Award #	06HQGR0172
Principal Investigator	Matthew T. Heizler
Title	$^{40}Ar/^{39}Ar$ Geochronology of Colorado Mineral Belt Magmatism

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1.0 Introduction

The $^{40}Ar/^{39}Ar$ geochronology investigation conducted under this award had two primary goals. These included; 1) Determine mineral cooling ages of several granitoids within and near the Colorado Front Range area west of Boulder, Colorado and 2) conduct the dating goals within the context of a student education project the would entail aspects of fieldwork, sample preparation, data interpretation, a seminar and lab class and final written reports. The primary goals were achieved as 11 stocks or dikes yielded 27 $^{40}Ar/^{39}Ar$ mineral ages that reveal a complex history of magmatism in the region and 6 graduate students participated in the yearlong project with successful completion of an integrated effort that has resulted in this final technical report.

2.0 Project timeline.

2.1 Fieldwork

The project was initiated in mid-August 2006 when PI Heizler traveled to the USGS in Denver and met for 1.5 days with Ed DeWitt and Terry Klein to gather maps, references and supporting information for targeted sample locations. Fieldwork initiated on Aug. 26, 2006 with rock collection near Rustic, Colorado. Following this, a vertical traverse along the Beaver Creek and Mitchell Lake trails to the summit of Mt. Audubon allowed sample collection of the Audubon stock from about 13,200' down to 11,000'. The collection effort moved to Aspen, CO where samples of Tertiary stocks were obtained along the trail to Conundrum Hot Springs. On Sept. 1, 2006 William McIntosh and 5 New Mexico Tech graduate students joined PI Heizler in Boulder, CO. We began our sample collection in the city of Boulder with collection of the Valmont dike and then moved west to concentrate efforts on the Cretaceous and Tertiary rocks in Gilpin and Jefferson counties. We used the geological map of Gable (1980) as our base map to guide sample collection of many of the intrusive centers. We were also joined by retired USGS scientist, Jim Ratte during our field efforts in the area. Our students were educated in basic geochronology sample collection that requires proper map location skills and attainment of the freshest possible samples. All students participated in note taking, GPS location and rock descriptions. Following 2 days in the Gable (1980) map region we finished up a 3rd day in the Georgetown, CO area to sample the Empire and Silver Plume stocks and a dike on the road to Guanella pass. In total, 31 rock samples were obtained and basic information is provided in Table 1 with locating maps given in Figures 1-8.

2.2 Course work

Six NM Tech graduate students enrolled in 3 separate classes that had complete or partial focus on $^{40}Ar/^{39}Ar$ methodology and Laramide magmatism. For fall semester 2006 GEOC-516, "$^{40}Ar/^{39}Ar$ geochronology" covered the basics and theory of argon geo and thermochronology. During this semester the students were also taught mineral separation methods and by semester's end had completed their separations on rocks for this project. For spring 2007, GEOC-589 "Practical aspects of $^{40}Ar/^{39}Ar$ geochronology" was taught and focused on hands-on noble gas mass spectrometry, ultra-high vacuum systems, data acquisition and data interpretation. In parallel, mineral separations were packaged with standards and readied for irradiation. This course was specifically designed for this MRP project and its excellent success has resulted in it being offered on a yearly basis. Each student was responsible for their own assigned samples and upon sample return from the irradiation process the students were guided in proper radioactive material handling methods and they individually loaded samples into the vacuum system and wrote appropriate scripts for computer-automated data collection. The isotope measurements provided a weekly basis for data interpretation, discussion and report writing. Each student was provided a laptop computer with access to the main database where they could individually workup results. Real time data access via wireless high speed Internet within a formal classroom setting allowed group discussions about individual findings and provided a very good venue for data interpretation. Because all but one of the students participated in the fieldwork component there was excellent understanding of sample context and geography; this provided a crucial link between data and interpretation.

The third course, GEOC-572 "Colorado Mineral Belt Geochronology", also took place during spring semester 2007. This course was designed to provide a border context of Colorado Mineral Belt magmatism towards the samples being dated in the Front Range. A wide range of appropriate literature was chosen and seminars led by Drs.

Charles Chapin, Steve Cather and Lang Farmer contributed significantly to the course. Most importantly for the students was that each was assigned a specific topic for which they would act as seminar leader. They we expected to provide a ca. 20 minute PowerPoint presentation and guide a two-hour discussion. Their final project was a write-up of the argon data collected from the samples for which they were individually responsible and each provided a brief presentation of this data and their interpretations.

3.0 $^{40}Ar/^{39}Ar$ geochronology

3.1 Methods

The $^{40}Ar/^{39}Ar$ dating effort was carried out at the New Mexico Geochronology Research Laboratory (NMGRL) at New Mexico Tech, Socorro, NM. Mineral separations were obtained by standard heavy liquid, magnetic and handpicking methods from crushed and sieved rock samples. Samples were packaged in machined Al trays along with neutron fluence monitor Fish Canyon tuff sanidine (FC-2 sanidine, 28.02 Ma, Renne et al., 1998) and irradiated for 6 hours within the Central Thimble of the USGS TRIGA reactor in Denver, CO. Following irradiation, 5 single crystals from each of 6 positions around the irradiation tray were fused with a 50 W Synrad CO_2 laser to determine J values with one sigma uncertainties of ca. 0.05%. All samples were step-heated within a double vacuum Mo resistance furnace (biotite 12 steps, hornblende 11 steps, K-feldspar 25 to 29 steps) and evolved gases were gettered during heating with a SAES GP-50 operated at ~450°C. Reactive gases were furthered scrubbed within a second stage of the extraction line for 1 to 6 minutes using two SAES GP-50 getters (one at ~450°C, one at 20°C) and also reacted with a tungsten filament operated at ~2000°C. Isotope measurement was conducted within a MAP-215-50 mass spectrometer with ion beams being measured on a Balzers 217 electron multiplier operated in analogue mode. Total extraction line and mass spectrometer sensitivity was $8x10^{-17}$ moles/pA. Typical total extraction line blank plus mass spectrometer backgrounds yielded an overall blank of 125, 0.7, 0.3, .03, 1.0, and $0.1x10^{-17}$ moles for masses 40, 39, 38, 37, 36 and 35, respectively. Additional analytical details regarding the overall operation and data handling methods employed by the NMGRL can be downloaded from Internet site http://geoinfo.nmt.edu/publications/openfile/argon/home.html.

3.2 General age spectrum comments

Incremental step-heating data are presented on age spectrum diagrams (Figures 9-11) and listed in Table 2. The spectra display a wide variety of forms with many yielding complex behavior and only limited flat segments. Typically biotite spectra show low temperature and high temperature steps with apparent ages lower than the older ages given by the intermediate part of the spectrum (e.g. 41-AD; Fig. 10e). This spectrum is fairly common for biotite in general (Heizler et al., 1988; Schneider et al., 2007) and has been attributed to redistribution of ^{39}Ar caused by recoil during the irradiation of the sample. Assuming that all complexity can be related to recoil, the total gas age (TGA) is commonly used to estimate the biotite age (Lo and Onstott, 1989). For this dating effort there is only minor difference between the TGA and the plateau age that is determined from the flattest part of the spectrum (Table 2). In general the preferred age for biotite is the calculated plateau age for the steps identified on the spectra (Tables 2, 3). Hornblende spectra also show a variety of behavior, but some have significant sections with plateau segments that also have acceptable MSWD values (e.g. 6-AD; 23-AX, Figures 10c, 11e). Plateau ages provided by these overall flat spectra are the preferred age for the hornblende sample. Other hornblende spectra demonstrate a climbing pattern such as those from 12-JT and 18-E (Figures 11a, 11b) and no single age can be obtained from these spectra types. These samples will be discussed in greater detail below. K-feldspar samples always yield spectra with age gradients with anomalously old apparent ages given by the earliest gas released that indicates excess ^{40}Ar. 40-AD (Figure 10d) is a good representative K-feldspar spectrum at shows oscillating apparent ages given by isothermal replicate heating steps that is attributed to citing of excess ^{40}Ar within fluid inclusions (cf. Harrison et al., 1993). The minimum ages of the 2nd isothermal step are generally similar and likely represent the true argon closure age for this part of the spectrum. Following the initial oscillation, the apparent ages rise to often exceed the ages provided by coexisting biotite or hornblende that also indicates excess ^{40}Ar contamination within the K-feldspars. This high temperature excess argon is attributed to trapping within large diffusion domains and renders this part of the spectrum useless for defining a geologically meaningful result (cf. Foster et al., 1990). Foster et al. (1990) did however show that the initial young part of K-feldspar spectra provide meaningful cooling age information.

4.0 $^{40}Ar/^{39}Ar$ results and discussion

4.1 Rustic, CO sample 1-R

Two samples from the Rustic, CO area were collected (Figures 1, 9a). Biotite from a dike from 2-R was too altered for argon analysis whereas 1-R gave a complex biotite spectrum with mostly Precambrian apparent ages. This sample location is identified on the Colorado state geological map (CSGM) as Tmi, however the old biotite age indicates that this unit is Precambrian.

4.2 Valmont dike sample 10-V

A hornblende from the Valmont dike collected within the Boulder, CO city limits (Figures 2, 9c) provides a preferred age of 60.4±1.0 Ma (Table 3). The spectrum is somewhat noisy and also shows a complex K/Ca spectrum (Figure 9c). The disturbance is likely due to sample alteration, but despite this the assigned age is interpreted to be accurate within the cited level of precision.

4.3 Empire stock samples 44-EW and 45-ES

Two samples from near Empire, CO were dated (Figures 3, 9d). K-feldspars from 44-EW and 45-ES provide minimum ages of ca. 54 Ma indicating that these samples cooled below about 200 °C at this time. Both climbing spectra of the K-feldspars rise above the 44-EW hornblende apparent ages thereby indicating excess ^{40}Ar. The hornblende has an overall saddle-shaped spectrum and isochron analysis indicates excess ^{40}Ar contamination (Figure 12). On the isochron, steps B-I, which comprise nearly 85% of the total ^{39}Ar released indicate a trapped $^{40}Ar/^{36}Ar$ initial value of 660±30 and an age of 55.5±0.6 Ma. This isochron age is the preferred hornblende age of the Empire stock and the concordance of the hornblende with the K-feldspar minimum ages suggests rapid cooling which further suggests that the intrusion age of the Empire stock is well approximated by the hornblende age at 55.5 Ma.

4.4 Aspen intrusions samples 8-AS and 9-AS

Three samples along the trail to Conundrum Hot Springs south of Aspen, CO were collected (Figure 4). These samples are identified as TKi on the CSGM and the two dated samples yield well-behaved biotite spectra (Figures 9e, 9f) with plateau ages of 32.43±0.11 Ma (8-AS) and 32.21±0.14 Ma (9-AS). These plateau ages are interpreted to closely approximate the intrusion of these granitoids.

4.5 Northern Front Range intrusions

The late Cretaceous and Tertiary rocks of Gilpin and Jefferson counties, Colorado are the main focus of this dating effort. Several samples of the Audubon, Caribou, Jamestown, North Fork, Bryan Mountain and Apex stocks of Gable (1980) were sampled (Table 1). Ages for biotite and hornblende fall between about 80 and 58 Ma with K-feldspars providing overall complex spectra that provide constraints on the low temperature (~200°C) history of the area.

4.5.1 Audubon stock samples 3-AD, 4-AD, 5-AD, 6-AD, 40-AD, 41-AD and 42-AD

Five samples within the mapped outcrop of Gable (1980) were collected from the Audubon stock (Figure 5). In addition, sample 5-AD was collected just to the NE of Audubon and comes from a small outcrop identified as Tgd and sample 6-AD was collected outside of Gable's (1980) mapped stock from an outcrop near tree line along the trail to the summit of Mt. Audubon. From these samples 3 hornblende, 2 biotite and 3 K-feldspars were analyzed (Figures 9b, 10a-e). Each hornblende has a plateau spectrum with 3-AD, 6-AD and 40-AD having plateau ages of 69.7±0.4 Ma, 67.66±0.11 Ma, and 65.01±0.10 Ma, respectively (Table 3). Biotite spectra have individually precise apparent ages, but their plateau ages have elevated MSWD values (Table 2). Biotite from 4-AD from the summit region yields a plateau age of 65.24±0.14 Ma whereas 41-AD near Lake Isabella has a plateau age of 66.01±0.19 Ma (Figures 10b, 10e). Several steps from the initial flat part of the 6-AD K-feldspar have a weighted mean of 62.76±0.09 Ma and the youngest steps returned from 40-AD are ca. 57 Ma (Figures 10c, 10d). K-feldspar 5-AD is very complicated and shows steps as young as 72 Ma before climbing to ~375 Ma and then decreasing back down to about 195 Ma (Figure 9b). Based on this K-feldspar alone it is difficult to know if 5-AD is Tertiary, late Cretaceous or Precambrian. Although speculative, the preferred interpretation is that 5-AD is late Cretaceous (ca. 70 Ma) with the older ages indicative of excess ^{40}Ar. It is unlikely that the sample is Tertiary as the minimum ages in the K-feldspar spectrum are probably fairly accurate cooling ages and thus Tgd should be mapped as Kgd.

The hornblende ages from the Audubon stock are distinct and indicate separate intrusions that span a 4 to 5 Ma duration. The 66 to 65 Ma biotite dates from 4-AD and 41-AD have non-unique interpretations. Perhaps the youngest episode of igneous activity at 65 Ma defined by 40-AD hornblende caused argon loss from biotites that represent older intrusions or both 4-AD and 41-AD are indeed ca. 65 Ma intrusions. Either way, this sample set indicates that major igneous activity within the Audubon stock began at about 70 Ma and persisted until 65 Ma. The 62.8 Ma age spectrum segment from 6-AD could represent the time the area cooled below ~200°C whereas the ca. 57 Ma minimum ages from the more southerly and lower elevation 40-AD sample might indicate later cooling resulting from a greater paleodepth and/or a slightly tilted section.

4.6 Apex stock sample 23-AX

A hornblende from the Apex stock collected on Jumbo Mountain was dated (Figure 6). Sample 23-AX yields a fairly well behaved spectrum (Figure 11e) with a plateau age of 65.21±0.15 Ma and appears to be contemporaneous with the younger intrusives of the Audubon stock.

4.7 North Fork stock sample 21-NF

Sample 21-NF biotite collected along 4th of July road northwest of Eldora, CO yields a slightly complex spectrum with a preferred age of 64.05±0.14 Ma (Figures 7, 11d). This biotite sample has a variety of possible interpretations similar to other biotites from the area, but indicates that the North Fork stock is at least ca. 64 Ma. The preferred interpretation is that this age closely approximates the emplacement of the stock and is tied temporally to the same period of activity observed at Audubon and Apex.

4.8 Bryan Mountain, Jamestown and Caribou stocks samples 18-E, 20-E, 12-JT and 43-PM

These intrusions (Figures 7 and 8) are presented in a grouped discussion due to similarities in results that may help understand the timing of intrusion of each individual unit. The first observation is that two biotite-bearing samples (18-E and 20-E) from Bryan Mt. have fairly flat spectra and nearly identical preferred plateau ages of 58.83±0.12 Ma and 58.75±0.27 Ma, respectively (Figures 11b, 11c). These are the youngest biotites from the Gable (1980) map area and could be considered good estimates of intrusion age. Supporting this interpretation is the 64 Ma biotite age from the nearby North Fork stock because if the North Fork and Bryan Mt. stocks are in similar crustal positions it means that the Bryan Mt. stock was emplaced into rocks that were below the biotite closure temperature by 64 Ma. This relatively shallow emplacement depth would facilitate rapid cooling and result in $^{40}Ar/^{39}Ar$ biotite ages being nearly equal to intrusion ages. Complicating this apparently simple interpretation is the hornblende data from Bryon Mt. (18-E) and the Jamestown (12-JT) stock (Figures 11a, 11b). Both hornblendes display overall age gradients beginning at about 60 Ma and climb to 70 and 78 Ma, respectively. Either the hornblende minimum ages are close approximations to the intrusion ages and the climbing part of the spectra is caused by excess ^{40}Ar or the stocks are actually greater than 70 Ma with the age gradients related to argon loss following emplacement. Further suggestive of igneous activity greater than 70 Ma are the hornblende data from the Caribou stock collected near Pomeroy Mt (43-PM; Figure 11f). From this location two hornblende aliquots were analyzed with the first effort yielding a poorly resolved spectrum giving a single step with an apparent age of 78.8 Ma and the second spectrum being fairly complex, but providing 4 steps giving a plateau age of 76.35±0.48 Ma. Despite this overall complexity, the Caribou stock is interpreted to be ca. 76 Ma with the younger K-feldspar age spectrum segment (Figure 11f; Table 2) at ca. 64 Ma recording either argon loss caused from younger intrusions in the area or reflecting regional exhumation below about 200°C at this time.

