$^{40}Ar/^{39}Ar$ Dating Studies of Minerals and Rocks in various areas in Mexico: USGS/CRM Scientific Collaboration (Part I)

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Open-File Report 03-020
on-line edition

2003

U.S. Department of the Interior
U.S. Geological Survey

INTRODUCTION

This publication contains reduced $^{40}Ar/^{39}Ar$ geochronology data of minerals and rocks collected in various areas in Mexico by geologists from Consejo de Recursos Minerales (CRM). Also included in this report is information on the geographical location of the samples as well as photomicrographs of the minerals and rocks dated. These analyses were done under Annex 2 of the Memorandum of Understanding between the U.S. Geological Survey (USGS) and the Consejo de Recursos Minerales de Mexico (CRM). The results presented here are intended only to be a preliminary publication of these geochronology studies and the data is not interpreted in a geological context. Therefore, users unfamiliar with argon isotopic data should use these results carefully. This report is primarily a detailed source document for subsequent scientific publications and maps that will integrate this data into a geological context.

METHODS

Sample Preparation

All of the different rocks provided by CRM were crushed, ground, and sized using 250, 180, and 150 μm sieves (60, 80, and 100 mesh respectively). We were using the largest size fraction possible of the target mineral that is free of inclusions from other mineral phases. Mineral separates of hornblende, muscovite, biotite, and K-feldspar were produced using magnetic separation, heavy liquids and hand picking to a purity of >99%. Basalt and basaltic andesite samples were processed through heavy liquids and or magnetic separation to remove phenocrysts from the volcanic matrix. The resulting volcanic matrix samples were leached with 10% cold HCl to remove any traces of secondary calcite. All samples were washed in acetone, alcohol, and deionized water (X3) in a Branson B-220 ultrasonic cleaner to remove dust and then re-sieved by hand.

Aliquots of sample were packaged in copper capsules and sealed under vacuum in quartz tubes. The samples were then irradiated in an aluminum container in the central thimble facility at the TRIGA reactor (GSTR) at the U.S. Geological Survey in Denver, Colorado. The monitor mineral

used was Fish Canyon Tuff (FCT-3) sanidine with an age of 27.79 Ma (Kunk et al., 1985; Cebula et al 1986) relative to MMhb-1 with an age of 519.4 ± 2.5 Ma (Alexander et al., 1978; Dalrymple et al., 1981). The type of container and the geometry of samples and standards is similar to that described by Snee et al. (1988).

Sample Analysis

The samples were analyzed at the U.S. Geological Survey Thermochronology lab in Denver, Colorado using a VG Isotopes Ltd., Model 1200B Mass Spectrometer fitted with an electron multiplier using the $^{40}Ar/^{39}Ar$ step heating method of dating. The samples were heated for 10 minutes per step and followed a schedule of four to seventeen steps per sample. The number and temperature of heating steps was selected to limit the percentage of gas released to less than 20% per step for most samples. Biotite aliquots were also melted in a single heating to produce total fusion ages.

Heating of samples was done in a small volume, molybdenum-lined low blank tantalum furnace similar to that described by Staudacher et al. (1978). The temperature was monitored by a W_5Re-$W_{26}Re$ thermocouple and controlled by a proportional programmable controller. The furnace and the rear manifold of the extraction system were pumped between steps with a turbo molecular pump. Two isolated ion pumps evacuated the front manifold and the mass spectrometer tube between each incremental step. The gas to be analyzed was purified in the first manifold by a SAES ST707 Zr-V-Fe getter operated at room temperature and by a hot tungsten filament. Gas was equilibrated with the second manifold with an empty cold finger in the first manifold at LN_2 temperature to trap water and other condensibles, then isolated and cleaned in the front manifold with a SAES ST101 Al-Zr getter operated at 400^0 C and with a Ti getter operated at 350^0 C.

An activated charcoal finger submerged in a constant boiling mixture of dry ice and acetone was used to remove gasses with a molecular weight greater than 60 or 80 (primarily other noble gasses) prior to the admission by expansion methods of the argon dominated gas to the mass spectrometer. A second SAES ST101 active gas getter operated at room temperature further purified

the argon-rich gas in the mass spectrometer. Its successful operation could be monitored by the drop in counts of mass 44 (dominated by CO_2) after the first gas analysis cycle. Argon isotopes with masses 40 through 36 and CO_2 (mass 44) were analyzed as a function of time in five analysis cycles. ^{40}Ar, ^{39}Ar, ^{38}Ar, ^{37}Ar, and ^{36}Ar peaks and their baselines, were measured for five-second integrations in each of the five cycles. After the analysis the mass spectrometer was evacuated. All phases of the sample heating, cleanup, equilibration and sample analysis were performed under computer control.

Isotopic Data Reduction

All the argon isotopic data were reduced using an updated version of the computer program ArAr* (Haugerud and Kunk, 1988). We used the decay constants recommended by Steiger and Jäger (1977). The isotopic measurements made in the five-cycle analysis had baseline values subtracted and then were regressed, to time zero, using standard linear regression techniques. These regressed values and associated statistical estimates of analytical uncertainties of the time zero peak values were used in data reduction. Sample blanks measured before the analyses were subtracted from the regressed results for ^{40}Ar, ^{39}Ar, ^{37}Ar and ^{36}Ar. Error estimates of the blanks were quadratically combined with the regression errors and propagated through the error equations.

Corrections for interfering reactor-produced argon isotopes from Ca, K, and Cl in the sample were made using the production ratios given in Dalrymple et al. (1981) and Roddick (1983). Errors in calculating ages or ratios include measurement errors in the analysis, decay factor uncertainties, measured atmospheric or calculated initial $^{40}Ar/^{36}Ar$ ratios, the irradiation parameter J, the production ratios of the various reactor induced argon producing reactions, the initial $^{38}Ar/^{36}Ar$ ratio, and the age of the monitor (Haugerud and Kunk, 1988).

The data tables and figures presented below include the identification of individual step ages, plateau ages, average ages, inverse isochron ages, total fusion ages, and total gas ages. Total gas ages represent the age calculated from the addition of all of the measured argon peaks for all steps in a single sample. The total gas ages are roughly equivalent to conventional K/Ar ages. No analytical

precision is calculated for total gas ages. Plateau ages were determined using the definition of Fleck et al. (1977) as modified by Haugerud and Kunk (1988). Average ages are calculated in the same manner as a plateau age but fail the definition of Fleck et (1977). Inverse isotope correlation analysis of the analytical data to assess if non-atmospheric argon components were trapped in any samples and to calculate an inverse isochron age was done using the method of York (1969). For additional information on the sample data reduction procedure see Haugerud and Kunk (1988).

RESULTS

$^{40}Ar/^{39}Ar$ Geochronology Data

The $^{40}Ar/^{39}Ar$ geochronology results in this report are presented in alphabetical order of the regional offices from CRM in Mexico. The geochronology results are presented in age-spectra diagrams that plot the cumulative percent $^{39}Ar_K$ of the steps against apparent age in millions of years. The precision estimate used to construct the error boxes of each step is at two-sigma. The upper, smaller graph plots the apparent K/Ca ratio of each step against cumulative $^{39}Ar_K$ released. This is only shown for samples with low-K minerals (hornblende and volcanic matrix) and occasionally for biotites.

In addition, data are presented in tabular form (Tables 1-23). Each table starts with a line that gives the sample number, regional office, the material analyzed, and the J-value used with its analytical uncertainty, the sample weight in milligrams, and the packet and package number from the irradiation. The table includes the temperature of the step, the percent of potassium derived $^{39}Ar_K$ for each step, the radiogenic yield (percentage of $^{40}Ar_R$ that is derived from the decay of potassium), moles of $^{39}Ar_K$, a corrected $^{40}Ar_R/^{39}Ar_K$ ratio from which the age can be directly calculated, apparent K/Ca, and K/Cl ratios for each step, a calculated apparent age for the step (in millions of years), and an estimate of the precision of each age at the 1 sigma level. The sample precision includes estimates of the errors that are unique to a single sample and can be used only for comparisons with other steps of the same sample. This error estimate does not include the error in "J". The last line in the table represents the total gas results for the sample. Note that no analytical error is calculated for the

age in this line. If the sample has a plateau age, the percentage of ^{39}Ar on the plateau, the steps on the plateau, and the plateau age and its precision are printed. The plateau, when present, is listed at the final line of the table.

We have calculated isochron ages using inverse-isotope correlation diagrams that plot $^{39}Ar/^{40}Ar$ against $^{36}Ar/^{40}Ar$ (shown occasionally). When reporting these isochron ages we included the apparent age of the sample (calculated from the inverse of the x-axis intercept), the calculated initial $^{40}Ar/^{36}Ar$ ratio of the sample (the inverse of the y-axis intercept), the MSWD of the data (a goodness of fit indicator), and the number of points used in the age regression.

Preliminary Interpretation of $^{40}Ar/^{39}Ar$ Geochronology

We want to reemphasize that the geochronologic interpretations presented in this report are preliminary, and that subsequent scientific publications and maps should integrate the data into a geological context. We are presenting the data in alphabetical order for the different regional offices of CRM in Mexico.

Oficina Regional Chihuahua

• Sample **DB-1**. We have analyzed a biotite separate for this porphyric dacite. The age spectrum for the biotite (#64KD18) is relatively well behaved but does not define a plateau. For that reason we used the total fusion age obtained from a second aliquot of biotite (#62KD18). This age of **27.82 ± 0.05 Ma** we interpret as the time of emplacement of the dacite body. The isochron age for #64KD18 is 27.98 ± 0.83 Ma ($[^{40}Ar/^{36}Ar]_i$ = 309 ± 25.6; MSWD = 0.0076; 8 of 12 steps with 91.6% of $^{39}Ar_K$), and within limits of error, supports the more precise total fusion age.

• Sample **ID-380**. We have analyzed K-feldspar for this monzonite and the sample shows a gradient in the spectrum from 34.47 Ma (150°C) to 36.09 Ma (250°C) which we interpret as being related to sample cooling.

Oficina Regional Chilpancingo

• Sample **HIX-14**. For this sample we have analyzed biotite and K-feldspar. The age spectrum for the biotite is disturbed (#76KD18), and for that reason we use the total fusion age for a second aliquot of the biotite (#74KD18). The total fusion age of **47.67 ± 0.05 Ma** is interpreted here as the minimum possible age for the intrusion of the granite. The K-feldspar analysis (#138KD18) shows a discordant cooling pattern with ages younger than the age obtained for the biotite. This is the expected behavior for the K-feldspar because its closure temperature is slightly less than that of biotite.

• Sample **PDO-2**. We have analyzed the volcanic matrix of this andesitic basalt. The age spectrum pattern for this sample is very disturbed, demonstrating that this sample was significantly altered. The total gas age of the sample at 70.39 Ma is the best estimate of its age. However, it would be safer to report that the sample is a **Late Cretaceous** andesitic basalt.

Oficina Regional Culiacán

• Sample **G13C21-001**. We have analyzed three different minerals with different closure temperatures for this granodiorite. The mineral with highest closure temperature is hornblende (500°C), and for this particular sample we obtained a plateau age at **23.22 ± 0.15 Ma** that should be the closest to crystallization of the granodiorite. The isochron age for the hornblende is 23.69 ± 0.69 Ma ($[^{40}Ar/^{36}Ar]_i$ = 274.17 ± 23.98; MSWD = 0.588; 6 of 6 steps with 100% of $^{39}Ar_K$), and within limits of error, supports the more precise plateau age. The age spectrum for the biotite (#80KD18) is relatively well behaved but does not yield a plateau. For that reason we used the total fusion age obtained from a second aliquot of biotite (#78KD18). This age of **22.82 ± 0.03 Ma** we interpret as the time of Early Miocene cooling for the intrusive body. The K-feldspar analysis (#136KD18) yields a plateau age of **22.44 ± 0.08 Ma** indicating that the sample was cooling very rapidly. Note that the K-feldspar yields the expected younger age than the biotite.

• Sample **G13C74-001**. We have analyzed the volcanic matrix of this basalt sample. The age spectrum pattern for the volcanic matrix is very disturbed, indicating significant alteration of the

sample. The total gas age is 15.07 Ma; however, a more precise isochron age at **15.8 ± 0.16 Ma** ($[^{40}Ar/^{36}Ar]_i$ = 301.12 ± 17.02; MSWD = 1.998; 8 of 10 steps with 79.1% of $^{39}Ar_K$) is used to interpret the time of extrusion of this basalt flow during Middle Miocene time.

Oficina Regional Durango

• Sample **JA-17**. Muscovite from this schist has been partially reset. The minimum age for the metamorphic event is ~252 Ma (the age of the highest temperature step) that represents cooling below 350°C. Later the sample has suffer a thermal event at ~68 Ma or younger that has partially reset the Permian-Triassic metamorphic muscovite.

• Sample **D-2**. Complex polymetamorphic sample with sigmoidal age spectrum pattern interpreted as representing two generations of white mica. The first generation has to be older than 56.6 Ma and the second younger than 33.0 Ma.

Oficina Regional Hermosillo

• Sample **DLC-10**. We have analyzed hornblende, biotite and K-feldspar from this tonalite to estimate its crystallization age as well as observing its cooling history. The hornblende yields a plateau age at **91.68 ± 0.32 Ma** and represent cooling through ~500°C . The age spectrum for the biotite (#84KD18) is fairly flat but does not plateau. We used the total fusion age from a second aliquot of biotite (#82KD18) to obtain an age of **89.39 ± 0.11 Ma** that we interpret as the time of cooling for the intrusive body below 300°C. The K-feldspar analysis (#156KD18) yields an age range of cooling between 86 and 81 Ma. The Late Cretaceous cooling history obtained from Ar/Ar studies shows that this particular sample cooled relatively rapidly, though not as rapidly as sample G13C21-001 from the Culiacán office.

• Sample **DSL-3**. The biotite from this schist yields a very complex age pattern with a difficult explanation. After observing the highly disturb age spectrum for the biotite, we can not have faith in the total fusion age at 73.09 ± 0.12 Ma. The best we can say about this sample is that the schist is **Late Cretaceous**.

• Sample **DSL-1**. Muscovite schist. The muscovite is intergrown with chlorite complicating the first 40% of the gas (recoil effect). The age for last 60% of the gas is about 91 Ma. This is a Late Cretaceous schist.

Oficina Regional Morelia

• Sample **TA-143**. We have analyzed a hornblende separate from this andesite sample. The age spectrum pattern is well behaved, yielding a plateau age of **3.17 ± 0.04 Ma**. We interpret this age as the time of emplacement of the andesite. The isochron age is 3.42 ± 0.75 Ma ($[^{40}Ar/^{36}Ar]_i$ = 286.97 ± 21.72; MSWD = 0.477; 4 of 4 steps with 100% of $^{39}Ar_K$), and within limits of error, supports the more precise plateau age.

Oficina Regional Oaxaca

• Sample **DR-1**. Complex polymetamorphic sample with sigmoidal age-spectrum pattern representing two generations of white mica. The oldest generation has to be at least 186 Ma, whereas the youngest could be as young as ~40 Ma.

Oficina Regional Puebla

• Sample **E-201**. We have analyzed a biotite separate for this granodiorite. The age spectrum for the biotite (#92KD18) is disturbed and we use the total fusion age from a second aliquot of biotite (#90KD18) to approximate the age of the intrusive body at **268.14 ± 0.24 Ma (Permian)**. This is the age when the granodiorite cooled below 300°C.

• Sample **E-202**. Mucovite from this schist yielded a reasonably well-behaved spectrum. The total gas age at ~281 Ma in this case is the best estimation for the age of metamorphism-deformation. This schist represents **Early Permian** metamorphism.

Oficina Regional Saltillo

• Sample **DAG-2**. We have analyzed hornblende and K-feldspar for this granodiorite. The

age spectrum for the hornblende yields a plateau age of **41.00 ±0.14 Ma** that we interpret as the best approximation for the time of emplacement of the granodiorite. The K-feldspar shows an age gradient between 43 and 40 Ma. It is very likely that the K-feldspar sample contains excess argon that makes its age too old. The closer temperature for K-feldspar is significantly lower than the one for biotite. Running a duplicate sample of the K-feldspar (#153KD18) we could reproduce the age spectrum from the previous K-feldspar sample.

• Sample **BDA-01**. We have analyzed a biotite separate for this granodiorite. The age spectrum for the biotite (#68KD18) is relatively well behaved but does not plateau. For that reason we used the total fusion age obtained from a second aliquot of biotite (#66KD18). This age of **38.64 ± 0.04 Ma** we interpret as the time when the intrusive cooled below 300°. The isochron age for #68KD18 is 38.69 ± 0.12 Ma ($[^{40}Ar/^{36}Ar]_i$ = 289.28 ± 4.43; MSWD = 1.153; 10 of 10 steps with 100% of $^{39}Ar_K$), and within limits of error, supports the more precise total fusion age.

• Sample **RA-01**. We have analyzed a biotite separate from this diorite sample. The age spectrum pattern for the biotite (#60KD18) is relatively well behaved but does not plateau. The total fusion age for a second aliquot of biotite (#58KD18) is **30.45 ± 0.06 Ma** that we interpret as the time the intrusive cooled below 300°C. The isochron age is 30.44 ± 0.23 Ma ($[^{40}Ar/^{36}Ar]_i$ = 268.54 ± 63.55; MSWD = 0.278; 8 of 10 steps with 92.2% of $^{39}Ar_K$), and within limits of error, supports the more precise total fusion age.

• Sample **RA-02**. We have analyzed a biotite separate for this monzonite. The age spectrum for the biotite (#72KD18) is relatively well behaved but does not plateau. We used the total fusion age obtained from a second aliquot of biotite (#70KD18). This age of **28.78 ± 0.08 Ma** we interpret as the time when the intrusive cooled below 300°. Based on the previously discussed data for the Saltillo Office it appears that we have two age-trends in this part of Mexico, with a first pulse of magmatism in the Late Eocene and a second one in Late Oligocene.

Oficina Regional San Luis Potosí

• Sample **PAR-2**. A hornblende separate from a basaltic andesite yielded a plateau age of

117.94 ± 0.40 Ma. We interpret this age as the time of emplacement of the volcanic rock. This age is supported, within limits of error, by a less precise isochron age at 117.71 ± 0.76 Ma ($[^{40}Ar/^{36}Ar]_i$ = 298.41 ± 16.71; MSWD = 0.319; 4 of 5 steps with 97.9% of $^{39}Ar_K$).

Oficina Regional Zacatecas

• Sample **TY-2**. We have analyzed a whole rock fraction of this phyllite. The best estimation for the age of metamorphism would be the total gas age at 79.23 Ma or the isochron age at 78.6 ± 2.06 Ma. However, it would be safer to say that the original sedimentary rock was metamorphosed during **Late Cretaceous** time.

• Sample **CAOP-1**. We have analyzed K-feldspar from a porphyroclast in a mylonite sample. The highly disturbed spectrum can be interpret as follow. The mylonite was formed at 79 Ma or older (**Late Cretaceous** time), but during the Early Miocene or more recent, the sample was partially reset by a thermal event.

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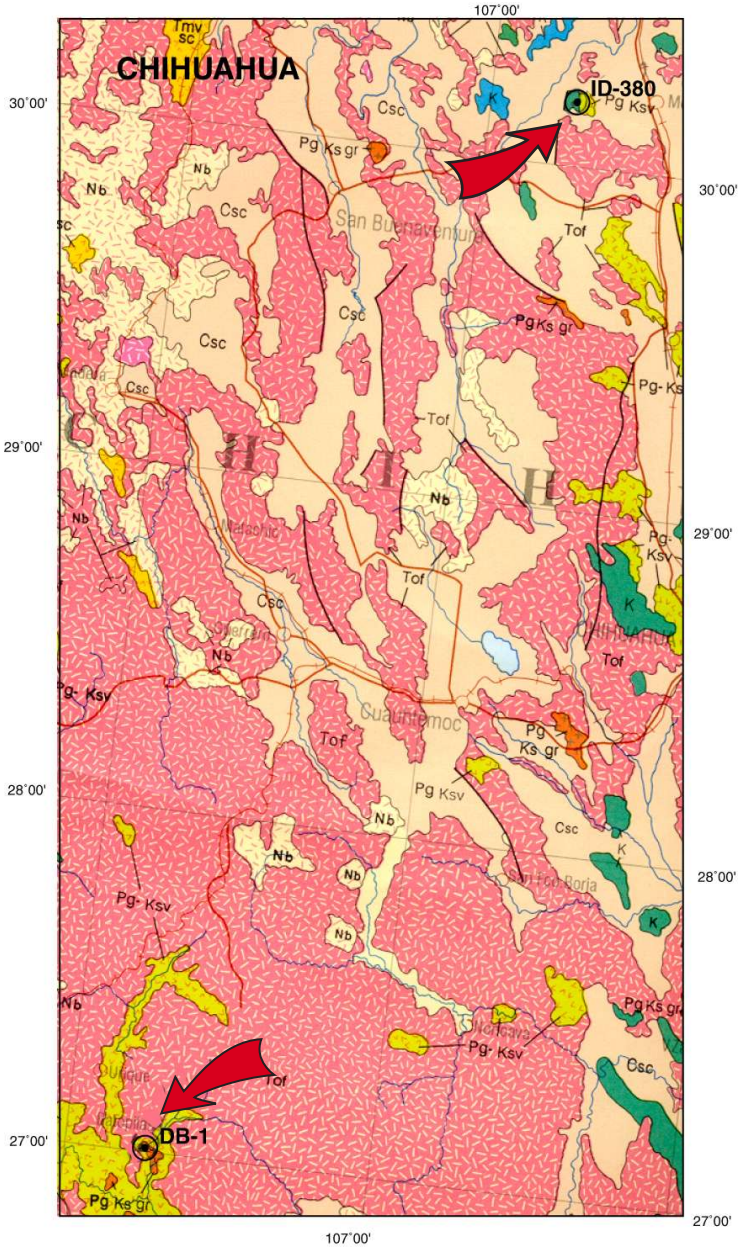
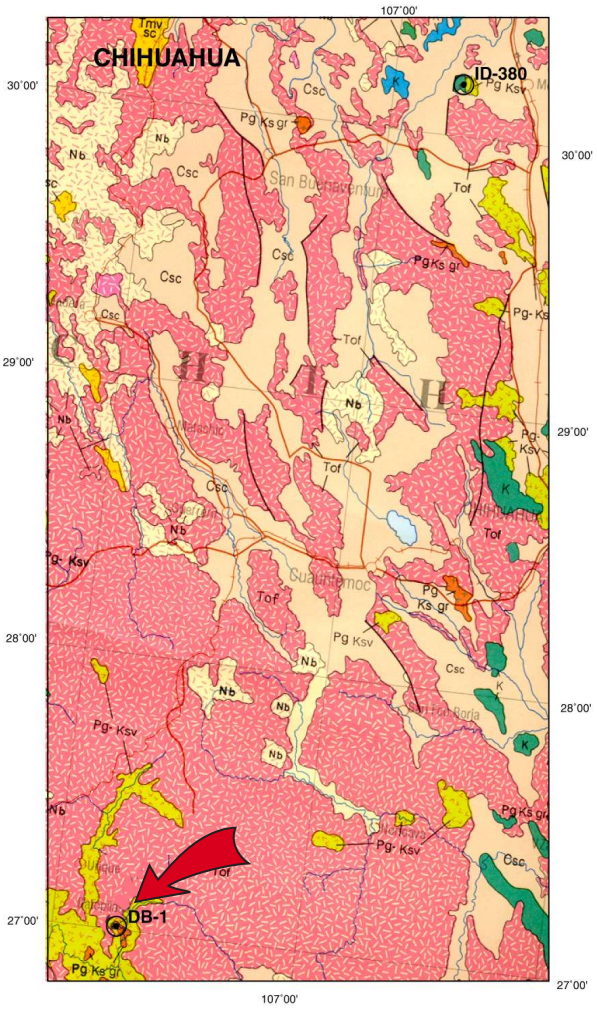
Oficina Regional Chihuahua



DB-1 Porphyric Dacite
ID-380 Monzonite



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

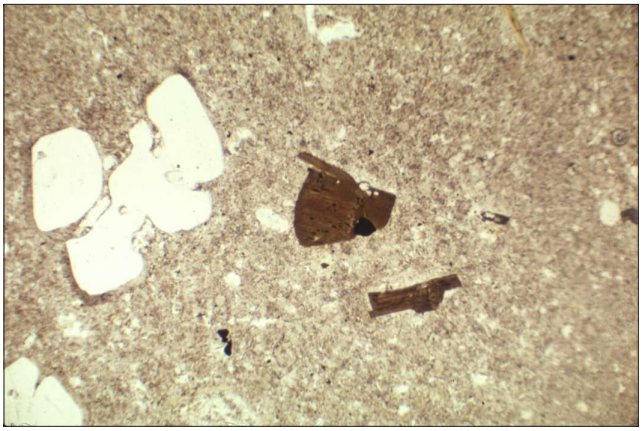
DB-1

Oficina Regional Chihuahua

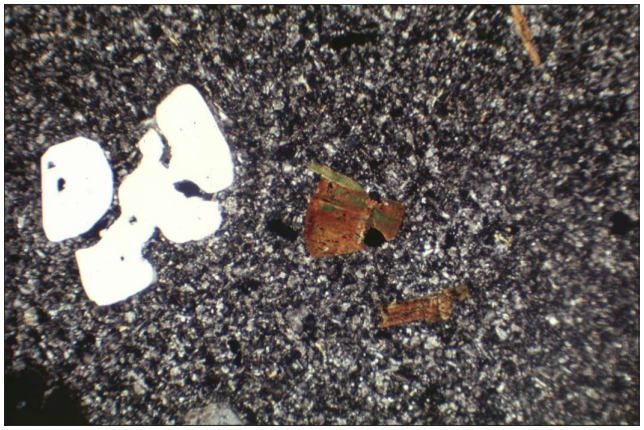
Porphyric Dacite

Mineral dated:
biotite

Lat. 27°01'00.3"
Long. 107°43'59.2"



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

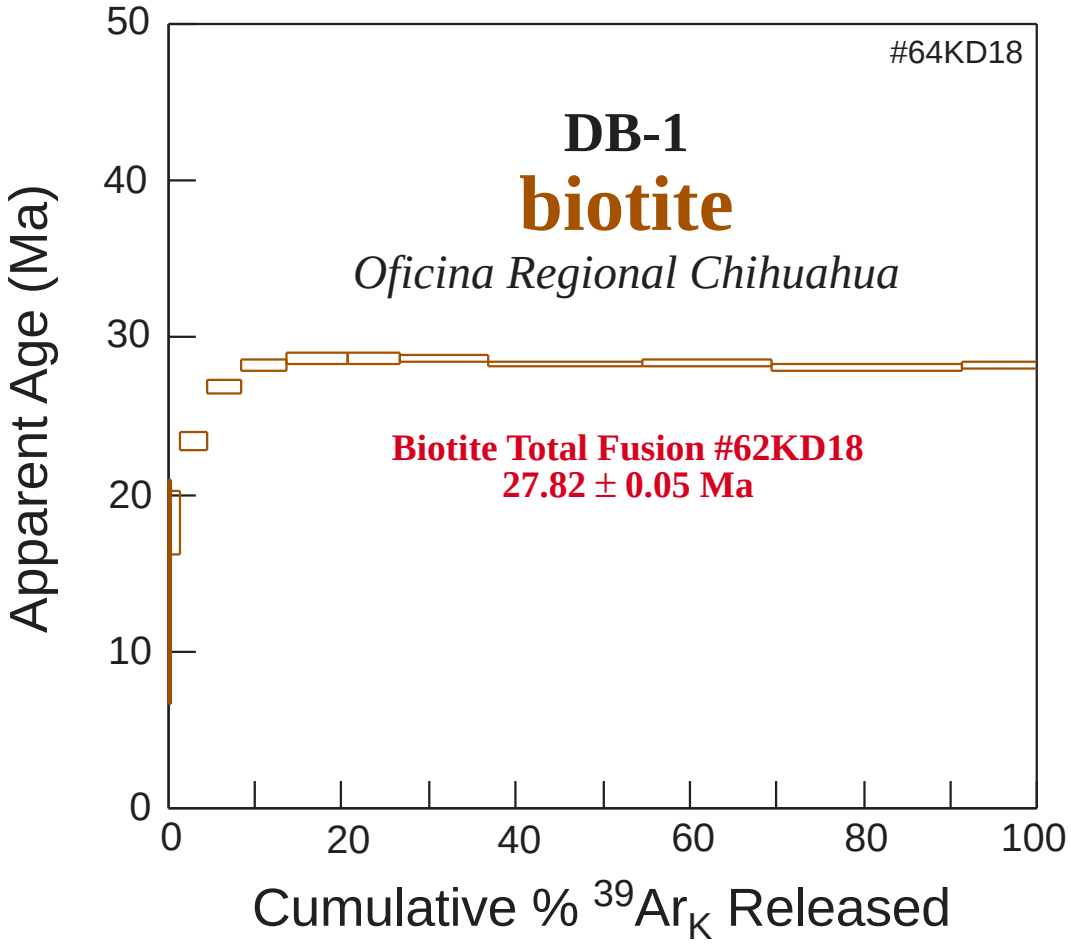
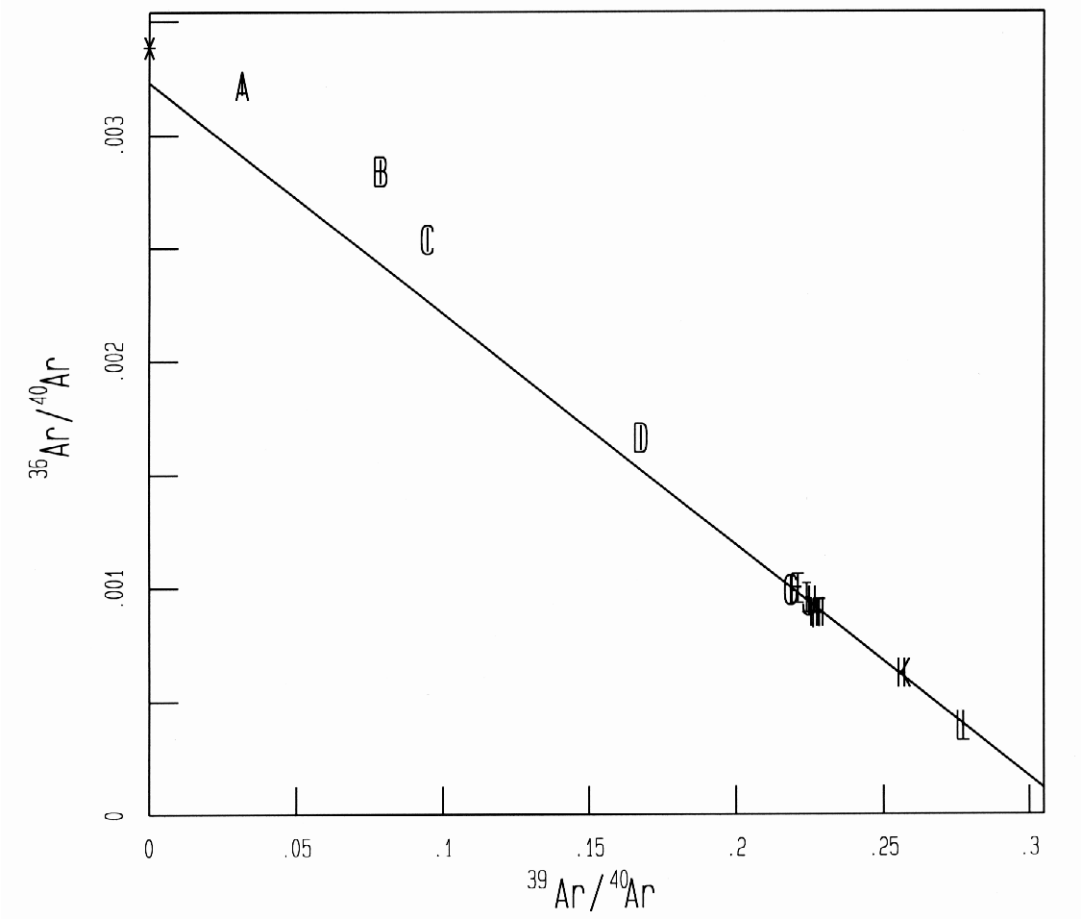


Table 2. $^{40}Ar/^{39}Ar$ analytical data for sample DB-1 Oficina Regional Chihuahua

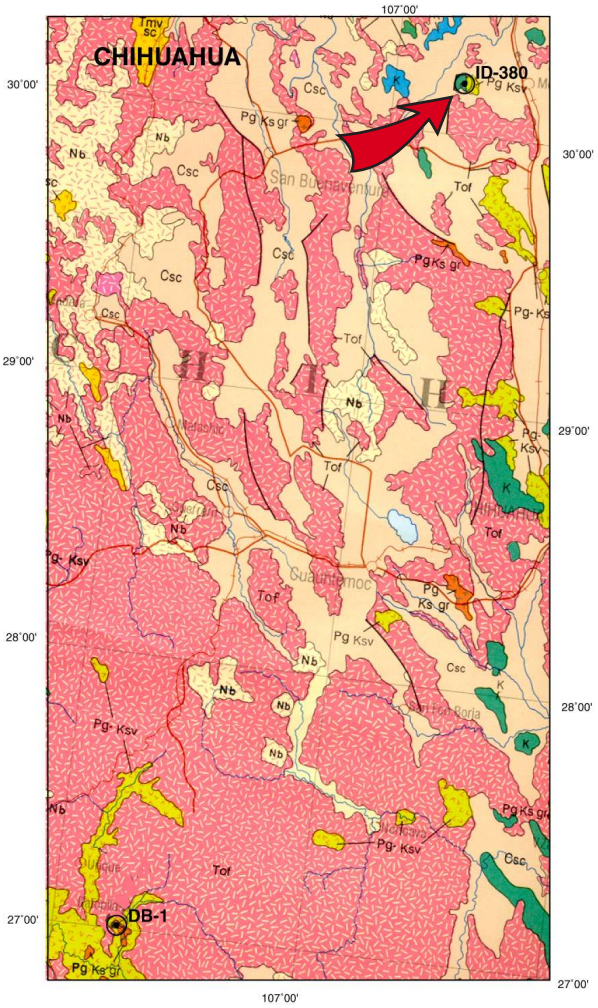
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error Ma
DB-1 *Chihuahua*		***biotite***	*J = 0.004948 ± 0.25%*	*wt = 40.8 mg*	*#64KD18*				
650	0.3	4.9	0.01992	1.554	4.61	25	13.81	±	3.55
750	1.1	16.1	0.07582	2.047	9.12	59	18.18	±	1.01
850	3.2	25.0	0.22793	2.645	22.38	62	23.45	±	0.27
900	3.8	50.9	0.27506	3.036	37.60	71	26.90	±	0.21
950	5.3	70.6	0.38232	3.193	47.66	77	28.28	±	0.18
1000	6.9	73.8	0.49789	3.236	46.09	79	28.66	±	0.18
1050	5.9	70.8	0.42413	3.239	33.04	78	28.68	±	0.21
1100	10.4	73.7	0.74475	3.239	25.46	78	28.69	±	0.08
1150	17.6	71.8	1.25951	3.205	24.40	79	28.39	±	0.08
1200	14.8	72.2	1.06086	3.211	17.31	61	28.44	±	0.09
1250	22.1	81.6	1.58452	3.172	16.37	79	28.10	±	0.09
1350	8.6	88.4	0.61431	3.188	12.37	79	28.23	±	0.10
Total Gas	100.0	72.6	0.00000	3.163	24.14	75	28.02		
DB-1 *Chihuahua*		***biotite total fusion***	*J = 0.004948 ± 0.25%*	*wt = 5.6 mg*	*#62KD18*				
1450	100.0	65.9	0.967633	3.141	22.29	56	**27.82**	±	**0.05**

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All errors are at one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.

