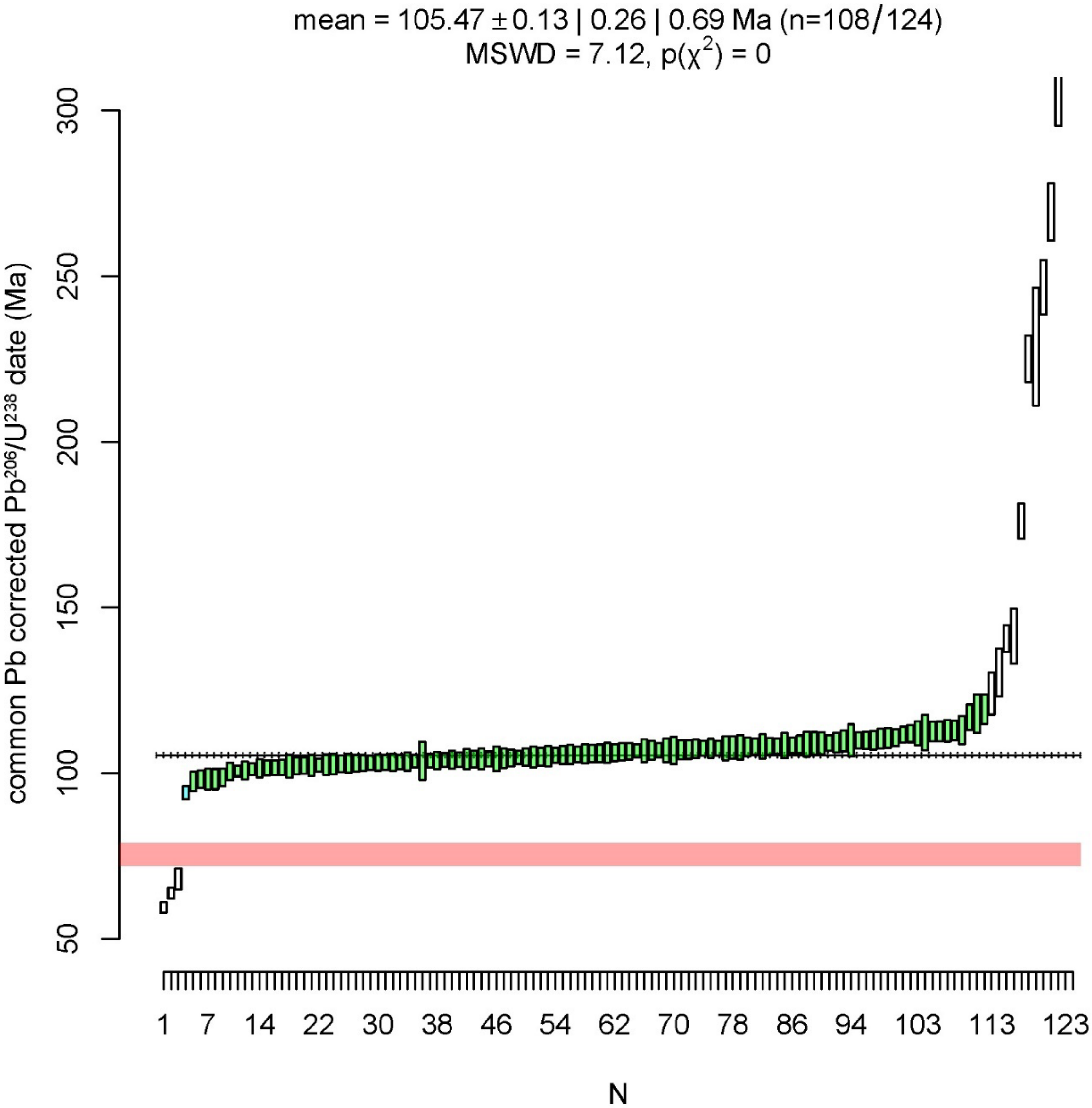

Figure 26 Weighted average age of Dawson Range batholith zircons detected in sample 21JM024B. Pink window 79-72 Ma represents Casino Suite as defined by Allan et al. (2013).