There are regionally several biotite plateau and K-feldspar minimum ages greater than 58 Ma that indicate regional ambient thermal conditions at 58 Ma were below 200 to

300°C. The preferred interpretation of the Bryan Mt. stock data is that the biotite ages of 58.8 Ma record the approximate time of intrusion. This would indicate that the climbing hornblende spectrum from Bryan Mt. is unreliable due to excess or inherited ^{40}Ar and its minimum age of ca. 60 Ma is a maximum estimate of intrusion. By corollary, the climbing hornblende spectrum from the Jamestown stock is also affected by excess and/or inherited ^{40}Ar and its minimum age of ca. 60-62 Ma is the best estimate for the intrusion age of the Jamestown stock.

5.0 Conclusions

5.1 Student education

The student participation allowed by the funding of this project provided an excellent yearlong integrated study. A key to the success was the ability to have the students participate in the fieldwork that allowed a strong connection between the outcrop geology and the geochronological results. The moderate complexity of the argon data could be viewed in terms of the episodic igneous activity observed within individual stocks that could only be appreciated within the context of the field effort. The outcome of the project was intellectual growth along with well-developed synergy amongst 6 graduate students. Also, two of the participants have chosen additional work in Colorado plutonic complexes to fulfill their graduate education at NM Tech.

5.2 ^{40}Ar/^{39}Ar geochronology

Several new ^{40}Ar/^{39}Ar age determinations in the Northern part of the Colorado Front Range and limited data from the Aspen, Empire and Rustic, CO areas significantly refine the age of several Cretaceous and Tertiary granitoids.

A unit mapped as Tmi in the Rustic, CO area is Precambrian. The Empire stock is interpreted to be 55.5±0.6 Ma based on hornblende and K-feldspar ages. TKi intrusives south of Aspen, CO along the trail to Conundrum Hot Springs are Oligocene based on biotite plateau ages of ca. 32.2 to 32.4 Ma. The Valmont dike located in Boulder, CO has a somewhat complex hornblende spectrum, but is interpreted to be 60.4±1.0 Ma.

Age determinations from Gilpin and Jefferson counties support several intrusive episodes and require significant modification for the Gable (1980) map. The oldest dated unit is the 76.4±0.5 Ma Caribou stock based on a somewhat complex hornblende spectrum. The Audubon stock is a composite unit with at least 3 intrusions with ages of 69.7±0.4, 67.7±0.1 and 65.0±0.1 Ma. Both the Apex stock and North Fork stock yield ages similar to the youngest dated phase of the Audubon stock. A hornblende from the Apex stock indicates an intrusion age of 65.2±0.2 Ma, whereas a biotite of 64.0±0.1 Ma from North Fork closely approximates the time of emplacement. The Jamestown stock appears to be no older than about 62 to 60 Ma whereas the Bryan Mountain stock emplacement age is estimated at 58.8 Ma based on two biotite age determinations. Less ambiguous interpretations of complex argon spectra will benefit from future U/Pb zircon dating efforts.

6.0 References cited

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7.0 Citations resulting from this work funded by the MRERP

None to date.

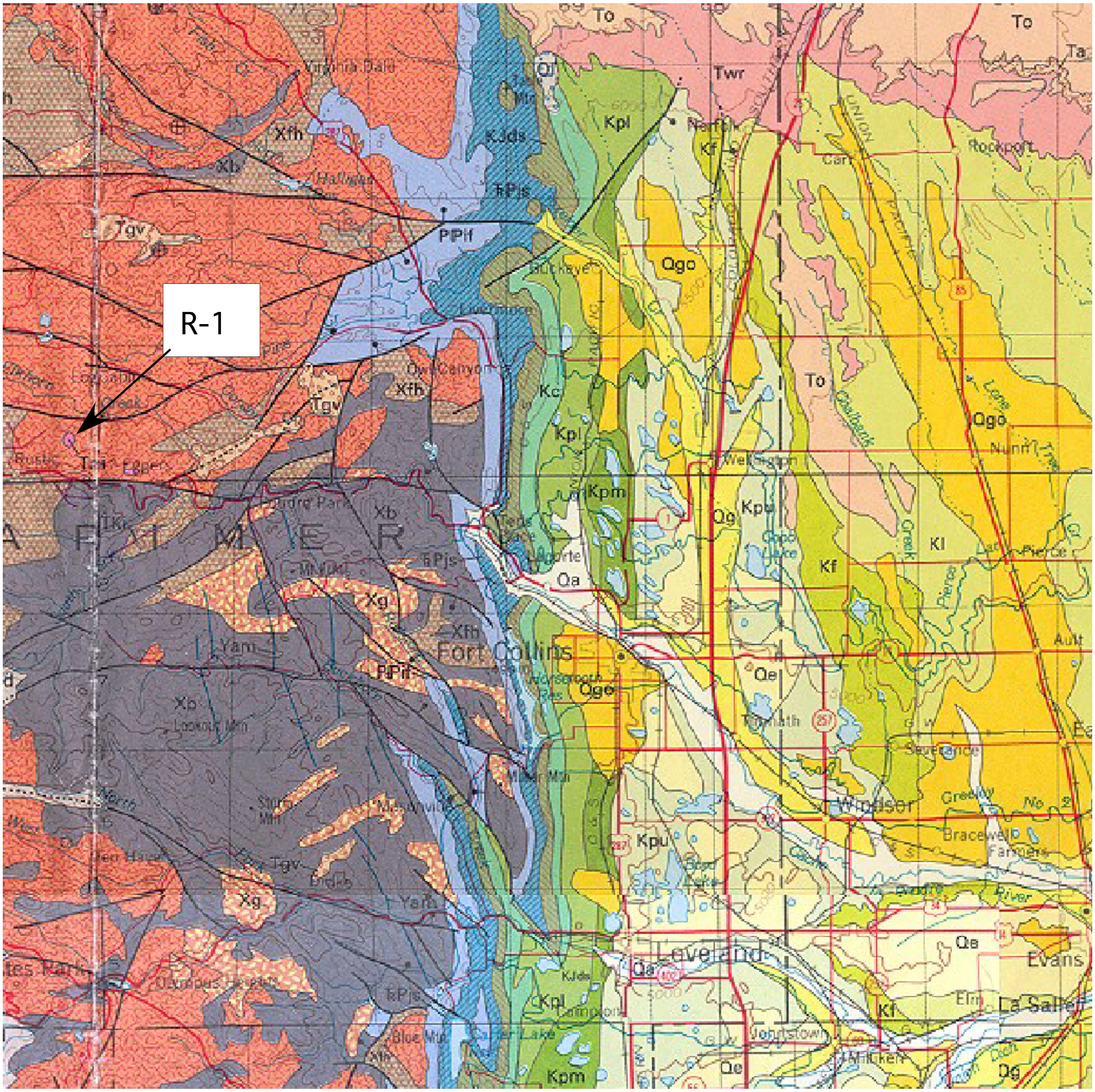

Figure 1 A part of the Colorado State Geological map showing sample location (R-1) of a granitoid near Rustic, CO. The sample location is mapped as Tmi. A nearby dike, R-2, was too altered for dating.

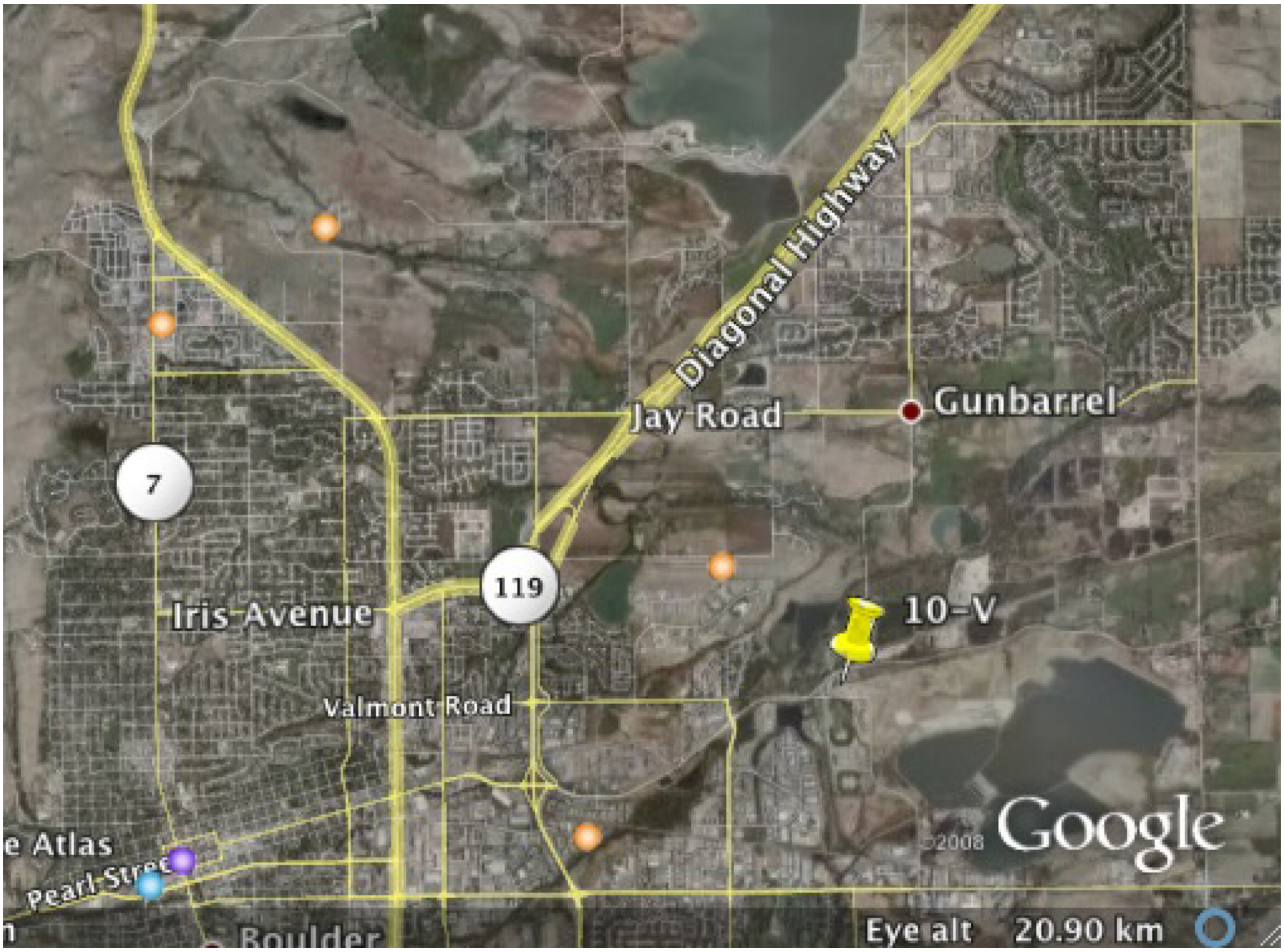

Figure 2. Goggle Earth image identifying sample of the Valmont dike located with Boulder, CO. Sample 10-V provided a hornblende sample.

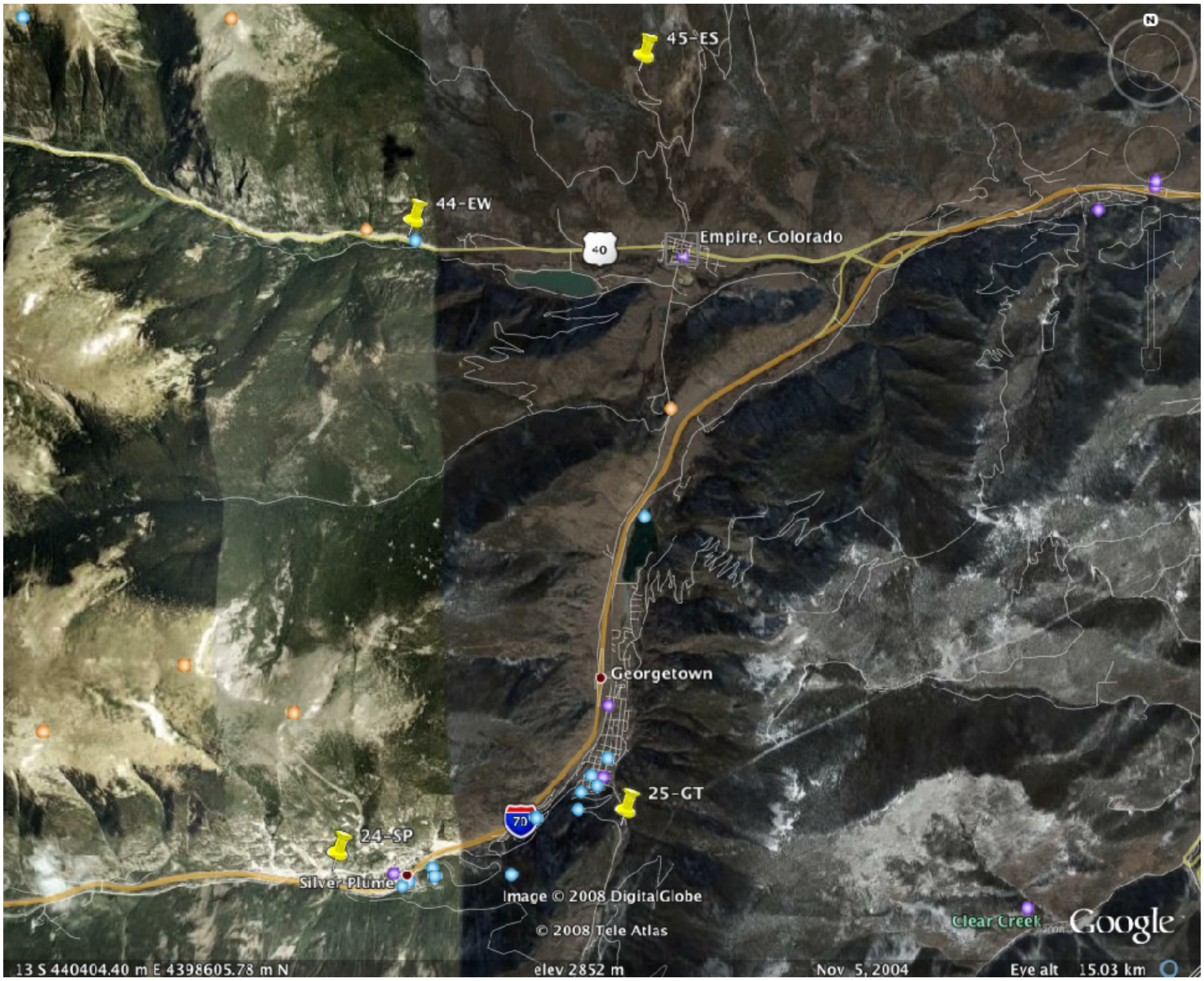

Figure 3. Goggle Earth image identifying sample locations from the Georgetown, CO area. Empire stock samples 44-EW and 45-ES were dated whereas 24-SP and 25-GT did not provide adequate dating material.

Figure 4. Goggle Earth image identifying sample locations of Tertiary intrusions collected south of Aspen, CO along the Conundrum Hot Springs trail. Sample 7-AS was too altered for dating. Samples 8-AS and 9-AS both yielded a biotite separate.