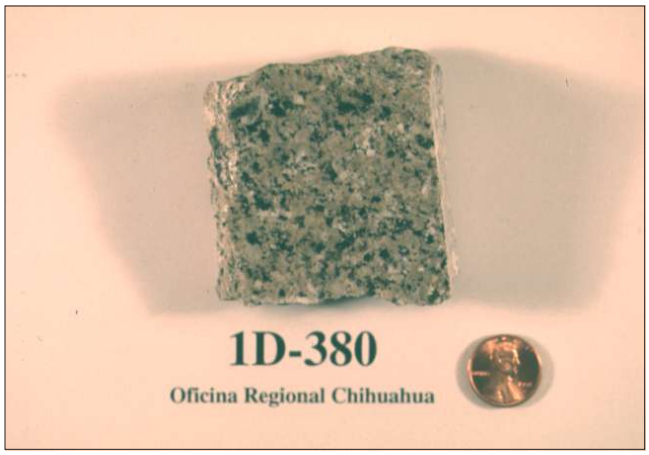
Inverse-isotope correlation diagram
DB-1
Biotite



Isochron Age = 27.98 ± 0.83 Ma
$[^{40}Ar/^{36}Ar]_i = 309 \pm 25.6$
MSWD = 0.0076
8 of 12 steps with 91.6% of $^{39}Ar_K$



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

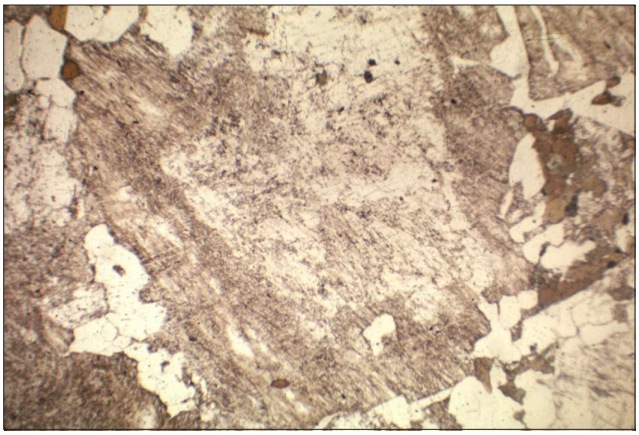


ID-380
Oficina Regional Chihuahua

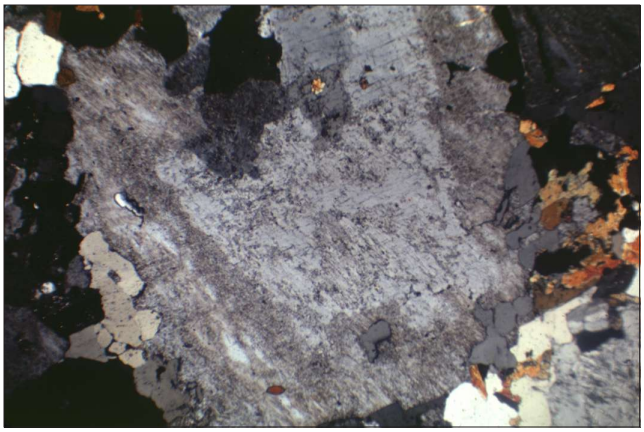
Monzonite

Mineral dated:
K-feldspar

Lat. 30°09’45.6”
Long. 106°45’35.8”



Photograph taken in plane-polarized light to show K-feldspar crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

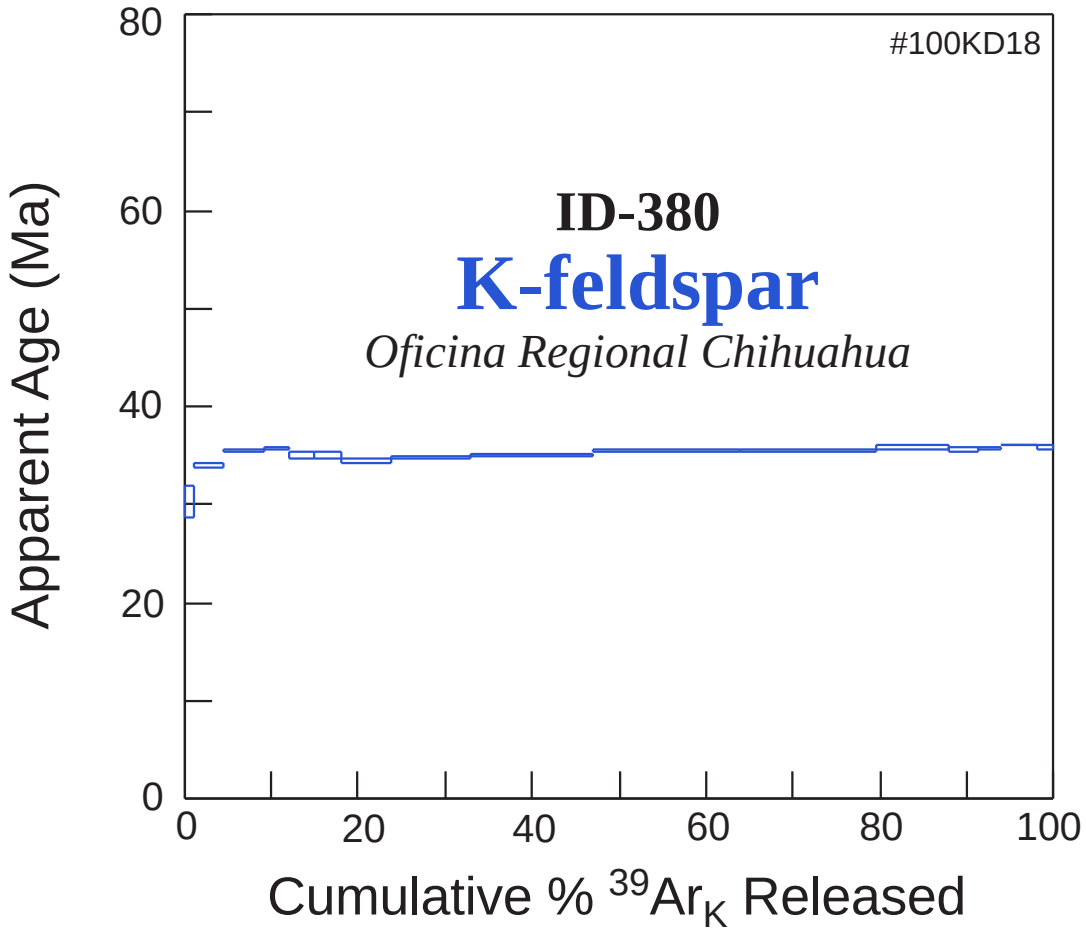


Table 3. $^{40}Ar/^{39}Ar$ analytical data for sample ID-380 Oficina Regional Chihuahua

Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
1D-380	*Chihuahua*	***K-feldspar***	*J = 0.004908 ± 0.25%*		*wt = 51.6 mg*	*#100KD18*			
750	1.1	23.7	0.131366	3.459	20.65	25	30.37	±	0.79
850	3.5	62.1	0.418111	3.885	11.46	82	34.07	±	0.09
950	4.7	76.6	0.570298	4.057	12.26	115	35.56	±	0.05
1000	3.0	82.4	0.358665	4.075	21.31	221	35.73	±	0.08
1050	2.9	74.4	0.346642	3.988	21.63	237	34.97	±	0.19
1100	3.1	75.6	0.375404	4.001	21.13	243	35.08	±	0.18
1150	5.5	77.8	0.667216	3.931	23.45	136	34.47	±	0.15
1200	9.2	75.2	1.111534	3.965	24.46	77	34.77	±	0.07
1225	14.3	74.1	1.728239	3.992	27.88	98	35.01	±	0.06
1250	17.0	76.1	2.053256	4.044	31.86	104	35.45	±	0.05
1275	15.4	74.2	1.865323	4.043	31.40	121	35.45	±	0.08
1300	8.4	67.2	1.015504	4.085	24.82	124	35.81	±	0.12
1325	3.5	64.8	0.419335	4.071	19.21	115	35.69	±	0.12
1350	2.7	65.8	0.327152	4.085	17.09	109	35.81	±	0.07
1450	4.0	66.2	0.479794	4.117	16.56	110	36.09	±	0.05
1550	2.0	67.5	0.245379	4.086	20.86	114	35.82	±	0.14
Total Gas	100.0	72.6	12.113218	4.019	25.14	118	35.24		

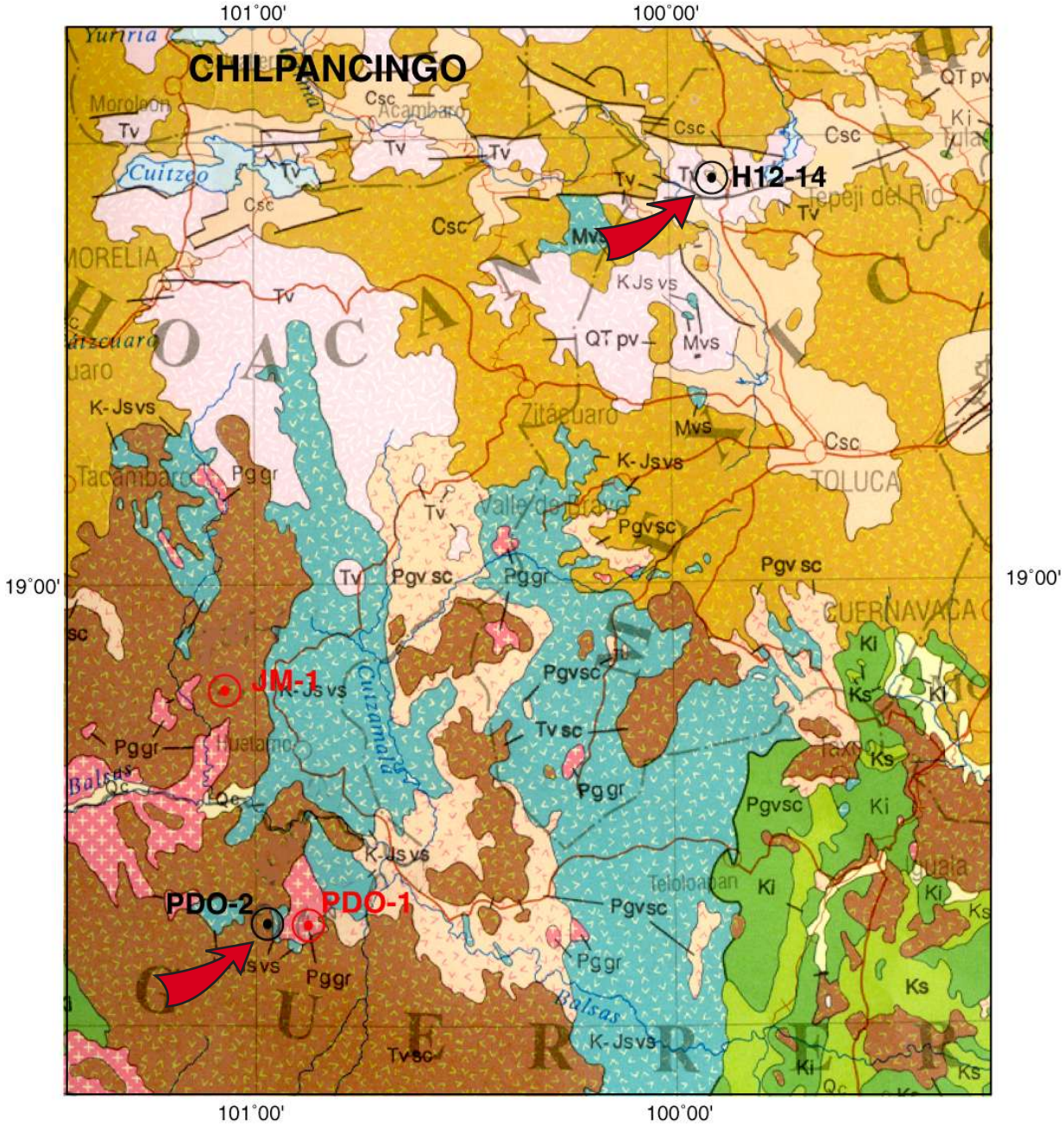
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Oficina Regional Chilpancingo



HIX-14 Granite
PDO-2 Andesitic Basalt

Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

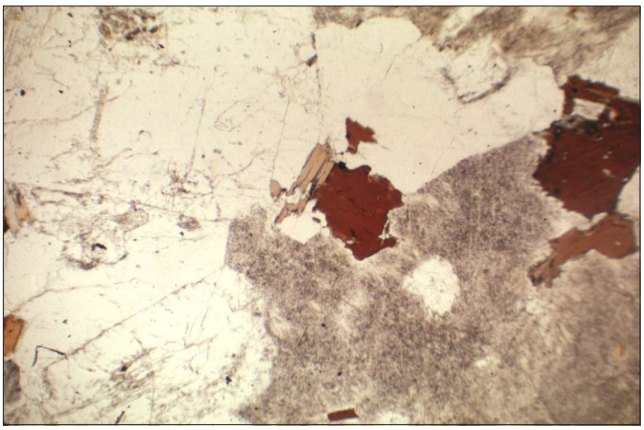
HIX-14

Oficina Regional Chilpancingo

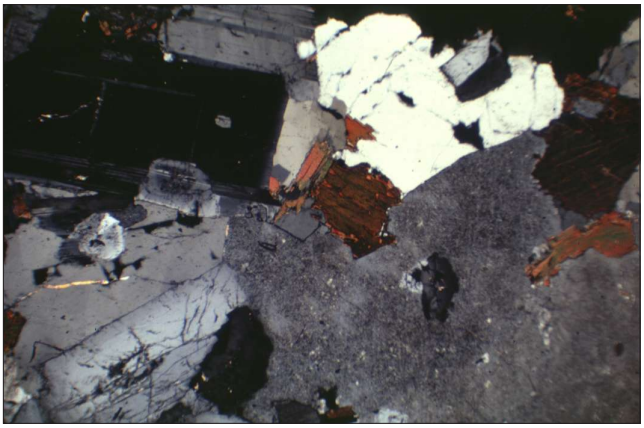
Granite

Minerals dated:
biotite
K-feldspar

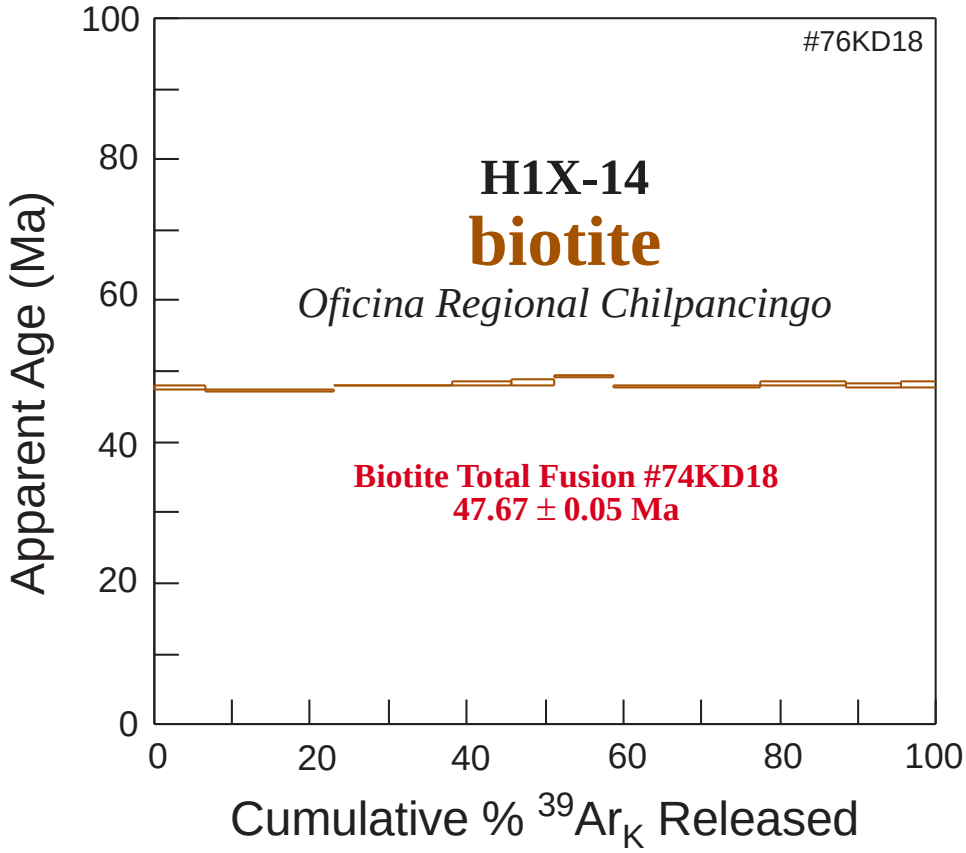
Lat. 19°31’39.9”
Long. 99°55’01.7”

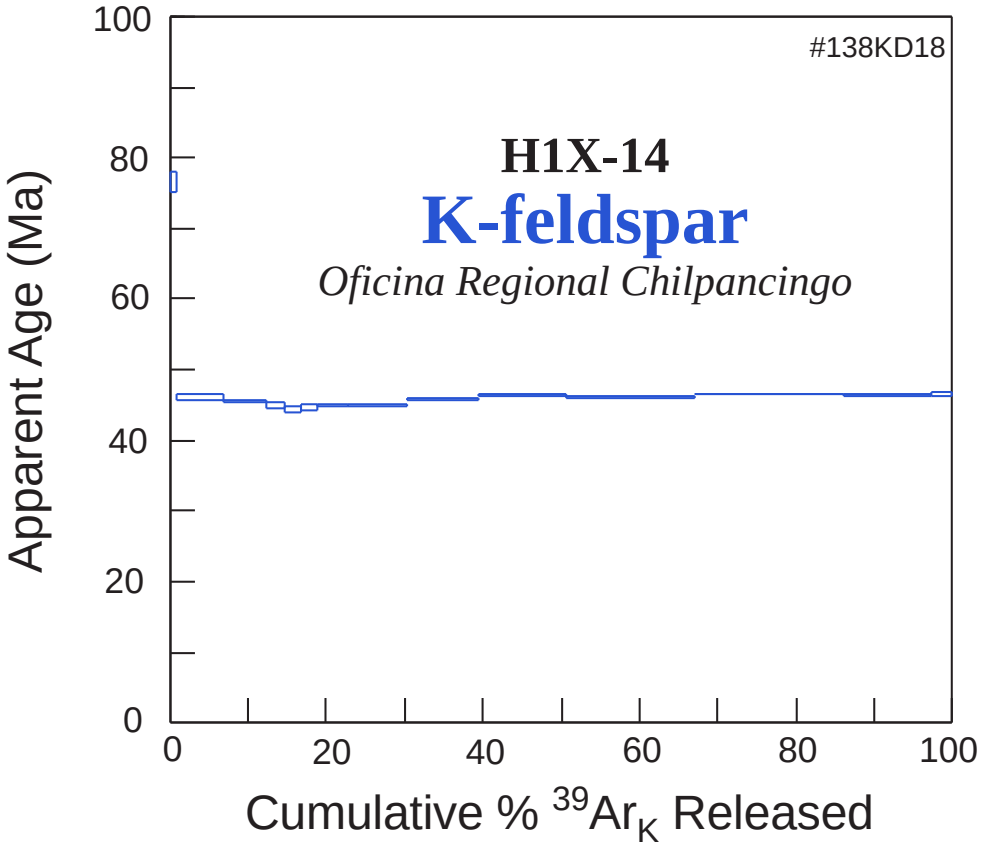


Photograph taken in plane-polarized light to show biotite and K-feldspar crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.


#76KD18
H1X-14
biotite
Oficina Regional Chilpancingo
Biotite Total Fusion #74KD18
47.67 ± 0.05 Ma
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released
0
20
40
60
80
100


#138KD18
H1X-14
K-feldspar
Oficina Regional Chilpancingo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released
0
20
40
60
80
100

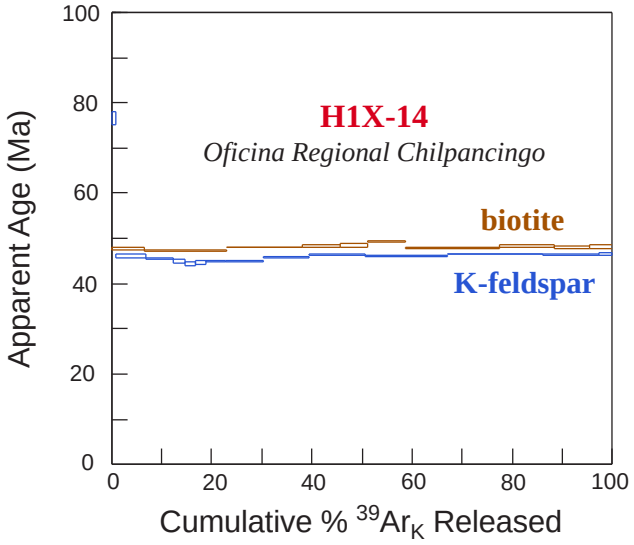


Table 4. $^{40}Ar/^{39}Ar$ analytical data for sample H1X-14 Oficina Regional Chilpancingo

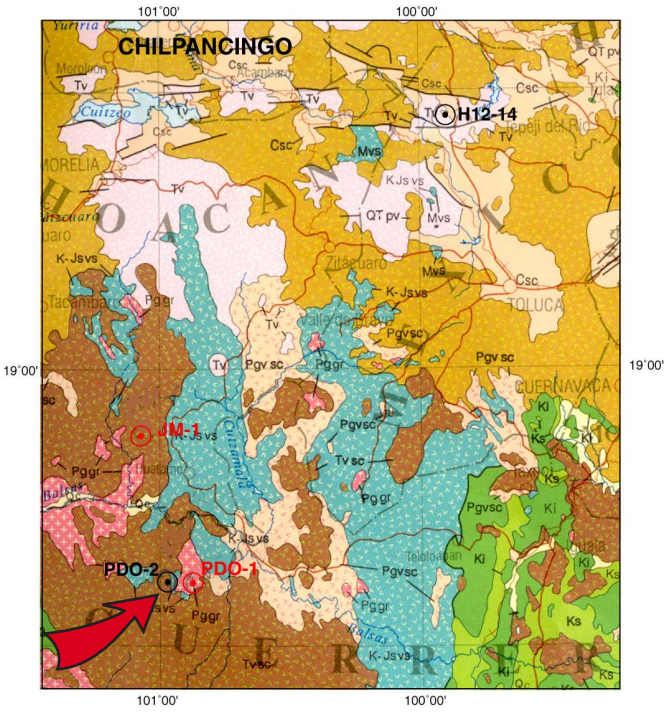
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
HIX-14	*Chilpancingo*	***biotite***	*J = 0.004748 ± 0.50%*	*wt = 37.8 mg*	*#76KD18*				
850	6.7	85.2	0.451687	5.658	47.58	100	47.82	±	0.13
900	16.3	97.9	1.101383	5.594	162.90	107	47.29	±	0.05
950	15.3	99.2	1.033717	5.682	195.79	107	48.03	±	0.05
1000	7.4	99.1	0.497696	5.716	108.33	106	48.31	±	0.09
1050	5.4	97.6	0.367475	5.732	35.65	106	48.44	±	0.24
1100	7.8	98.8	0.525640	5.837	26.05	107	49.31	±	0.10
1150	18.7	99.4	1.266898	5.665	32.24	109	47.88	±	0.04
1200	10.8	99.0	0.729309	5.714	11.82	68	48.29	±	0.10
1250	7.1	99.2	0.480909	5.665	3.64	99	47.89	±	0.14
1350	4.6	99.4	0.307767	5.696	3.78	106	48.14	±	0.17
Total Gas	100.0	98.0	6.762481	5.683	79.32	102	48.03		
HIX-14	*Chilpancingo*	***biotite total fusion***	*J = 0.004748 ± 0.50%*	*wt = 5.7 mg*	*#74KD18*				
1450	100.0	96.4	1.045455	5.640	20.42	78	**47.67**	±	**0.05**
HIX-14	*Chilpancingo*	***K-feldspar***	*J = 0.004914 ± 0.25%*	*wt = 52.6 mg*	*#138KD18*				
750	0.9	64.5	0.135213	8.824	30.96	65	76.58	±	0.68
850	5.8	90.9	0.848257	5.270	54.45	1384	46.12	±	0.15
950	5.6	95.0	0.816909	5.202	30.88	5008	45.54	±	0.14
1000	2.4	97.0	0.343155	5.135	17.69	5356	44.95	±	0.18
1050	1.9	95.0	0.281434	5.075	20.39	2860	44.44	±	0.22
1100	2.2	93.3	0.322359	5.114	33.77	2478	44.77	±	0.19
1150	4.0	89.6	0.577382	5.143	58.17	2078	45.03	±	0.11
1200	7.4	90.1	1.075114	5.148	65.25	263	45.07	±	0.07
1225	9.1	91.4	1.322721	5.244	66.28	1595	45.90	±	0.09
1250	11.3	93.6	1.640169	5.309	68.30	3672	46.46	±	0.05
1275	16.4	95.6	2.380948	5.268	81.12	9467	46.11	±	0.06
1300	19.0	96.7	2.767673	5.315	107.41	11447	46.51	±	0.04
1325	11.2	96.6	1.630629	5.294	113.74	16914	46.33	±	0.06
1350	2.8	95.4	0.407301	5.322	59.07	6183	46.58	±	0.20
Total Gas	100.0	94.0	14.549264	5.289	75.72	7055	46.29		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

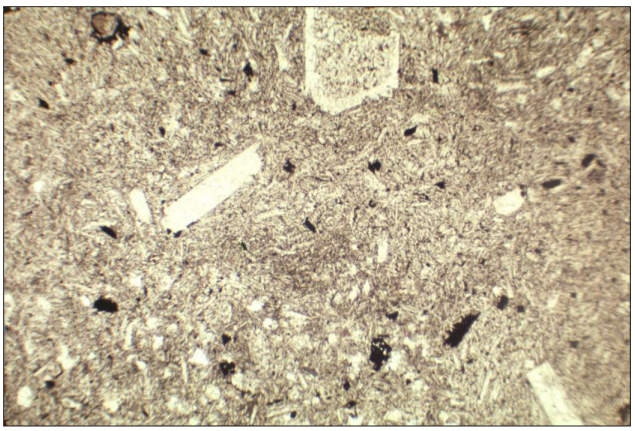
PDO-2

Oficina Regional Chilpancingo

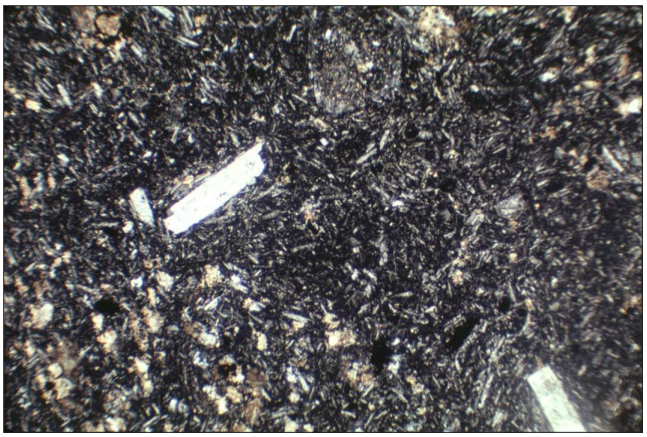
Andesitic Basalt

Mineral dated:
volcanic matrix

Lat. 18°08'17.6"
Long. 100°54'58.1"



Photograph taken in plane-polarized light to show volcanic matrix used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

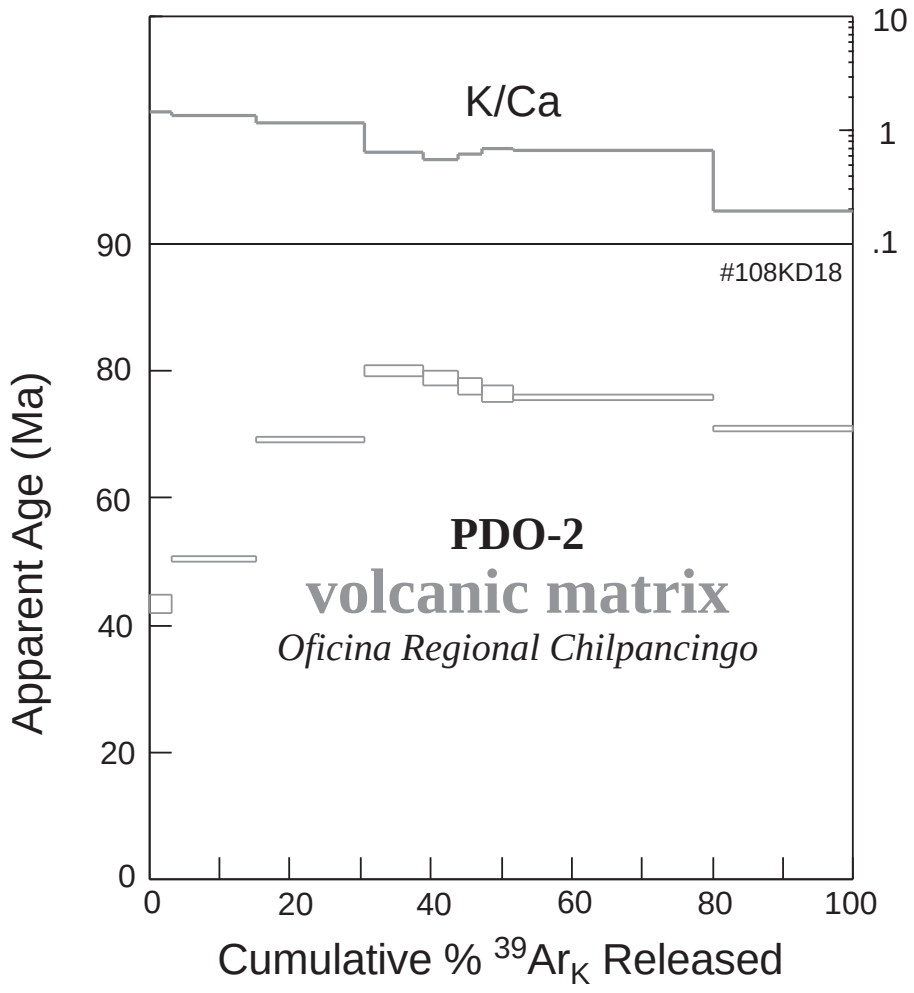


Table 5. $^{40}Ar/^{39}Ar$ analytical data for sample PDO-2 Oficina Regional Chilpancingo

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
PDO-2 *Chilpancingo*		***volcanic matrix***	*J = 0.004900 ± 0.25%*		*wt = 44.3 mg*		*#108KD18*		
650	3.1	29.8	0.048716	4.959	1.47	31	43.31	±	0.68
750	12.1	75.1	0.189579	5.783	1.36	225	50.41	±	0.21
850	15.4	80.3	0.240504	7.985	1.17	539	69.24	±	0.18
900	8.2	95.5	0.128760	9.254	0.63	1342	80.00	±	0.45
950	5.0	93.6	0.078321	9.127	0.55	717	78.92	±	0.62
1000	3.4	96.6	0.053748	8.965	0.62	483	77.56	±	0.60
1050	4.4	96.0	0.068264	8.844	0.69	415	76.53	±	0.66
1150	28.4	92.1	0.442990	8.774	0.67	333	75.93	±	0.23
1450	19.9	83.8	0.310082	8.188	0.19	33	70.96	±	0.22
Total Gas	100.0	85.3	1.560964	8.121	0.75	394	70.39		

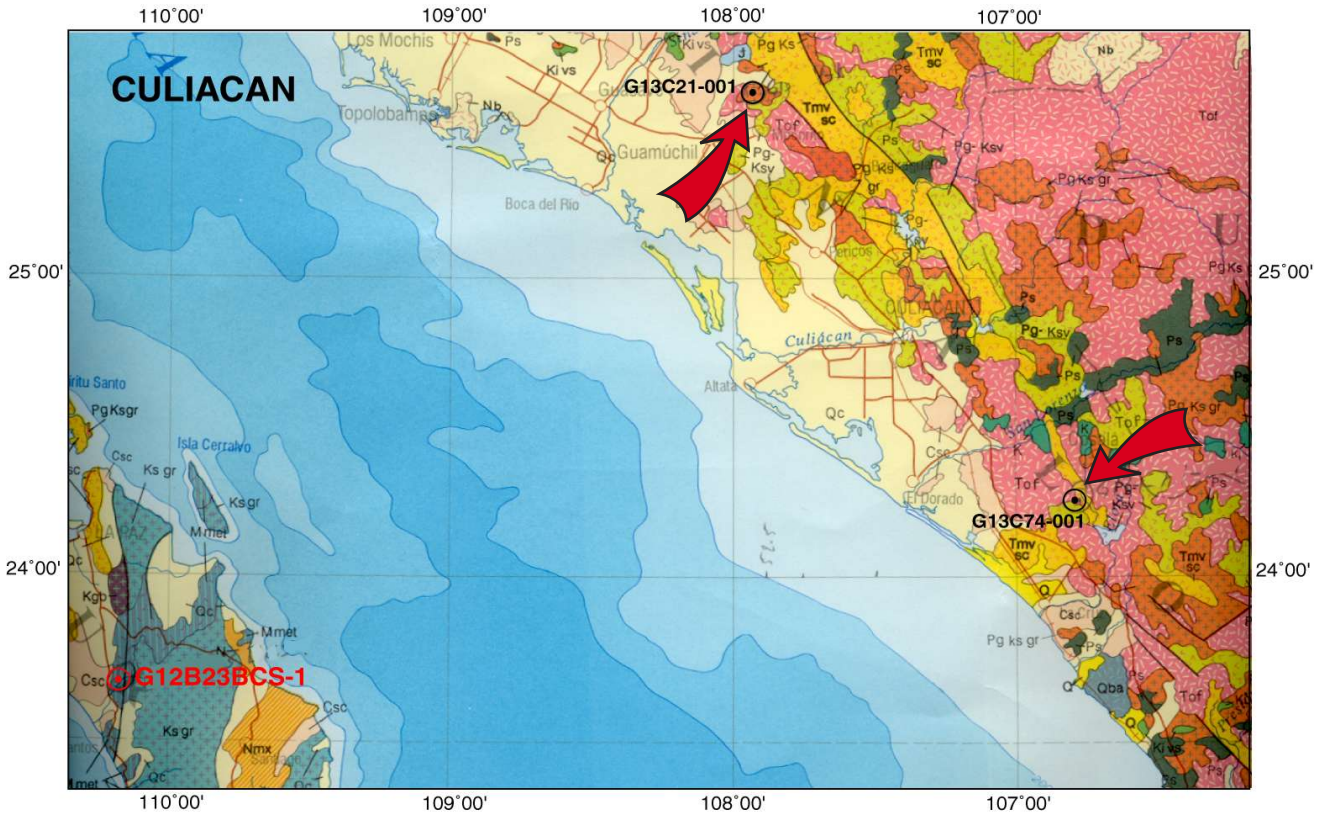
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