Zircon Chemistry

Methodology outlined in Lee et al. (2020) was followed and zircons with Ca concentrations above detection (~>300 ppm Ca) and La > 1 ppm were excluded to avoid cases where apatite and melt inclusions may have been ablated. The REE concentrations were normalized to chondrite values (Anders and Grevesse, 1989), multiplied by 1.3596 (after Mazdab and Wooden, 2006). Normalized values (Ce_N, Nd_N, Sm_N, Gd_N) were used to calculate Ce/Ce_N^* ($Ce_N/((Nd_N)^2)/Sm_N$) using the method of Loader et al. (2017) and Eu/Eu_N^*

($Eu_N/(Sm_N*Nd_N)^{0.5}$) by the method of Dilles et al. (2015). An exponential power function was used to calculate Ce/Ce_C* values using a new method that omits Ho, Tb and Tm from the calculation (but otherwise following methods in Zhong et al., 2019; Lee et al., 2020). Some calculations were hampered by a high detection limit for Nd (~0.1-1.0 ppm varying in each analytical session), Sm and Eu – particularly the routine first analysis of each grain in 2021. The re-runs were analyzed using increased integration times on the LREE in order to lower detection limits and make these calculations possible. Values of Eu, Nd and Sm below detection preclude the calculation of the Eu/Eu_N* value – the best indicator of porphyry fertility in zircon chemistry. Values of Eu/Eu_N* above 0.3 are considered fertile for porphyry mineralization. Only the chemistry of zircons from samples containing Casino Suite age zircons are discussed here but full data are in digital Appendix 4. Temperatures were calculated using the Ti in zircon geothermometer (Ferry and Watson, 2007). Zircons with Ti concentrations greater than 30 ppm were discarded from all temperature plots, to preclude the influence of Ti-bearing mineral inclusions such as rutile.

<u>Europium anomalies</u>

The Casino Suite zircons in samples from the 2020 orientation study from Canadian and Casino creeks produced Eu/Eu_N* values of 0.38 to 1.08, well above the threshold value of 0.3 that is considered fertile for porphyry mineralization. This is a good indication that Eu/Eu_N* can be used as an indicator of fertility in the Casino area. Results are summarized here for the promising samples, and full data can be found in the Appendix 4.

Prospector Mtn and Palaeocene age zircons in 21JM021B returned Eu/Eu_N* values averaging 0.45, which is above the threshold value of 0.3 to be considered fertile with respect to porphyry potential.

Prospector Mtn age zircons in neighbouring drainages 21JM017B and 21JM018B returned Eu/Eu_N* values averaging 0.51, although only a few grains were analyzed.

From the 2020 YMEP project, many zircons from the Dawson Range Batholith, Coffee Creek age rocks, and Prospector Mountain suite also displayed high Eu/Eu_N* values, with mean values for each group all exceeding 0.3. This indicates that Eu/Eu_N* values alone are not a good discrimination tool for fertile plutons in the Dawson Range. The distinctive age of Casino Suite rocks is thought to be a much better indicator of potential mineralization, owing to the common association of Casino Suite rocks and Cu-Au-Mo mineralization across Yukon.

EXPLORATION SIGNIFICANCE AND INTERPRETATIONS

Exploration Potential of Anomalous Drainages

Although Casino Suite and Prospector Mtn age zircons were found in a number of drainages, two samples stand out as being the most highly anomalous in multiple datasets: 21JM021B and 21JM023B.

Sample site 21JM021B has 3 Prospector Mtn Suite age zircons, 1 Casino Suite zircon, 1 crossover Casino-Prospector Mtn age grain, scheelite present, and 22 gold grains (60 if recalculated to 10 kg sample). The presence of Casino Suite and Prospector Mtn age zircons in this sample and lack of glacial sediments in the area strongly suggests that there is an unmapped bedrock source of Casino Suite and Prospector Mtn age zircon-bearing rocks in the drainage. The high Eu/Eu_N* values of ~0.43 in Prospector Mtn age zircons, and ~0.46 in Palaeocene rocks suggests that both intrusive suites are fertile with respect to porphyry mineralization.

Sample 21JM023B has 4 Casino Suite age zircons, some supergene goethite, 10 gold grains (14 on a recalculated basis), and Eu/Eu_N* values averaging 0.28 in the Casino Suite zircon.

Samples 21JM017B and 21JM018B are notable for the presence of Casino Suite zircons, high Eu/Eu_N* values and a 40 ppb Au silt anomaly with 16 gold grains in 21JM017B.