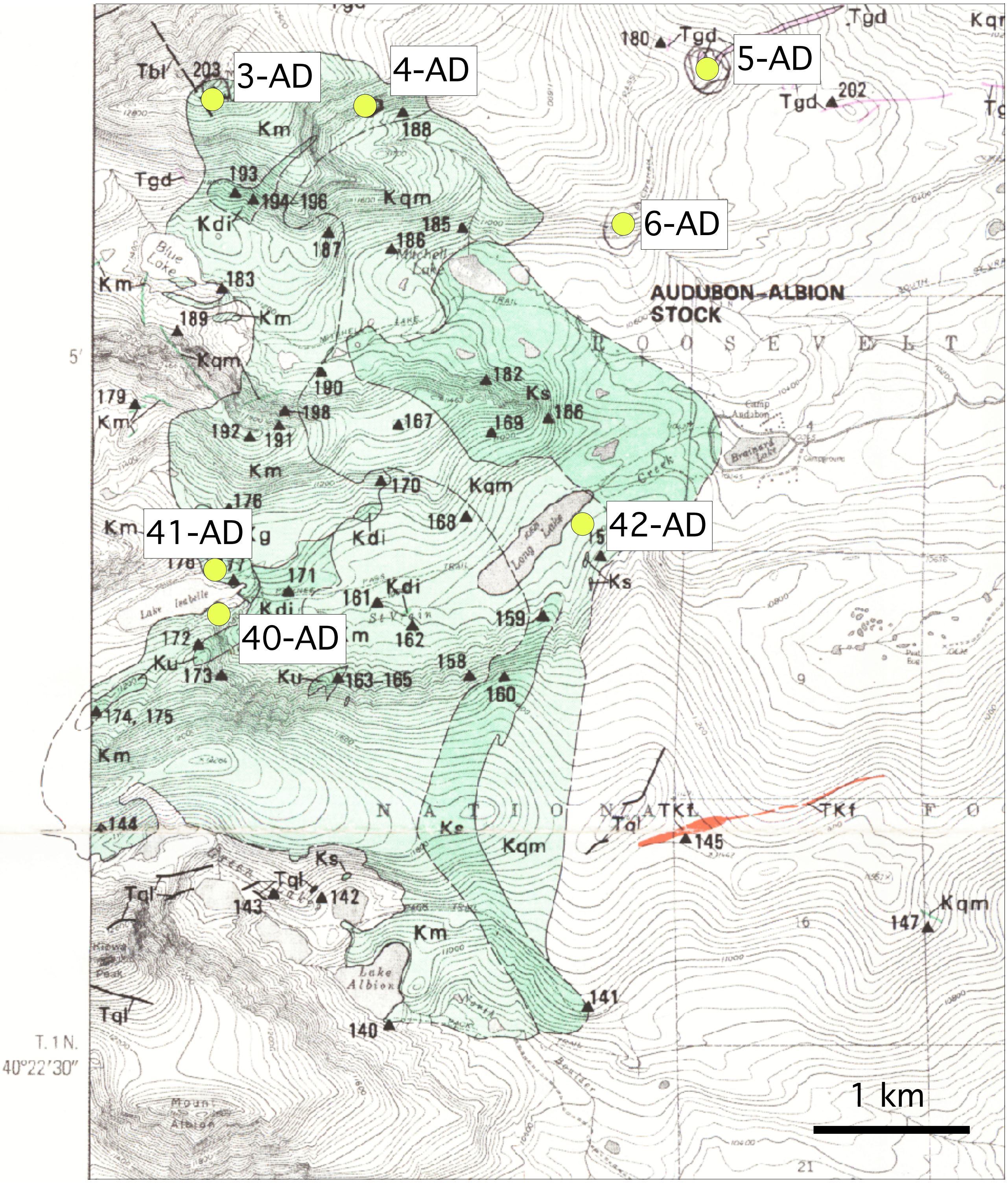

Figure 5. Part of the Gable (1980) map showing sample locations of the Audubon stock and nearby intrusions. Sample 6-AD is not mapped by Gable (1980), however this location is considered outcrop of the stock.

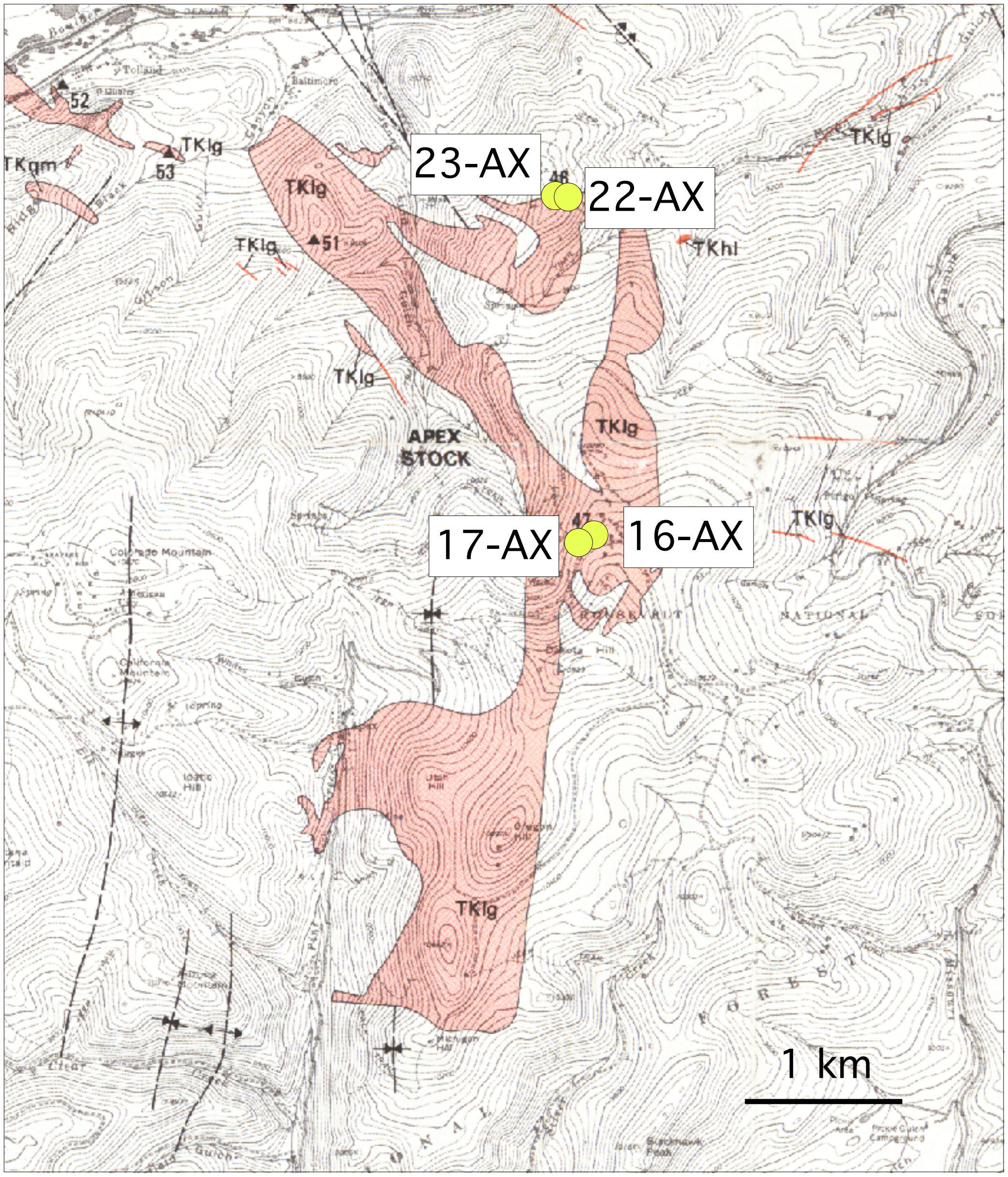

Figure 6. A part of the Gable (1980) map showing sample locations of the Apex stock. Samples 16-AX and 17-AX were not dated and 22-AX yielded a Precambrian biotite. 23-AX provided a hornblende age for the stock.

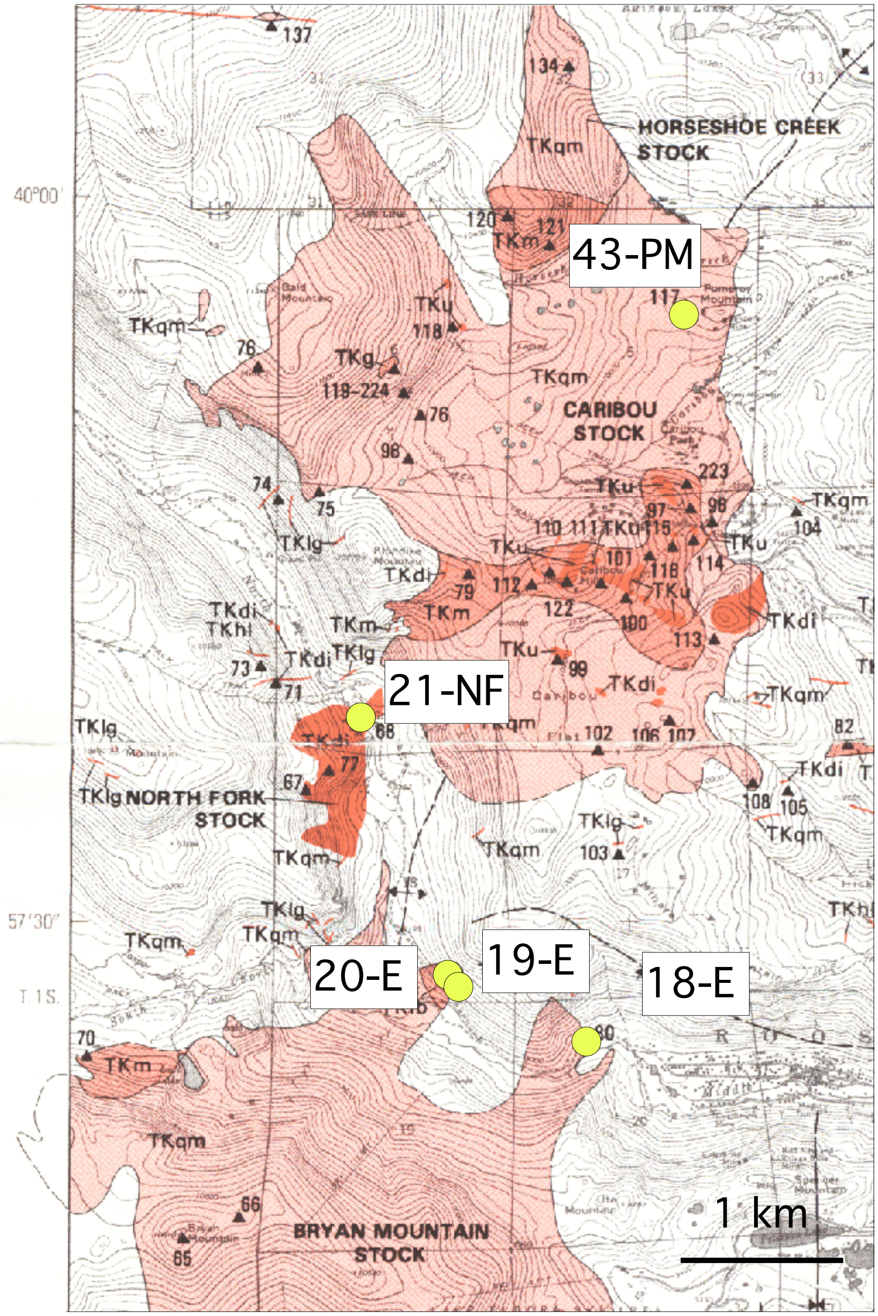

Figure 7. A part of the Gable (1980) map showing sample locations of the Bryan Mountain, North Fork and Caribou stocks. All samples except 19-E were dated.

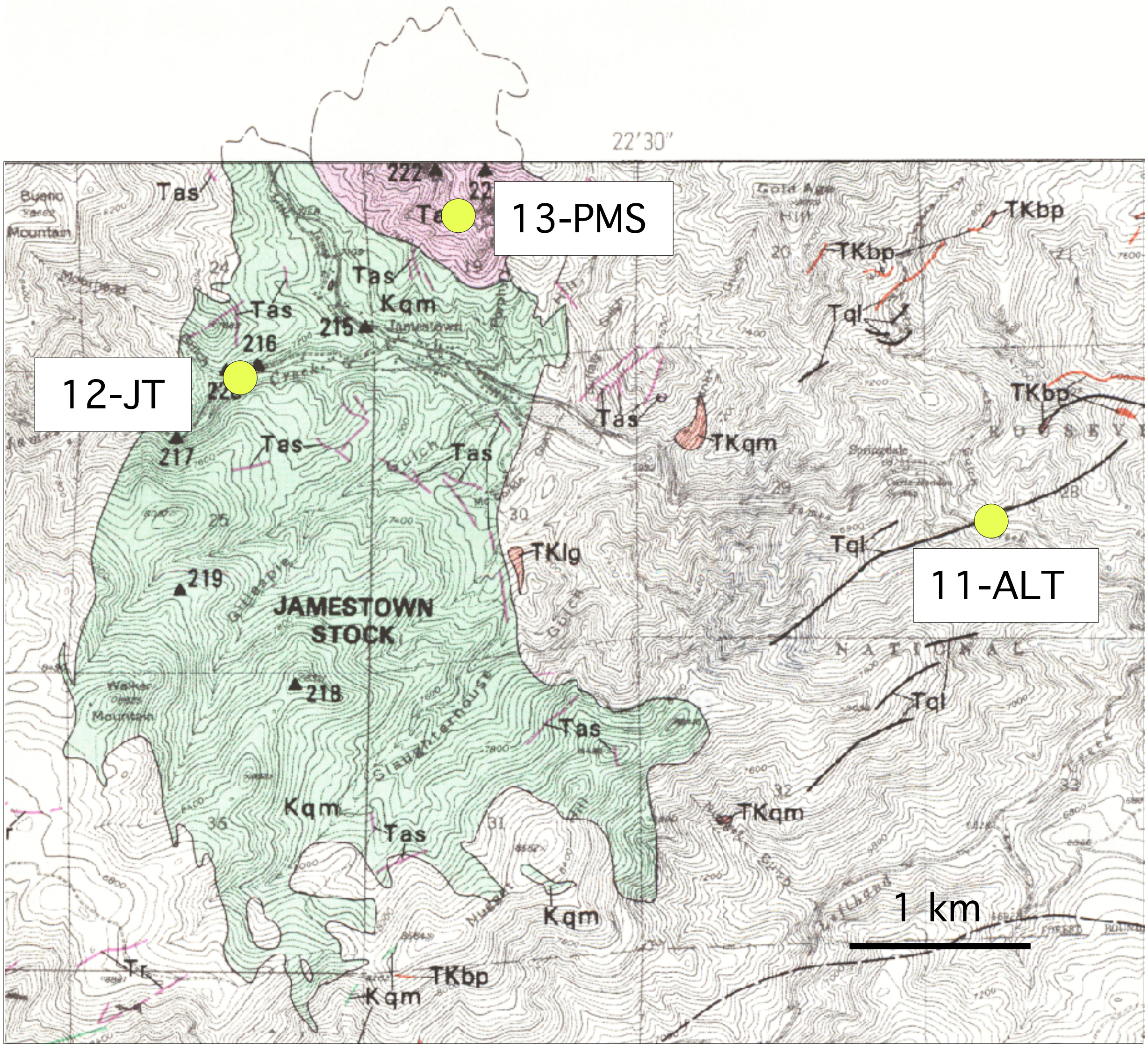

Figure 8. A part of the Gable (1980) map showing sample locations of the Jamestown (12-JT), Porphyry Mountain (13-PMS) stocks and Altona dike (11-ALT). Only 12-JT yielded adequate material for dating.