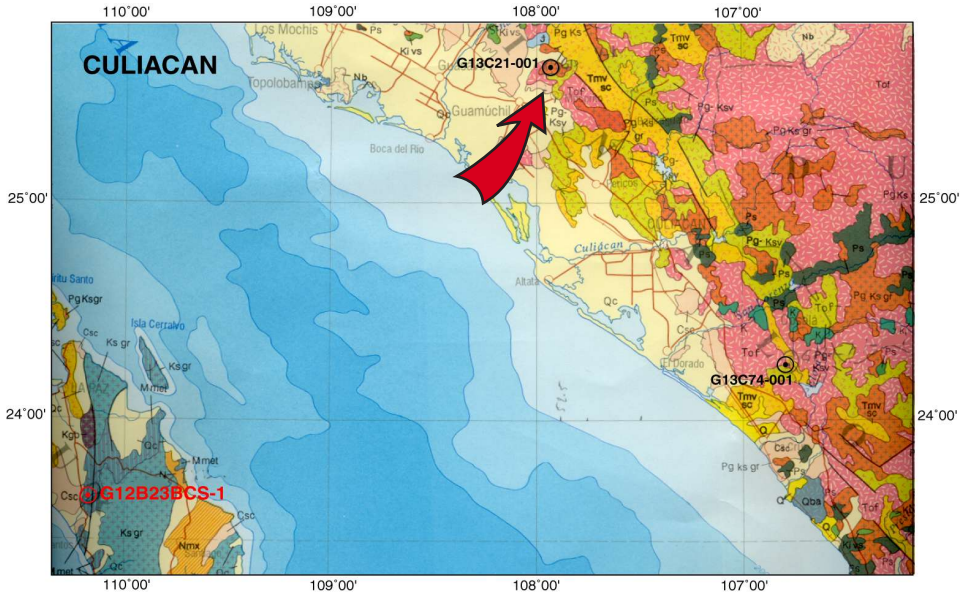
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Oficina Regional Culiacán



G13C21-001 Granodiorite
G13C74-001 Basalt



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

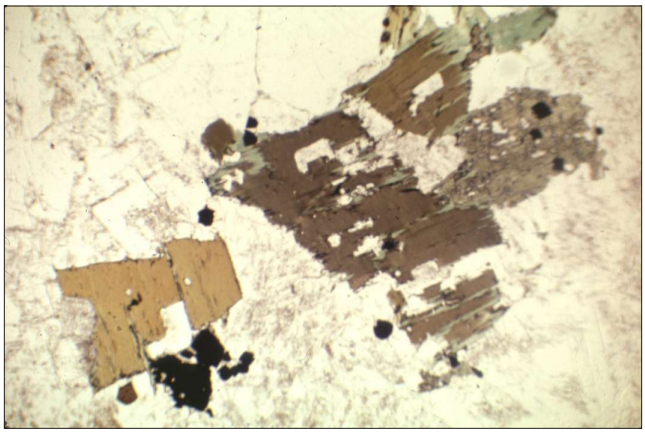
G13C21-001

Oficina Regional Culiacán

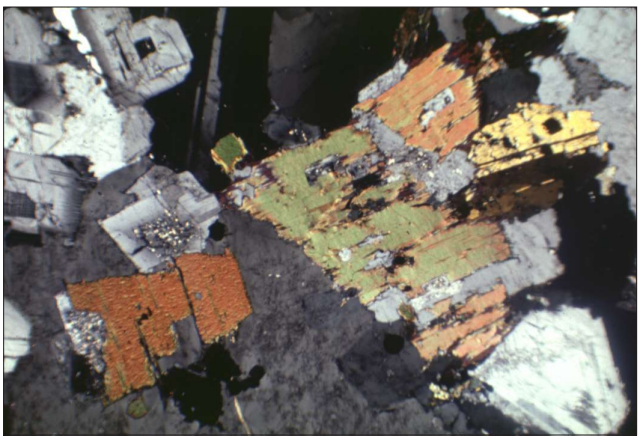
Granodiorite

Minerals dated:
hornblende
biotite
K-feldspar

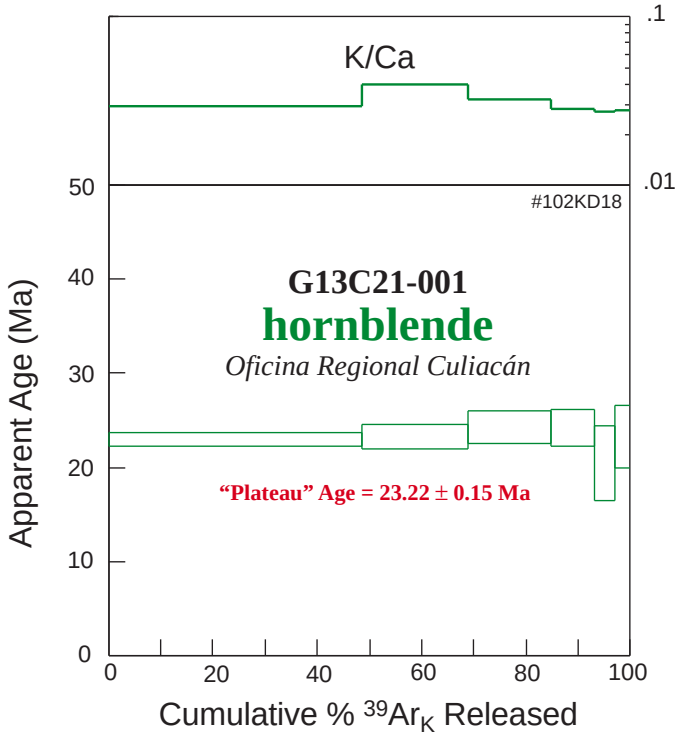
Lat. 25°39’45.9”
Long. 107°54’22.3”

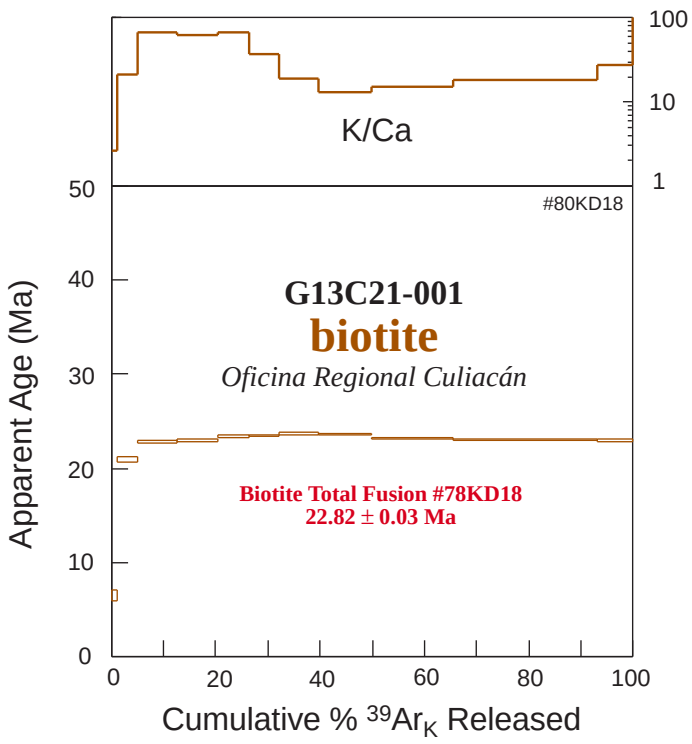


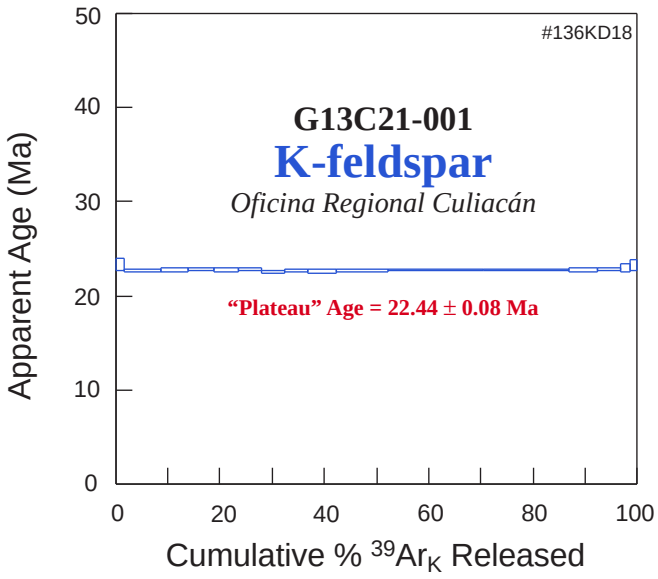
Photograph taken in plane-polarized light to show hornblende, biotite, and K-feldspar crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.


K/Ca
.1
.01
#102KD18
G13C21-001
hornblende
Oficina Regional Culiacán
"Plateau" Age = 23.22 ± 0.15 Ma
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released


K/Ca
100
10
1
#80KD18
G13C21-001
biotite
Oficina Regional Culiacán
Biotite Total Fusion #78KD18
22.82 ± 0.03 Ma
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released


#136KD18
G13C21-001
K-feldspar
Oficina Regional Culiacán
"Plateau" Age = 22.44 ± 0.08 Ma
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

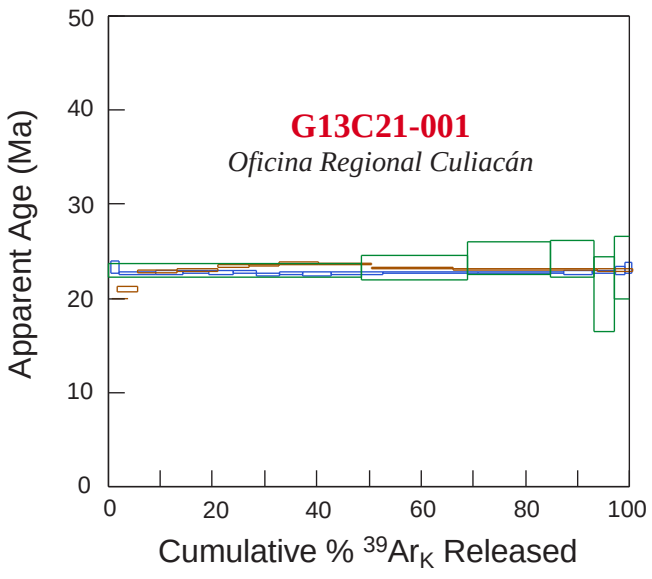

G13C21-001
Oficina Regional Culiacán
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

Table 6. $^{40}Ar/^{39}Ar$ analytical data for sample G13C21-001 Oficina Regional Culiacán

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
G13C21-001	*Culiacán*	***hornblende***	*J = 0.004768± 0.25%*		*wt = 258.4 mg*		*#102KD18*		
1150	48.6	69.3	0.762511	2.687	0.03	15	22.96	±	0.37
1200	20.3	88.6	0.319221	2.723	0.04	9	23.27	±	0.65
1250	15.9	93.0	0.250193	2.845	0.03	13	24.31	±	0.86
1300	8.4	93.6	0.131315	2.832	0.03	11	24.20	±	0.99
1350	3.8	79.6	0.059604	2.396	0.03	10	20.49	±	1.98
1650	3.0	85.4	0.046606	2.723	0.03	11	23.27	±	1.63
Total Gas	100.0	79.9	1.569450	2.722	0.03	13	23.26		
	100% of gas on plateau in 1150 through 1650 steps					**Plateau Age =**	**23.22**	±	**0.15**
G13C21-001	*Culiacán*	***biotite***	*J = 0.004917± 0.25%*		*wt = 54.7 mg*		*#80KD18*		
750	1.2	22.0	0.122069	0.736	2.57	96	6.52	±	0.31
850	3.9	61.6	0.401716	2.377	20.89	126	20.97	±	0.17
900	7.6	90.8	0.784964	2.592	64.81	138	22.84	±	0.06
950	7.8	93.3	0.801706	2.612	59.84	139	23.03	±	0.06
1000	5.8	93.0	0.601819	2.654	64.17	138	23.39	±	0.08
1050	5.7	92.7	0.589888	2.667	35.73	138	23.50	±	0.06
1100	7.7	89.3	0.795066	2.694	18.87	137	23.74	±	0.07
1150	10.2	92.9	1.048283	2.685	12.98	141	23.66	±	0.05
1200	15.6	96.0	1.607299	2.634	15.06	100	23.21	±	0.05
1250	27.5	97.7	2.830475	2.615	18.36	141	23.04	±	0.02
1350	6.9	97.5	0.714500	2.607	27.05	142	22.98	±	0.07
Total Gas	100.0	92.5	10.297785	2.602	28.29	132	22.94		
G13C21-001	*Culiacán*	***biotite total fusion***	*J = 0.004734± 0.25%*		*wt = 9.5 mg*		*#78KD18*		
1450	100.0	87.5	1.655472	2.689	19.06	102	**22.82**	±	**0.03**
G13C21-001	*Culiacán*	***K-feldspar***	*J = 0.004911 ± 0.25%*		*wt = 53.3 mg*		*#136KD18*		
850	1.7	66.0	0.279764	2.655	24.37	318	23.37	±	0.35
950	7.0	93.2	1.115802	2.577	44.00	8695	22.68	±	0.06
1000	5.3	97.5	0.847519	2.585	72.81	0	22.76	±	0.10
1050	4.9	96.3	0.780031	2.589	95.25	0	22.79	±	0.08
1100	4.6	95.1	0.732473	2.584	105.82	12047	22.75	±	0.12
1150	4.6	93.9	0.741829	2.591	85.35	6211	22.81	±	0.09
1200	4.4	91.8	0.707263	2.560	66.30	181	22.54	±	0.08
1225	4.4	87.8	0.707690	2.574	49.58	3991	22.66	±	0.08
1250	5.4	85.0	0.862608	2.570	50.37	3395	22.63	±	0.09
1275	9.8	86.0	1.575536	2.575	80.33	3653	22.67	±	0.06
1300	18.4	86.0	2.956960	2.580	159.04	3690	22.71	±	0.03
1325	16.3	82.4	2.604797	2.587	221.31	3271	22.78	±	0.04
1350	5.5	78.1	0.880079	2.587	166.57	2443	22.78	±	0.09
1450	4.5	79.9	0.728450	2.595	135.42	2088	22.85	±	0.10
1550	1.7	79.1	0.279024	2.618	150.03	1406	23.04	±	0.21
1650	1.4	78.6	0.227672	2.640	170.91	1737	23.24	±	0.28
Total Gas	100.0	86.8	16.027497	2.584	122.13	3666	22.75		
	66.1% of gas on plateau in 1225 through 1550 steps					**Plateau Age =**	**22.44**	±	**0.08**

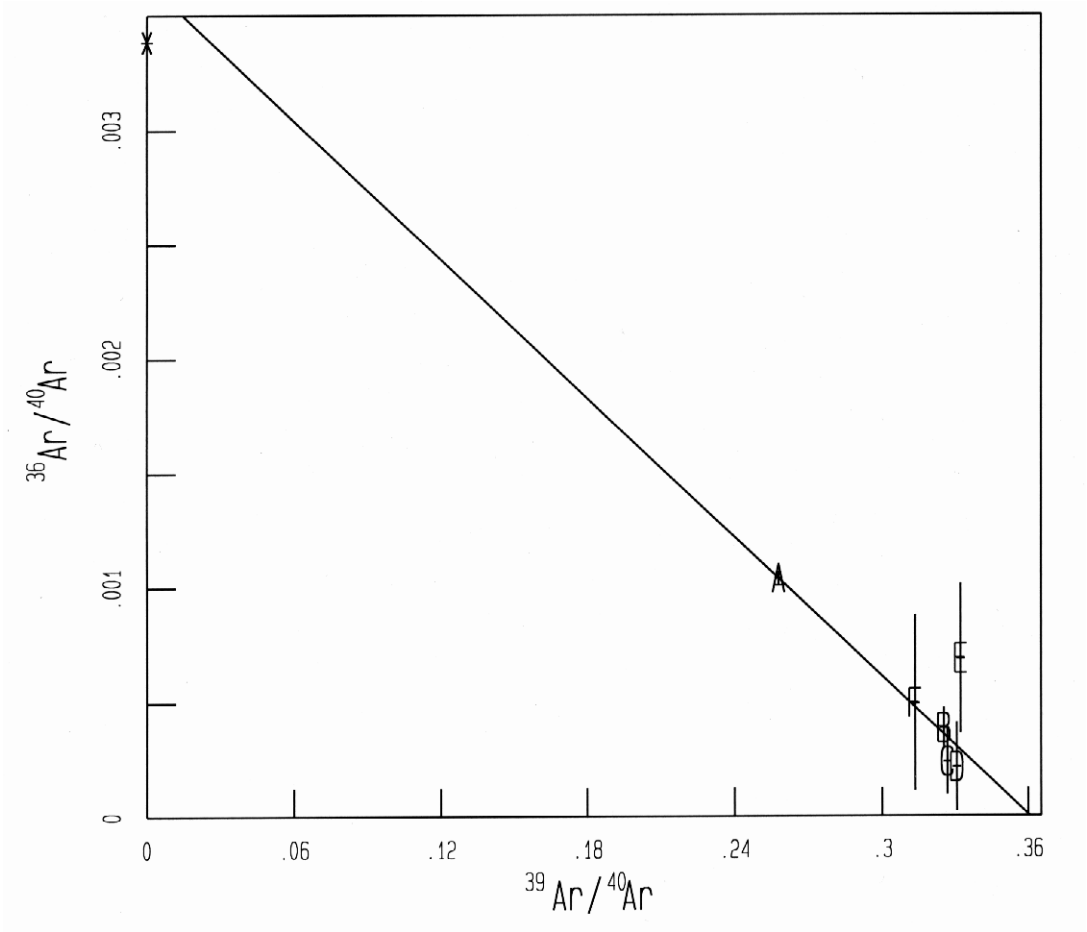
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

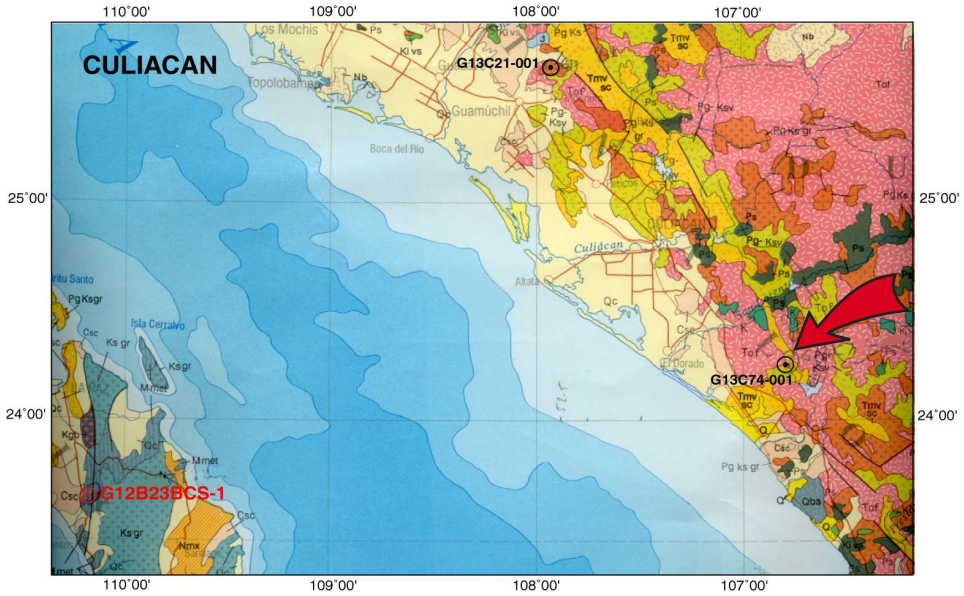
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Inverse-isotope correlation diagram
G13C21-001
Hornblende



Isochron Age = 23.69 ± 0.69 Ma
$[^{40}Ar/^{36}Ar]_i = 274.17 \pm 23.98$
MSWD = 0.588
6 of 6 steps with 100% of $^{39}Ar_K$



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

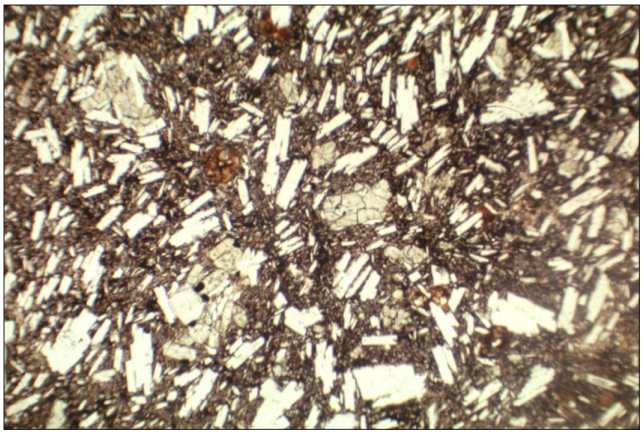
G13C74-001

Oficina Regional Culiacán

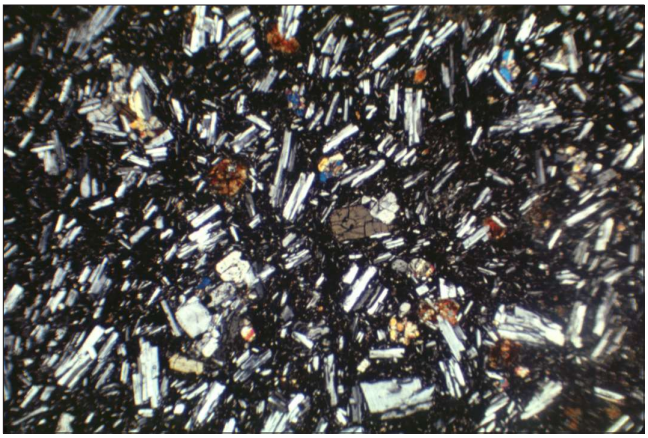
Basalt

Minerals dated:
volcanic matrix

Lat. 24°15’21”
Long. 106°46’51.7”



Photograph taken in plane-polarized light to show volcanic matrix used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

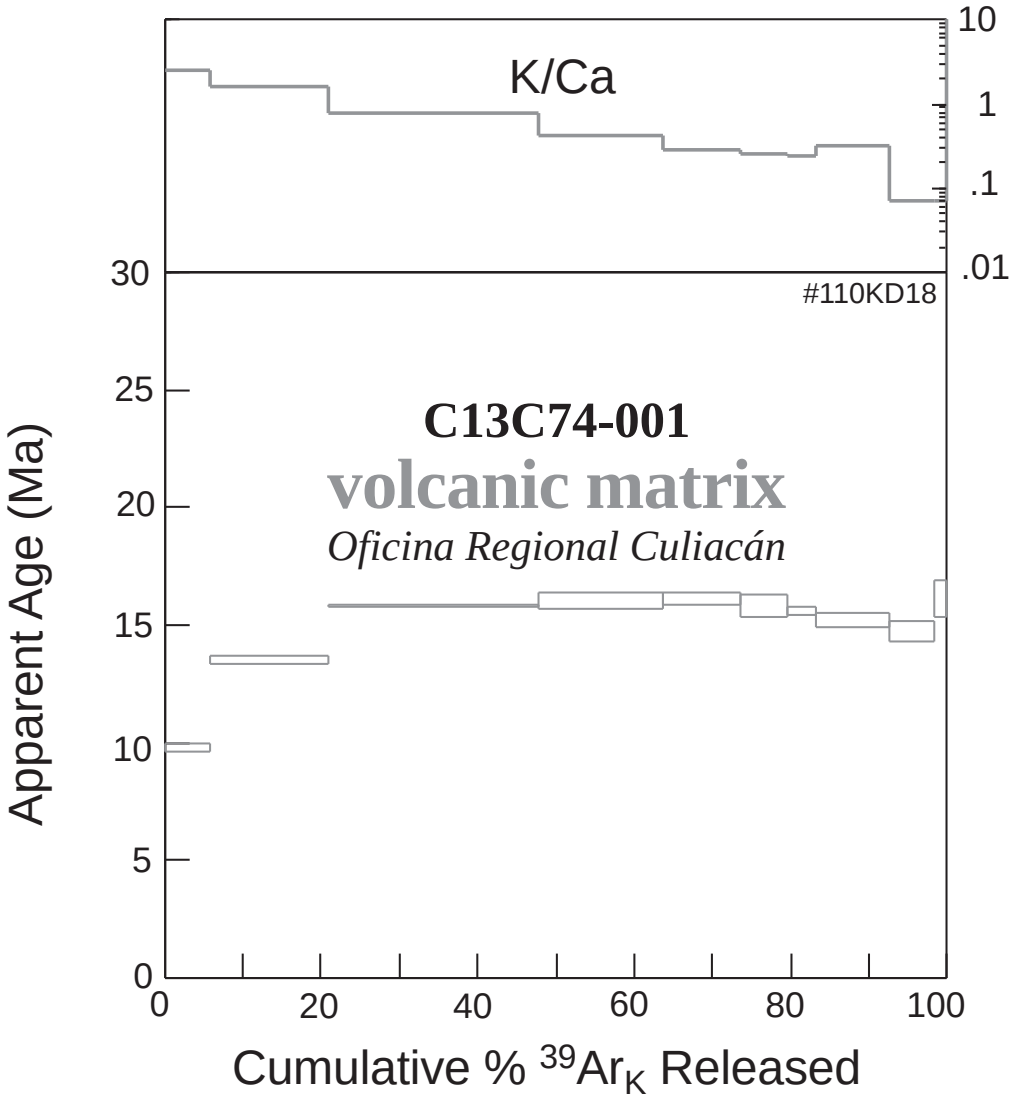


Table 7. $^{40}Ar/^{39}Ar$ analytical data for sample G13C74-001 Oficina Regional Culiacán

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
G13C74-001	*Culiacán*	***volcanic matrix***		*J = 0.004816 ± 0.25%*		*wt = 254.3 mg*	*#110KD18*		
650	5.9	23.7	0.545326	1.132	2.53	43	9.81	±	0.07
750	15.0	57.6	1.387755	1.562	1.61	64	13.52	±	0.08
850	26.8	85.2	2.480890	1.832	0.80	125	15.85	±	0.03
900	15.9	91.0	1.466244	1.854	0.42	223	16.03	±	0.17
950	10.1	93.1	0.930445	1.863	0.29	349	16.11	±	0.12
1000	6.0	91.5	0.554096	1.832	0.25	403	15.85	±	0.23
1050	3.6	91.1	0.335544	1.807	0.24	364	15.63	±	0.09
1150	9.3	93.3	0.864173	1.759	0.32	537	15.22	±	0.16
1450	5.7	78.8	0.528612	1.703	0.07	69	14.73	±	0.22
1650	1.6	52.1	0.152210	1.864	0.07	211	16.13	±	0.37
Total Gas	100.0	79.6	9.245295	1.742	0.76	211	15.07		

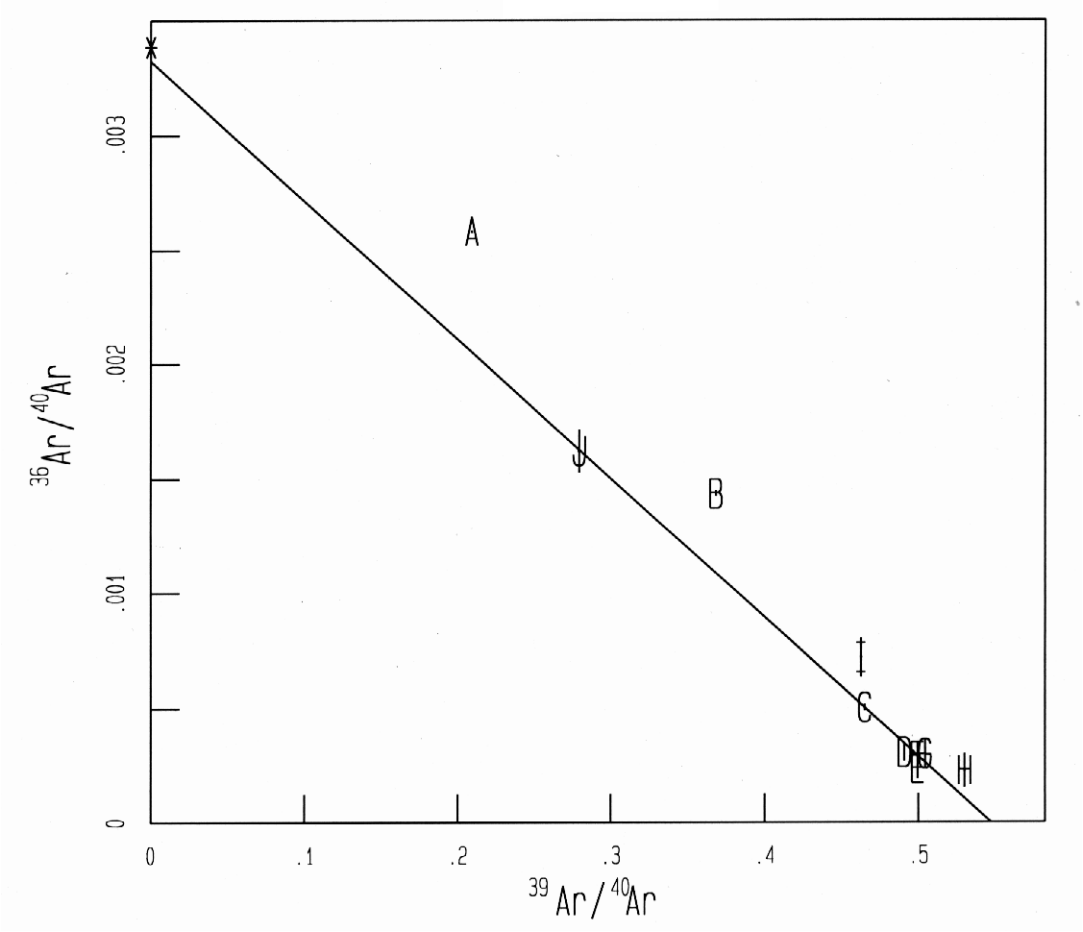
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

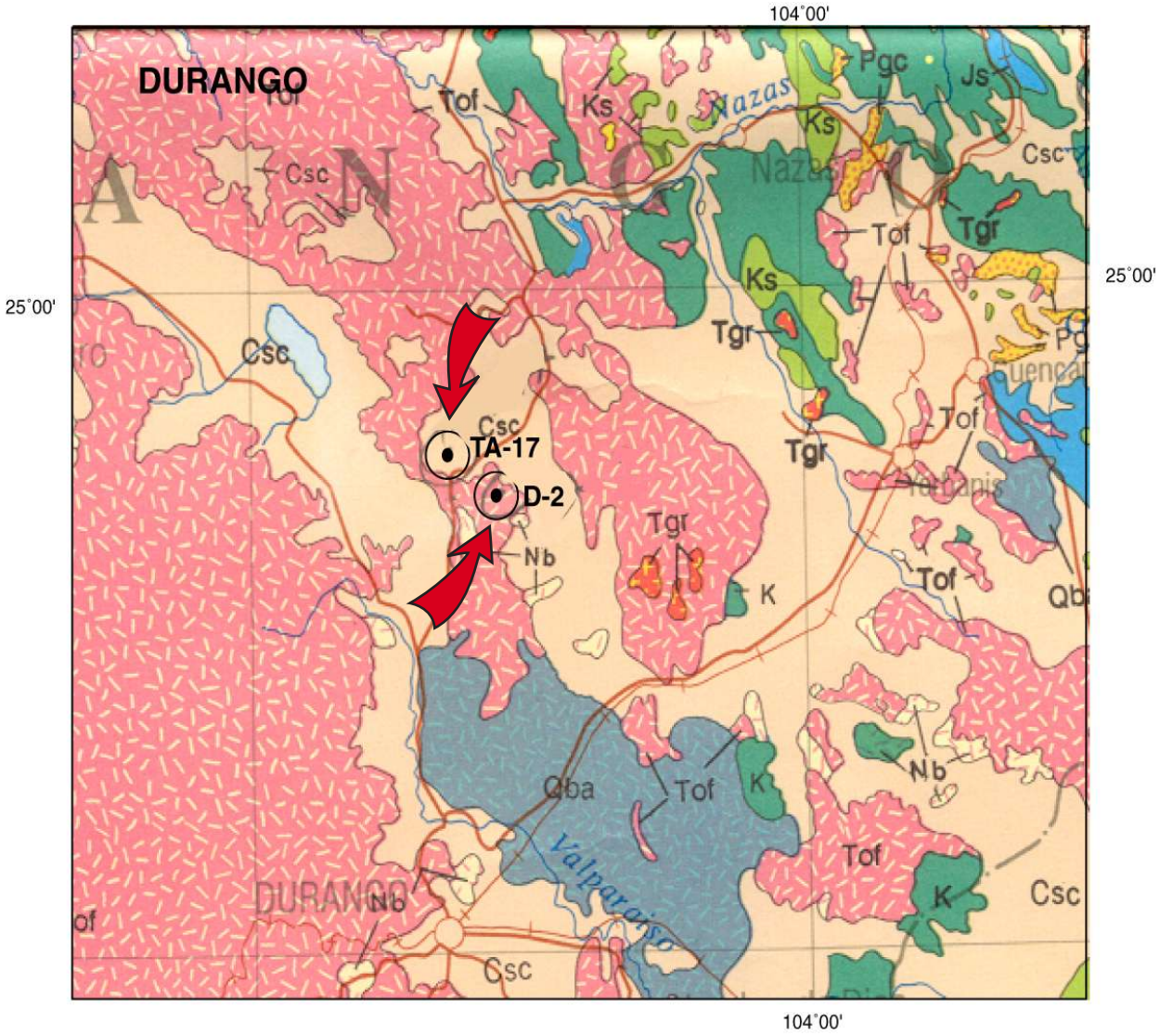
No error is calculated for the total gas age.