The intimate time and spatial association of Casino Suite age rocks with Cu-Au-Mo mineralization makes these drainages prime targets for follow-up work. The small volume Casino Suite intrusive rocks are almost always associated with at least some degree of mineralization all across the Yukon, e.g., Casino, Cash, Tad/Toro, Nucleus-Revenue, Klaza. Therefore, the discovery of Casino Suite age zircons in samples within this project is very significant and could lead to the discovery of Casino Suite intrusions in the area that may host associated Cu-Au-Mo mineralization, using a new method that has the potential to detect buried, blind, or deeply oxidized deposits. The increasing recognition of Prospector Mtn age mineralization in the Klaza district is also encouraging.

Predicting the size of the porphyry: sampling bias and statistics

Sampling theory according to a binomial distribution has driven the number of zircons chosen for dating from each sample. The probability of success for dating a zircon of Casino Suite age has been assumed to relate to the fraction of the area of Casino Suite rocks present in a drainage relative to drainage size. For example, a 1 km^2 Casino Suite intrusion in a 10 km^2 drainage has been assumed to have a total stream sediment zircon population of 10% Casino Suite age zircons. This assumes that there is no bias and fractionation in zircon distribution, formation, weathering, transport, deposition, sampling, concentration, picking, or dating – the “zircon bias”. Now that there are data on the number of successful outcomes, i.e., number of Casino Suite zircons dated in each drainage, binomial probability theory can be used to calculate confidence limits on the sample population, and from this estimate the expected area of Casino Suite rocks in each drainage within confidence limits, assuming that there is no zircon bias.

For sample 21JM021B, n=49 (zircons sampled) and x=5 (Prospector Mtn and Casino Suite zircons detected). For this sample size, it can be predicted with 95% confidence that an area of combined Prospector Mtn and Casino Suite rocks of 0.43 to 1.05 km^2 is present within the drainage, assuming no zircon bias and a direct relationship between areal fraction of Prospector Mtn/Casino Suite rocks in the drainage and stream sediment zircon population.

For sample 21JM023B, n=107 (zircons sampled) and x=4 (Prospector Mtn and Casino Suite zircons detected). For this sample size, it can be predicted with 95% confidence that an area of combined Prospector Mtn and Casino Suite rocks of 0.31 to 0.90 km^2 is present within the drainage, assuming no zircon bias and a direct relationship between areal fraction of Prospector Mtn/Casino Suite rocks in the drainage and stream sediment zircon population.

CONCLUSIONS

- Several anomalous drainages have been identified that may host unmapped occurrences of Casino Suite or Prospector Mtn age rocks that may host associated Cu-Au-Mo mineralization.

RECOMMENDATIONS

Further sampling in the field would comprise following the drainages up-creek taking samples above confluences, in order to trace the zircons back to a bedrock source. This should be combined with prospecting in the drainages for porphyritic rocks, intrusion or explosion breccias, veining, alteration and mineralization. Further bulk sampling for PIMS and zircon-dating should be carried out in addition to fine-fraction stream sediment sampling. Horseshoe-shaped contour and ridge-spur soil sampling traverses should also be carried out to try and detect porphyry Cu-Au-Mo mineralization, with particular focus on any Au and Mo anomalies generated.

2021 EXPENDITURE STATEMENT

Expense	**TOTAL**
ODM PCIM, gold grains and zircon separation	$ 5,881.69
BV stream sediment assays	$ 533.17
UBCO LA-ICP-MS zircon dating	$ 8,352.50
Helicopter	$ 8,249.04
Shipping samples	$ 160.00
Geologist sampler	$ 945.00
Senior Geologist	$ 4,000.00
Daily field expenses	$ 1,000.00
Staking flight	$ 2,500.00
Report	$ 3,333.00
Soil assays	$ 558.35
Expediting	$ 258.88
GRAND TOTAL	**$ 35,771.62**

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STATEMENT OF QUALIFICATIONS

- I am a Professional Geologist registered with Engineers and Geoscientists of BC.
- I graduated with a Ph.D. in Geological Sciences from the University of British Columbia in 2015.
- I graduated with an M.Sc. in Mining Geology from the Camborne School of Mines, University of Exeter, 2009.
- I graduated with a first-class honours B.Sc. in Applied Geology from the Camborne School of Mines, University of Exeter, 2008.
- I have worked in mineral exploration continuously since graduation on projects in Yukon, N.W.T. and B.C.

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DIGITAL APPENDICES

Appendix 1: Sample locations.

Appendix 2: Fine fraction stream sediment and soil sample aqua regia ICP-MS data.

Appendix 3: Heavy mineral concentrate and PCIM logging results.

Appendix 4: Zircon geochronology and geochemistry.

Appendix 5: High resolution figures from this report.