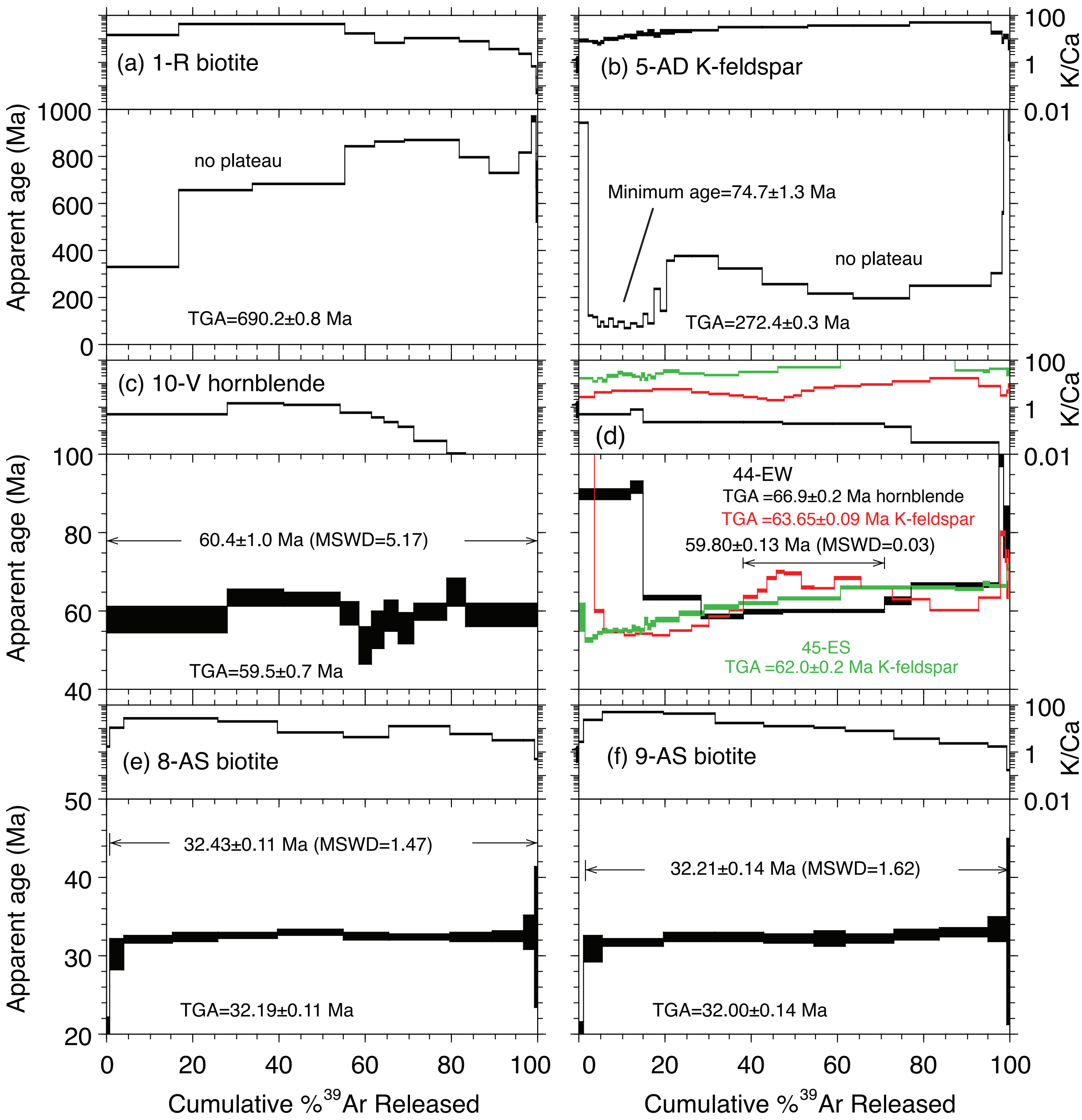

Figure 9. Age spectra for Rustic (R-1), Valmont dike (10-V), Empire stock (44-EW, 45-ES), and Aspen (8-AS, 9-AS) samples. Sample 5-AD from Audubon is also included here as it best correlates in scale to the old date given by the Rustic biotitte.

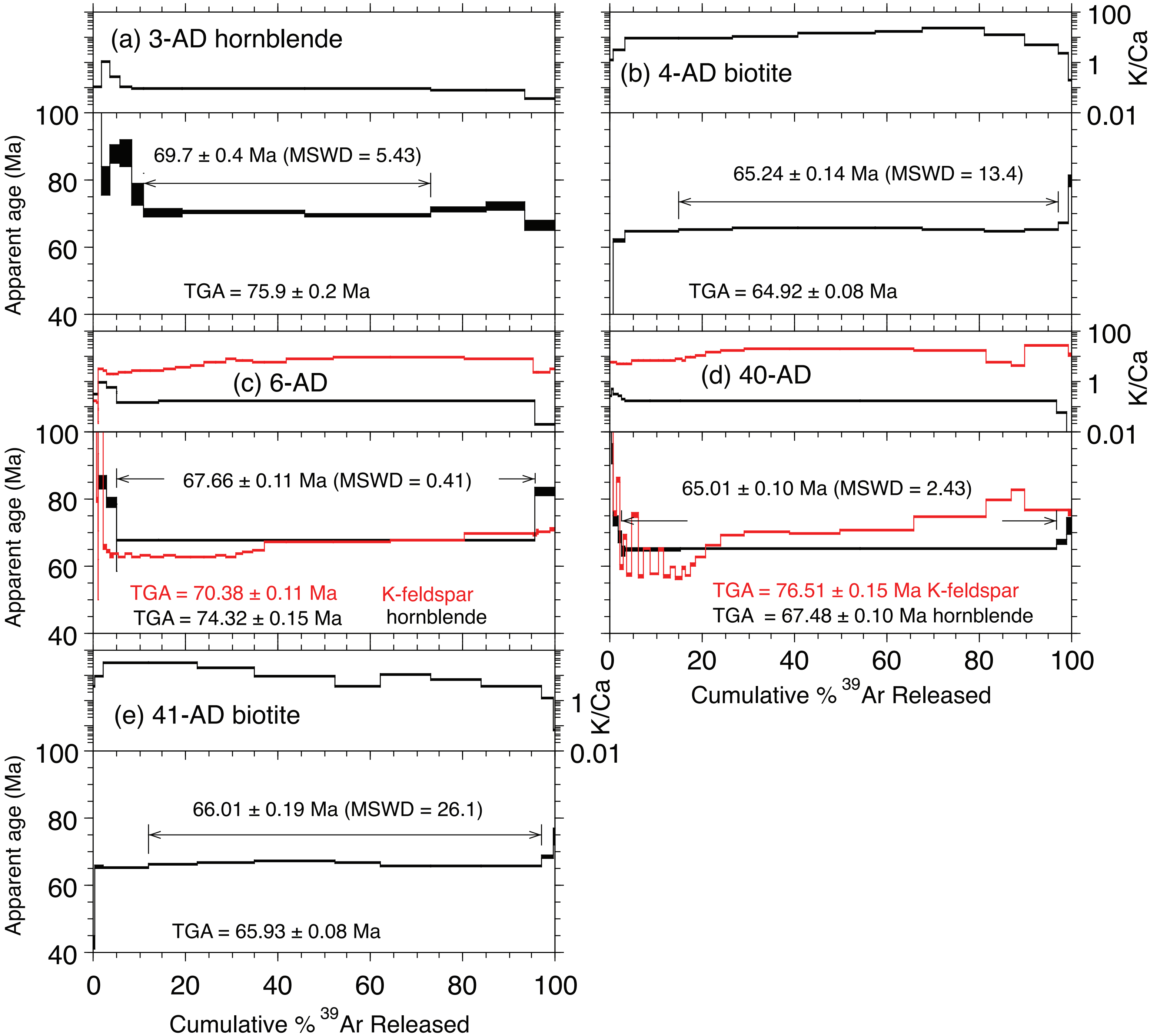

Figure 10. Age spectra for Audubon stock samples. Three distinct hornblende ages indicate separate intrusion episodes between about 70 and 65 Ma.

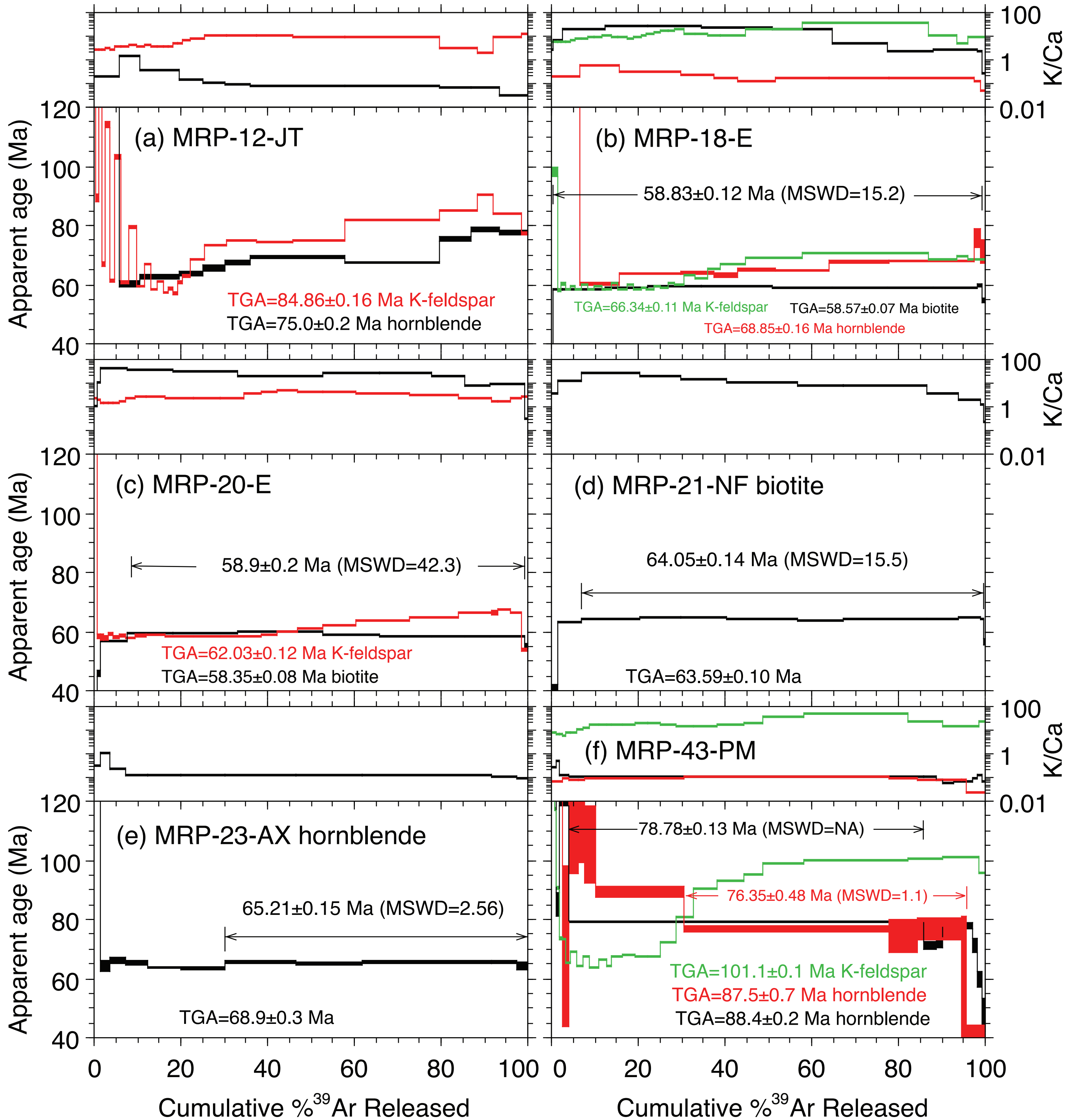

Figure 11. Age spectra for Jamestown (12-JT), Bryan Mountain (18-E, 20-E), North Fork (21-NF), Apex (23-AX) and Caribou (43-PM) stocks. Plateau ages indicated by arrows are interpreted to closely approximate intrusion ages. Climbing spectra for hornblendes from Jamestown and Bryan Mountain indicate excess argon contamination.

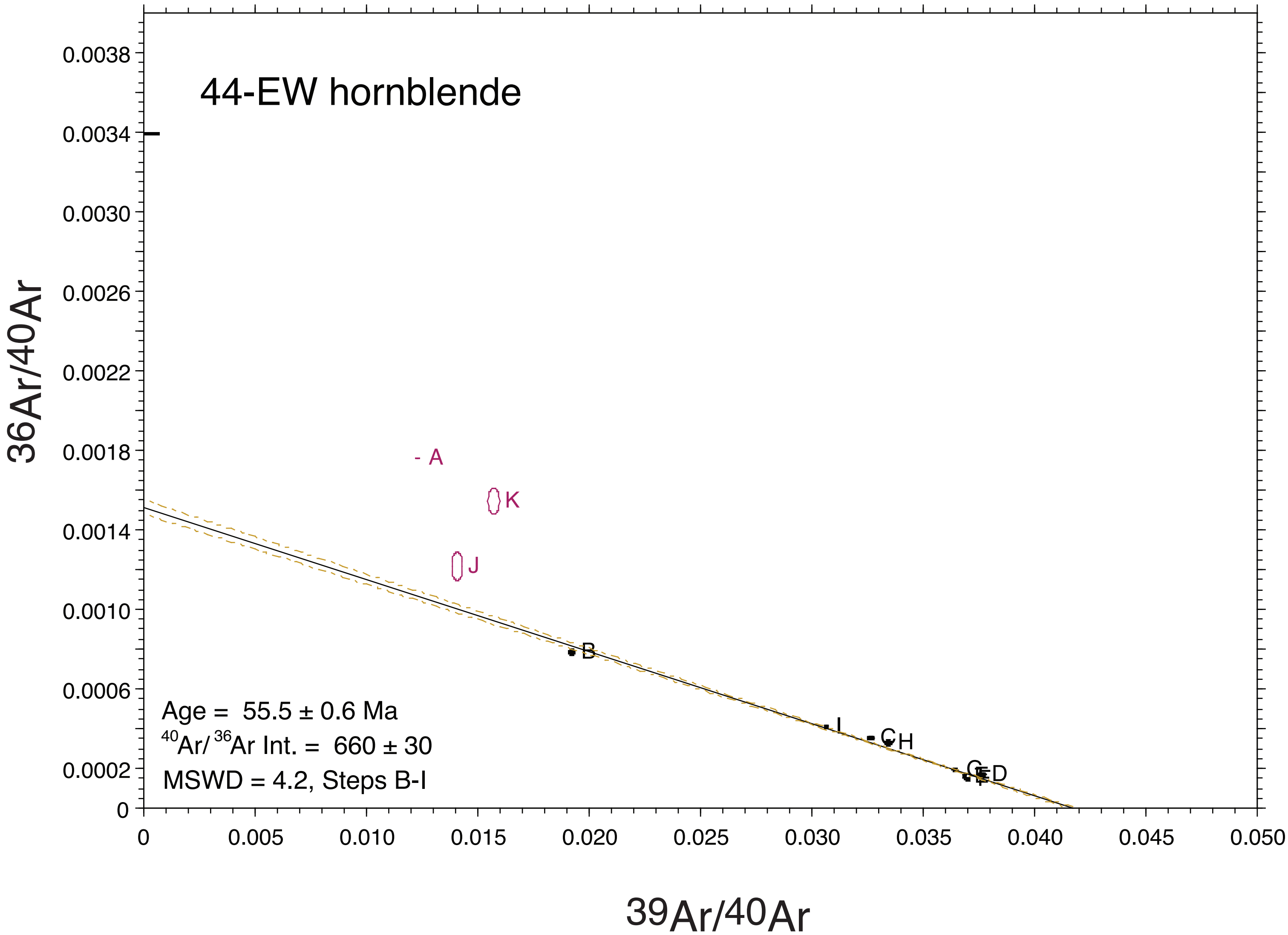

Figure 12. Isochron diagram for Empire stock hornblende sample 44-EW. Linear trend defined by steps B-I indicate excess ^{40}Ar and a preferred age of 55.5±0.6 Ma

Table 1. Samples collected for award 06HQGR0172.