Inverse-isotope correlation diagram
C13C74-001
Volcanic matrix

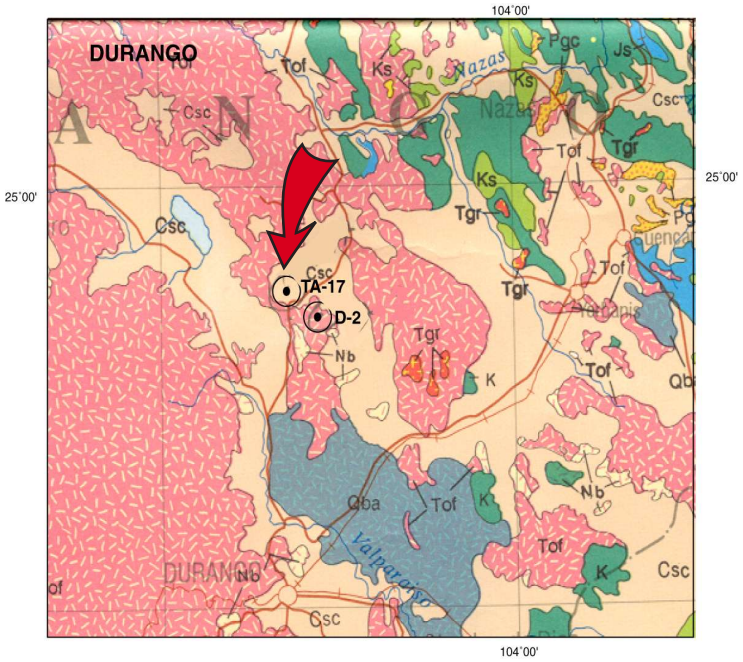


Isochron Age = 15.80 ± 0.16 Ma
$[^{40}Ar/^{36}Ar]_i = 301.12 \pm 17.02$
MSWD = 1.998
8 of 10 steps with 79.1% of $^{39}Ar_K$

Oficina Regional Durango



JA-17 Schist
D-2 Gneiss



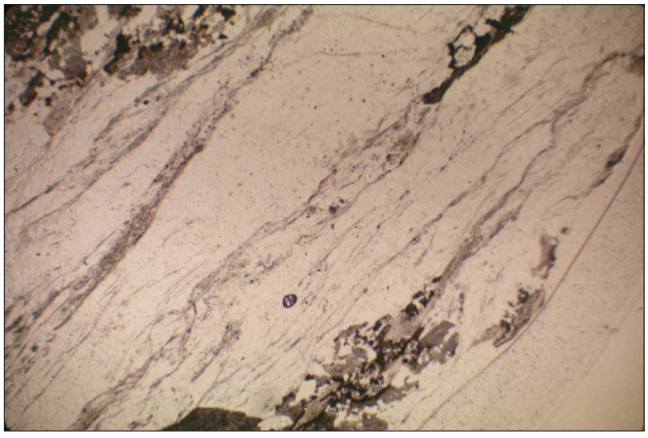
Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

JA-17
Oficina Regional Durango

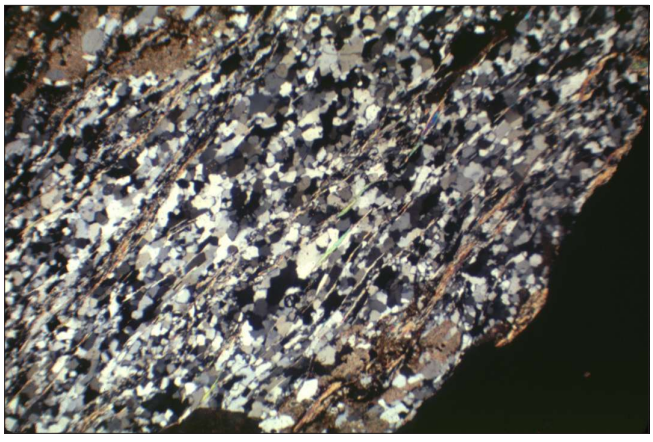
Schist

Mineral dated:
muscovite

Lat. 24°46’20.9”
Long. 104°38’50.8”



Photograph taken in plane-polarized light to show muscovite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

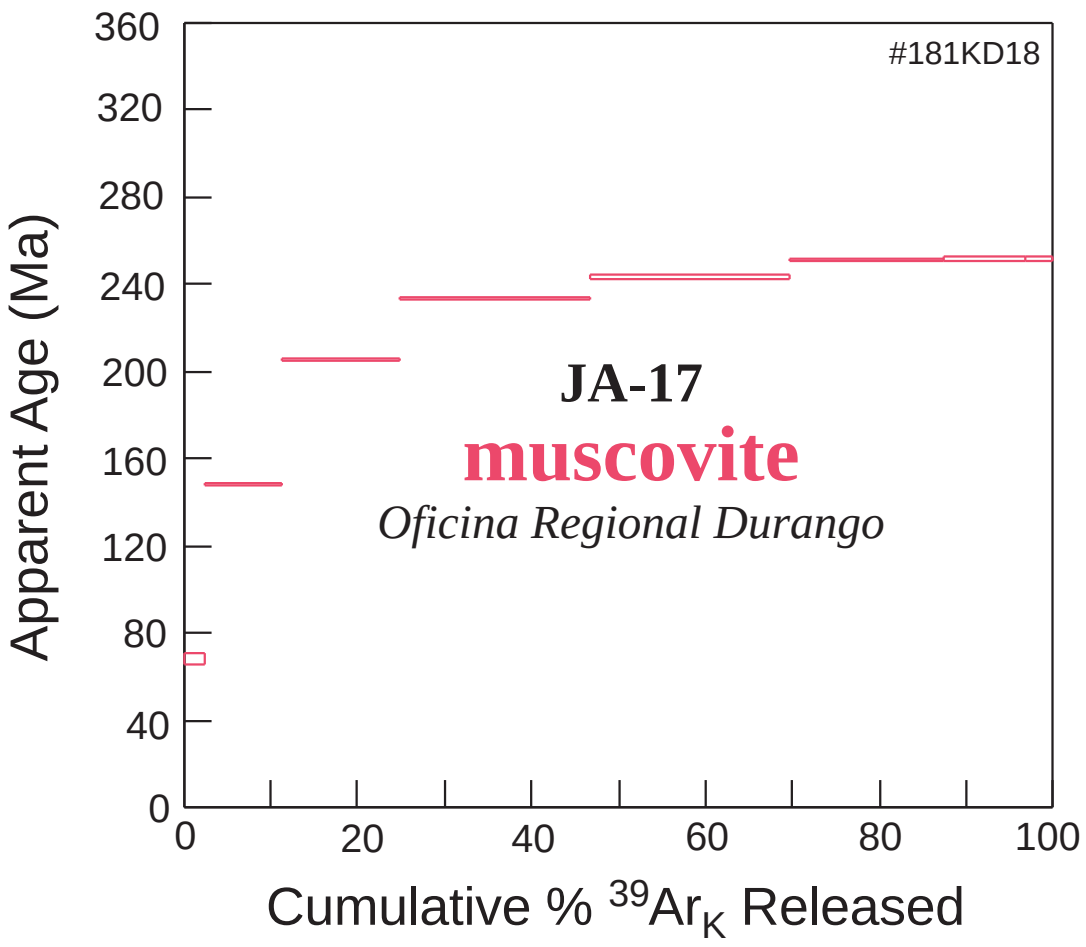


Table 8. $^{40}Ar/^{39}Ar$ analytical data for sample JA-17 Oficina Regional Durango

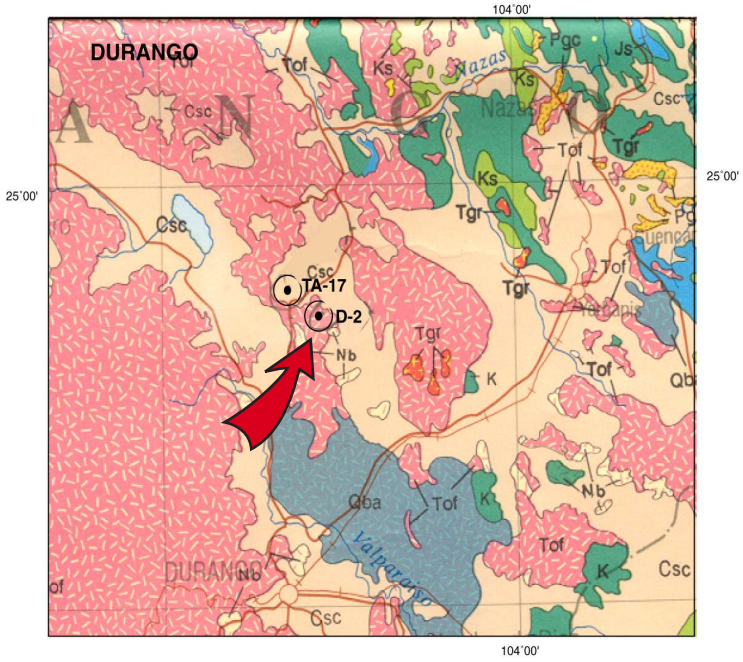
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
JA-17 *Durango*		***muscovite***	*J = 0.004883 ± 0.25%*		*wt = 31.5 mg*	*#181KD18*			
650	2.4	44.4	0.053929	7.875	16.87	31	68.07	±	1.34
750	8.8	95.9	0.194294	17.559	43.27	227	148.40	±	0.28
800	13.7	99.3	0.302100	24.763	90.14	1669	205.92	±	0.24
850	21.8	99.6	0.481640	28.286	124.34	2901	233.40	±	0.20
900	22.8	99.5	0.504528	29.619	133.81	4490	243.69	±	0.40
950	17.9	99.6	0.396184	30.568	190.92	3670	250.97	±	0.17
975	9.4	99.4	0.207562	30.659	169.41	1510	251.67	±	0.34
1000	3.1	98.9	0.068382	30.668	102.03	614	251.74	±	0.63
Total Gas	100.0	97.8	2.208619	27.372	127.56	2726	226.31		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



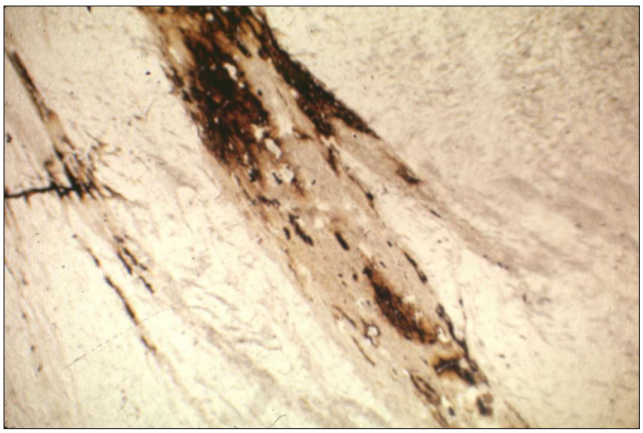
Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

D-2
Oficina Regional Durango

Gneiss

Mineral dated:
muscovite

Lat. 24°42’14.2”
Long. 104°38’46.9”



Photograph taken in plane-polarized light to show muscovite crystals used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.

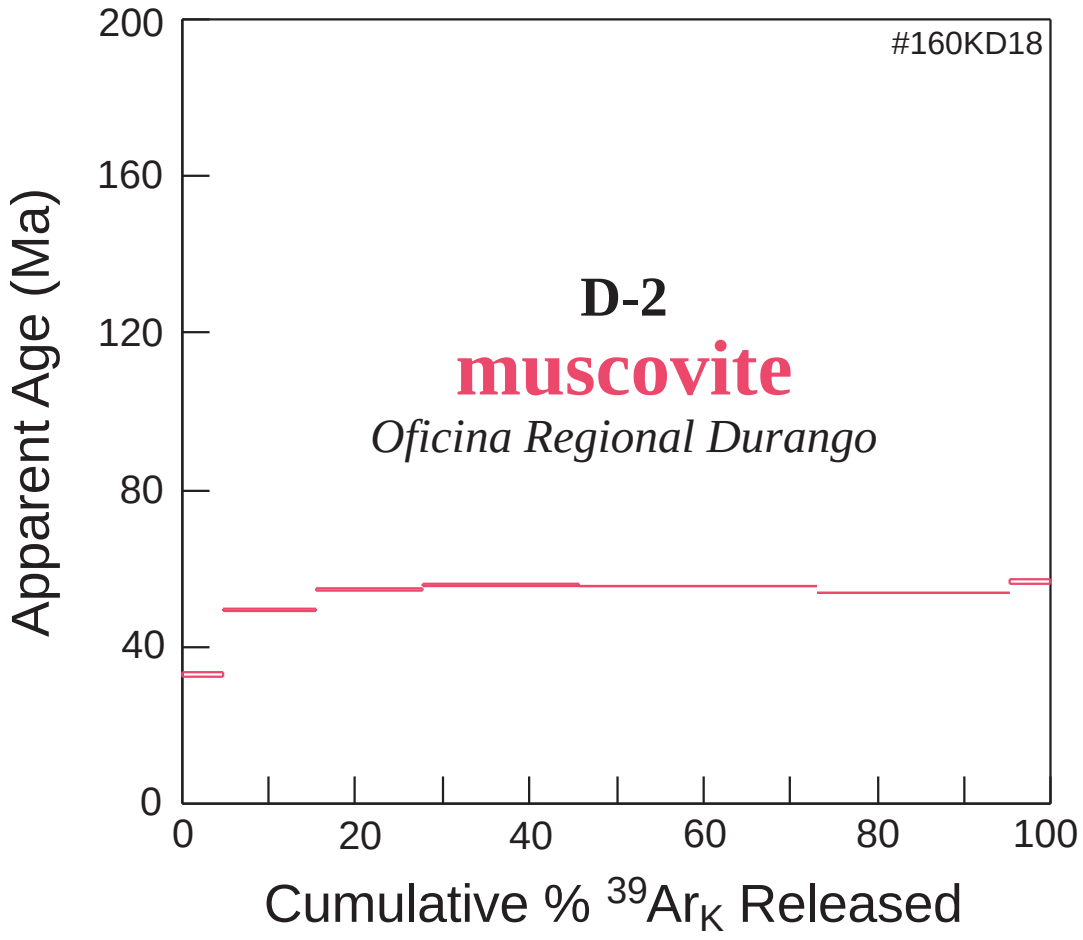


Table 9. $^{40}Ar/^{39}Ar$ analytical data for sample D-2 Oficina Regional Durango

Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
D-2 *Durango*	***muscovite***	*J = 0.004917 ± 0.25%*		*wt = 22.5 mg*	*#160KD18*				
650	4.9	55.8	0.105133	3.749	11.23	112	32.96	±	0.19
750	10.6	92.9	0.228780	5.655	14.97	513	49.47	±	0.21
800	12.4	97.6	0.268546	6.257	8.50	947	54.67	±	0.17
850	17.8	98.6	0.386154	6.408	20.34	1074	55.96	±	0.08
900	27.5	99.2	0.594528	6.342	53.80	1491	55.39	±	0.07
950	22.2	98.9	0.481426	6.174	61.48	1402	53.95	±	0.07
975	4.7	96.9	0.101165	6.480	54.88	480	56.58	±	0.32
Total Gas	100.0	96.0	2.165732	6.114	37.81	1112	53.43		

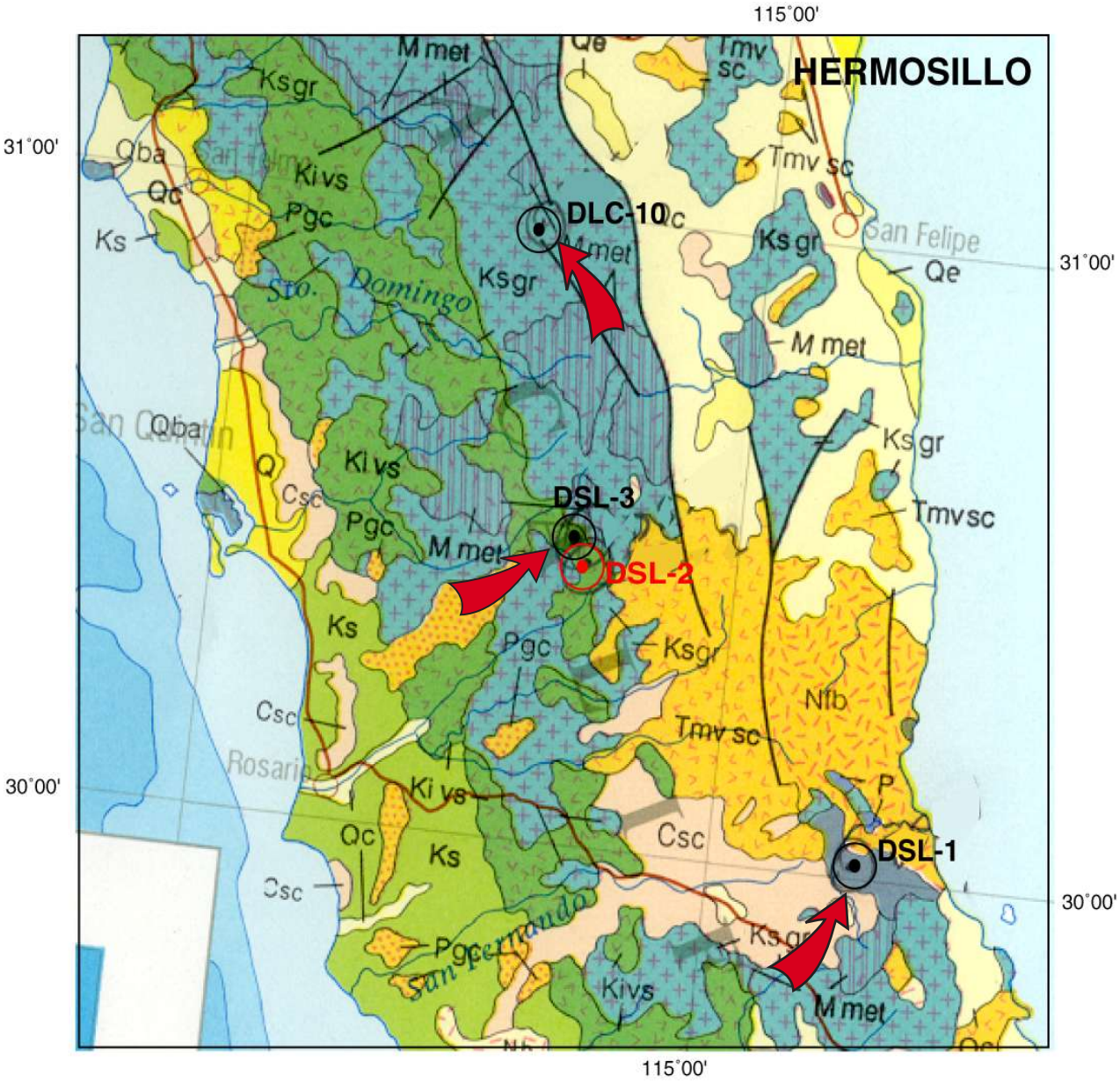
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

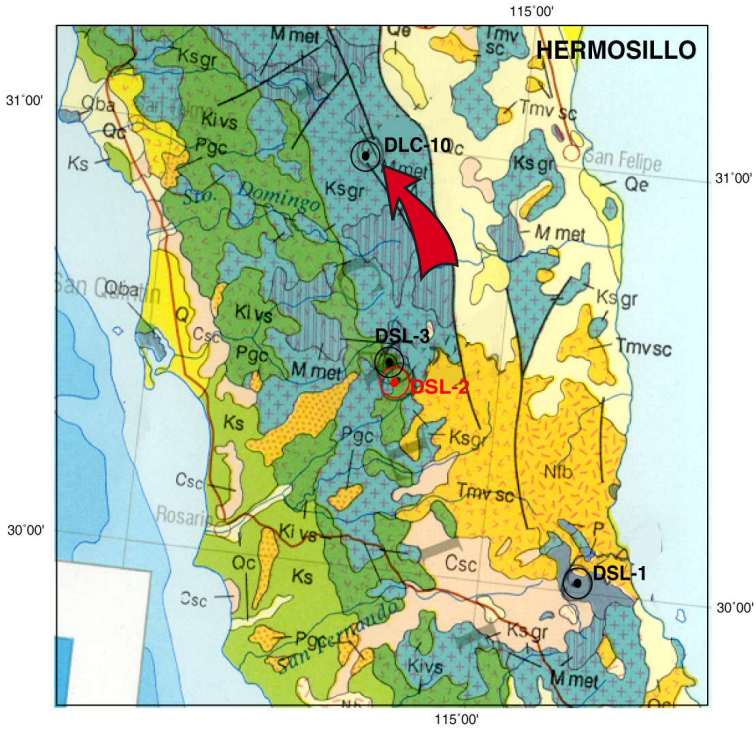
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Oficina Regional Hermosillo



DLC-10 Tonalite
DSL-3 Biotite Schist
DSL-1 Muscovite Schist



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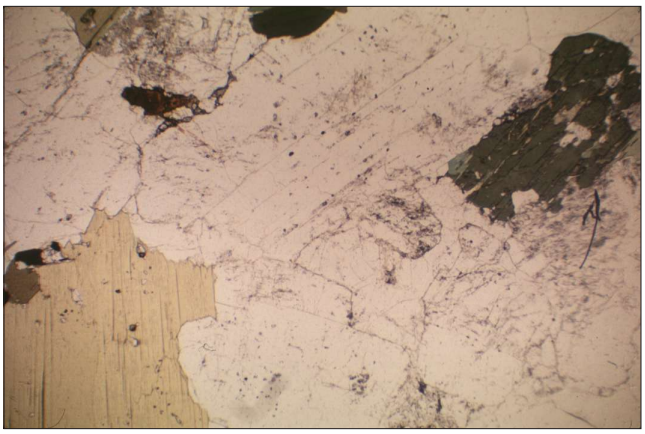
DLC-10

Oficina Regional Hermosillo

Tonalite

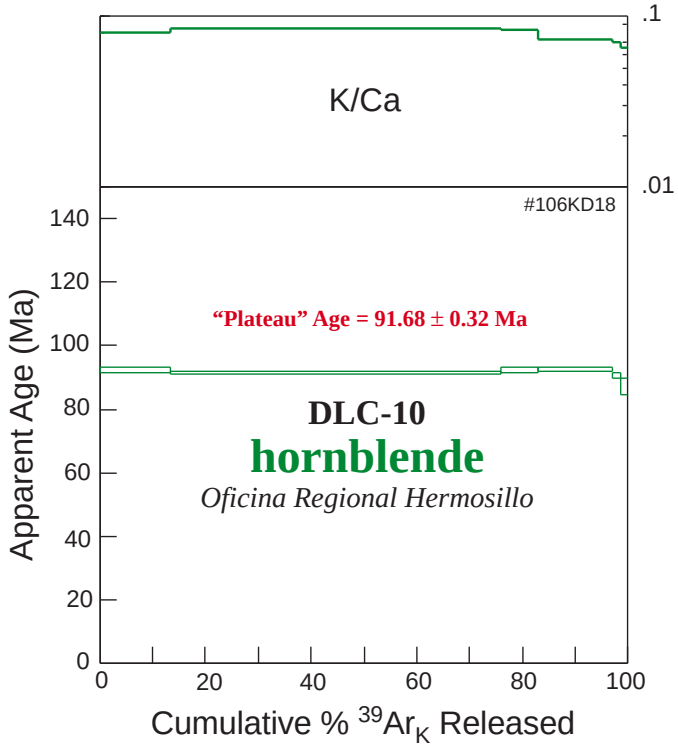
Minerals dated:
hornblende
biotite
K-felspar

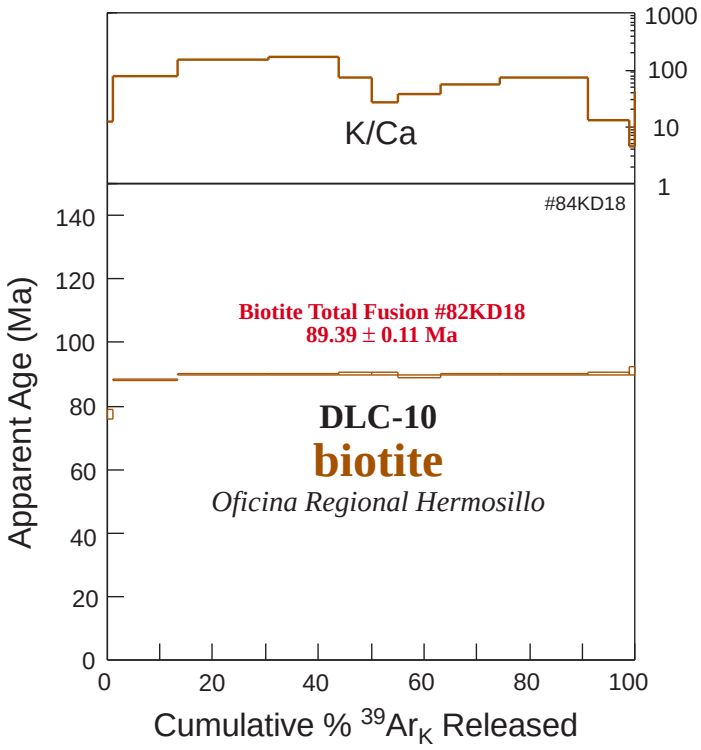
Lat. 30°59’21.2”
Long. 115°34’09.6”

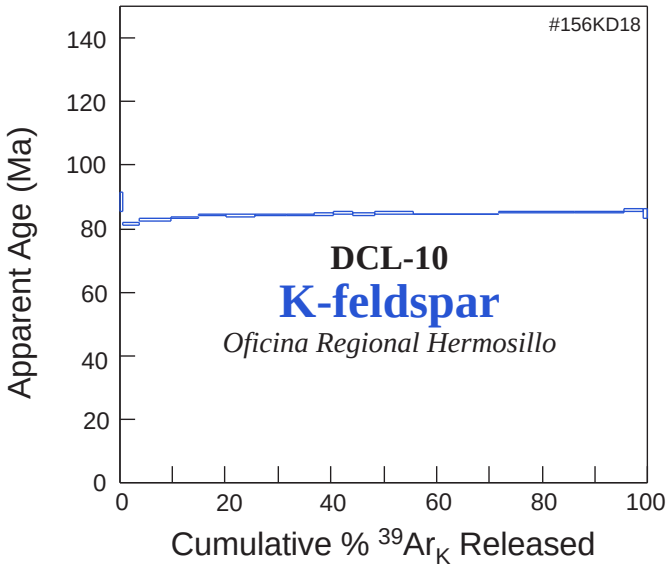


Photograph taken in plane-polarized light to show hornblende, biotite, and K-feldspar crystals used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.


K/Ca
.1
.01
#106KD18
"Plateau" Age = 91.68 ± 0.32 Ma
DLC-10
hornblende
Oficina Regional Hermosillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released


K/Ca
1000
100
10
1
#84KD18
Biotite Total Fusion #82KD18
89.39 ± 0.11 Ma
DLC-10
biotite
Oficina Regional Hermosillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released


#156KD18
DCL-10
K-feldspar
Oficina Regional Hermosillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

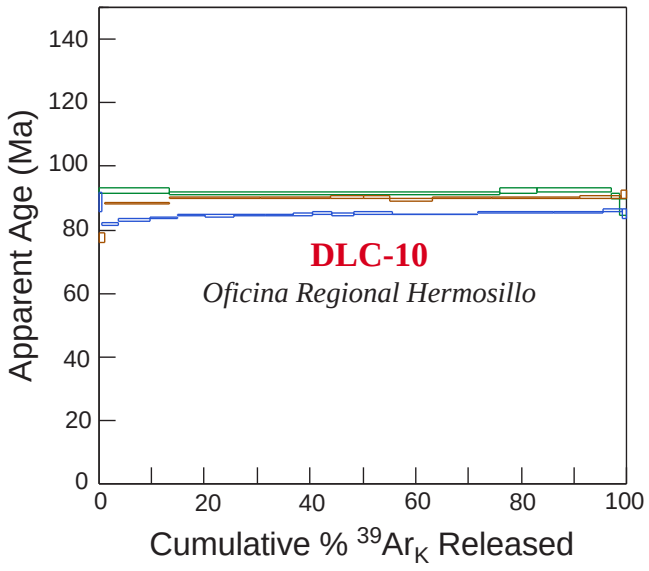

DLC-10
Oficina Regional Hermosillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

Table 10. $^{40}Ar/^{39}Ar$ analytical data for sample DLC-10 Oficina Regional Hermosillo

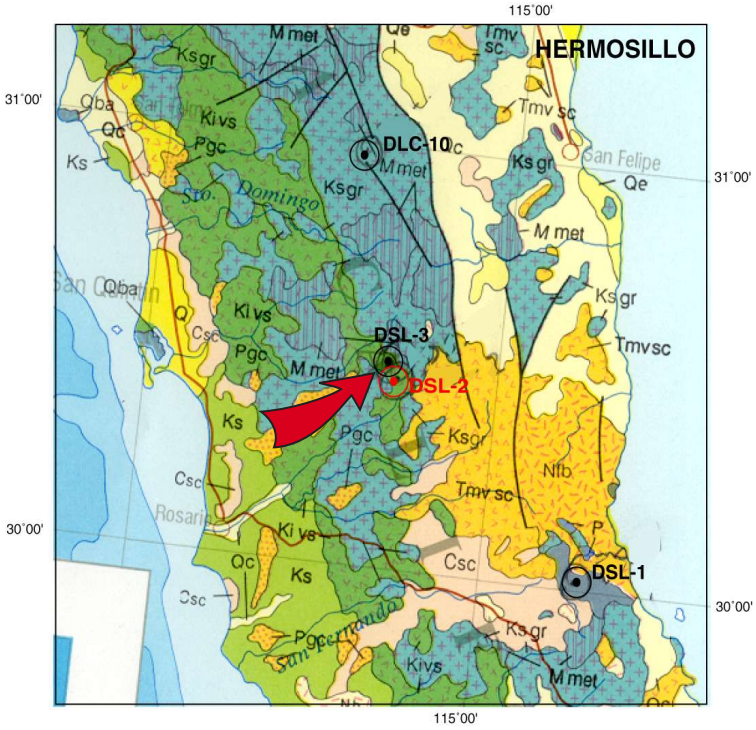
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
DLC-10	*Hermosillo*	***hornblende***	*J = 0.004770 ± 0.25%*	*wt = 251.9 mg*	*#106KD18*				
1150	13.3	94.3	0.564701	11.028	0.08	16	92.48	±	0.41
1200	62.6	98.4	2.648010	10.912	0.09	16	91.53	±	0.23
1250	7.2	97.3	0.303692	10.996	0.08	14	92.22	±	0.45
1300	13.8	98.7	0.584629	11.023	0.07	16	92.45	±	0.35
1350	1.8	96.4	0.074289	10.799	0.07	16	90.61	±	0.48
1650	1.3	95.6	0.056341	10.381	0.07	16	87.19	±	1.28
Total Gas	100.0	97.8	4.231662	10.940	0.08	16	91.76		
	69.8% of gas on plateau in 1200 through 1250 steps				**Plateau Age =**		**91.68**	±	**0.32**
DLC-10	*Hermosillo*	***biotite***	*J = 0.004930 ± 0.25%*	*wt = 24.6 mg*	*#84KD18*				
750	1.2	64.7	0.060085	8.907	12.67	98	77.52	±	0.78
850	12.1	94.5	0.618528	10.151	78.34	245	88.09	±	0.10
900	17.3	98.7	0.881613	10.385	150.29	264	90.08	±	0.11
950	13.3	98.3	0.679941	10.367	174.10	251	89.92	±	0.10
1000	6.2	96.7	0.318755	10.380	74.79	240	90.03	±	0.19
1050	4.9	95.0	0.249638	10.384	26.35	231	90.07	±	0.20
1100	8.1	96.5	0.412795	10.291	36.82	253	89.28	±	0.15
1150	11.2	98.3	0.572359	10.361	56.69	262	89.87	±	0.14
1200	16.7	99.0	0.850192	10.370	74.63	135	89.95	±	0.10
1250	7.9	99.4	0.400963	10.395	13.04	253	90.16	±	0.17
1350	1.2	99.2	0.058753	10.501	4.44	197	91.06	±	0.64
Total Gas	100.0	97.3	5.103622	10.326	87.61	231	89.57		
DLC-10	*Hermosillo*	***biotite total fusion***	*J = 0.004932 ± 0.25%*	*wt = 4.4 mg*	*#82KD18*				
1450	100.0	96.3	0.958853	10.300	33.06	118	**89.39**	±	**0.11**
DLC-10	*Hermosillo*	***K-feldspar***	*J = 0.004918 ± 0.25%*	*wt = 24.8 mg*	*#156KD18*				
750	0.5	38.4	0.042354	10.219	8.26	22	88.46	±	1.43
850	3.1	90.9	0.240737	9.396	18.54	561	81.49	±	0.23
950	6.2	96.9	0.475884	9.537	15.67	2465	82.69	±	0.19
1000	5.0	98.1	0.387004	9.628	23.18	4794	83.46	±	0.14
1050	5.3	98.3	0.405372	9.723	31.42	6816	84.26	±	0.12
1100	5.5	98.9	0.427041	9.717	47.35	10277	84.21	±	0.15
1150	5.9	98.8	0.454523	9.721	62.04	5741	84.25	±	0.15
1200	5.3	98.4	0.407618	9.750	49.87	168	84.49	±	0.13
1225	3.7	97.6	0.282311	9.748	35.10	261	84.48	±	0.18
1250	3.6	96.6	0.277755	9.792	27.30	1442	84.85	±	0.23
1275	4.3	95.3	0.330270	9.745	27.04	1093	84.45	±	0.25
1300	7.3	94.6	0.564082	9.814	43.22	840	85.03	±	0.14
1325	16.1	94.2	1.245303	9.762	100.57	923	84.60	±	0.10
1350	14.3	92.7	1.103405	9.842	143.74	942	85.27	±	0.08
1450	9.6	91.9	0.738012	9.823	78.14	856	85.11	±	0.11
1550	3.4	91.3	0.266165	9.930	82.58	732	86.02	±	0.20
1650	1.0	88.5	0.073505	9.776	64.50	594	84.72	±	0.76
Total Gas	100.0	94.8	7.721341	9.752	67.58	2249	84.51		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



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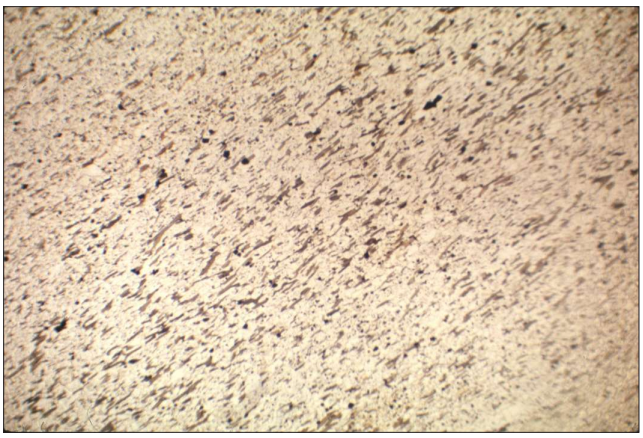
DSL-3

Oficina Regional Hermosillo

Biotite Schist

Mineral dated:
Biotite

Lat. 30°29’32.2”
Long. 115°18’47.7”



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.