Sample	Unit	Datum	Zone	E	N	Comment
1-R	Rustic stock	WGS 84	13T	454191	4507922	Bt granite
2-R	Rustic dike	WGS 84	13T	499000	4509300	Too altered
3-AD	Audubon stock	WGS 84	13T	447475	4438951	13,226' summit
4-AD	Audubon stock	WGS 84	13T	448547	4438968	12227' S of trail
5-AD	Audubon stock	WGS 84	13T	450238	4438954	11446' Beaver Creek trail
6-AD	Audubon stock	WGS 84	13T	450160	4437995	11048' Mitchel Lake trail
7-AS	Aspen intrusion	WGS 84	13S	336901	4322282	Conundrum Hot Springs
8-AS	Aspen intrusion	WGS 84	13S	336897	4323225	Conundrum trail
9-AS	Aspen intrusion	WGS 84	13S	337301	4325539	Conundrum trail
10-V	Valmont dike	WGS 84	13S	481896	4431172	Valmont, Boulder
11-ALT	Altona dike	WGS 84	13S	469963	4439721	Too altered
12-JT	Jamestown stock	NAD 27	13S	466086	4440340	At Jamestown
13-PMS	Porphyry Mt stock	NAD 27	13S	467317	4442000	Too altered
14-BR	Barker Reservoir dike	NAD 27	13S	460372	4424792	Altered dike
15-BR	Barker Reservoir dike	NAD 27	13S	460372	4424792	Altered dike
16-AX	Apex stock	NAD 27	13S	452922	4414027	Mine dump
17-AX	Apex stock	NAD 27	13S	452246	4413811	Likely basement
18-E	Byran Mt. stock	NAD 27	13S	449713	4422211	Hart locality
19-E	Byran Mt. stock	NAD 27	13S	449062	4422613	4th of July road
20-E	Byran Mt. stock	NAD 27	13S	449040	4422638	4th of July road
21-NF	North Fork stock	NAD 27	13S	448482	4424423	4th of July road
22-AX	Apex stock	NAD 27	13S	452822	4416657	Questionable stock
23-AX	Apex stock	NAD 27	13S	452649	4416193	Jumbo Mt. adit
24-SP	Silver Plume stock	NAD 27	13S	437001	4394095	Mine dump
25-GT	Georgetown dike	NAD 27	13S	440538	4394305	Guanella pass road
40-AD	Audubon stock	NAD 27	13T	447529	4435244	S of Lake Isabelle
41-AD	Audubon stock	NAD 27	13T	447637	4435640	N of Lake Isabelle
42-AD	Audubon stock	NAD 27	13T	449350	4436652	N of Long Lake
43-PM	Caribou stock	NAD 27	13S	450638	4426929	Pomeroy Mountain
44-EW	Empire stock	NAD 27	13S	438205	4401543	W of Empire, US 40
45-ES	Empire stock	NAD 27	13S	441490	4403462	Minnesota mine

Note: Sample outlined yielded minerals for $^{40}Ar/^{39}Ar$ analysis

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	3-AD, Audubon summit, Hornblende, 21.51 mg, J=0.0013451±0.06%, NM-202F, Lab#=56732-01										
X	A	800	246.3	5.046	373.3	0.310	0.10	55.4	1.9	304.9	3.2
X	B	900	42.24	0.4889	29.48	0.290	1.0	79.5	3.7	79.7	2.1
X	C	1000	42.96	1.841	20.97	0.381	0.28	85.9	6.1	87.5	1.4
X	D	1030	40.22	5.127	12.35	0.367	0.100	92.0	8.4	87.9	2.0
X	E	1050	35.92	5.742	16.09	0.427	0.089	88.1	11.0	75.5	1.6
	F	1080	32.94	5.884	13.90	1.372	0.087	89.0	19.6	70.06	0.54
	G	1120	31.23	5.807	7.784	4.27	0.088	94.2	46.1	70.27	0.25
	H	1180	29.72	5.564	4.132	4.40	0.092	97.5	73.4	69.20	0.22
X	I	1250	30.23	6.040	3.616	1.90	0.084	98.1	85.2	70.86	0.40
X	J	1300	30.32	6.835	2.397	1.345	0.075	99.6	93.6	72.11	0.57
X	K	1700	30.52	14.94	13.98	1.033	0.034	90.5	100.0	66.48	0.75
	Integrated age ± 1σ			n=11		16.1	0.082	K2O=0.21%		75.87	0.21
	Plateau ± 1σ		steps F-H	n=3	MSWD=5.43	10.037			62.4	69.7	0.4
	4-AD, Audubon 12,287', Biotite, 5.6 mg, J=0.001308±0.03%, NM-202C, Lab#=56713-01										
X	A	650	45.11	0.4016	105.3	1.074	1.3	31.1	0.8	32.78	0.64
X	B	750	32.95	0.1754	21.38	3.12	2.9	80.9	3.3	61.80	0.22
X	C	850	28.74	0.0582	3.354	15.3	8.8	96.6	15.3	64.321	0.099
	D	920	28.56	0.0545	1.332	14.7	9.4	98.6	26.8	65.275	0.098
	E	1000	28.61	0.0493	1.325	17.9	10.4	98.7	40.7	65.384	0.097
	F	1075	28.82	0.0341	1.407	21.8	15.0	98.6	57.8	65.799	0.100
	G	1110	28.56	0.0297	1.058	12.68	17.2	98.9	67.7	65.43	0.12
	H	1180	28.29	0.0223	1.016	17.4	22.9	99.0	81.3	64.85	0.10
	I	1210	28.20	0.0419	0.9416	11.13	12.2	99.0	90.0	64.702	0.098
	J	1250	28.48	0.0996	1.055	9.43	5.1	98.9	97.4	65.28	0.10
X	K	1300	29.53	0.2226	2.195	2.75	2.3	97.9	99.6	66.92	0.18
X	L	1720	46.05	2.739	40.12	0.569	0.19	74.7	100.0	79.59	0.80
	Integrated age ± 1σ			n=12		127.9	7.6	K2O=6.71%		64.918	0.079
	Plateau ± 1σ		steps D-J	n=7	MSWD=13.43	105.103			82.2	65.24	0.14

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	5-AD, Audubon 11,446', (mapped as Tert) K-Feldspar, 10.3 mg, J=0.0013448±0.06%, NM-202F, Lab#=56731-01										
X	B	600	544.8	0.0619	122.2	2.97	8.2	93.4	2.4	940.4	1.9
X	C	600	58.49	0.0723	23.78	1.381	7.1	88.0	3.5	120.71	0.57
X	D	650	55.35	0.0793	18.36	1.228	6.4	90.2	4.5	117.22	0.59
	E	650	37.87	0.0856	16.55	0.944	6.0	87.1	5.3	78.28	0.72
X	F	700	43.16	0.0720	14.00	0.998	7.1	90.4	6.1	92.28	0.70
	G	700	35.80	0.0532	14.10	1.131	9.6	88.4	7.0	75.14	0.55
X	H	750	50.94	0.0564	14.73	1.46	9.1	91.5	8.2	109.62	0.51
	I	750	35.22	0.0513	10.29	1.45	10.0	91.4	9.4	76.43	0.49
X	J	800	43.64	0.0483	8.917	1.68	10.6	94.0	10.8	96.83	0.42
	K	800	33.09	0.0392	9.186	1.76	13.0	91.8	12.2	72.23	0.40
X	L	850	38.68	0.0440	6.531	1.64	11.6	95.0	13.5	87.03	0.43
X	M	850	33.31	0.0316	8.248	1.86	16.2	92.7	15.0	73.37	0.37
X	N	900	59.46	0.0343	11.78	1.63	14.9	94.1	16.4	130.92	0.54
X	O	900	41.85	0.0292	10.67	1.72	17.5	92.5	17.8	91.51	0.42
X	P	950	108.7	0.0372	19.53	1.71	13.7	94.7	19.1	233.91	0.69
X	Q	950	64.78	0.0252	12.20	1.86	20.3	94.4	20.7	142.62	0.50
X	R	1000	167.0	0.0275	21.21	2.25	18.6	96.2	22.5	352.99	0.74
X	S	1050	176.9	0.0247	20.48	4.69	20.7	96.6	26.3	373.15	0.62
X	T	1100	176.3	0.0233	16.63	7.85	21.9	97.2	32.7	374.19	0.57
X	U	1150	150.5	0.0177	14.36	12.18	28.9	97.2	42.5	323.88	0.46
X	V	1200	116.2	0.0180	11.37	13.35	28.3	97.1	53.4	254.85	0.35
X	W	1200	96.13	0.0148	9.792	12.68	34.6	97.0	63.7	213.08	0.33
X	X	1200	88.44	0.0149	10.98	16.4	34.1	96.3	77.0	195.67	0.30
X	Y	1300	113.4	0.0118	6.942	23.0	43.2	98.2	95.7	251.73	0.37
X	Z	1350	139.0	0.0304	8.254	3.17	16.8	98.2	98.3	304.08	0.62
X	AA	1400	277.9	0.0597	30.93	0.658	8.6	96.7	98.8	556.6	2.4
X	AB	1550	592.2	0.0440	49.41	1.200	11.6	97.5	99.8	1037.0	2.8
X	AC	1750	535.7	0.0870	241.5	0.281	5.9	86.7	100.0	875.3	6.1
	Integrated age ± 1σ			n=28		123.2	21.1	K2O=3.42%		272.35	0.34
	Plateau ± 1σ	steps E-K		n=4	MSWD=25.08	5.289			4.3	74.7	1.3
	6-AD, Audubon 11,048', Hornblende, 57.58 mg, J=0.0013451±0.08%, NM-202F, Lab#=56730-01										
X	A	800	341.5	1.566	490.1	0.584	0.33	57.6	1.4	424.2	3.0
X	B	900	43.55	0.5655	26.64	0.717	0.90	82.0	3.1	84.68	0.96
X	C	1000	39.01	0.8832	20.06	0.821	0.58	85.0	5.1	78.73	0.67
	D	800	70.71	26.14	220.4	0.008	0.020	11.0	5.1	19.1	68.0
	E	875	32.60	1.593	-17.3666	0.014	0.32	116.2	5.2	89.7	37.3
	F	975	35.46	1.375	23.46	0.106	0.37	80.8	5.4	68.2	5.1
	G	1075	30.61	3.250	8.816	3.79	0.16	92.4	14.6	67.49	0.22
	H	1250	29.53	3.112	4.765	33.7	0.16	96.1	96.0	67.71	0.12
X	I	1700	39.75	25.28	26.78	1.66	0.020	85.4	100.0	81.92	0.63
	Integrated age ± 1σ			n=9		41.4	0.13	K2O=0.21%		74.32	0.16
	Plateau ± 1σ	steps D-H		n=5	MSWD=0.42	37.6			90.9	67.66	0.12

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	6-AD, K-Feldspar, Audubon 11,000', 18.2 mg, J=0.0013535±0.06%, NM-202G, Lab#=56736-01										
X	B	600	147.6	0.1596	350.0	4.65	3.2	30.0	1.0	104.9	1.3
X	C	600	37.60	0.1960	34.79	3.17	2.6	72.7	1.7	65.54	0.34
X	D	650	34.64	0.2556	26.48	3.70	2.0	77.5	2.5	64.35	0.29
X	E	650	31.06	0.2568	16.30	4.03	2.0	84.6	3.4	63.00	0.26
X	F	700	29.89	0.2691	11.75	4.42	1.9	88.5	4.4	63.43	0.20
X	G	700	28.80	0.2405	9.289	5.95	2.1	90.5	5.7	62.55	0.18
X	H	750	28.18	0.2165	5.886	6.65	2.4	93.9	7.2	63.45	0.16
	I	750	27.41	0.1928	4.342	9.17	2.6	95.4	9.2	62.73	0.12
	J	800	27.15	0.2063	2.836	10.02	2.5	97.0	11.4	63.15	0.12
	K	800	26.96	0.1968	3.106	13.22	2.6	96.7	14.4	62.51	0.11
	L	850	26.93	0.1774	2.216	12.22	2.9	97.6	17.1	63.06	0.10
	M	850	26.66	0.1414	2.154	14.7	3.6	97.7	20.3	62.46	0.10
	N	900	26.82	0.1211	2.271	12.18	4.2	97.5	23.0	62.75	0.10
	O	900	26.77	0.0915	2.222	12.98	5.6	97.6	25.9	62.67	0.11
	P	950	27.05	0.0905	2.983	9.55	5.6	96.8	28.0	62.79	0.12
	Q	950	27.03	0.0719	2.941	9.71	7.1	96.8	30.1	62.76	0.11
X	R	1000	27.54	0.0763	3.515	7.14	6.7	96.2	31.7	63.56	0.15
X	S	1050	27.65	0.0759	3.528	9.31	6.7	96.3	33.7	63.82	0.13
X	T	1100	28.19	0.0842	4.270	11.75	6.1	95.5	36.3	64.59	0.11
X	U	1150	29.96	0.0935	6.735	21.8	5.5	93.4	41.2	67.04	0.12
X	V	1200	30.53	0.0667	8.615	47.0	7.6	91.7	51.5	67.06	0.11
X	W	1200	30.93	0.0560	9.755	56.4	9.1	90.7	64.0	67.20	0.11
X	X	1200	31.07	0.0591	9.536	74.1	8.6	90.9	80.4	67.70	0.10
X	Y	1300	31.00	0.0674	6.633	67.8	7.6	93.7	95.4	69.54	0.10
X	Z	1350	32.33	0.2392	11.50	3.76	2.1	89.5	96.2	69.34	0.24
X	AA	1400	33.31	0.2146	14.05	1.92	2.4	87.6	96.6	69.86	0.38
X	AB	1550	32.22	0.2064	10.30	11.95	2.5	90.6	99.3	69.91	0.14
X	AC	1750	36.73	0.1716	24.12	3.37	3.0	80.6	100.0	70.88	0.29
	Integrated age ± 1σ			n=28		452.6	5.0	K2O=7.06%		66.69	0.11
	Plateau ± 1σ	steps I-Q		n=9	MSWD=4.25	103.734			22.9	62.76	0.09
	40-AD, Hornblende, Audubon near Lake Isabellel, 22.37 mg, J=0.0013092±0.03%, NM-202C, Lab#=56714-01										
X	A	800	257.6	1.918	267.2	0.557	0.27	69.4	0.6	379.9	2.5
X	B	900	49.22	0.9825	29.95	0.398	0.52	82.2	1.1	93.1	1.5
X	C	1000	35.58	1.609	13.65	0.776	0.32	89.0	1.9	73.38	0.74
X	D	1030	32.43	2.020	10.66	0.578	0.25	90.8	2.6	68.33	0.89
	E	1050	30.85	2.715	11.77	0.805	0.19	89.5	3.5	64.14	0.71
	F	1080	29.10	2.927	5.060	5.00	0.17	95.7	9.0	64.72	0.18
	G	1120	29.05	2.940	4.773	5.66	0.17	96.0	15.3	64.79	0.17
	H	1180	28.52	2.948	2.404	35.0	0.17	98.4	54.2	65.196	0.093
	I	1250	28.28	2.958	1.924	38.4	0.17	98.9	97.0	64.97	0.10
X	J	1300	30.30	9.339	7.834	1.91	0.055	94.9	99.1	67.09	0.38
X	K	1650	38.33	54.88	44.42	0.789	0.009	77.6	100.0	71.6	1.2
	Integrated age ± 1σ			n=11		89.9	0.14	K2O=1.18%		67.48	0.10
	Plateau ± 1σ	steps E-I		n=5	MSWD=2.43	84.9			94.4	65.01	0.10

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	40-AD, K-Feldspar, Audubon near Lake Isabellel, 9.6 mg, J=0.0013083±0.04%, NM-202C, Lab#=56712-01										
X	B	600	839.4	0.0898	1616.2	2.55	5.7	43.1	0.8	699.2	4.3
X	C	600	47.99	0.0974	51.81	2.53	5.2	68.1	1.6	75.53	0.39
X	D	650	49.17	0.1056	40.94	2.47	4.8	75.4	2.3	85.45	0.44
X	E	650	33.37	0.1153	26.44	2.59	4.4	76.6	3.1	59.32	0.34
X	F	700	36.03	0.1083	21.98	2.70	4.7	82.0	3.9	68.41	0.32
	G	700	29.91	0.1079	17.94	3.31	4.7	82.3	5.0	57.18	0.28
X	H	750	39.66	0.0761	24.40	4.14	6.7	81.8	6.2	75.00	0.28
	I	750	27.96	0.0759	12.03	4.46	6.7	87.3	7.6	56.69	0.20
X	J	800	32.29	0.0744	14.27	4.55	6.9	87.0	9.0	65.07	0.21
	K	800	26.45	0.0816	5.922	5.09	6.2	93.4	10.6	57.38	0.18
X	L	850	31.24	0.0768	10.92	4.50	6.6	89.7	12.0	64.92	0.21
	M	850	25.90	0.0817	4.941	4.44	6.2	94.4	13.3	56.78	0.18
X	N	900	28.00	0.0760	7.905	3.75	6.7	91.7	14.5	59.58	0.21
	O	900	25.83	0.0712	5.410	3.94	7.2	93.8	15.7	56.30	0.21
X	P	950	28.53	0.0756	10.33	2.86	6.7	89.3	16.6	59.14	0.26
	Q	950	26.48	0.0631	6.655	3.94	8.1	92.6	17.8	56.95	0.20
X	R	1000	29.67	0.0628	12.61	3.47	8.1	87.5	18.8	60.21	0.26
X	S	1050	30.89	0.0472	13.28	6.15	10.8	87.3	20.7	62.53	0.19
X	T	1100	32.82	0.0372	14.65	10.92	13.7	86.8	24.1	66.00	0.16
X	U	1150	34.18	0.0299	14.89	16.6	17.1	87.1	29.2	68.94	0.14
X	V	1200	34.30	0.0245	13.53	32.3	20.8	88.3	39.1	70.13	0.13
X	W	1200	33.35	0.0250	10.91	35.7	20.4	90.3	50.1	69.71	0.12
X	X	1200	33.43	0.0271	9.635	52.0	18.8	91.5	66.1	70.75	0.11
X	Y	1300	34.92	0.0328	9.061	50.6	15.6	92.3	81.7	74.52	0.12
X	Z	1350	38.03	0.0859	12.39	17.9	5.9	90.4	87.2	79.34	0.16
X	AA	1400	39.50	0.1236	12.81	8.84	4.1	90.4	89.9	82.39	0.17
X	AB	1550	36.04	0.0203	10.22	31.1	25.2	91.6	99.4	76.29	0.13
X	AC	1750	45.89	0.0476	44.53	1.80	10.7	71.3	100.0	75.64	0.50
	Integrated age ± 1σ			n=28		325.2	11.6	K2O=9.94%		76.51	0.15
	Plateau ± 1σ		steps G-Q	n=6	MSWD=3.57	25.183			7.7	56.89	0.16
	41-AD, Biotite, Audubon near Lake Isabellel, 5.83 mg, J=0.0013108±0.03%, NM-202C, Lab#=56715-01										
X	A	650	80.57	0.1525	211.3	0.646	3.3	22.6	0.5	42.5	1.0
X	B	750	34.00	0.0608	19.96	2.03	8.4	82.7	2.2	65.26	0.27
X	C	850	29.31	0.0183	4.166	12.21	27.9	95.8	12.2	65.20	0.10
	D	920	28.76	0.0160	1.388	12.86	31.9	98.6	22.7	65.80	0.10
	E	1000	28.92	0.0256	1.054	15.1	20.0	98.9	35.1	66.396	0.097
	F	1075	29.20	0.0528	1.372	21.2	9.7	98.6	52.4	66.84	0.10
	G	1110	28.94	0.1360	1.220	12.36	3.8	98.8	62.5	66.370	0.098
	H	1180	28.81	0.0519	1.771	13.29	9.8	98.2	73.4	65.684	0.096
	I	1210	28.52	0.0746	0.9174	13.04	6.8	99.1	84.1	65.587	0.097
	J	1250	28.47	0.1370	0.8987	16.1	3.7	99.1	97.3	65.510	0.094
X	K	1300	30.02	0.4314	2.246	2.95	1.2	97.9	99.7	68.21	0.19
X	L	1720	52.82	7.848	73.02	0.356	0.065	60.4	100.0	74.3	1.3
	Integrated age ± 1σ			n=12		122.1	5.3	K2O=6.13%		65.929	0.081
	Plateau ± 1σ		steps D-J	n=7	MSWD=26.08	103.860			85.1	66.01	0.19

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	10-V, Hornblende, Valmont dike - altered, 15.42 mg, J=0.0013099±0.06%, NM-202C, Lab#=56717-01										
	A	800	154.3	1.064	438.7	2.11	0.48	16.1	28.2	57.7	1.7
	B	900	62.12	0.3367	118.4	0.960	1.5	43.7	41.1	63.1	1.1
	C	1000	36.97	0.4200	33.62	0.977	1.2	73.2	54.2	62.86	0.86
	D	1030	34.74	0.9207	31.70	0.348	0.55	73.3	58.9	59.2	1.5
	E	1050	30.28	0.8813	28.46	0.214	0.58	72.5	61.7	51.1	2.4
	F	1080	30.05	1.401	22.10	0.209	0.36	78.7	64.5	55.0	2.4
	G	1120	30.67	2.441	19.47	0.253	0.21	81.9	67.9	58.5	2.0
	H	1180	35.43	3.752	40.51	0.269	0.14	67.2	71.5	55.6	2.0
	I	1250	38.89	13.50	49.29	0.563	0.038	65.4	79.1	59.7	1.2
	J	1300	43.49	47.58	69.37	0.339	0.011	61.9	83.6	64.7	1.7
	K	1650	48.62	90.22	109.4	1.223	0.006	48.9	100.0	59.0	1.5
	Integrated age ± 1σ			n=11		7.46	0.026	K2O=0.14%		59.49	0.72
	Plateau ± 1σ		steps A-K	n=11	MSWD=5.17	7.46			100.0	60.4	1.0
	12-JT, Hornblende, Jamestown, 15.77 mg, J=0.0013195±0.05%, NM-202D, Lab#=56723-01										
X	A	800	137.8	2.556	206.6	1.78	0.20	55.8	5.9	174.7	1.1
X	B	900	45.27	0.3652	66.65	1.48	1.4	56.6	10.8	59.94	0.58
X	C	1000	34.26	1.501	26.48	2.67	0.34	77.5	19.7	62.20	0.38
X	D	1030	32.55	3.299	19.48	1.74	0.15	83.2	25.4	63.43	0.43
X	E	1050	33.00	4.441	18.34	1.44	0.11	84.7	30.2	65.51	0.52
X	F	1080	33.25	5.261	17.22	1.78	0.097	86.0	36.1	67.04	0.43
X	G	1120	33.42	6.474	15.05	6.56	0.079	88.3	57.8	69.22	0.22
X	H	1180	30.41	6.089	7.456	6.65	0.084	94.4	79.9	67.35	0.19
X	I	1250	36.62	7.989	17.66	2.18	0.064	87.6	87.1	75.16	0.39
X	J	1300	37.11	8.015	14.23	1.97	0.064	90.5	93.6	78.62	0.40
X	K	1650	38.62	15.55	23.89	1.92	0.033	85.1	100.0	77.35	0.46
	Integrated age ± 1σ			n=11		30.2	0.087	K2O=0.56%		75.05	0.20
	Plateau ± 1σ		no plateau								

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	12-JT, K-Feldspar, Jamestown, 11.2 mg, J=0.00132±0.05%, NM-202D, Lab#=56722-01										
X	B	600	1229.1	0.2064	2316.5	1.83	2.5	44.3	0.6	977.3	5.2
X	C	600	64.76	0.1920	89.55	1.56	2.7	59.2	1.2	89.00	0.67
X	D	650	99.66	0.1822	87.01	2.11	2.8	74.2	1.9	168.06	0.66
X	E	650	37.77	0.2115	31.57	2.20	2.4	75.3	2.7	66.53	0.40
X	F	700	64.06	0.1805	49.79	2.91	2.8	77.1	3.7	113.86	0.44
X	G	700	30.49	0.2081	15.22	3.37	2.5	85.3	4.8	60.90	0.25
X	H	750	55.30	0.1399	36.78	4.82	3.6	80.4	6.5	102.83	0.32
X	I	750	28.78	0.1504	9.833	5.02	3.4	89.9	8.2	60.60	0.19
X	J	800	39.84	0.1295	19.65	5.39	3.9	85.4	10.1	79.29	0.24
X	K	800	27.18	0.1416	6.630	5.31	3.6	92.8	11.9	59.08	0.16
X	L	850	32.02	0.1324	11.88	4.31	3.9	89.1	13.4	66.65	0.20
	M	850	26.42	0.1484	5.632	4.32	3.4	93.7	14.9	58.02	0.18
	N	900	28.16	0.1479	7.397	3.25	3.4	92.3	16.0	60.84	0.23
	O	900	26.32	0.1348	6.777	3.63	3.8	92.4	17.3	57.00	0.23
	P	950	27.30	0.1396	7.810	2.73	3.7	91.6	18.2	58.57	0.27
	Q	950	26.33	0.1104	7.033	3.57	4.6	92.1	19.4	56.84	0.20
X	R	1000	29.01	0.1140	10.77	3.11	4.5	89.1	20.5	60.49	0.24
X	S	1050	29.97	0.0816	10.85	5.53	6.3	89.3	22.4	62.63	0.19
X	T	1100	32.31	0.0664	10.74	9.23	7.7	90.2	25.6	68.08	0.15
X	U	1150	35.20	0.0496	12.92	14.5	10.3	89.2	30.6	73.23	0.14
X	V	1200	35.96	0.0475	13.14	20.9	10.8	89.2	37.8	74.80	0.15
X	W	1200	35.41	0.0471	12.19	23.7	10.8	89.8	46.0	74.19	0.14
X	X	1200	35.31	0.0529	10.87	34.9	9.7	90.9	58.0	74.85	0.12
X	Y	1300	37.86	0.0539	9.319	63.4	9.5	92.7	79.9	81.71	0.12
X	Z	1350	39.87	0.1632	11.44	24.7	3.1	91.6	88.4	84.88	0.14
X	AA	1400	42.83	0.2458	13.58	10.56	2.1	90.7	92.1	90.18	0.18
X	AB	1550	39.48	0.0603	11.70	19.4	8.5	91.3	98.8	83.79	0.15
X	AC	1750	39.50	0.0427	22.05	3.57	11.9	83.5	100.0	76.86	0.28
	Integrated age ± 1σ			n=28		289.8	5.7	K2O=7.53%		84.86	0.16
	Plateau ± 1σ	steps M-Q		n=5	MSWD=52.07	17.507			6.0	58.14	0.697
	18-E, Biotite, Eldora (Hart location),7.45 mg, J=0.0013029±0.07%, NM-202B, Lab#=56710-01										
X	A	650	37.42	0.2017	94.54	1.213	2.5	25.4	0.7	22.20	0.51
	B	750	31.62	0.0733	22.07	3.41	7.0	79.4	2.6	58.05	0.21
	C	850	26.12	0.0252	2.846	17.6	20.2	96.8	12.5	58.457	0.100
	D	920	25.74	0.0182	0.8539	17.9	28.1	99.0	22.5	58.925	0.089
	E	1000	25.81	0.0188	0.7854	21.6	27.1	99.1	34.6	59.126	0.094
	F	1075	25.99	0.0219	0.9634	29.2	23.3	98.9	51.0	59.424	0.079
	G	1110	25.71	0.0260	0.9468	24.5	19.6	98.9	64.8	58.788	0.083
	H	1180	25.67	0.0986	1.115	23.1	5.2	98.8	77.8	58.600	0.080
	I	1210	25.61	0.2279	1.088	18.9	2.2	98.8	88.3	58.513	0.089
	J	1250	25.60	0.2030	0.8681	17.6	2.5	99.1	98.2	58.626	0.090
	K	1300	26.09	0.2353	1.182	2.36	2.2	98.7	99.5	59.55	0.18
X	L	1720	31.84	2.008	28.95	0.819	0.25	73.6	100.0	54.34	0.45
	Integrated age ± 1σ			n=12		178.1	5.9	K2O=7.05%		58.574	0.077
	Plateau ± 1σ	steps B-K		n=10	MSWD=15.21	176.032			98.9	58.83	0.12

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	18-E, Hornblende, (Hart location), 4.84 mg, J=0.001301±0.06%, NM-202B, Lab#=56711-01										
X	A	800	87.93	2.776	116.7	1.350	0.18	61.0	6.6	122.0	1.0
X	B	900	28.94	0.9114	10.34	1.90	0.56	89.7	15.8	59.93	0.33
X	C	1000	29.47	1.611	6.951	2.96	0.32	93.5	30.1	63.58	0.20
X	D	1030	29.09	2.133	5.763	1.51	0.24	94.8	37.5	63.64	0.33
X	E	1050	29.28	2.881	7.729	1.169	0.18	93.0	43.1	62.92	0.43
X	F	1080	30.04	3.869	7.860	1.78	0.13	93.4	51.8	64.79	0.30
X	G	1120	29.65	3.143	6.743	2.58	0.16	94.2	64.3	64.50	0.23
X	H	1180	31.57	3.207	9.010	2.81	0.16	92.4	78.0	67.35	0.22
X	I	1250	31.13	3.235	7.065	4.08	0.16	94.2	97.8	67.65	0.18
X	J	1300	37.54	4.371	17.23	0.241	0.12	87.4	98.9	75.6	1.6
X	K	1650	50.24	10.15	69.28	0.218	0.050	60.9	100.0	70.9	2.1
	Integrated age ± 1σ			n=11		20.6	0.18	K2O=1.26%		68.86	0.16
	Plateau ± 1σ	no plateau									
	18-E, K-Feldspar, Eldora (Hart location), 16.81 mg, J=0.0013111±0.05%, NM-202C, Lab#=56716-01										
X	B	600	115.2	0.0835	245.6	8.86	6.1	37.0	1.6	98.02	0.85
	C	600	32.03	0.0844	24.20	5.12	6.0	77.7	2.5	57.90	0.22
X	D	650	30.53	0.0968	16.14	5.16	5.3	84.4	3.4	59.92	0.20
	E	650	28.36	0.0895	11.35	6.10	5.7	88.2	4.5	58.20	0.17
X	F	700	28.68	0.0839	10.76	6.08	6.1	88.9	5.5	59.34	0.17
	G	700	26.65	0.0661	5.632	8.00	7.7	93.8	7.0	58.13	0.13
X	H	750	27.83	0.0665	7.255	7.98	7.7	92.3	8.4	59.76	0.13
	I	750	25.94	0.0533	3.464	10.16	9.6	96.1	10.2	57.97	0.11
X	J	800	27.18	0.0556	5.418	9.54	9.2	94.1	11.8	59.49	0.12
	K	800	25.76	0.0519	2.545	11.31	9.8	97.1	13.9	58.20	0.10
X	L	850	27.23	0.0552	4.843	9.55	9.2	94.8	15.5	60.01	0.13
	M	850	25.74	0.0561	2.465	10.86	9.1	97.2	17.5	58.20	0.11
X	N	900	27.38	0.0627	6.029	8.97	8.1	93.5	19.0	59.55	0.13
	O	900	25.98	0.0572	3.217	9.80	8.9	96.4	20.8	58.25	0.11
X	P	950	27.02	0.0509	5.891	7.87	10.0	93.6	22.2	58.82	0.14
	Q	950	26.26	0.0405	4.255	9.40	12.6	95.2	23.8	58.18	0.12
X	R	1000	27.58	0.0373	7.136	7.79	13.7	92.4	25.2	59.24	0.14
X	RA	1000	27.04	0.0307	5.743	9.97	16.6	93.7	27.0	58.95	0.11
X	S	1050	28.98	0.0321	10.53	9.10	15.9	89.3	28.6	60.17	0.14
X	SA	1050	28.41	0.0290	9.112	12.65	17.6	90.5	30.8	59.82	0.11
X	T	1100	31.86	0.0408	16.02	14.4	12.5	85.1	33.4	63.03	0.15
X	TA	1100	30.55	0.0412	13.50	16.8	12.4	87.0	36.4	61.74	0.14
X	U	1150	33.52	0.0455	18.34	15.8	11.2	83.8	39.1	65.27	0.15
X	V	1200	33.71	0.0481	16.60	32.3	10.6	85.5	44.8	66.87	0.14
X	W	1250	33.08	0.0250	11.18	73.9	20.4	90.0	57.9	69.08	0.11
X	X	1300	32.87	0.0136	8.194	164.7	37.5	92.6	87.1	70.59	0.11
X	Y	1350	31.95	0.0457	8.380	37.9	11.2	92.3	93.8	68.40	0.12
X	Z	1400	32.62	0.1095	9.395	13.48	4.7	91.5	96.1	69.25	0.13
X	AA	1750	32.36	0.0610	10.20	21.8	8.4	90.7	100.0	68.10	0.13
	Integrated age ± 1σ			n=29		565.4	13.2	K2O=9.85%		66.34	0.11
	Plateau ± 1σ	steps C-Q		n=8	MSWD=0.79	70.748			12.5	58.15	0.05