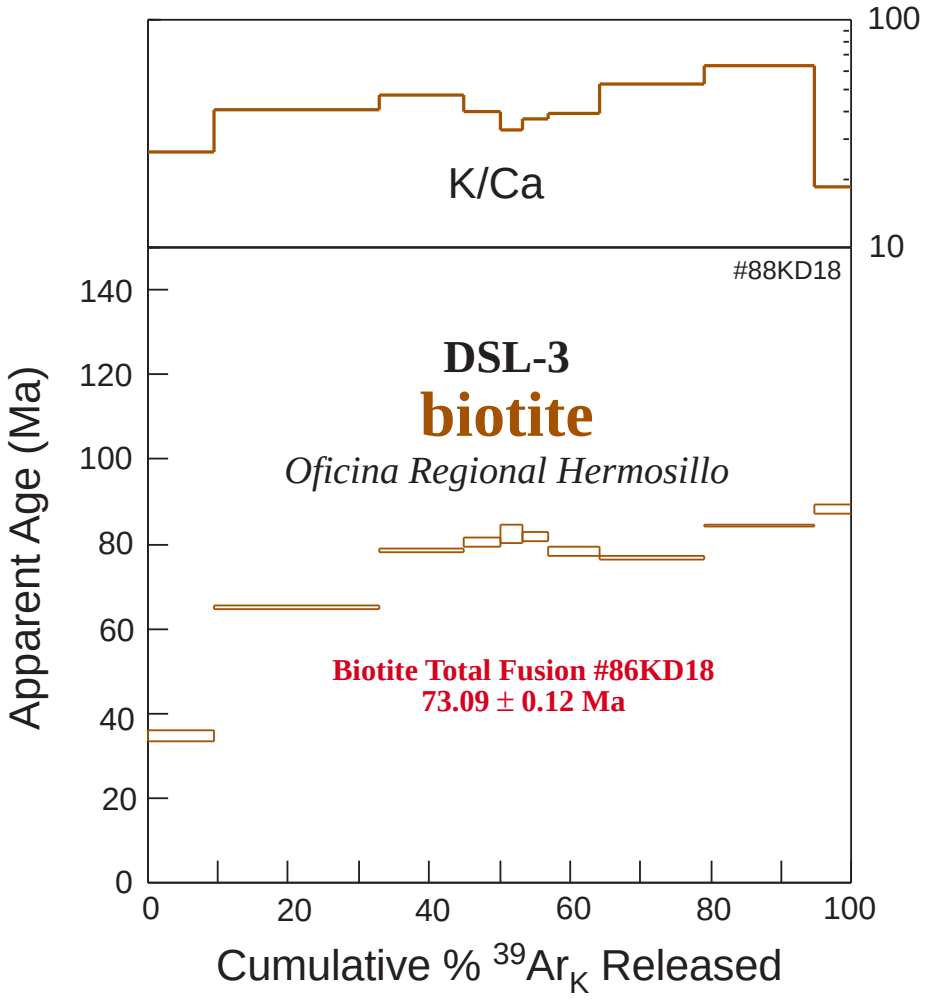


Table 11. $^{40}Ar/^{39}Ar$ analytical data for sample DSL-3 Oficina Regional Hermosillo

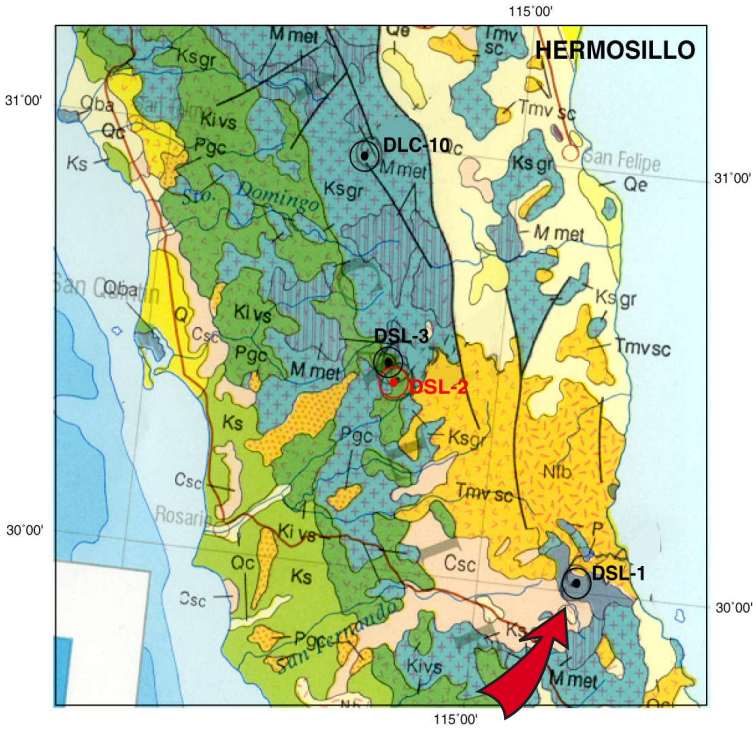
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
DLS-3 *Hermosillo*	***biotite***	*J = 0.004900± 0.25%*	*wt = 10.0 mg*	*#88KD18*					
750	9.4	44.7	0.173411	3.972	26.42	112	34.77	±	0.59
850	23.5	75.3	0.432539	7.503	40.15	319	65.14	±	0.18
900	12.0	82.2	0.220399	9.067	47.11	383	78.42	±	0.15
950	5.2	82.1	0.095014	9.319	39.77	324	80.55	±	0.47
1000	3.3	83.8	0.060624	9.519	32.78	272	82.24	±	0.96
1050	3.5	84.2	0.064695	9.440	36.95	292	81.57	±	0.34
1100	7.4	83.0	0.135297	9.039	39.01	390	78.18	±	0.47
1150	14.7	82.7	0.270362	8.872	52.27	446	76.77	±	0.11
1200	15.7	89.6	0.288077	9.754	63.17	79	84.22	±	0.08
1250	5.4	93.1	0.099058	10.211	18.35	475	88.08	±	0.48
Total Gas	100.0	79.0	1.839476	8.398	43.45	300	72.75		
DLS-3 *Hermosillo*	***biotite total fusion***	*J = 0.004936± 0.25%*	*wt = 5.5 mg*	*#86KD18*					
1450	100.0	80.4	1.031783	8.376	37.67	172	**73.09**	±	**0.12**

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

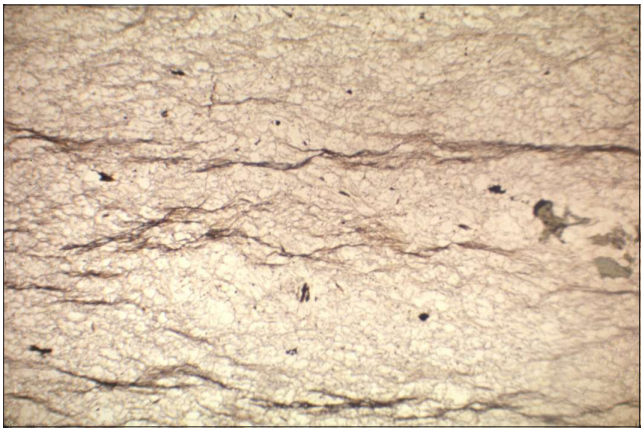
DSL-1

Oficina Regional Hermosillo

Muscovite Schist

Mineral dated:
muscovite

Lat. 30°00’16.8”
Long. 114°44’12.5”



Photograph taken in plane-polarized light to show muscovite crystals used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.

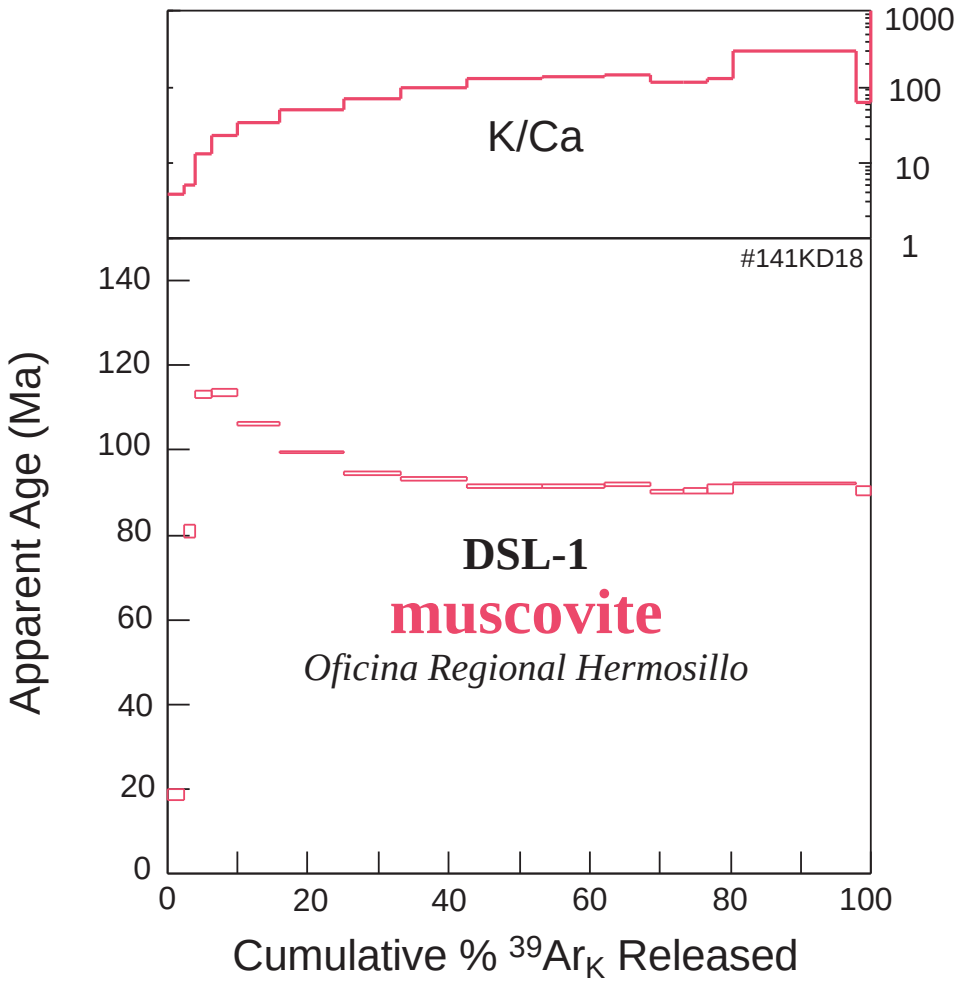


Table 12. $^{40}Ar/^{39}Ar$ analytical data for sample DSL-1 Oficina Regional Hermosillo

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
DLS-1 *Hermosillo*		***muscovite***	*J = 0.004764 ± 0.25%*		*wt = 30.9 mg*	*#141KD18*			
650	2.4	15.5	0.087663	2.176	3.89	53	18.61	±	0.62
750	1.7	76.7	0.060802	9.638	4.94	112	80.98	±	0.71
800	2.3	92.0	0.083886	13.577	12.88	269	113.07	±	0.46
850	3.6	96.1	0.129786	13.637	22.63	499	113.55	±	0.49
900	5.9	97.2	0.217162	12.741	34.28	1099	106.30	±	0.22
950	9.2	97.6	0.335743	11.897	48.43	2379	99.45	±	0.17
975	8.1	97.8	0.293832	11.299	70.45	4808	94.59	±	0.18
1000	9.4	98.2	0.343362	11.116	97.34	3603	93.09	±	0.22
1025	10.6	98.1	0.386889	10.919	131.99	2823	91.48	±	0.14
1050	8.9	97.7	0.324519	10.934	139.09	3564	91.60	±	0.17
1075	6.7	96.8	0.243925	10.976	145.35	2383	91.95	±	0.21
1100	4.6	95.0	0.167135	10.747	117.98	1976	90.08	±	0.26
1125	3.4	94.5	0.125895	10.786	117.86	1710	90.39	±	0.33
1150	3.6	94.4	0.131720	10.836	128.93	1230	90.80	±	0.50
1250	17.5	97.8	0.638059	10.995	296.39	206	92.10	±	0.12
1450	2.2	86.0	0.079400	10.777	61.82	503	90.32	±	0.55
Total Gas	100.0	94.6	3.649778	11.093	125.96	2054	92.90		

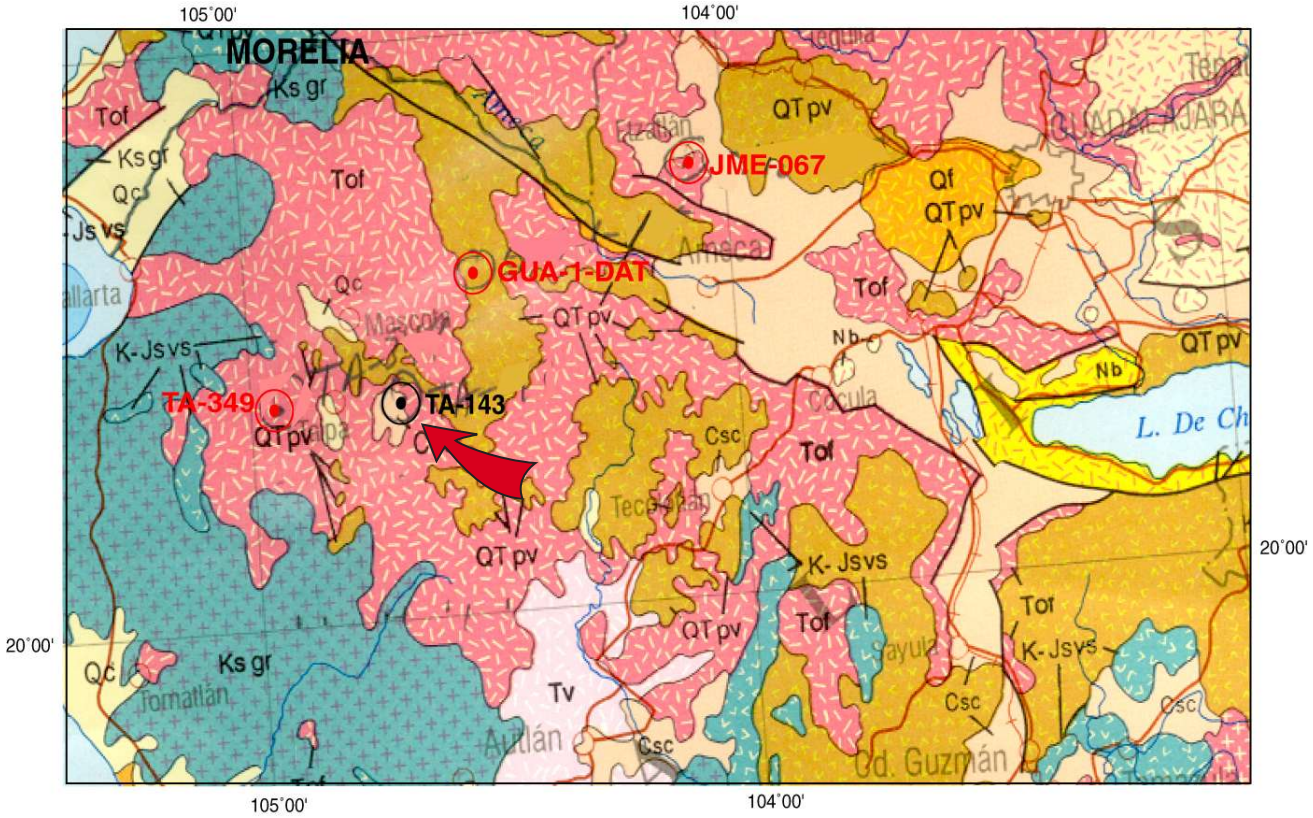
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

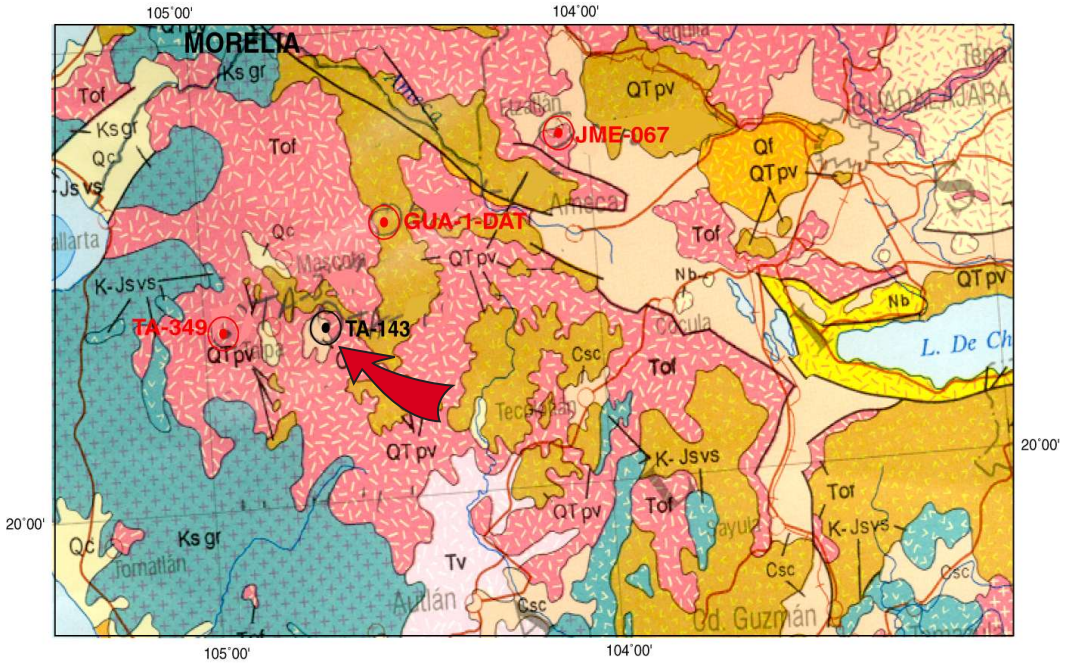
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Oficina Regional Morelia



TA-143 Andesite



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

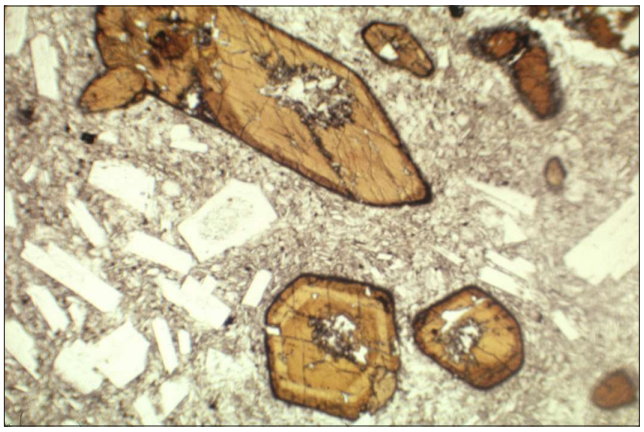
TA-143

Oficina Regional Morelia

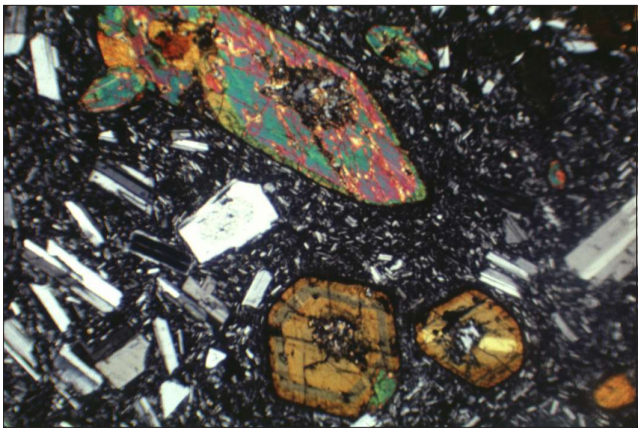
Andesite

Mineral dated:
hornblende

Lat. 20°23’45”
Long. 104°42’59”



Photograph taken in plane-polarized light to show hornblende crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

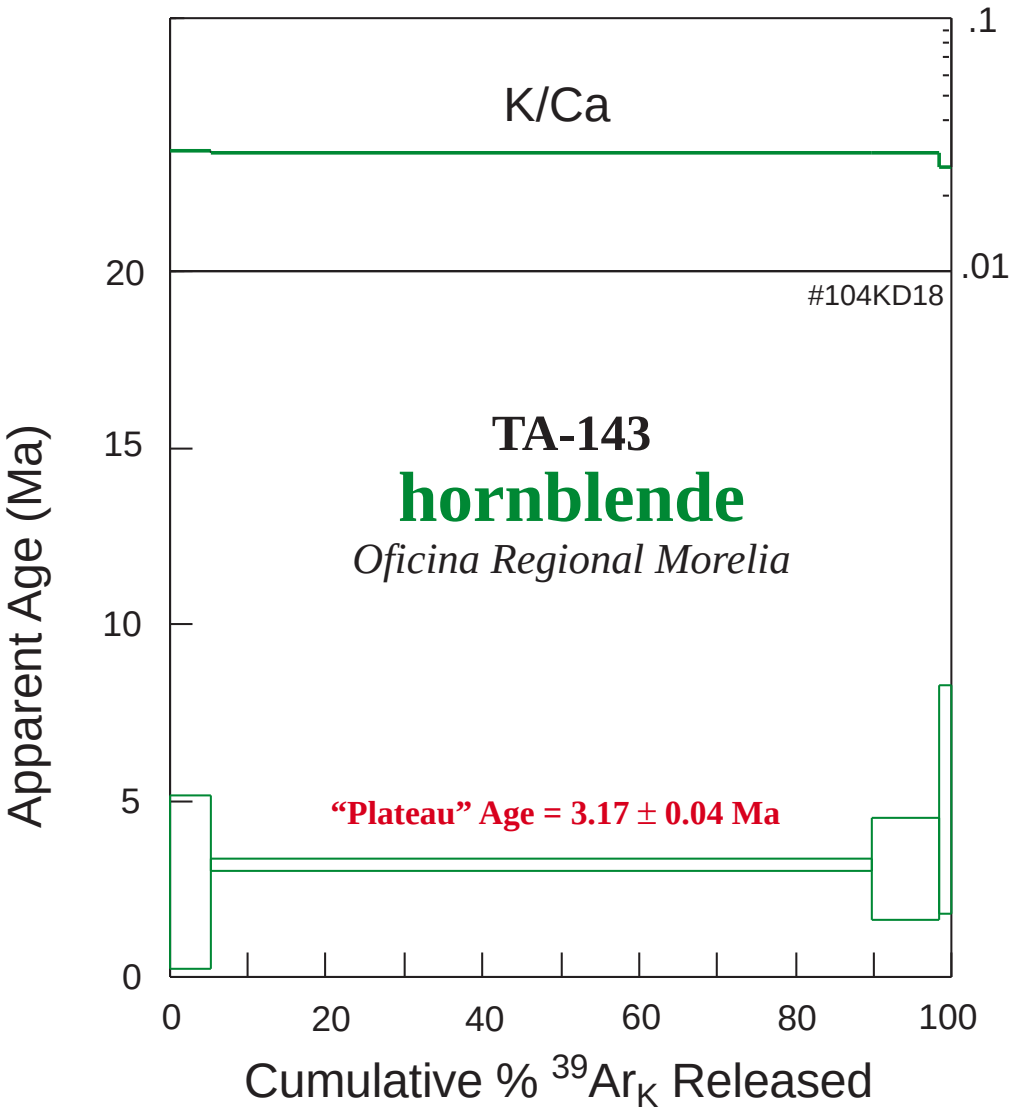


Table 13. $^{40}Ar/^{39}Ar$ analytical data for sample TA-143 Oficina Regional Morelia

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
TA-143 *Morelia*	***hornblende***	*J = 0.004762 ± 0.25%*		*wt = 255.5 mg*	*#104KD18*				
1200	5.2	10.3	0.085924	0.316	0.03	9	2.71	±	1.23
1250	84.6	28.9	1.403594	0.369	0.03	10	3.17	±	0.09
1300	8.6	38.6	0.142982	0.357	0.03	11	3.06	±	0.73
1350	1.6	51.9	0.026535	0.584	0.03	10	5.01	±	1.61
Total Gas	100.0	29.1	1.659035	0.368	0.03	10	3.16		
	100% of gas on plateau in 1200 through 1350 steps				**Plateau Age =**		**3.17**	±	**0.04**

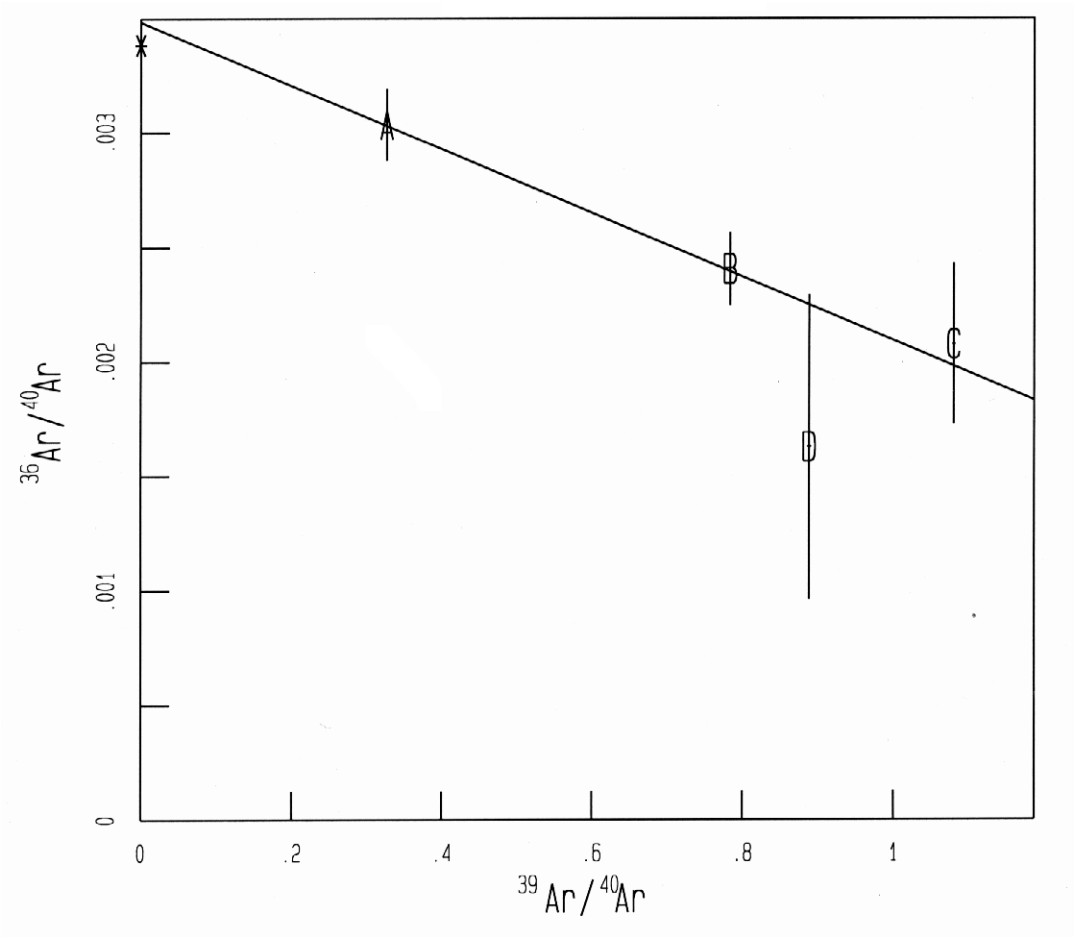
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

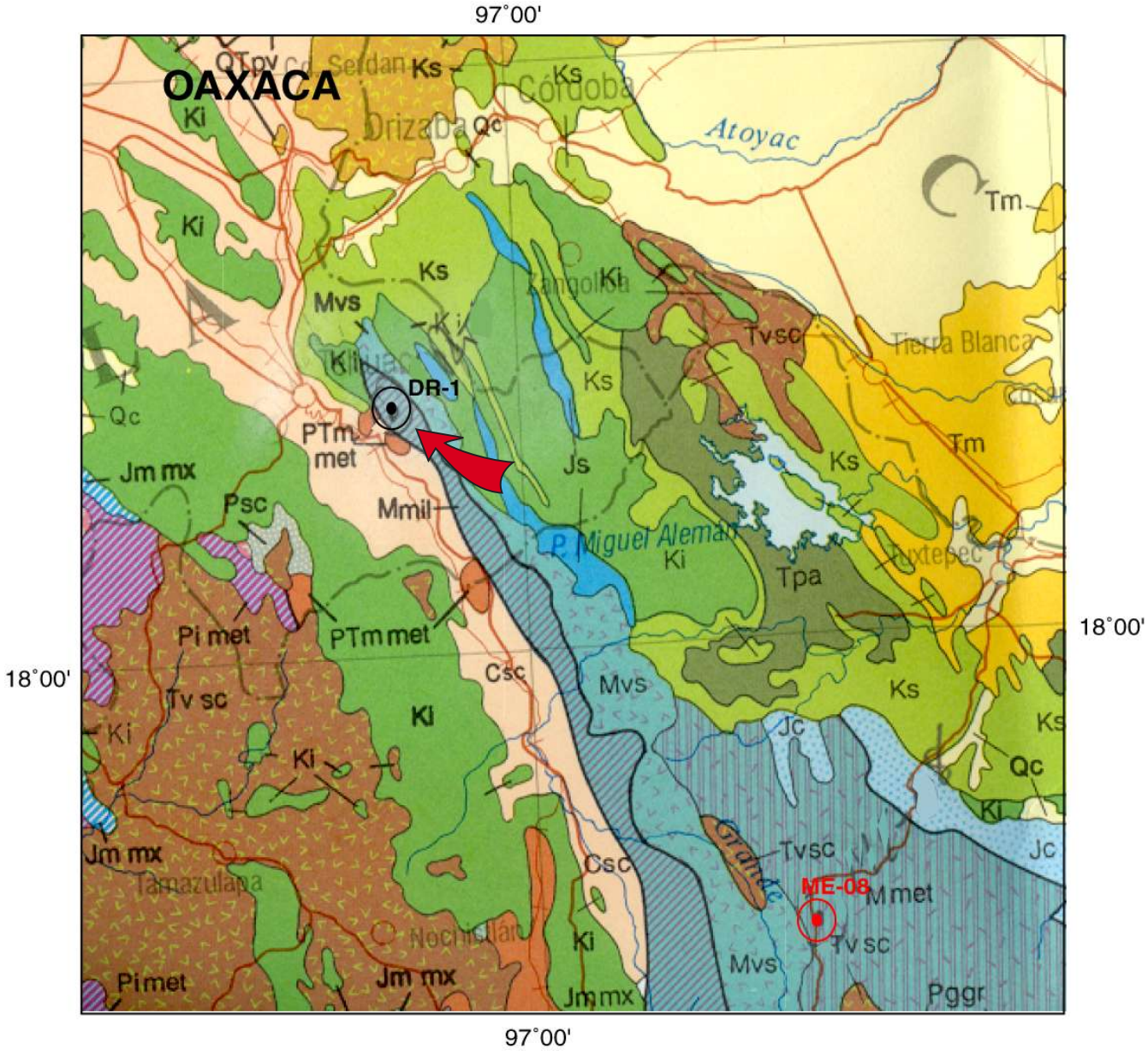
No error is calculated for the total gas age.