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	20-E, Biotite, Eldora (near Hart location), 8.05 mg, J=0.0012855±0.04%, NM-202A, Lab#=56701-01										
X	A	650	63.31	0.4596	194.0	1.89	1.1	9.5	0.8	13.92	0.92
X	B	750	43.80	0.0515	80.90	2.01	9.9	45.4	1.7	45.55	0.49
X	C	850	29.94	0.0136	17.65	13.29	37.5	82.6	7.7	56.42	0.15
	D	920	27.04	0.0142	3.918	23.6	36.0	95.7	18.2	59.023	0.092
	E	1000	27.06	0.0170	3.193	33.9	30.0	96.5	33.4	59.545	0.090
	F	1075	27.58	0.0271	4.439	43.8	18.8	95.3	52.9	59.888	0.091
	G	1110	26.50	0.0185	2.429	29.0	27.7	97.3	65.8	58.816	0.099
	H	1180	26.15	0.0196	1.731	27.6	26.0	98.1	78.2	58.488	0.088
	I	1210	25.95	0.0286	1.377	16.6	17.9	98.4	85.6	58.277	0.098
	J	1250	25.93	0.0615	1.353	13.20	8.3	98.5	91.5	58.25	0.10
	K	1300	25.96	0.0550	1.209	17.6	9.3	98.6	99.4	58.421	0.098
X	L	1700	29.67	1.720	19.87	1.373	0.30	80.7	100.0	54.73	0.43
	Integrated age ± 1σ			n=12		223.9	12.8	K2O=8.31%		58.354	0.081
	Plateau ± 1σ	steps D-K		n=8	MSWD=42.32	205.370			91.7	58.9	0.2
	20-E, K-Feldspar, Eldora (near Hart location), 18.83 mg, J=0.0012878±0.05%, NM-202A, Lab#=56702-01										
X	B	600	274.4	0.2368	719.7	2.05	2.2	22.5	1.0	138.1	2.3
	C	600	41.94	0.2666	55.95	1.65	1.9	60.6	1.7	58.12	0.51
	D	650	33.84	0.3623	28.94	1.54	1.4	74.8	2.4	57.87	0.47
	E	650	30.26	0.3807	17.08	2.14	1.3	83.4	3.4	57.70	0.37
	F	700	31.25	0.3751	18.61	2.08	1.4	82.5	4.4	58.91	0.34
	G	700	28.11	0.3307	9.517	3.15	1.5	90.1	5.8	57.89	0.23
	H	750	29.25	0.3098	12.33	3.37	1.6	87.6	7.4	58.58	0.25
	I	750	26.81	0.2280	5.421	5.04	2.2	94.1	9.7	57.67	0.17
	J	800	27.64	0.1838	7.096	4.96	2.8	92.5	12.0	58.41	0.18
	K	850	27.42	0.2001	5.662	9.88	2.5	94.0	16.6	58.86	0.11
	L	900	26.47	0.2257	3.092	13.81	2.3	96.6	23.0	58.443	0.099
	M	950	26.37	0.2310	3.315	13.66	2.2	96.4	29.3	58.078	0.093
	N	1000	26.68	0.2076	4.068	11.27	2.5	95.6	34.6	58.27	0.11
	O	1050	27.08	0.1478	5.210	8.82	3.5	94.4	38.6	58.40	0.13
X	P	1100	27.79	0.1170	7.108	8.27	4.4	92.5	42.5	58.72	0.13
X	Q	1150	29.06	0.1060	9.786	10.26	4.8	90.1	47.2	59.79	0.13
X	R	1200	30.87	0.1196	14.21	12.60	4.3	86.4	53.1	60.94	0.15
X	S	1200	32.31	0.1192	17.32	16.0	4.3	84.2	60.5	62.09	0.14
X	T	1200	33.30	0.1312	18.79	27.0	3.9	83.4	73.0	63.34	0.14
X	U	1200	34.81	0.1573	21.91	24.4	3.2	81.4	84.3	64.68	0.15
X	V	1300	33.50	0.2151	15.59	16.6	2.4	86.3	92.0	65.93	0.14
X	W	1350	36.79	0.2988	26.64	3.10	1.7	78.7	93.4	66.02	0.35
X	X	1400	36.91	0.3110	25.16	6.24	1.6	79.9	96.3	67.26	0.22
X	Y	1550	36.33	0.2174	24.88	5.07	2.3	79.8	98.6	66.13	0.25
X	Z	1750	36.48	0.1948	44.25	2.93	2.6	64.2	100.0	53.58	0.34
	Integrated age ± 1σ			n=25		215.9	2.7	K2O=3.42%		62.03	0.12
	Plateau ± 1σ	steps C-O		n=13	MSWD=4.86	81.372			37.7	58.32	0.097

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	^{40}Ar/^{39}Ar	^{37}Ar/^{39}Ar	^{36}Ar/^{39}Ar (x 10^{-3})	^{39}Ar$_K$ (x 10^{-15} mol)	K/Ca	^{40}Ar* (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	21-NF, Biotite, Northfork Stock, 9.68 mg, J=0.0012893±0.06%, NM-202A, Lab#=56705-01										
X	A	650	70.48	0.1534	179.0	3.54	3.3	25.0	1.5	40.45	0.63
X	B	750	39.30	0.0434	39.92	13.02	11.7	70.0	6.9	62.84	0.20
	C	850	30.13	0.0195	7.346	32.2	26.2	92.8	20.5	63.867	0.098
	D	920	29.30	0.0262	3.720	23.0	19.5	96.3	30.1	64.41	0.10
	E	1000	29.55	0.0341	4.174	24.9	15.0	95.8	40.6	64.675	0.099
	F	1075	28.95	0.0449	3.333	38.9	11.4	96.6	56.9	63.890	0.090
	G	1110	28.74	0.0662	3.382	24.8	7.7	96.5	67.3	63.382	0.092
	H	1180	28.99	0.0664	3.369	45.9	7.7	96.6	86.6	63.969	0.085
	I	1210	29.14	0.1332	3.788	17.8	3.8	96.2	94.0	64.029	0.098
	J	1250	29.37	0.2611	4.113	11.63	2.0	95.9	98.9	64.374	0.097
	K	1300	29.88	0.4390	6.562	1.79	1.2	93.6	99.7	63.92	0.22
X	L	1720	38.74	2.161	48.93	0.786	0.24	63.1	100.0	56.07	0.55
	Integrated age ± 1σ			n=12		238.2	6.9	K2O=7.33%		63.587	0.096
	Plateau ± 1σ		steps C-K	n=9	MSWD=15.48	220.896			92.7	64.05	0.14
	23-AX, Hornblende, Apex stock (summit Jumbo Mtn), 15 mg, J=0.0012985±0.05%, NM-202B, Lab#=56706-01										
X	A	800	821.6	1.595	2343.0	0.929	0.32	15.7	1.8	280.4	6.6
X	B	900	75.88	0.5023	162.8	1.058	1.0	36.6	3.8	64.0	1.0
X	C	1000	44.69	2.350	54.77	1.90	0.22	64.2	7.3	66.09	0.52
X	D	1030	35.18	4.271	24.83	2.81	0.12	80.2	12.7	65.04	0.31
X	E	1050	31.46	4.031	14.44	4.01	0.13	87.5	20.2	63.52	0.23
X	F	1080	31.82	4.096	16.01	5.35	0.12	86.2	30.3	63.29	0.21
	G	1120	34.60	4.107	22.18	8.63	0.12	82.0	46.6	65.46	0.20
	H	1180	33.47	3.858	19.18	8.17	0.13	84.0	62.0	64.87	0.18
	I	1250	32.53	4.217	15.42	15.8	0.12	87.1	91.7	65.33	0.15
	J	1300	32.90	4.482	16.67	3.14	0.11	86.2	97.7	65.38	0.27
	K	1650	36.80	5.256	32.37	1.229	0.097	75.2	100.0	63.89	0.65
	Integrated age ± 1σ			n=11		53.0	0.13	K2O=1.04%		68.90	0.26
	Plateau ± 1σ		steps G-K	n=5	MSWD=2.56	36.9			69.7	65.21	0.15
	43-PM, Hornblende, Caribou Stock (Pomeroy Mt.), 14.32 mg, J=0.0012861±0.06%, NM-202A, Lab#=56700-01										
X	A	800	541.9	1.912	556.8	0.447	0.27	69.7	1.3	714.8	4.9
X	B	900	52.35	1.080	50.91	0.307	0.47	71.4	2.1	84.8	1.9
X	C	1000	66.63	4.104	46.07	0.692	0.12	80.1	4.1	120.1	1.0
	D	1100	35.86	4.883	5.688	29.2	0.10	96.5	86.1	78.78	0.13
X	E	1130	35.54	4.451	16.47	0.972	0.11	87.4	88.9	70.88	0.57
X	F	1160	35.05	6.524	13.85	0.547	0.078	89.9	90.4	71.98	0.92
X	G	1190	36.81	8.831	11.05	0.959	0.058	93.1	93.1	78.31	0.63
X	H	1220	36.30	7.253	9.821	1.47	0.070	93.7	97.2	77.59	0.44
X	I	1250	33.05	5.313	8.249	0.445	0.096	94.0	98.5	70.9	1.2
X	J	1300	30.79	4.107	17.45	0.353	0.12	84.4	99.5	59.4	1.4
X	K	1650	55.28	7.732	119.1	0.189	0.066	37.5	100.0	47.7	2.8
	Integrated age ± 1σ			n=11		35.6	0.10	K2O=0.74%		88.35	0.17
	Plateau ± 1σ		steps D-D	n=1	MSWD=0.00	29.210			82.1	78.78	0.13

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	43-PM, Hornblende, Caribou Stock (Pomeroy Mt.), 8.9 mg, J=0.0012861±0.06%, NM-202A, Lab#=56700-02										
X	A	800	300.7	7.480	456.3	0.075	0.068	55.4	2.8	351.6	9.8
X	B	900	50.52	5.689	67.88	0.036	0.090	61.2	4.2	70.6	13.7
X	C	1000	68.39	6.752	66.30	0.055	0.076	72.2	6.2	111.5	8.2
X	D	1030	68.94	6.704	43.93	0.038	0.076	82.0	7.7	127.2	14.2
X	E	1050	52.11	6.193	20.88	0.073	0.082	89.2	10.5	105.1	6.6
X	F	1080	42.52	5.361	12.51	0.538	0.095	92.4	30.7	89.22	0.97
	G	1120	34.51	4.888	4.687	1.251	0.10	97.2	77.9	76.43	0.48
	H	1180	34.79	5.923	9.666	0.177	0.086	93.3	84.6	74.1	2.9
	I	1250	34.47	6.624	5.045	0.265	0.077	97.3	94.6	76.5	1.8
	J	1300	27.71	7.102	14.15	0.037	0.072	87.1	96.0	55.4	12.8
X	K	1700	31.81	23.97	63.48	0.107	0.021	47.3	100.0	35.1	4.4
	Integrated age ± 1σ			n=11		2.65	0.082	K2O=0.09%		87.48	0.66
	Plateau ± 1σ	steps G-J		n=4	MSWD=1.12	1.73			65.2	76.35	0.48
	43-PM, K-Feldspar, Caribou Stock (Pomeroy Mt.), 16.81 mg, J=0.0012916±0.04%, NM-202A, Lab#=56704-01										
X	B	600	715.6	0.0706	173.5	4.51	7.2	92.8	0.9	1117.7	2.0
X	C	600	55.09	0.0704	10.68	2.99	7.2	94.3	1.4	117.12	0.32
X	D	650	41.87	0.0850	6.753	3.30	6.0	95.2	2.1	90.59	0.26
X	E	650	33.55	0.0835	4.656	3.73	6.1	95.9	2.8	73.46	0.22
X	F	700	32.80	0.0868	2.642	4.12	5.9	97.6	3.6	73.10	0.20
	G	700	29.10	0.0704	2.491	5.49	7.2	97.5	4.6	64.90	0.16
X	H	750	30.95	0.0657	2.532	6.52	7.8	97.6	5.9	69.04	0.14
	I	750	28.36	0.0487	1.579	8.42	10.5	98.4	7.5	63.83	0.12
X	J	800	29.90	0.0422	1.438	7.59	12.1	98.6	8.9	67.38	0.14
	K	800	28.19	0.0332	1.291	11.54	15.4	98.7	11.1	63.65	0.11
X	L	850	29.32	0.0325	1.024	9.78	15.7	99.0	13.0	66.36	0.11
	LA	850	28.32	0.0323	1.129	6.07	15.8	98.8	14.2	64.05	0.13
X	LB	900	29.81	0.0305	1.198	11.64	16.7	98.8	16.4	67.36	0.11
X	M	950	29.99	0.0301	1.253	15.2	16.9	98.8	19.3	67.71	0.10
X	N	1000	29.68	0.0274	1.155	15.9	18.6	98.9	22.4	67.081	0.099
X	O	1050	29.98	0.0266	1.576	15.8	19.2	98.5	25.4	67.48	0.10
X	P	1100	32.19	0.0331	2.439	19.1	15.4	97.8	29.0	71.86	0.11
X	Q	1150	36.57	0.0343	3.848	20.7	14.9	96.9	33.0	80.71	0.13
X	R	1200	41.09	0.0380	4.658	27.8	13.4	96.7	38.3	90.23	0.14
X	S	1200	42.22	0.0333	4.436	32.4	15.3	96.9	44.5	92.89	0.14
X	T	1200	42.97	0.0279	4.040	22.1	18.3	97.2	48.8	94.80	0.14
X	U	1250	44.42	0.0144	2.792	50.8	35.4	98.1	58.5	98.80	0.14
X	V	1300	44.86	0.0106	2.554	125.5	48.1	98.3	82.5	99.93	0.12
X	W	1350	45.03	0.0230	2.747	40.8	22.2	98.2	90.3	100.18	0.14
X	X	1550	45.35	0.0378	3.170	43.5	13.5	97.9	98.7	100.62	0.14
X	Y	1750	46.77	0.0245	15.90	7.00	20.8	90.0	100.0	95.45	0.20
	Integrated age ± 1σ			n=26		522.5	18.4	K2O=9.24%		101.10	0.12
	Plateau ± 1σ	steps G-LA		n=4	MSWD=15.40	31.515			6.0	63.99	0.25