Inverse-isotope correlation diagram
TA-143
Hornblende

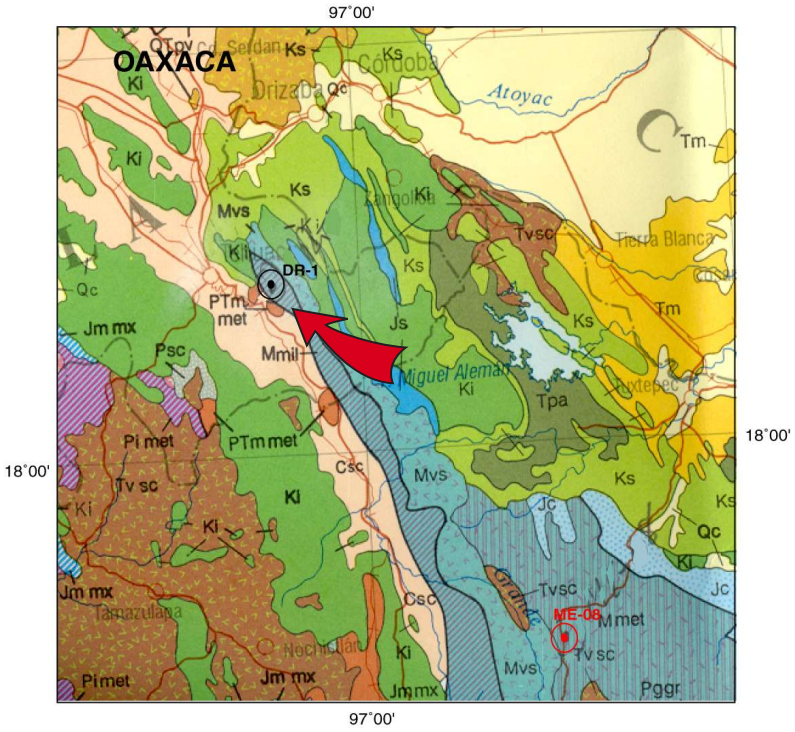


Isochron Age = 3.42 ± 0.75 Ma
$[^{40}Ar/^{36}Ar]_i = 286.97 \pm 21.72$
MSWD = 0.477
4 of 4 steps with 100% of $^{39}Ar_K$

Oficina Regional Oaxaca



DR-1 Schist



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

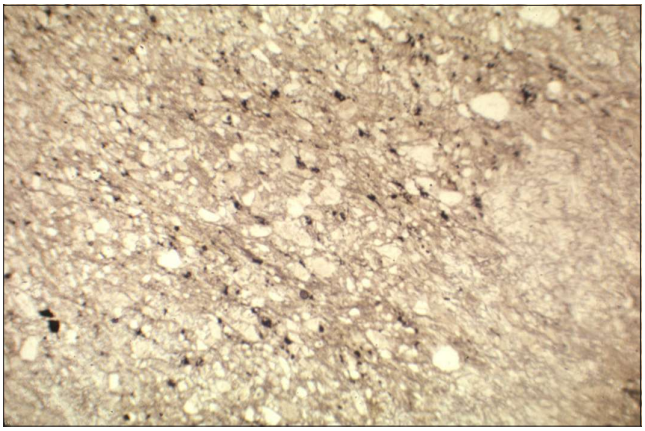
DR-1

Oficina Regional Oaxaca

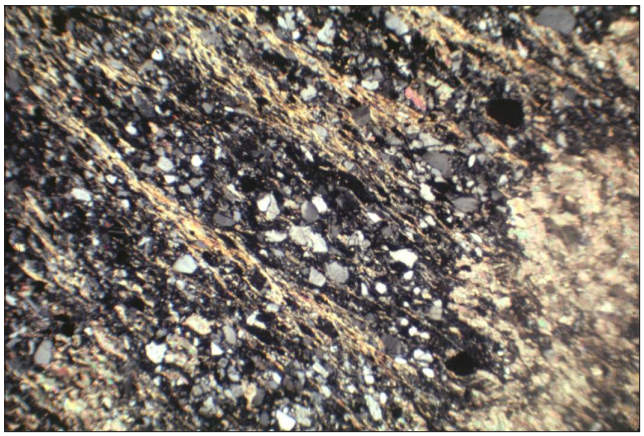
Schist

Mineral dated:
muscovite

Lat. 18°29’50”
Long. 97°16’12”



Photograph taken in plane-polarized light to show muscovite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

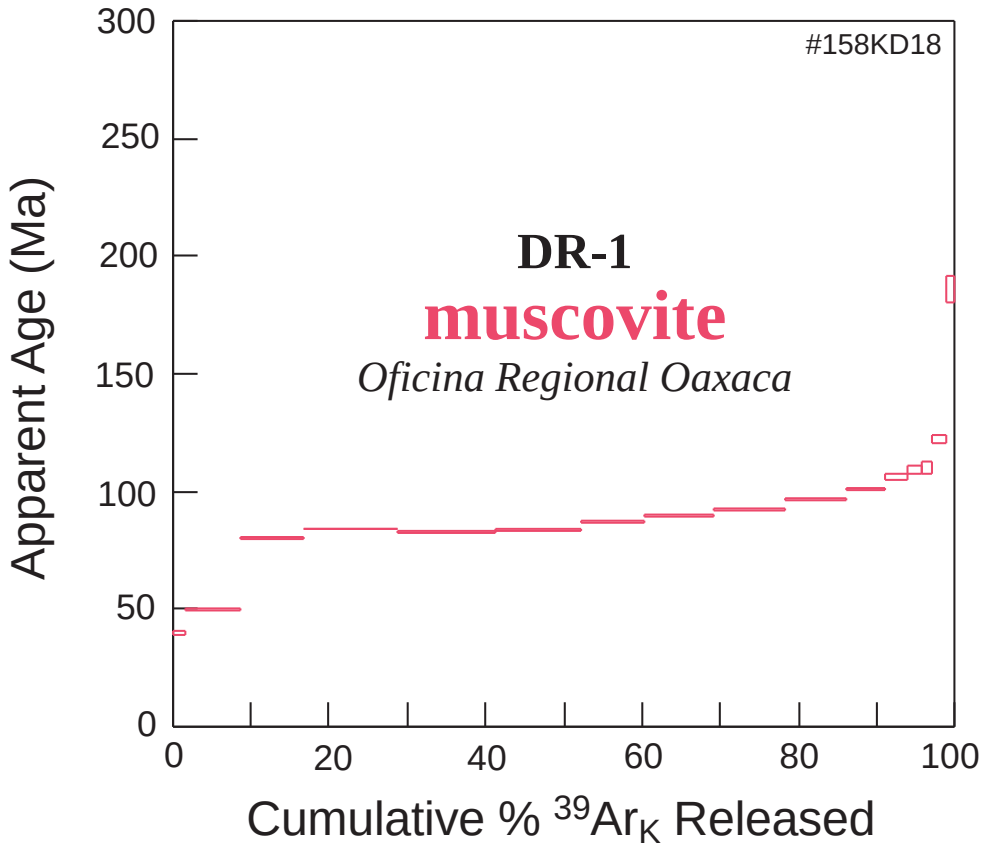
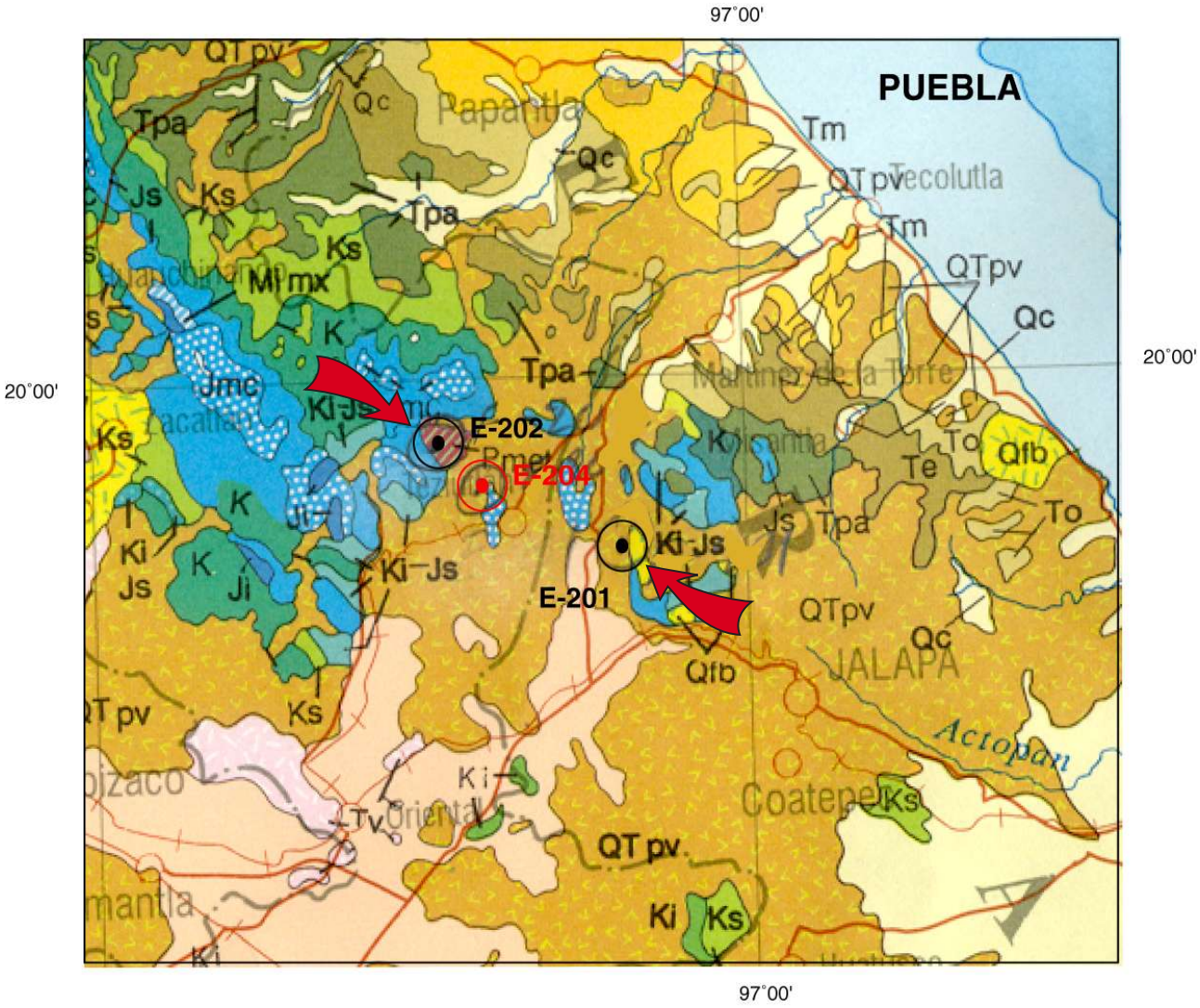


Table 14. $^{40}Ar/^{39}Ar$ analytical data for sample DR-1 Oficina Regional Oaxaca

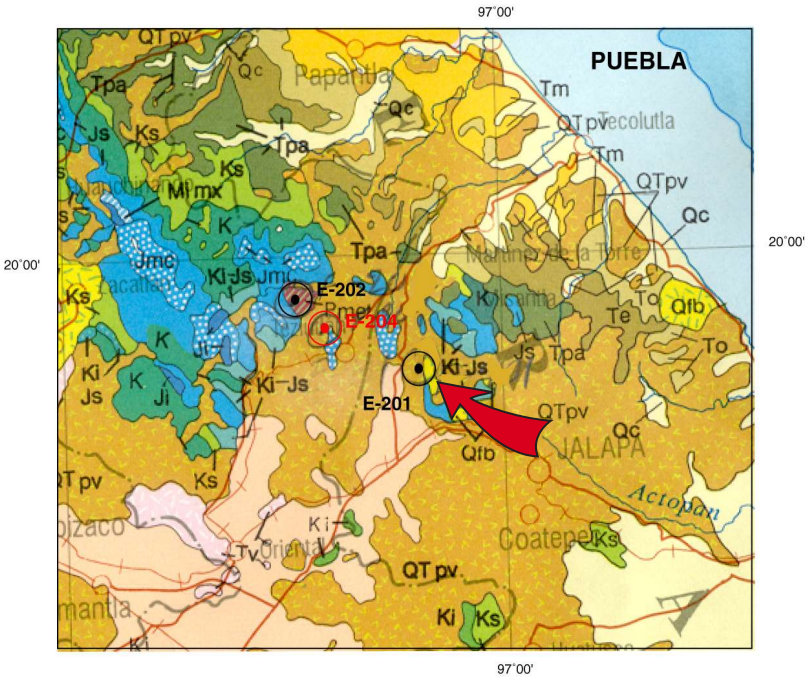
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
DR-1 *Oaxaca*	***muscovite***	*J = 0.004922 ± 0.25%*	*wt = 27.3 mg*	*#158KD18*					
650	1.6	32.3	0.039339	4.526	3.16	45	39.75	±	0.49
750	7.1	92.3	0.177238	5.737	2.60	268	50.24	±	0.24
800	8.2	98.0	0.203983	9.260	5.40	1139	80.40	±	0.16
850	11.7	98.8	0.292173	9.687	7.52	3467	84.03	±	0.11
900	12.5	99.5	0.311624	9.579	9.29	5163	83.11	±	0.14
950	11.1	99.4	0.276088	9.645	11.59	6340	83.67	±	0.23
975	8.1	99.8	0.202719	10.063	14.05	3326	87.21	±	0.21
1000	8.7	99.5	0.215852	10.346	13.01	5057	89.61	±	0.13
1025	9.1	99.4	0.227635	10.716	10.18	8212	92.72	±	0.21
1050	7.8	99.4	0.193310	11.236	6.88	2473	97.10	±	0.22
1075	5.1	99.1	0.127614	11.753	3.62	1347	101.45	±	0.19
1100	2.7	97.4	0.067109	12.329	1.47	485	106.28	±	0.49
1125	1.9	95.9	0.047183	12.675	0.77	307	109.18	±	0.96
1150	1.3	95.2	0.031808	12.826	0.37	213	110.44	±	1.35
1250	1.9	93.5	0.046991	14.272	0.08	15	122.47	±	0.74
1450	1.2	88.9	0.028721	22.077	0.04	15	186.09	±	3.00
Total Gas	100.0	97.3	2.489387	10.077	7.99	3613	87.33		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All errors are at one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.

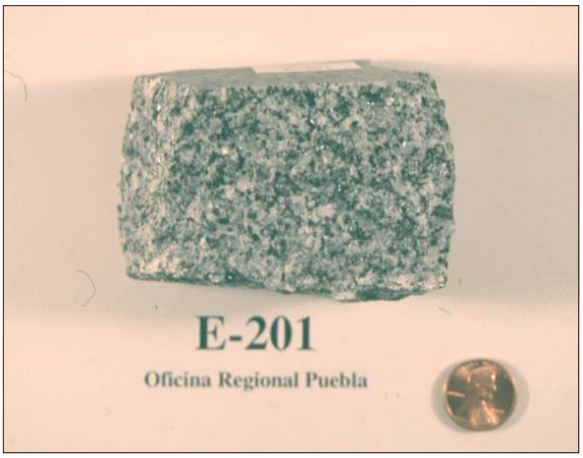
Oficina Regional Puebla



E-201 Granodiorite
E-202 Schist



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000



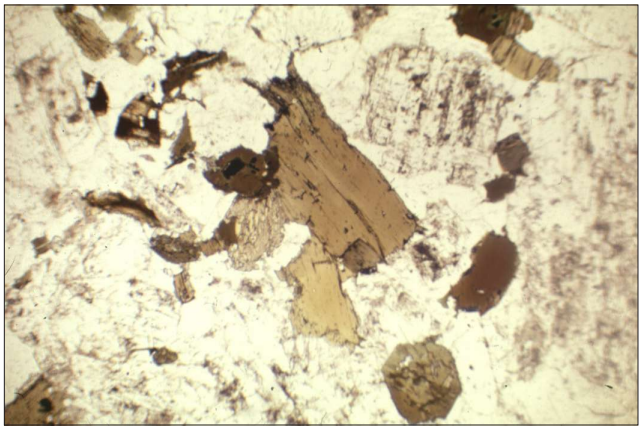
E-201

Oficina Regional Puebla

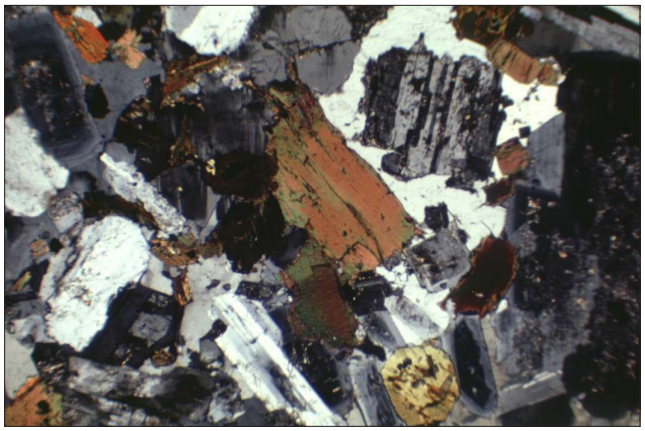
Granodiorite

Mineral dated:
biotite

Lat. 19°44’47”
Long. 97°10’5.7”



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

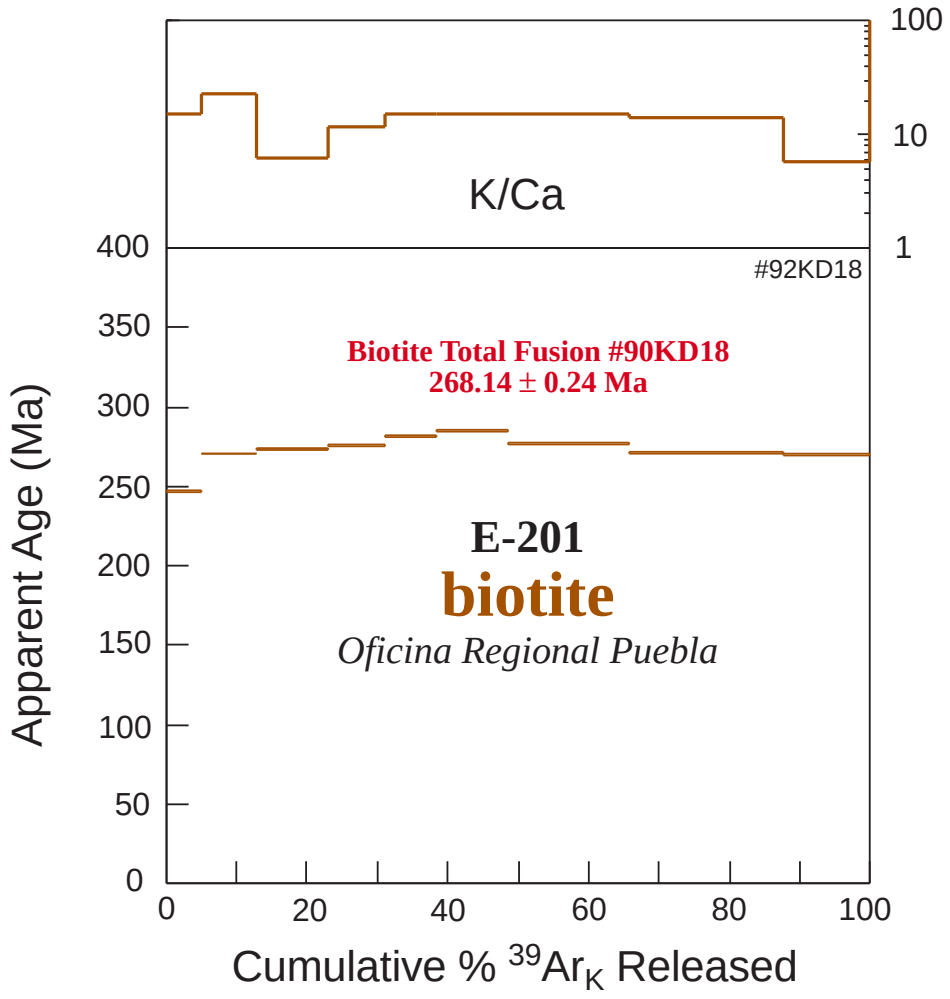
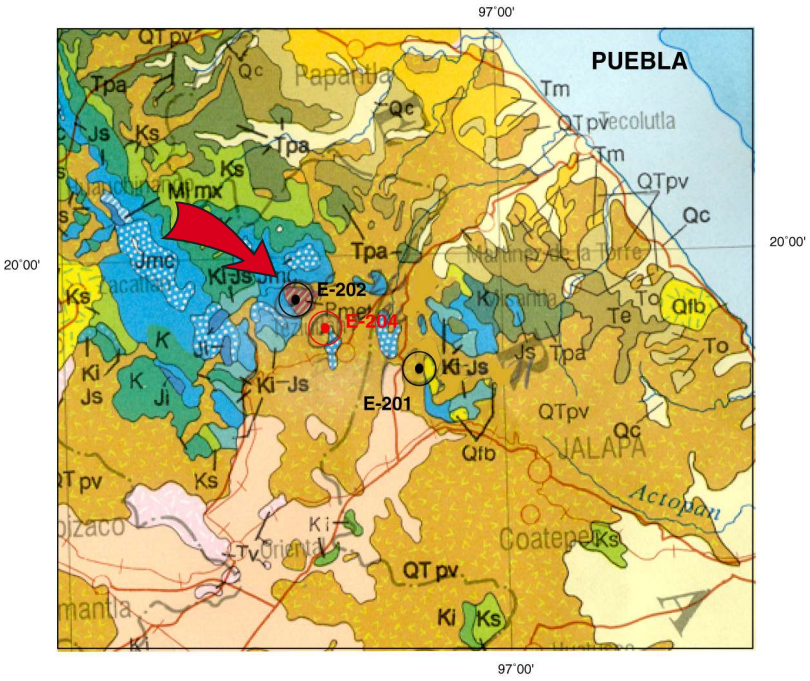


Table 15. $^{40}Ar/^{39}Ar$ analytical data for sample E-201 Oficina Regional Puebla

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
E-201 *Puebla*	***biotite***	*J = 0.004948 ± 0.25%*	*wt = 10.6 mg*	*#92KD18*					
850	5.0	96.0	0.090820	29.667	15.40	60	247.10	±	0.35
900	7.9	98.9	0.145258	32.697	22.42	58	270.52	±	0.26
950	10.1	99.4	0.184572	33.063	6.25	57	273.33	±	0.32
1000	8.1	99.5	0.148400	33.342	11.66	56	275.48	±	0.35
1050	7.3	99.3	0.133008	34.126	14.87	57	281.47	±	0.50
1100	10.3	99.5	0.189088	34.543	14.96	64	284.65	±	0.29
1150	17.1	99.7	0.313186	33.487	15.15	65	276.58	±	0.19
1200	21.8	99.7	0.399603	32.766	14.15	38	271.05	±	0.25
1250	12.4	99.7	0.226689	32.673	5.77	57	270.34	±	0.28
Total Gas	100.0	99.4	1.830624	33.078	13.14	55	273.45		
E-201 *Puebla*	***biotite total fusion***	*J = 0.004908 ± 0.25%*	*wt = 5.2 mg*	*#90KD18*					
1450	100.0	97.9	0.789697	32.651	9.31	46	**268.14**	±	**0.24**

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All errors are at one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

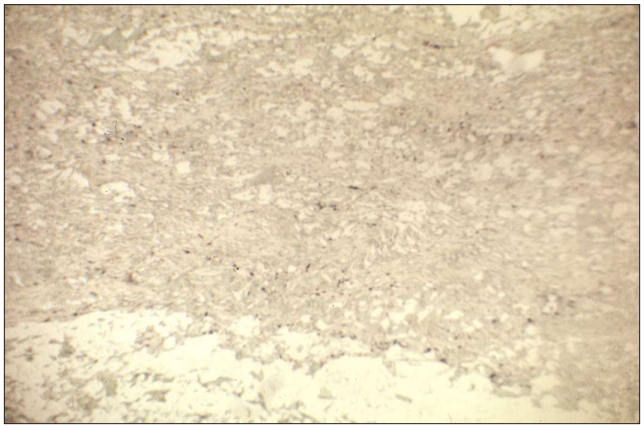
E-202

Oficina Regional Puebla

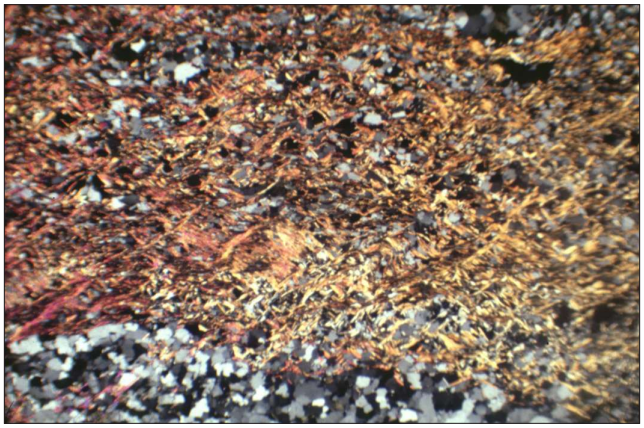
Schist

Mineral dated:
muscovite

Lat. 19°55’53.8”
Long. 97°29’2.5”



Photograph taken in plane-polarized light to show muscovite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

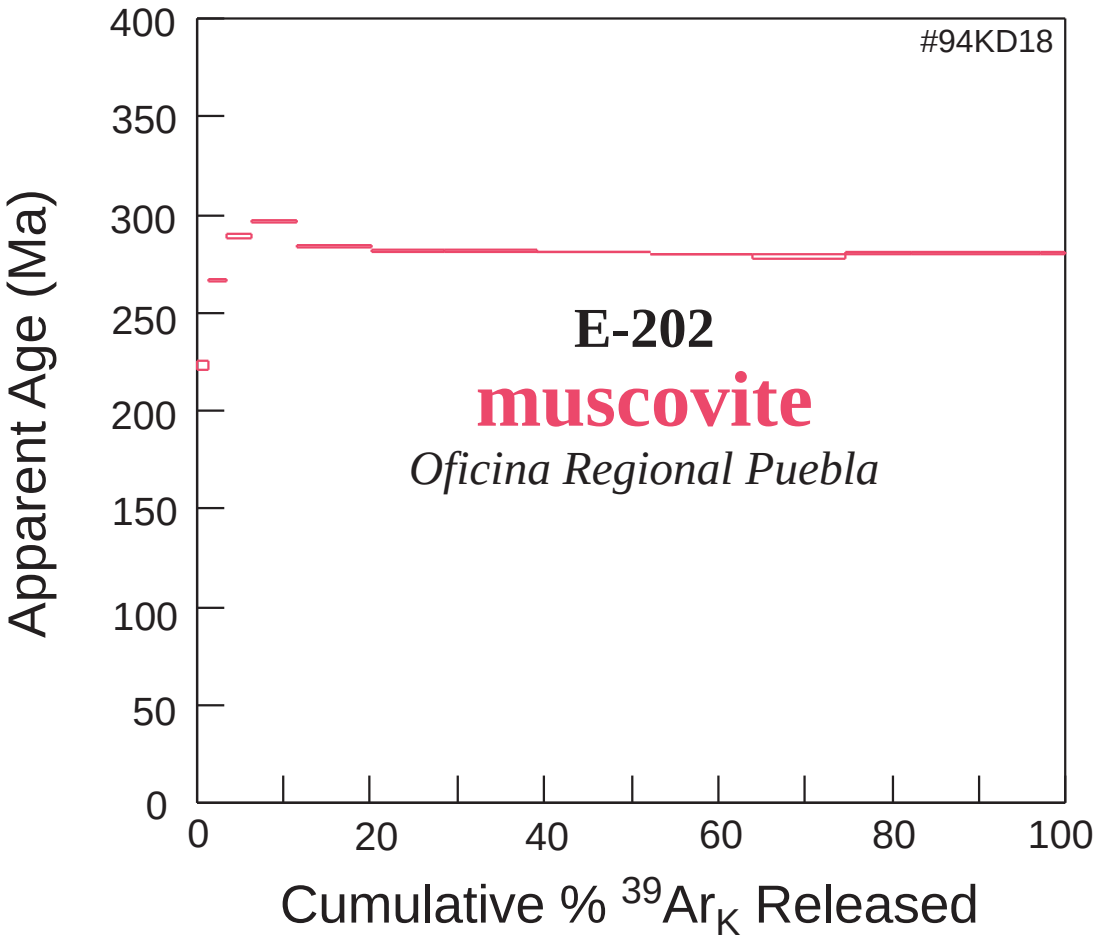


Table 16. $^{40}Ar/^{39}Ar$ analytical data for sample E-202 Oficina Regional Puebla

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
E-202 *Puebla*	***mucovite***	*J = 0.004948 ± 0.25%*	*wt = 10.7 mg*	*#94KD18*					
750	1.5	96.3	0.031946	26.588	73.66	131	222.97	±	1.01
800	1.9	98.1	0.042241	32.189	80.24	376	266.62	±	0.40
850	3.1	99.4	0.067801	35.165	154.08	570	289.39	±	0.69
900	5.2	99.5	0.113772	36.133	1133.72	1234	296.73	±	0.18
950	8.6	99.6	0.189465	34.462	394.30	2682	284.03	±	0.32
975	8.2	99.7	0.179317	34.169	526.42	2944	281.80	±	0.26
1000	10.7	99.8	0.234205	34.121	583.27	6948	281.43	±	0.28
1025	13.0	99.8	0.286349	34.061	604.89	7589	280.98	±	0.21
1050	11.9	99.8	0.261564	33.948	391.66	6616	280.11	±	0.09
1075	10.7	99.8	0.235121	33.769	245.53	10029	278.74	±	0.37
1100	7.5	99.7	0.165042	34.035	146.26	5979	280.77	±	0.36
1150	14.8	99.9	0.325110	33.935	172.82	9708	280.01	±	0.21
1250	3.0	99.3	0.065950	34.000	11.90	24	280.50	±	0.43
Total Gas	100.0	99.7	2.197883	34.040	393.73	6037	280.81		

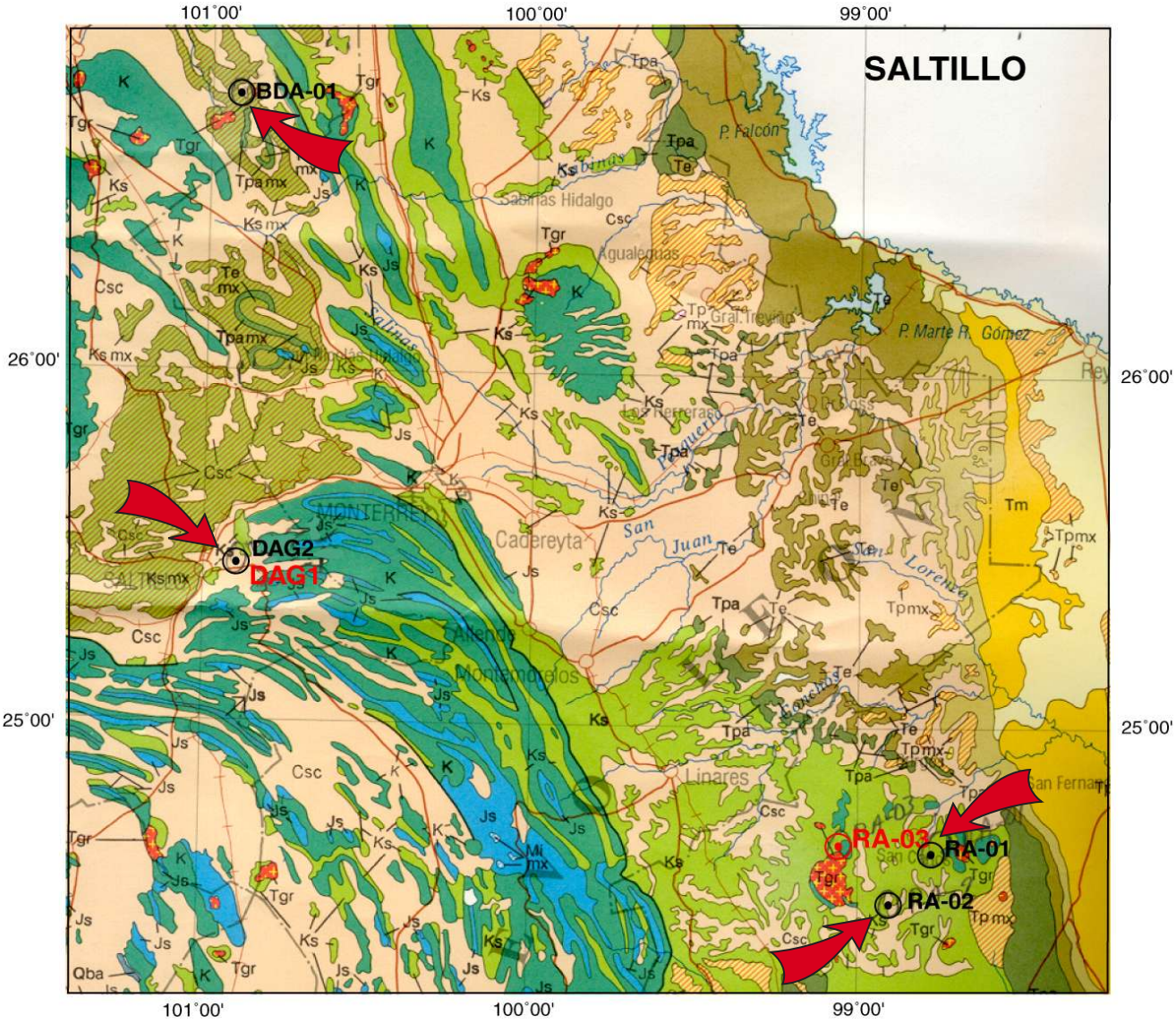
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

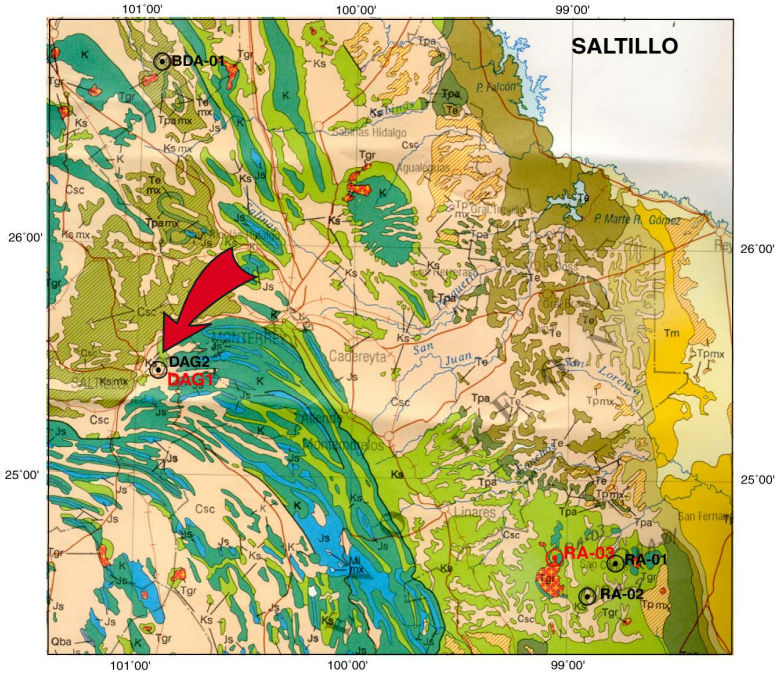
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Oficina Regional Saltillo



DAG-2 Granodiorite
BDA-01 Granodiorite
RA-01 Diorite
RA-02 Monzonite



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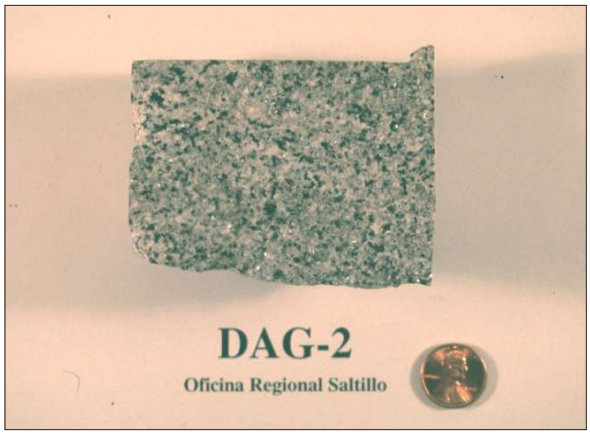
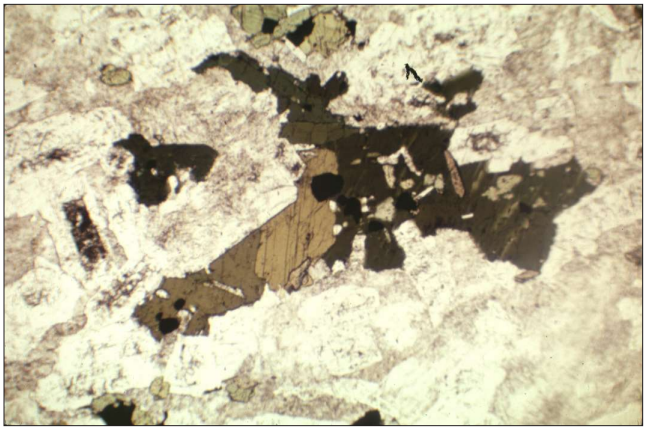


DAG-2
Oficina Regional Saltillo

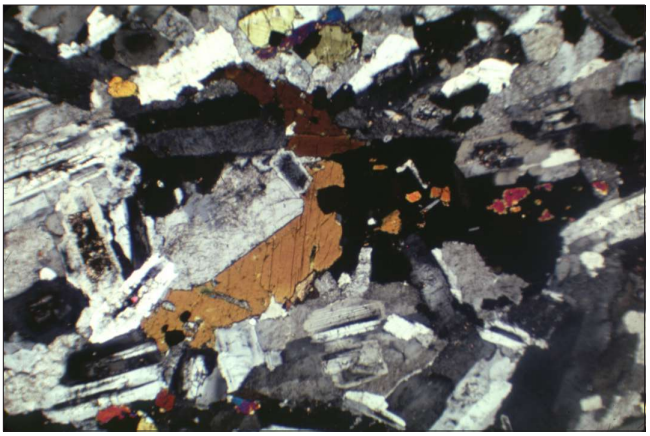
Granodiorite

Minerals dated:
hornblende
K-feldspar

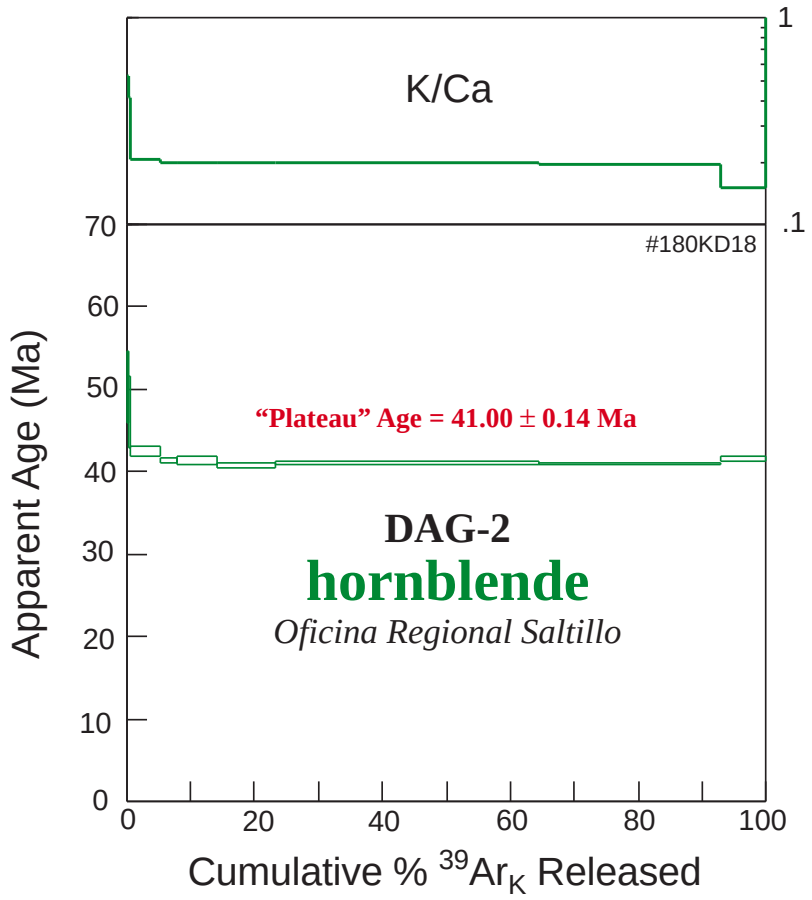
Lat. 25°27’08”
Long. 100°59’09”

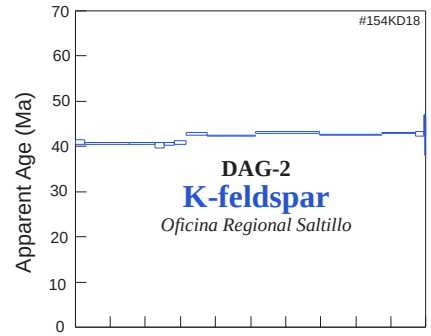


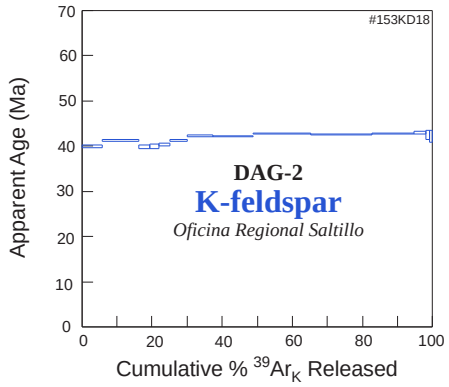
Photograph taken in plane-polarized light to show hornblende and K-feldspar crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.


K/Ca
1
.1
#180KD18
"Plateau" Age = 41.00 ± 0.14 Ma
DAG-2
hornblende
Oficina Regional Saltillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released


#154KD18
DAG-2
K-feldspar
Oficina Regional Saltillo
Apparent Age (Ma)


#153KD18
DAG-2
K-feldspar
Oficina Regional Saltillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

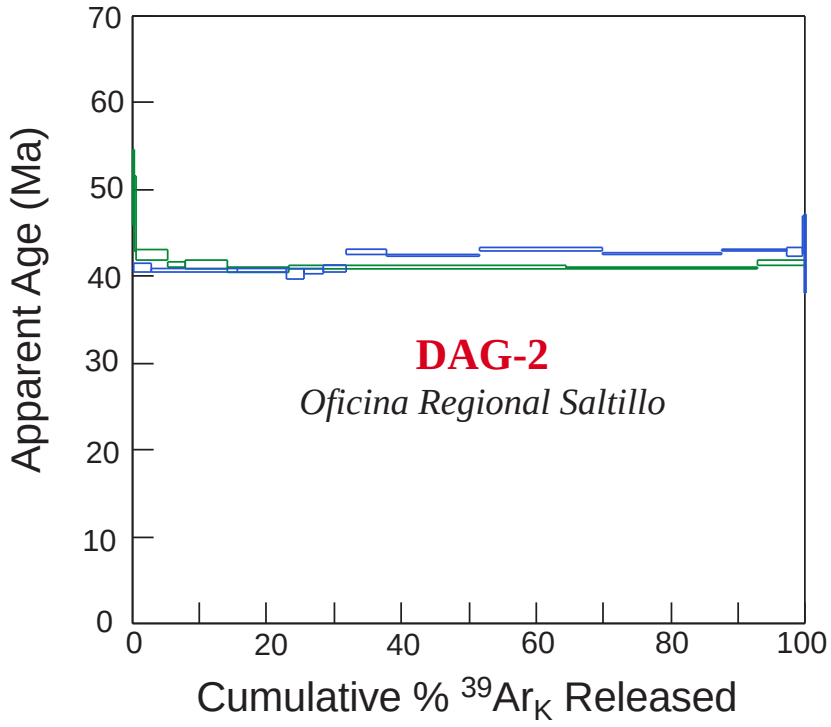

DAG-2
Oficina Regional Saltillo
Apparent Age (Ma)
Cumulative % $^{39}Ar_K$ Released

Table 17. $^{40}Ar/^{39}Ar$ analytical data for sample DAG-2 Oficina Regional Saltillo

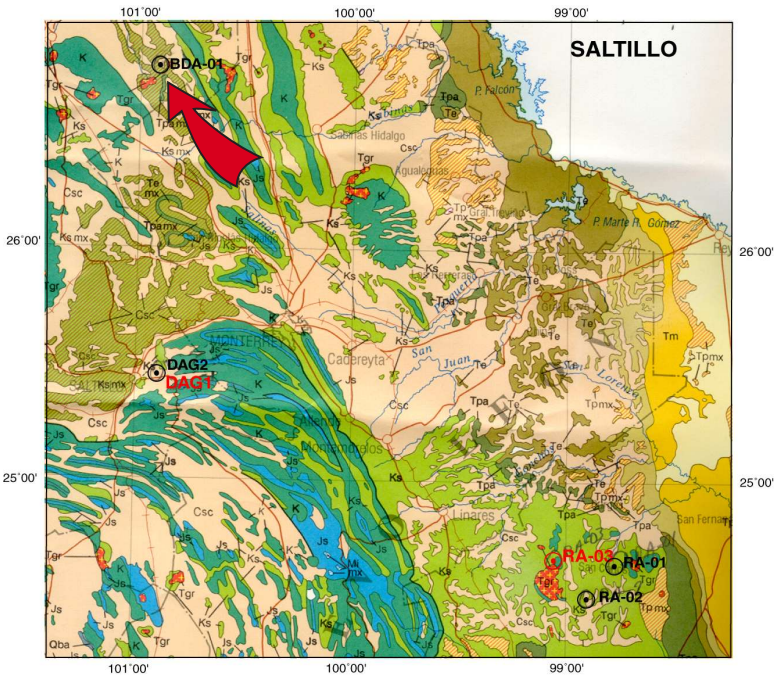
Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
DAG-2 *Saltillo*	***hornblende***	*J = 0.004807 ± 0.25%*	*wt = 238.2 mg*	*#180KD18*					
1000	0.3	72.2	0.025612	5.879	0.53	15	50.27	±	2.16
1050	0.3	71.2	0.027267	5.519	0.41	26	47.24	±	2.17
1100	4.7	90.0	0.451149	4.958	0.21	40	42.49	±	0.28
1150	2.7	95.7	0.256255	4.823	0.20	46	41.35	±	0.14
1175	6.1	96.5	0.581115	4.833	0.20	46	41.44	±	0.24
1200	9.4	95.8	0.895341	4.759	0.20	47	40.80	±	0.15
1250	41.1	97.3	3.926206	4.794	0.20	46	41.10	±	0.10
1300	28.5	98.5	2.719684	4.781	0.19	49	40.99	±	0.09
1350	7.0	98.4	0.673266	4.853	0.15	49	41.60	±	0.17
Total Gas	100.0	97.0	9.555895	4.807	0.20	47	41.21		
	78.9% of gas on plateau in 1200 through 1300 steps					**Plateau Age =**	**41.00**	±	**0.14**
DAG-2 *Saltillo*	***K-feldspar***	*J = 0.004900 ± 0.25%*	*wt = 40.7 mg*	*#154KD18*					
750	2.8	59.0	0.291613	4.689	8.72	44	40.98	±	0.29
850	12.6	91.6	1.317046	4.646	17.72	177	40.61	±	0.09
950	7.5	92.4	0.783843	4.654	10.04	234	40.68	±	0.10
1000	2.4	92.8	0.255719	4.603	6.07	360	40.24	±	0.32
1050	2.8	91.1	0.296989	4.641	7.17	343	40.57	±	0.15
1100	3.4	91.6	0.354637	4.677	13.55	294	40.87	±	0.16
1150	6.2	90.2	0.650668	4.892	22.60	151	42.73	±	0.14
1200	13.7	90.6	1.435547	4.850	28.06	73	42.37	±	0.07
1225	18.1	90.9	1.896803	4.932	33.82	148	43.08	±	0.09
1250	17.9	91.7	1.872694	4.866	38.68	176	42.51	±	0.06
1275	9.6	91.8	1.003052	4.917	34.33	197	42.95	±	0.06
1300	2.3	90.7	0.243495	4.896	17.24	198	42.77	±	0.23
1325	0.4	93.7	0.037907	5.136	6.64	143	44.84	±	1.10
1350	0.3	87.8	0.031348	4.877	4.42	132	42.60	±	2.30
Total Gas	100.0	90.4	10.471361	4.816	26.06	172	42.08		
DAG-2 *Saltillo*	***K-feldspar***	*J = 0.004737 ± 0.50%*	*wt = 41.5 mg*	*#153KD18*					
850	5.8	82.6	0.556205	4.722	15.82	95	39.93	±	0.16
950	10.5	91.3	1.009442	4.883	12.23	185	41.27	±	0.09
1000	3.1	91.0	0.299610	4.720	5.50	411	39.91	±	0.22
1050	2.6	89.2	0.247320	4.721	5.63	428	39.92	±	0.24
1100	3.1	89.8	0.294318	4.771	9.31	404	40.33	±	0.15
1150	4.8	87.9	0.463468	4.890	17.99	193	41.33	±	0.11
1200	7.5	89.0	0.714718	5.006	25.52	88	42.30	±	0.08
1225	11.3	89.7	1.085435	4.994	29.82	136	42.20	±	0.07
1250	16.4	90.3	1.569629	5.061	34.04	143	42.75	±	0.07
1275	17.7	91.2	1.694441	5.042	37.73	163	42.60	±	0.04
1300	11.9	91.5	1.137827	5.071	35.02	177	42.84	±	0.07
1325	3.5	90.3	0.336778	5.089	21.26	189	42.99	±	0.17
1350	0.8	87.9	0.080129	5.038	10.82	167	42.57	±	0.52
1450	1.0	85.3	0.092260	4.985	4.91	164	42.12	±	0.66
Total Gas	100.0	89.9	9.581580	4.972	26.25	176	42.01		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

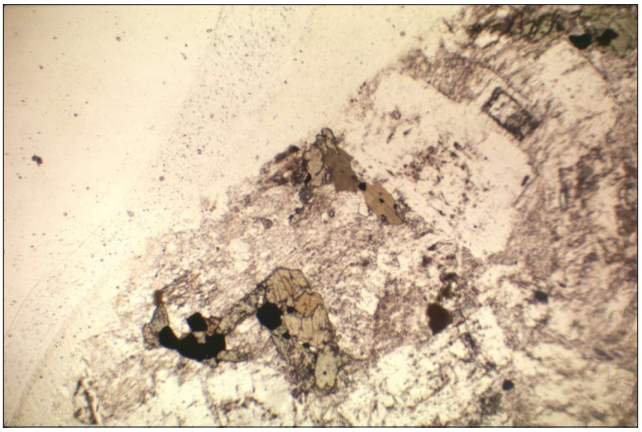
BDA-01

Oficina Regional Saltillo

Granodiorite

Mineral dated:
biotite

Lat. 26°42’32.3”
Long. 100°59’22.1”



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.

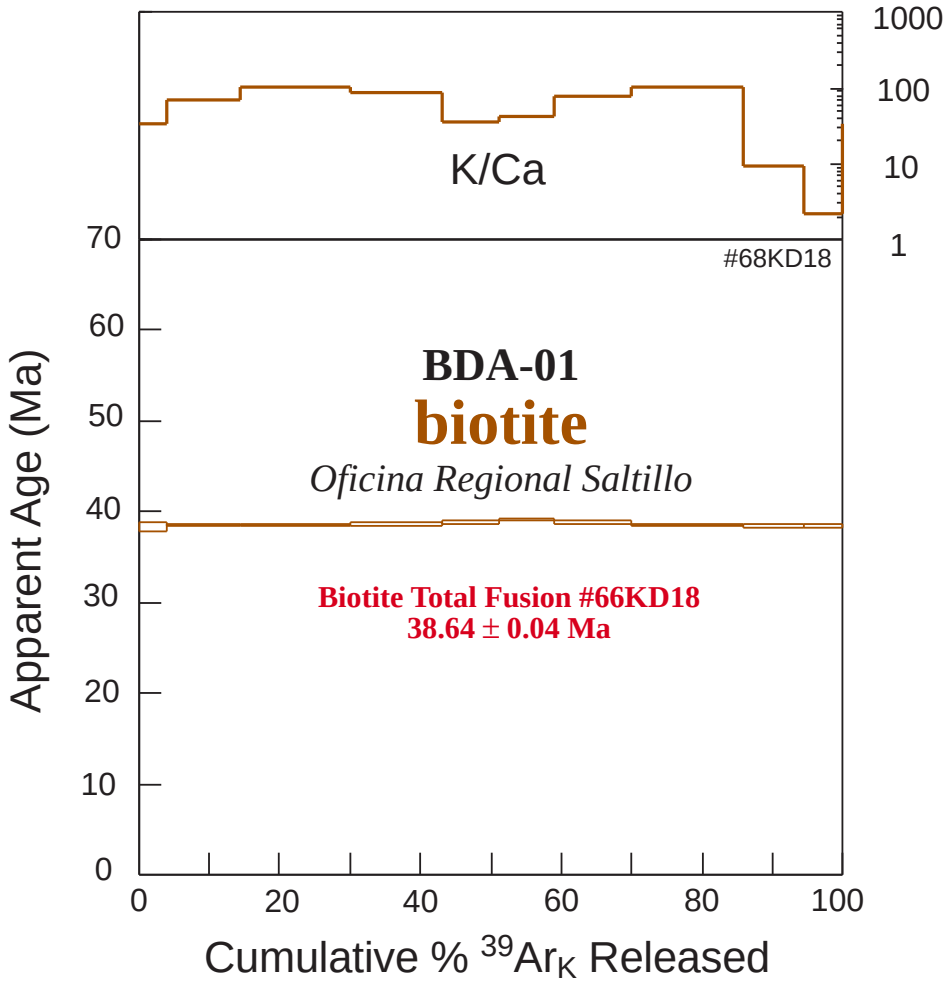
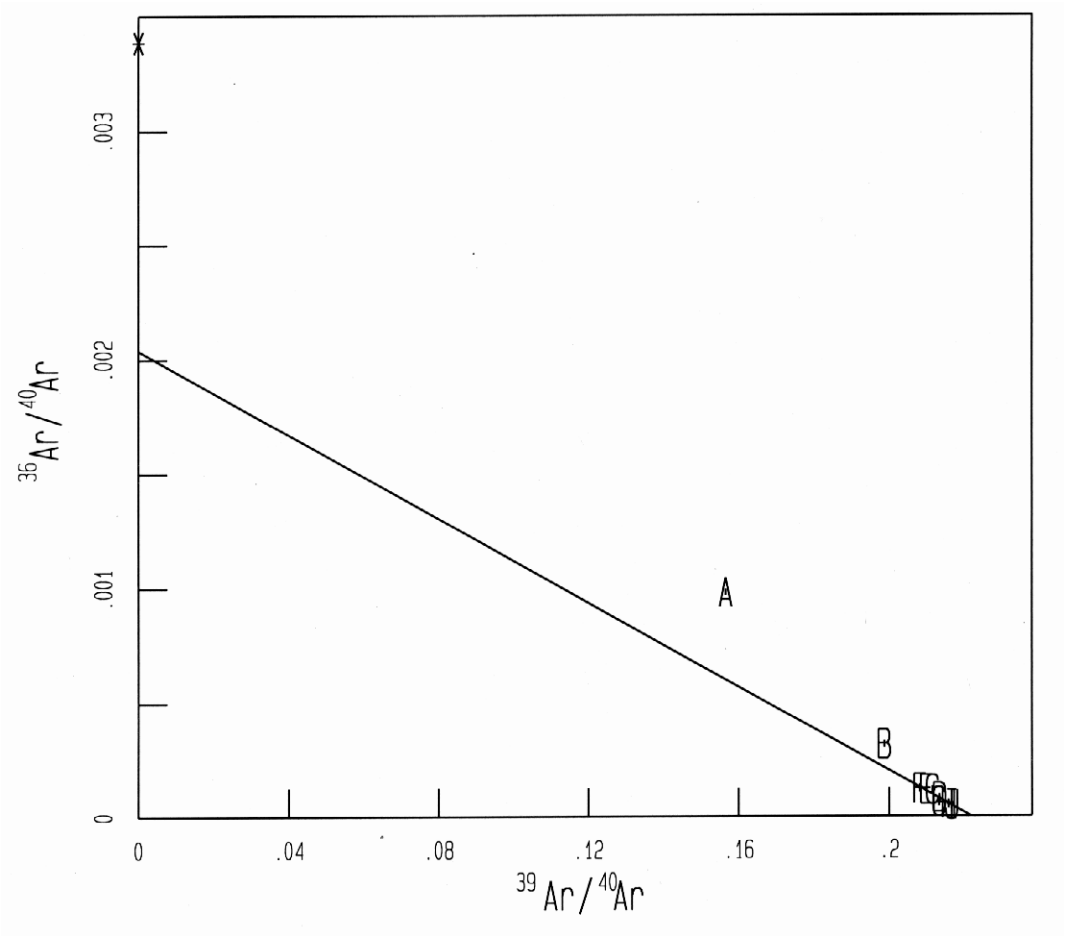


Table 18. $^{40}Ar/^{39}Ar$ analytical data for sample BDA-01 Oficina Regional Saltillo

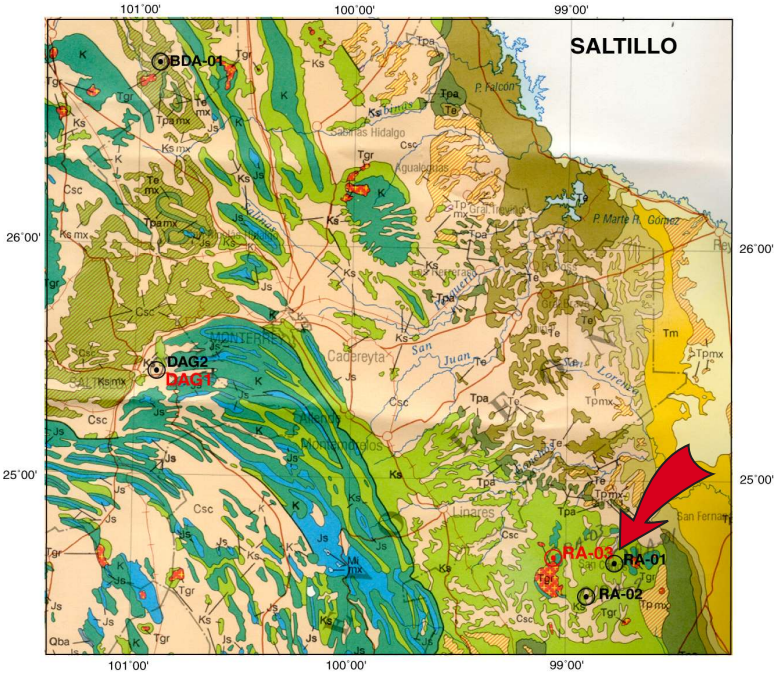
Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
BDA-01 *Saltillo* ***biotite*** *J = 0.004736 ± 0.25%* *wt = 43.5 mg* *#68KD18*									
850	4.0	71.0	0.359514	4.535	33.88	161	38.33	±	0.21
900	10.4	90.6	0.923598	4.562	70.11	238	38.56	±	0.07
950	15.5	96.5	1.383880	4.562	101.51	257	38.56	±	0.06
1000	13.1	97.6	1.167580	4.570	86.29	260	38.63	±	0.06
1050	8.2	96.5	0.733833	4.595	36.61	251	38.84	±	0.08
1100	7.7	96.4	0.686558	4.631	42.16	262	39.14	±	0.09
1150	10.9	98.1	0.971948	4.598	76.65	276	38.86	±	0.07
1200	16.0	98.4	1.421533	4.559	102.57	162	38.54	±	0.06
1250	8.5	98.5	0.755553	4.544	9.49	248	38.41	±	0.09
1350	5.6	98.5	0.501150	4.546	2.17	240	38.43	±	0.10
Total Gas	100.0	95.8	8.905147	4.571	67.66	237	38.64		
BDA-01 *Saltillo* ***biotite total fusion*** *J = 0.004948 ± 0.25%* *wt = 5.9 mg* *#66KD18*									
1450	100.0	95.6	1.256591	4.376	28.11	142	**38.64**	±	**0.04**

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All errors are at one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.

Inverse-isotope correlation diagram
BDA-1
Biotite



Isochron Age = 38.69 ± 0.12 Ma
$[^{40}Ar/^{36}Ar]_i = 289.28 \pm 4.43$
MSWD = 1.153
10 of 10 steps with 100% of $^{39}Ar_K$



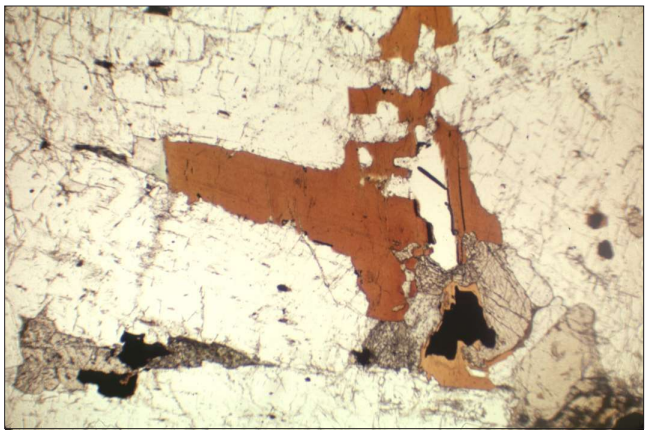
Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

RA-01
Oficina Regional Saltillo

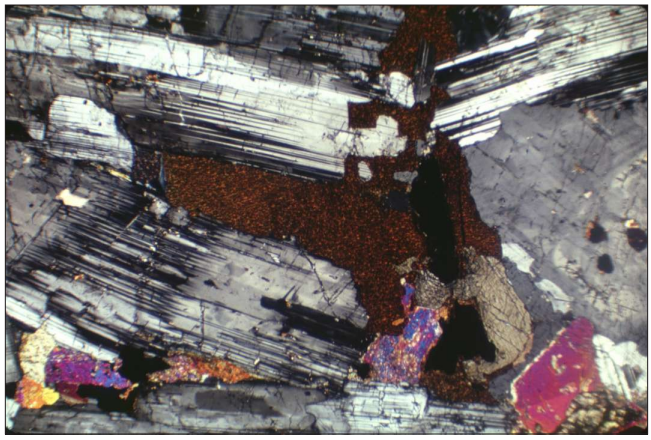
Diorite

Mineral dated:
biotite

Lat. 24°37’38.5”
Long. 98°46’04.1”



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

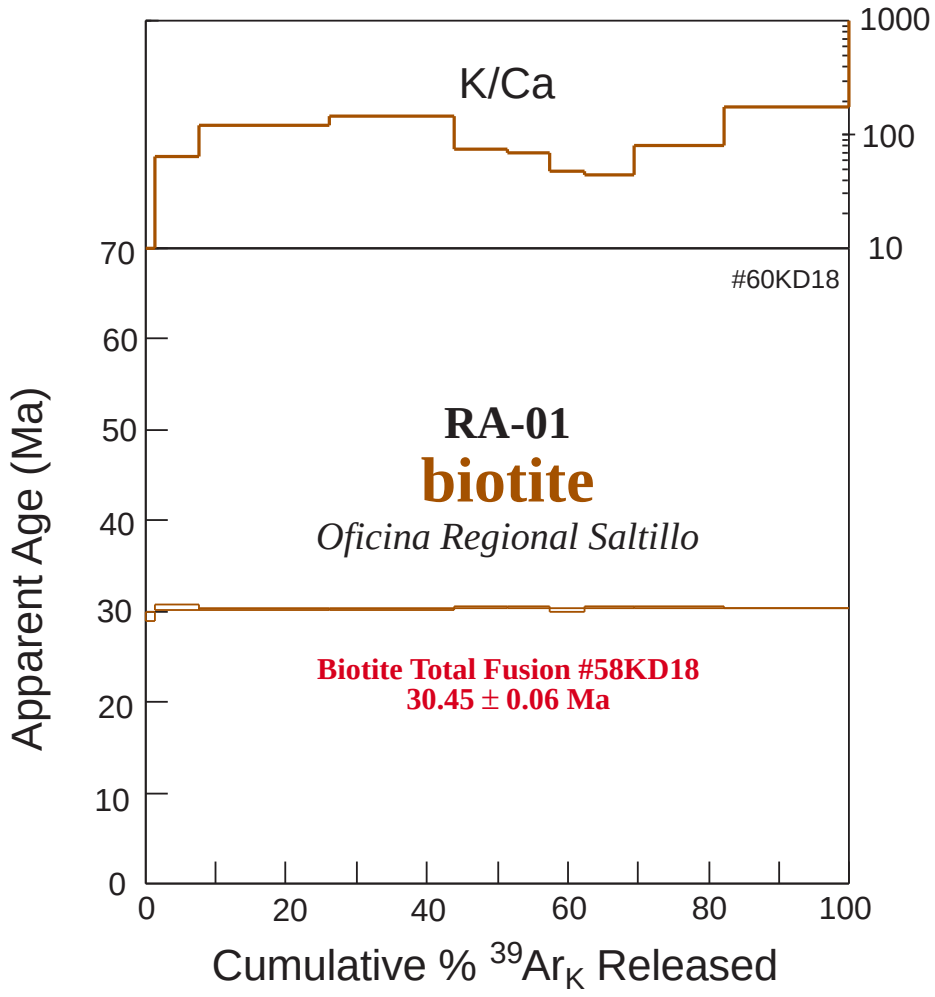


Table 19. $^{40}Ar/^{39}Ar$ analytical data for sample RA-01 Oficina Regional Saltillo

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
RA-01 *Saltillo*	***biotite***	*J = 0.004734 ± 0.25%*		*wt = 45.3 mg*	*#60KD18*				
850	1.5	40.3	0.135862	3.478	10.06	43	29.46	±	0.26
900	6.3	78.5	0.591051	3.594	63.12	55	30.44	±	0.18
950	18.4	94.7	1.719469	3.570	119.55	61	30.23	±	0.04
1000	17.7	97.7	1.655323	3.573	146.47	64	30.26	±	0.04
1050	7.7	97.8	0.725054	3.603	74.52	61	30.51	±	0.07
1100	6.0	97.4	0.558864	3.595	69.96	57	30.45	±	0.09
1150	5.0	96.8	0.463572	3.572	47.62	57	30.25	±	0.10
1200	6.8	96.8	0.640578	3.594	43.49	44	30.44	±	0.08
1250	12.8	97.2	1.201393	3.588	80.82	62	30.38	±	0.05
1350	17.8	96.9	1.669085	3.585	173.89	69	30.36	±	0.05
Total Gas	100.0	94.8	9.360251	3.582	108.66	61	30.33		
RA-01 *Saltillo*	***biotite total fusion***	*J = 0.004903 ± 0.25%*		*wt = 5.0 mg*	*#58KD18*				
1450	100.0	84.8	1.174803	3.471	95.23	51	**30.45**	±	**0.06**

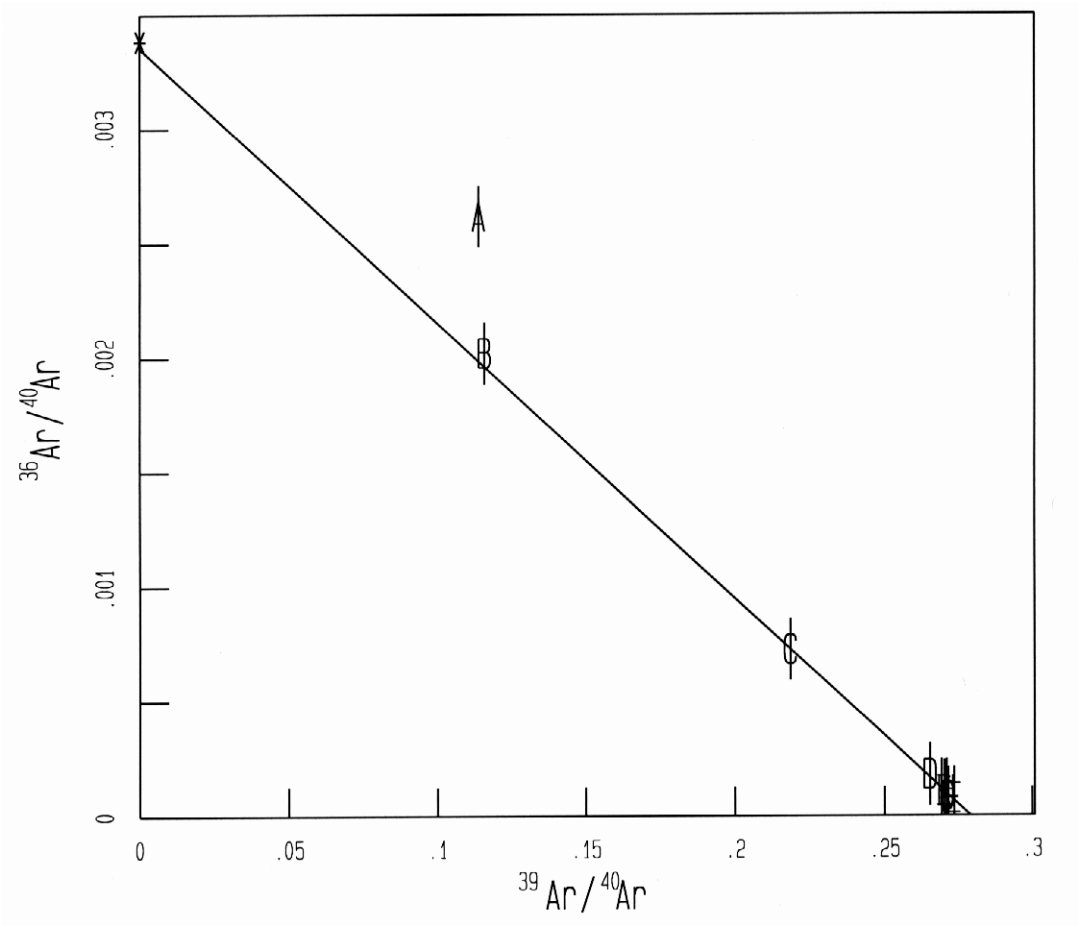
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

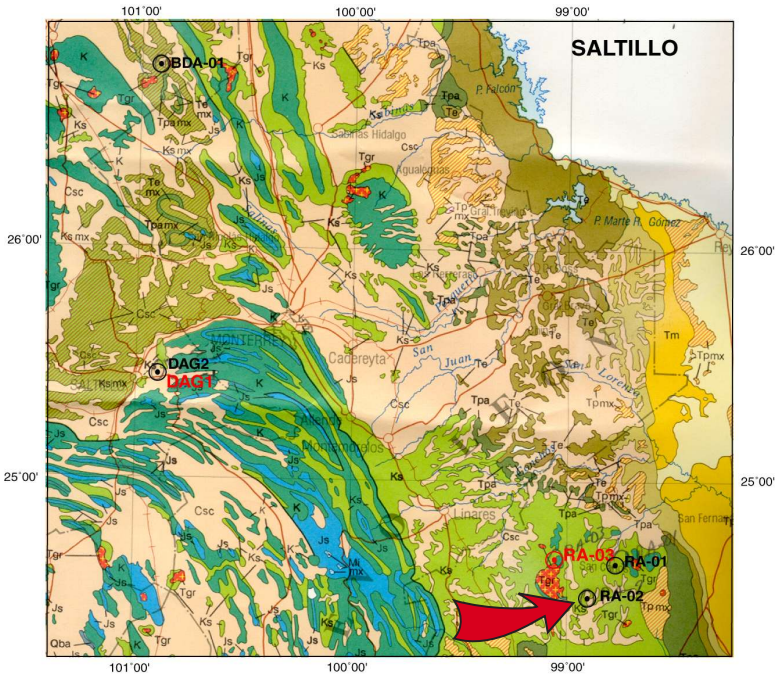
Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.