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	44-EW, Hornblende, Empire stock 13.4 mg, J=0.0013025±0.07%, NM-202B, Lab#=56709-01										
X	A	800	81.06	0.9699	142.4	3.33	0.53	48.2	12.1	89.60	0.64
X	B	900	51.89	0.7052	40.69	0.832	0.72	77.0	15.1	91.50	0.78
X	C	1000	30.54	2.058	11.30	3.66	0.25	89.6	28.4	63.27	0.24
X	D	1030	26.50	2.274	5.048	2.78	0.22	95.1	38.5	58.34	0.24
	E	1050	27.09	2.386	4.995	2.45	0.21	95.3	47.4	59.74	0.28
	F	1080	26.98	2.411	4.523	3.25	0.21	95.8	59.2	59.82	0.20
	G	1120	27.38	2.415	5.832	3.24	0.21	94.4	71.0	59.83	0.22
X	H	1180	29.81	3.712	10.68	1.72	0.14	90.5	77.3	62.41	0.41
X	I	1250	32.29	15.59	17.39	5.64	0.033	88.1	97.8	66.31	0.29
X	J	1300	61.99	179.0	124.8	0.312	0.003	64.4	98.9	104.1	3.7
X	K	1650	56.15	164.6	131.9	0.307	0.003	54.8	100.0	79.9	3.3
	Integrated age ± 1σ			n=11		27.5	0.055	K2O=0.61%		66.94	0.22
	Plateau ± 1σ		steps E-G	n=3	MSWD=0.03	8.945			32.5	59.80	0.13
	44-EW, K-Feldspar, Empire stock,11.1 mg, J=0.0013±0.06%, NM-202B, Lab#=56708-01										
X	B	600	74.03	0.1961	79.94	7.65	2.6	68.1	3.7	114.56	0.41
X	C	600	28.87	0.1257	9.915	4.54	4.1	89.9	5.9	59.85	0.21
X	D	650	25.16	0.1324	5.106	4.41	3.9	94.1	8.0	54.64	0.17
X	E	650	25.29	0.1110	5.477	5.64	4.6	93.6	10.7	54.69	0.15
	F	700	24.26	0.1073	3.734	5.39	4.8	95.5	13.3	53.52	0.14
	G	700	24.43	0.0975	3.739	8.25	5.2	95.5	17.3	53.91	0.12
	H	750	24.06	0.0967	2.962	8.19	5.3	96.4	21.2	53.57	0.11
X	I	750	24.81	0.0964	3.548	10.49	5.3	95.8	26.3	54.90	0.11
X	J	800	25.07	0.1146	2.904	8.57	4.5	96.6	30.4	55.93	0.12
X	K	800	26.51	0.1326	3.929	9.71	3.8	95.7	35.1	58.52	0.13
X	L	850	27.24	0.1702	4.260	6.68	3.0	95.5	38.3	59.98	0.14
X	M	850	29.36	0.1928	6.399	6.73	2.6	93.7	41.5	63.37	0.16
X	N	900	30.17	0.2430	6.893	4.47	2.1	93.4	43.7	64.89	0.20
X	O	900	32.24	0.2585	9.109	4.80	2.0	91.8	46.0	68.11	0.21
X	P	950	32.89	0.2717	8.941	3.62	1.9	92.1	47.7	69.71	0.22
X	Q	950	32.83	0.2012	9.360	4.54	2.5	91.7	49.9	69.27	0.22
X	R	1000	32.52	0.1657	8.235	3.85	3.1	92.7	51.8	69.31	0.22
X	S	1050	30.35	0.1081	6.058	6.43	4.7	94.2	54.9	65.82	0.16
X	T	1100	30.15	0.0731	5.757	9.67	7.0	94.4	59.5	65.56	0.13
X	U	1150	31.42	0.0688	6.080	12.57	7.4	94.4	65.6	68.21	0.12
X	V	1200	29.86	0.0575	4.567	15.1	8.9	95.5	72.8	65.66	0.11
X	W	1200	28.27	0.0420	3.441	18.5	12.1	96.4	81.7	62.81	0.11
X	X	1250	26.72	0.0287	2.260	23.6	17.8	97.5	93.1	60.075	0.096
X	Y	1300	28.43	0.0623	3.363	10.00	8.2	96.5	97.9	63.22	0.12
X	Z	1350	37.63	0.1722	9.963	2.19	3.0	92.2	99.0	79.58	0.34
X	AA	1400	36.80	0.1850	15.77	0.787	2.8	87.4	99.3	73.87	0.81
X	AB	1550	40.83	0.1221	42.54	0.641	4.2	69.2	99.6	65.1	1.1
X	AC	1750	65.39	0.0623	113.7	0.736	8.2	48.6	100.0	73.1	1.3
	Integrated age ± 1σ			n=28		207.7	4.8	K2O=5.53%		63.644	0.096
	Plateau ± 1σ		steps F-H	n=3	MSWD=2.99	21.827			10.5	53.68	0.13

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	45-ES, K-Feldspar, Empire stock (Minnesota mine), 10 mg, J=0.0012982±0.05%, NM-202B, Lab#=56707-01										
X	B	600	204.4	0.0315	606.2	6.63	16.2	12.4	1.8	58.3	1.8
X	C	600	39.75	0.0316	57.88	5.55	16.1	57.0	3.3	52.27	0.33
	D	650	34.90	0.0451	39.81	4.21	11.3	66.3	4.5	53.36	0.31
	E	650	31.81	0.0340	28.09	4.66	15.0	73.9	5.8	54.22	0.24
	F	700	32.25	0.0395	28.94	3.74	12.9	73.5	6.8	54.65	0.30
	G	700	28.72	0.0260	16.99	4.75	19.6	82.5	8.1	54.65	0.21
	H	750	29.43	0.0247	18.85	4.14	20.6	81.1	9.2	55.02	0.21
	I	750	26.79	0.0194	10.47	4.91	26.2	88.5	10.5	54.64	0.18
X	J	800	27.91	0.0220	13.63	3.80	23.2	85.6	11.6	55.07	0.23
X	K	800	26.77	0.0212	10.30	4.07	24.0	88.6	12.7	54.70	0.22
X	L	850	29.28	0.0247	17.77	2.78	20.6	82.1	13.5	55.40	0.32
X	M	850	27.28	0.0270	11.28	2.96	18.9	87.8	14.3	55.22	0.25
X	N	900	33.03	0.0330	31.62	2.31	15.5	71.7	14.9	54.62	0.36
X	O	900	29.05	0.0237	17.59	2.61	21.5	82.1	15.6	55.01	0.29
X	P	950	39.02	0.0347	48.04	2.41	14.7	63.6	16.3	57.21	0.45
X	Q	950	33.32	0.0234	30.93	2.96	21.8	72.6	17.1	55.75	0.34
X	R	1000	45.29	0.0286	70.11	3.41	17.8	54.3	18.0	56.64	0.39
X	S	1050	43.79	0.0214	63.83	6.92	23.8	56.9	19.9	57.44	0.30
X	T	1100	42.16	0.0159	58.10	12.83	32.1	59.3	23.4	57.59	0.25
X	U	1150	43.83	0.0190	61.49	22.1	26.9	58.5	29.4	59.10	0.25
X	V	1200	43.57	0.0231	58.00	28.6	22.1	60.7	37.3	60.86	0.24
X	W	1200	41.12	0.0167	48.06	33.9	30.5	65.5	46.5	61.96	0.22
X	X	1200	39.66	0.0114	41.36	52.1	44.8	69.2	60.7	63.12	0.19
X	Y	1300	38.74	0.0049	34.22	97.4	103.5	73.9	87.4	65.81	0.17
X	Z	1350	41.66	0.0158	44.71	23.7	32.4	68.3	93.8	65.40	0.22
X	AA	1400	43.56	0.0159	48.88	5.98	32.0	66.8	95.5	66.92	0.29
X	AB	1550	43.35	0.0133	49.08	13.97	38.4	66.5	99.3	66.31	0.25
X	AC	1750	49.89	0.0167	64.02	2.64	30.5	62.1	100.0	71.10	0.44
	Integrated age ± 1σ			n=28		366.0	32.9	K2O=10.83%		61.95	0.21
	Plateau ± 1σ		steps D-I	n=6	MSWD=4.41	26.410			7.2	54.54	0.20
	8-AS, Biotite, Aspen (Trail to Conudrum), 7.3 mg, J=0.0013187±0.05%, NM-202D, Lab#=56720-01										
X	A	650	64.44	0.2963	194.3	2.22	1.7	11.0	1.1	16.7	2.7
	B	750	21.74	0.0466	30.29	5.95	10.9	58.8	4.0	30.15	0.98
	C	850	14.90	0.0203	4.412	23.1	25.1	91.3	15.4	32.05	0.26
	D	920	14.47	0.0190	2.570	21.6	26.9	94.8	26.0	32.31	0.27
	E	1000	14.47	0.0277	2.318	28.2	18.4	95.3	39.9	32.48	0.21
	F	1075	14.74	0.0708	2.617	30.7	7.2	94.8	55.0	32.91	0.19
	G	1110	14.33	0.1244	1.982	21.5	4.1	96.0	65.5	32.42	0.27
	H	1180	14.15	0.0435	1.473	29.2	11.7	97.0	79.9	32.32	0.20
	I	1210	14.05	0.0842	1.228	19.6	6.1	97.5	89.5	32.28	0.30
	J	1250	14.14	0.1696	1.377	14.8	3.0	97.2	96.8	32.40	0.39
	K	1300	14.34	0.1568	1.342	5.25	3.3	97.3	99.4	32.9	1.1
X	L	1720	19.22	1.061	19.09	1.285	0.48	71.1	100.0	32.2	4.5
	Integrated age ± 1σ			n=12		203.5	6.9	K2O=8.12%		32.19	0.11
	Plateau ± 1σ		steps B-K	n=10	MSWD=1.64	200.0			98.3	32.43	0.11

Table 2. 40Ar/39Ar analytical data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	9-AS, Biotite, Aspen (Trail to Conudrum), 6.8 mg, J=0.0013197±0.05%, NM-202D, Lab#=56721-01										
X	A	650	89.11	0.1823	278.9	2.25	2.8	7.5	1.4	15.9	2.8
	B	750	24.71	0.0231	39.40	7.08	22.0	52.9	5.6	30.82	0.83
	C	850	16.03	0.0112	8.796	23.7	45.7	83.8	20.0	31.68	0.25
	D	920	14.92	0.0121	4.150	19.3	42.2	91.8	31.7	32.29	0.30
	E	1000	15.44	0.0330	5.877	18.6	15.5	88.8	42.9	32.32	0.32
	F	1075	15.09	0.0440	5.073	19.5	11.6	90.1	54.8	32.05	0.30
	G	1110	14.41	0.0499	2.759	11.94	10.2	94.4	62.0	32.06	0.49
	H	1180	14.13	0.0703	1.817	18.9	7.3	96.2	73.4	32.06	0.31
	I	1210	14.12	0.1373	1.131	17.3	3.7	97.7	83.8	32.54	0.34
	J	1250	14.23	0.2333	0.9477	18.6	2.2	98.2	95.1	32.94	0.31
	K	1300	14.49	0.2918	1.262	7.16	1.7	97.6	99.4	33.35	0.81
	L	1720	24.55	3.001	36.69	0.970	0.17	56.8	100.0	33.0	6.0
	Integrated age ± 1σ			n=12		165.4	5.2	K2O=7.08%		32.00	0.14
	Plateau ± 1σ	steps B-L		n=11	MSWD=1.62	163.1			98.6	32.21	0.14

Notes:
Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.
Integrated age calculated by summing isotopic measurements of all steps.
Integrated age error calculated by quadratically combining errors of isotopic measurements of all steps.
Plateau age is inverse-variance-weighted mean of selected steps.
Plateau age error is inverse-variance-weighted mean error (Taylor, 1982) times root MSWD where MSWD>1.
Plateau error is weighted error of Taylor (1982).
Decay constants and isotopic abundances after Steiger and Jäger (1977).
X symbol preceding sample ID denotes analyses excluded from plateau age calculations.
Weight percent K_2O calculated from ^{39}Ar signal, sample weight, and instrument sensitivity.
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 28.02 Ma
Decay Constant (LambdaK (total)) = 5.543e-10/a
Correction factors:
$(^{39}Ar/^{37}Ar)_{Ca}$ = 0.0007 ± 5e-05
$(^{36}Ar/^{37}Ar)_{Ca}$ = 0.00028 ± 2e-05
$(^{38}Ar/^{39}Ar)_K$ = 0.013
$(^{40}Ar/^{39}Ar)_K$ = 0.01 ± 0.002

Table 3. Summary of $^{40}Ar/^{39}Ar$ results

Sample	Unit	L#	Irrad	min	analysis	n	%^{39}Ar	MSWD	Preferred Age Age(Ma)	± 1σ	TGA Age(Ma)	± 1σ
3-AD	Audubon	56732-01	NM-202F	Hornblende	Plateau	3	62.4	5.4	69.69	± 0.37	75.87	± 0.21
4-AD	Audubon	56713-01	NM-202C	Biotite	Plateau	7	82.2	13.4	65.24	± 0.14	64.92	± 0.08
5-AD	Audubon	56731-01	NM-202F	K-Feldspar	Plateau	4	4.3	25.1	74.73	± 1.27	272.35	± 0.34
6-AD	Audubon	56730-01	NM-202F	Hornblende	Plateau	5	90.9	0.4	67.66	± 0.12	74.32	± 0.16
6-AD	Audubon	56736-01	NM-202G	K-Feldspar	Plateau	9	22.9	4.3	62.76	± 0.09	66.69	± 0.11
40-AD	Audubon	56714-01	NM-202C	Hornblende	Plateau	5	94.4	2.4	65.01	± 0.10	67.48	± 0.10
40-AD	Audubon	56712-01	NM-202C	K-Feldspar	Plateau	6	7.7	3.6	56.89	± 0.16	76.51	± 0.15
41-AD	Audubon	56715-01	NM-202C	Biotite	Plateau	7	85.1	26.1	66.01	± 0.19	65.93	± 0.08
10-V	Valmont dike	56717-01	NM-202C	Hornblende	Plateau	11	100.0	5.2	60.42	± 0.98	59.49	± 0.72
12-JT	Jamestown	56723-01	NM-202D	Hornblende	no plateau	0					75.05	± 0.20
12-JT	Jamestown	56722-01	NM-202D	K-Feldspar	Plateau	5	6.0	52.1	58.14	± 0.70	84.86	± 0.16
18-E	Bryan Mt.	56710-01	NM-202B	Biotite	Plateau	10	98.9	15.2	58.83	± 0.12	58.57	± 0.08
18-E	Bryan Mt.	56711-01	NM-202B	Hornblende	no plateau	0					68.86	± 0.16
18-E	Bryan Mt.	56716-01	NM-202C	K-Feldspar	Plateau	8	12.5	0.8	58.15	± 0.05	66.34	± 0.11
20-E	Bryan Mt.	56701-01	NM-202A	Biotite	Plateau	8	91.7	42.3	58.87	± 0.22	58.35	± 0.08
20-E	Bryan Mt.	56702-01	NM-202A	K-Feldspar	Plateau	13	37.7	4.9	58.32	± 0.10	62.03	± 0.12
21-NF	Northfork	56705-01	NM-202A	Biotite	Plateau	9	92.7	15.5	64.05	± 0.14	63.59	± 0.10
23-AX	Apex	56706-01	NM-202B	Hornblende	Plateau	5	69.7	2.6	65.21	± 0.15	68.90	± 0.26
43-PM	Caribou	56700-01	NM-202A	Hornblende	Plateau	1	82.1	0.0	78.78	± 0.13	88.35	± 0.17
43-PM	Caribou	56700-02	NM-202A	Hornblende	Plateau	4	65.2	1.1	76.35	± 0.48	87.48	± 0.66
43-PM	Caribou	56704-01	NM-202A	K-Feldspar	Plateau	4	6.0	15.4	63.99	± 0.25	101.10	± 0.12
44-EW	Empire	56709-01	NM-202B	Hornblende	Isochron	8	85.7	4.2	55.50	± 0.60	66.94	± 0.22
44-EW	Empire	56708-01	NM-202B	K-Feldspar	Plateau	3	10.5	3.0	53.68	± 0.13	63.64	± 0.10
45-ES	Empire	56707-01	NM-202B	K-Feldspar	Plateau	6	7.2	4.4	54.54	± 0.20	61.95	± 0.21
8-AS	Aspen	56720-01	NM-202D	Biotite	Plateau	10	98.3	1.6	32.43	± 0.11	32.19	± 0.11
9-AS	Aspen	56721-01	NM-202D	Biotite	Plateau	11	98.6	1.6	32.21	± 0.14	32.00	± 0.14

Notes:
L#: NMGRL lab identifier
Irrad: NMGRL irradiation identifier
min: Mineral dated
n: Number of steps for plateau or isochron
TGA: Total gas age