Inverse-isotope correlation diagram
RA-01
Biotite



Isochron Age = 30.44 ± 0.23 Ma
$[^{40}Ar/^{36}Ar]_i = 268.54 \pm 63.55$
MSWD = 0.278
8 of 10 steps with 92.2% of $^{39}Ar_K$



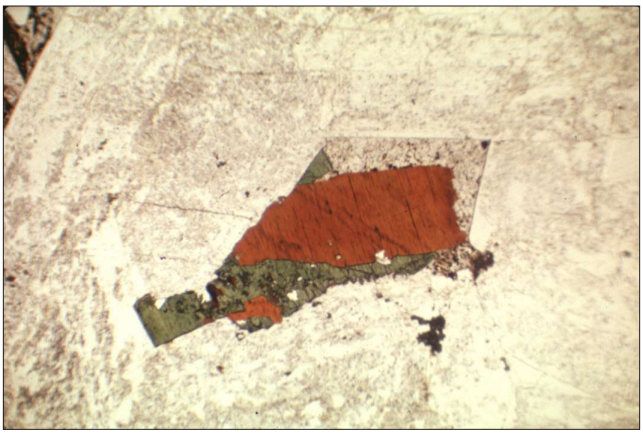
Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

RA-02
Oficina Regional Saltillo

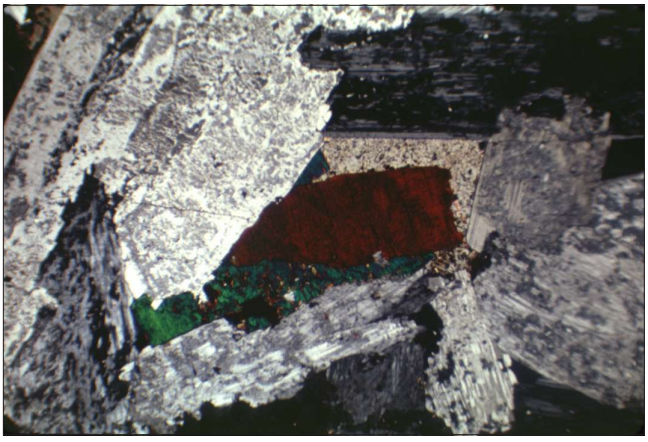
Monzonite

Mineral dated:
biotite

Lat. 24°31’44”
Long. 98°57’25.4”



Photograph taken in plane-polarized light to show biotite crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

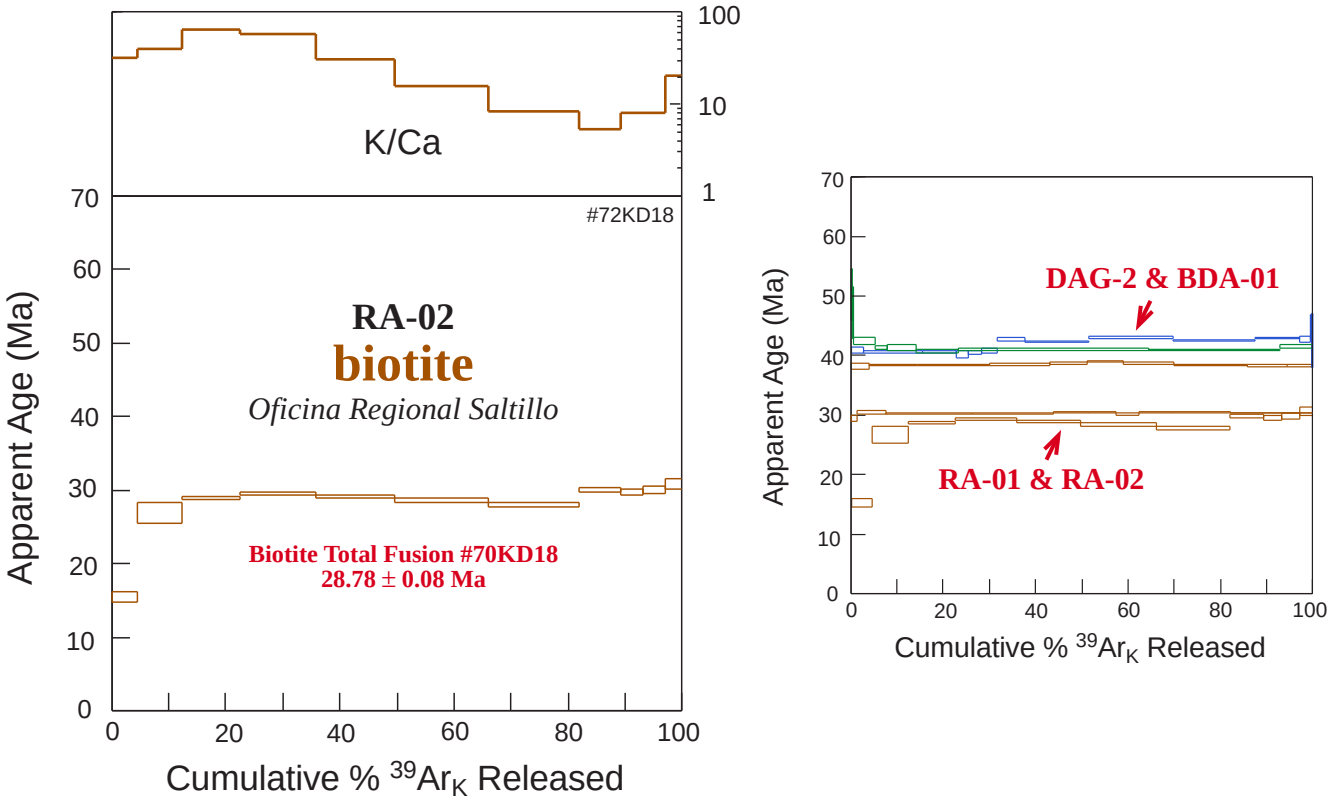
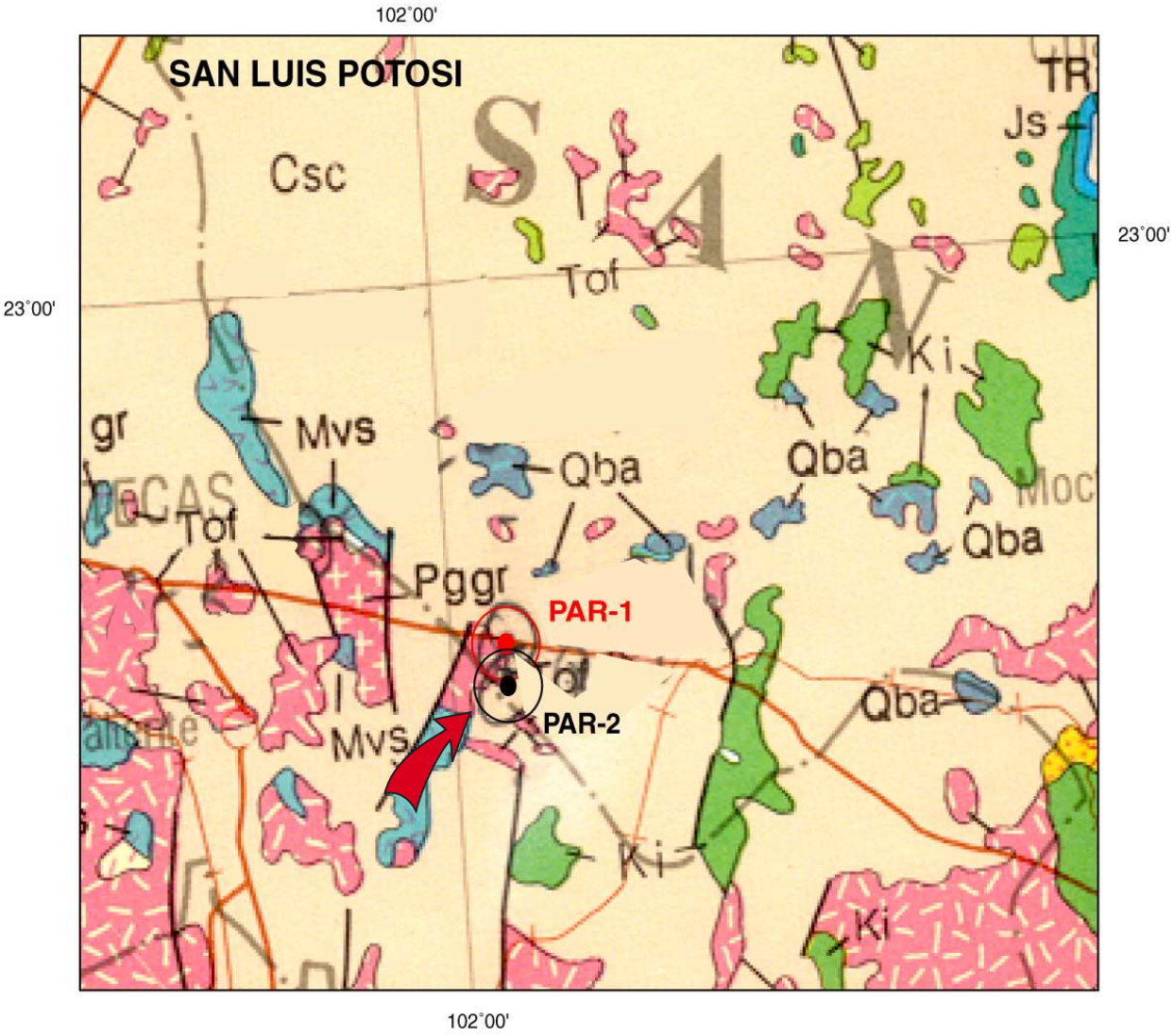


Table 20. $^{40}Ar/^{39}Ar$ analytical data for sample RA-02 Oficina Regional Saltillo

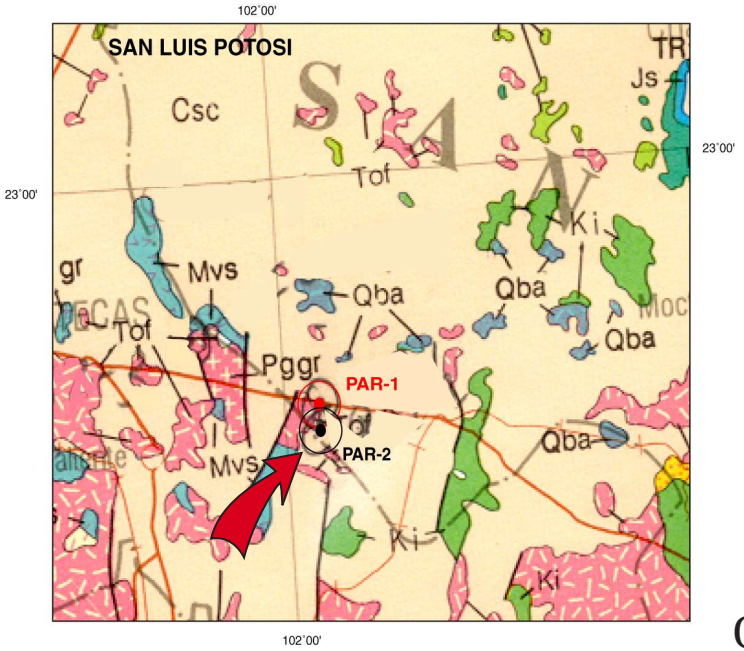
Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
RA-02 *Saltillo* ***biotite*** *J = 0.004746 ± 0.25%* *wt = 39.1 mg* *#72KD18*									
750	4.6	11.9	0.264469	1.824	32.27	80	15.55	±	0.33
850	7.6	44.5	0.431583	3.177	40.01	142	27.00	±	0.71
900	10.4	57.9	0.590116	3.409	65.71	167	28.96	±	0.13
950	13.3	63.0	0.759525	3.476	57.15	176	29.52	±	0.11
1000	13.7	57.9	0.779786	3.429	30.29	164	29.13	±	0.08
1050	16.5	53.5	0.937678	3.371	15.76	153	28.63	±	0.11
1100	16.0	57.7	0.909846	3.299	8.31	165	28.03	±	0.16
1150	7.3	60.1	0.417264	3.537	5.40	158	30.03	±	0.18
1200	3.9	63.3	0.221998	3.512	8.08	43	29.83	±	0.20
1250	3.9	59.0	0.223212	3.533	7.99	155	30.00	±	0.23
1350	2.9	63.0	0.164031	3.635	20.31	174	30.86	±	0.38
Total Gas	100.0	55.2	5.699508	3.331	28.62	154	28.29		
RA-02 *Saltillo* ***biotite total fusion*** *J = 0.004751 ± 0.25%* *wt = 5.6 mg* *#70KD18*									
1450	100.0	53.2	1.034745	3.385	19.42	99	**28.78**	±	**0.08**

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All errors are at one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.

Oficina Regional San Luis Potosí



PAR-2 Basaltic Andesite



Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

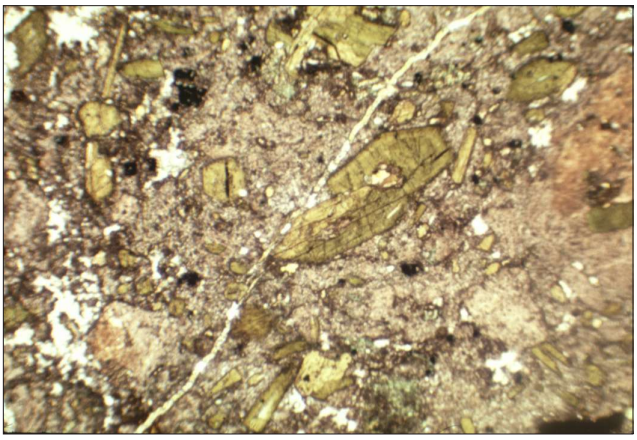
PAR-2

Oficina Regional San Luis Potosí

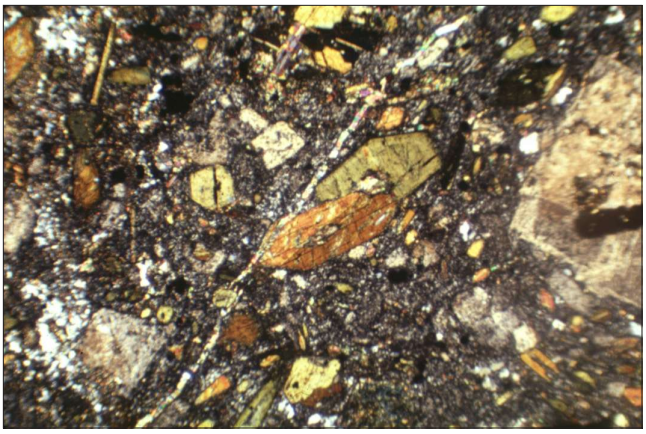
Basaltic Andesite

Mineral dated:
hornblende

Lat. 22°38'07"
Long. 101°58'27"



Photograph taken in plane-polarized light to show hornblende crystals used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

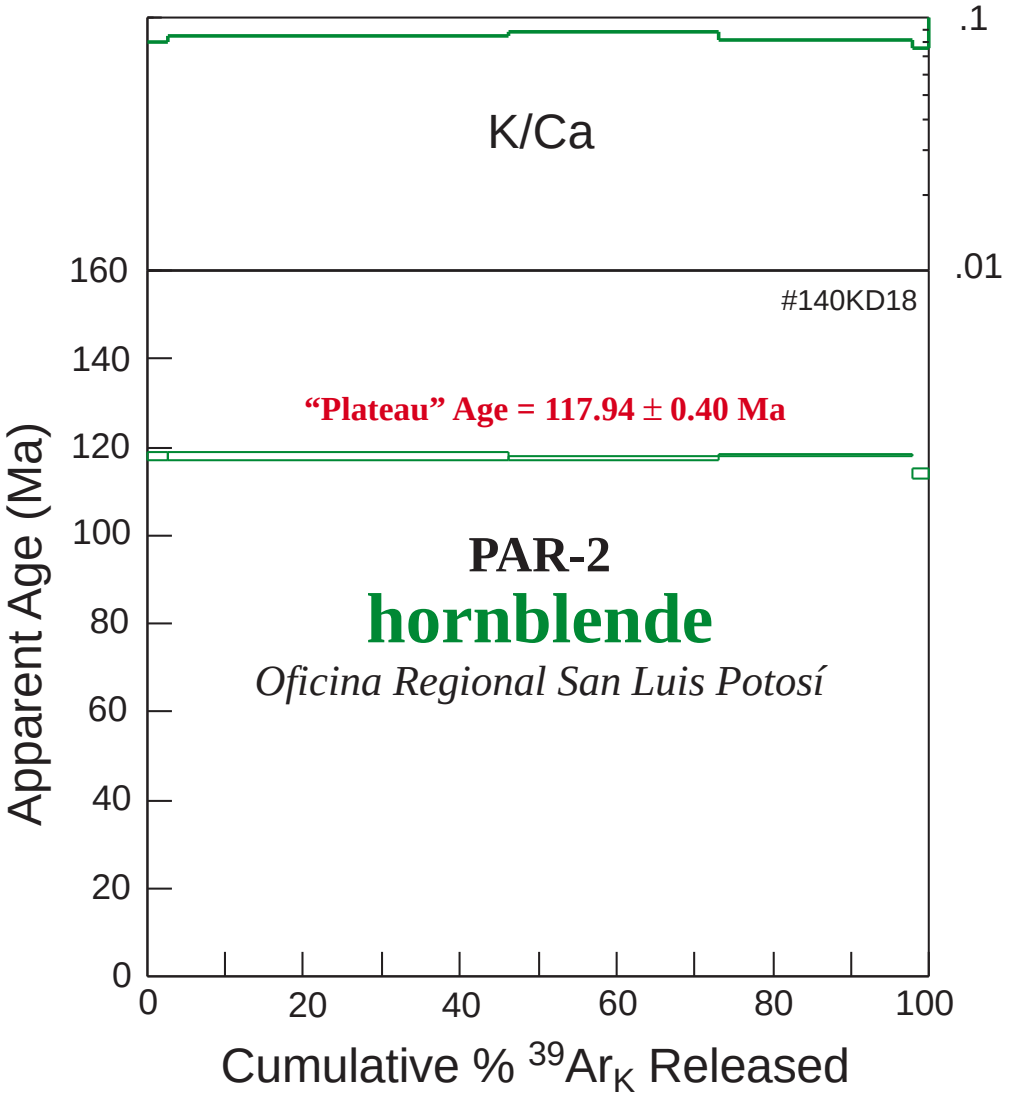


Table 21. $^{40}Ar/^{39}Ar$ analytical data for sample PAR-2 Oficina Regional San Luis Potosí

Temperature °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
PAR-2 *San Luis Potosí*		***hornblende***	*J = 0.004835 ± 0.25%*		*wt = 227.9 mg*		*#140KD18*		
1150	2.7	86.9	0.102633	13.954	0.08	53	117.78	±	0.45
1200	43.6	91.1	1.685446	13.976	0.08	51	117.96	±	0.42
1250	26.8	96.3	1.036567	13.914	0.09	68	117.46	±	0.26
1300	24.7	93.7	0.955654	14.001	0.08	48	118.17	±	0.17
1350	2.1	89.1	0.081691	13.494	0.08	53	114.02	±	0.65
Total Gas	100.0	93.0	3.861991	13.955	0.09	55	117.79		
	97.9% of gas on plateau in 1150 through 1300 steps					**Plateau Age =**	**117.94**	±	**0.40**

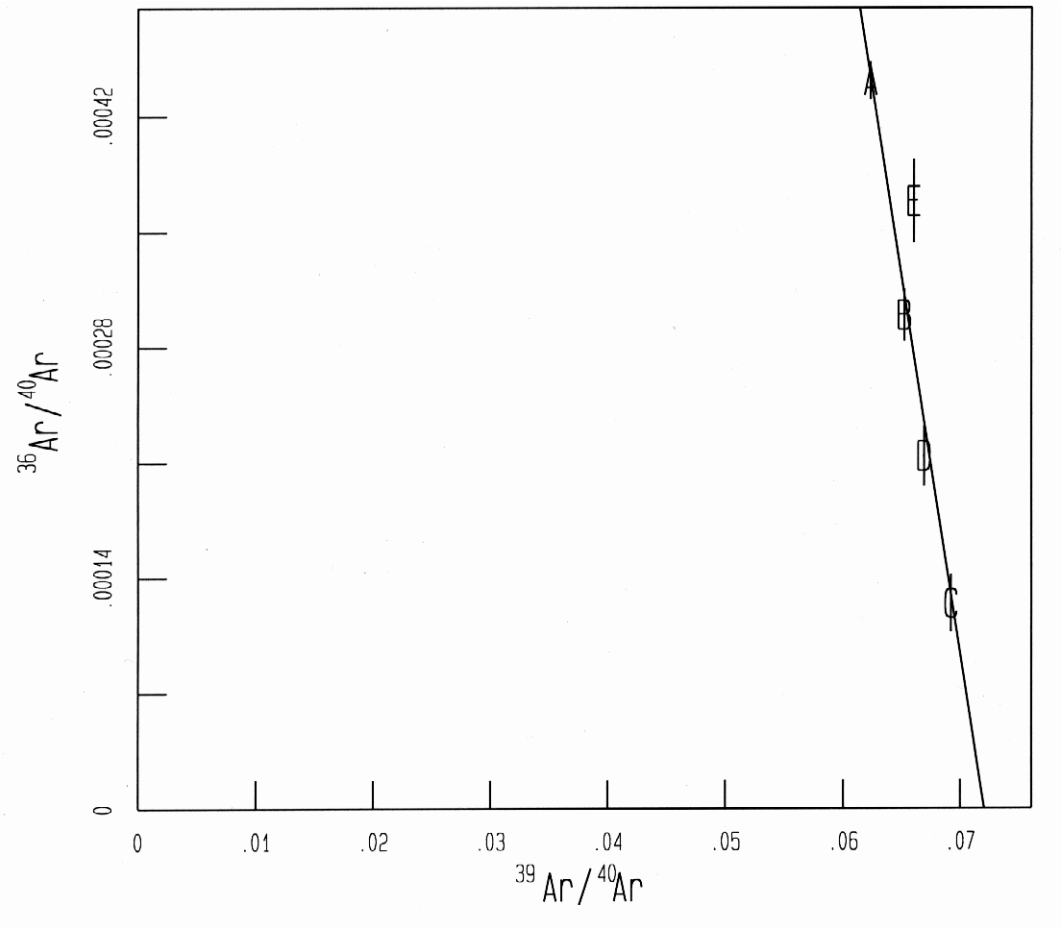
Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

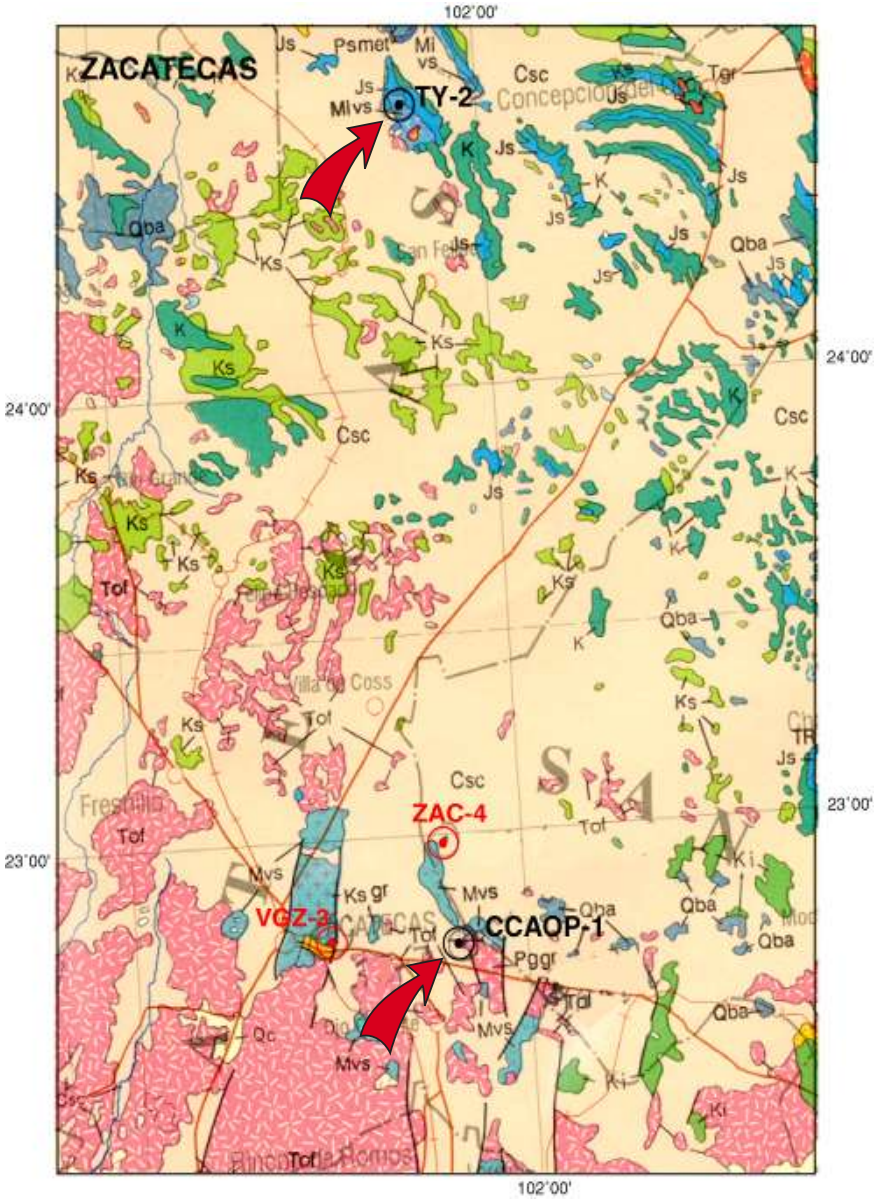
No error is calculated for the total gas age.

Inverse-isotope correlation diagram
PAR-2
Hornblende

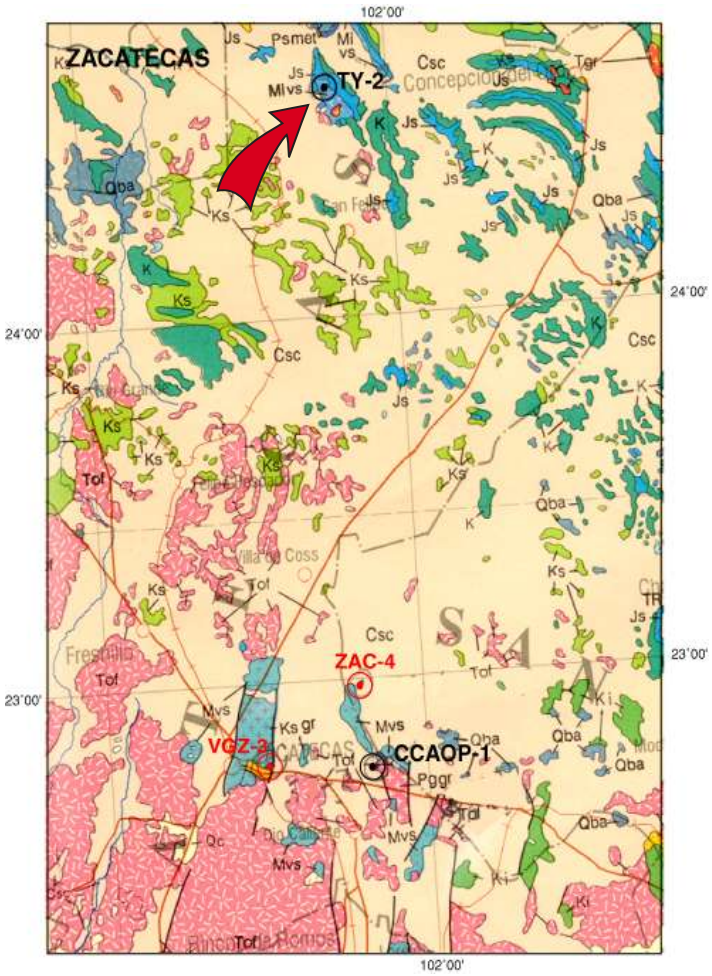


Isochron Age = 117.71 ± 0.76 Ma
$[^{40}Ar/^{36}Ar]_i = 298.41 \pm 16.71$
MSWD = 0.319
4 of 5 steps with 97.9% of $^{39}Ar_K$

Oficina Regional Zacatecas



TY-2 Phyllite
CAOP-1 Mylonite



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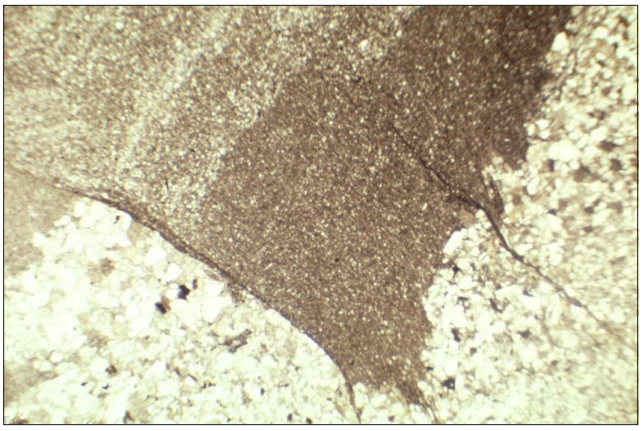
TY-2
Oficina Regional Zacatecas

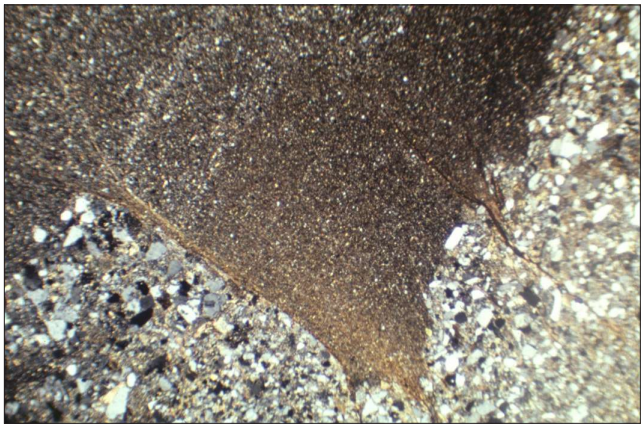
Phyllite

Mineral dated:
whole rock

Lat. 24°34’26.6”
Long. 102°11’39.1”



Photograph taken in plane-polarized light to show whole rock (very small muscovite crystals) used for geochronology. Field of view is 5mm across.



Photograph taken under crossed polars.

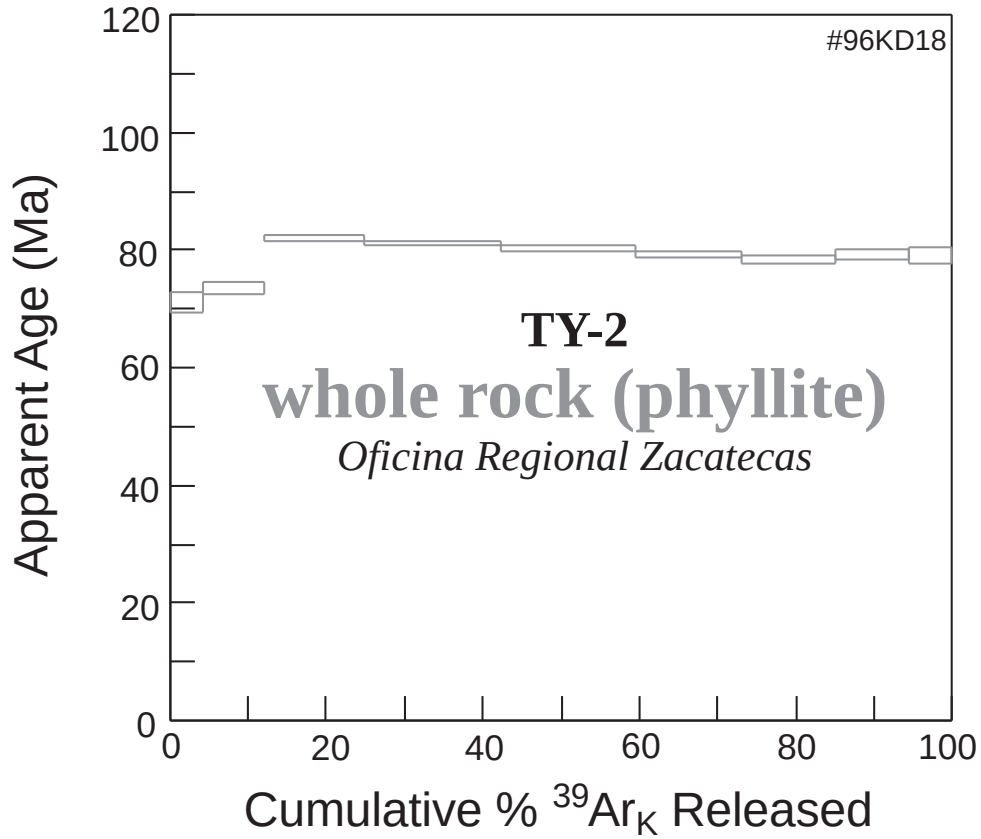


Table 22. $^{40}Ar/^{39}Ar$ analytical data for sample TY-2 Oficina Regional Zacatecas

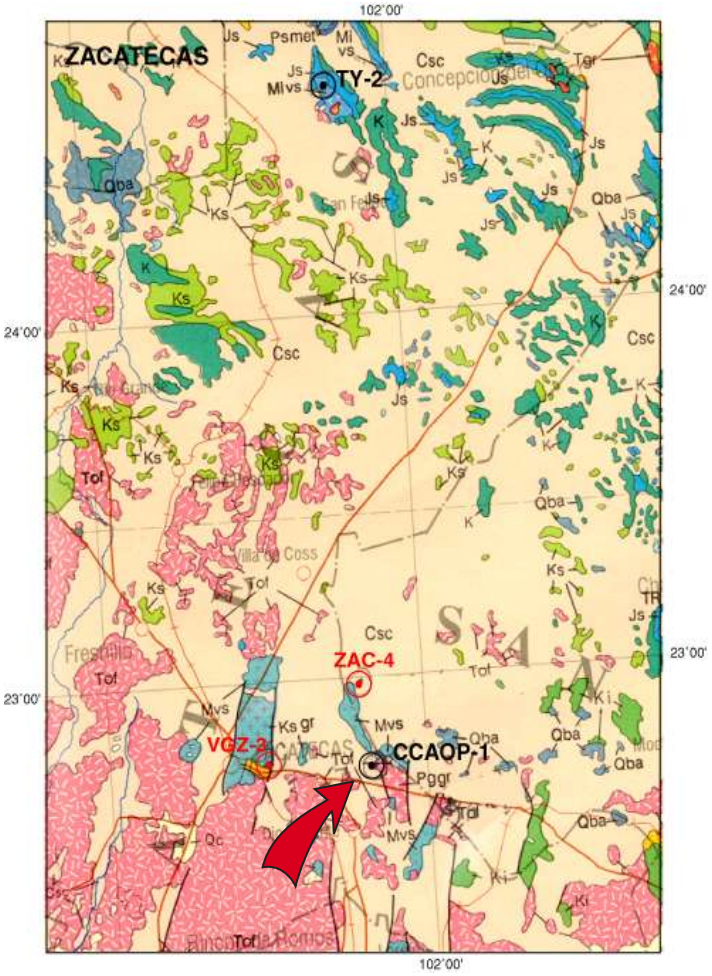
Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
TY-2 *Zacatecas*	***phyllite (whole rock)***	*J = 0.004948 ± 0.25%*	*wt = 27.8 mg*	*#96KD18*					
700	4.2	88.1	0.078335	8.125	21.57	189	71.11	±	0.93
750	8.0	95.4	0.150066	8.412	21.78	207	73.57	±	0.51
800	12.8	97.3	0.240236	9.406	27.33	289	82.06	±	0.29
850	17.4	98.1	0.326783	9.299	30.81	320	81.15	±	0.24
900	17.1	98.6	0.322045	9.207	34.79	409	80.36	±	0.22
950	13.6	98.6	0.255581	9.086	32.24	1069	79.33	±	0.30
1000	12.0	98.5	0.225468	8.974	36.34	1295	78.38	±	0.37
1050	9.6	98.3	0.180102	9.073	24.88	947	79.22	±	0.39
1100	5.5	94.1	0.102812	9.043	11.26	226	78.97	±	0.70
Total Gas	100.0	97.4	1.881428	9.074	29.16	590	79.23		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.



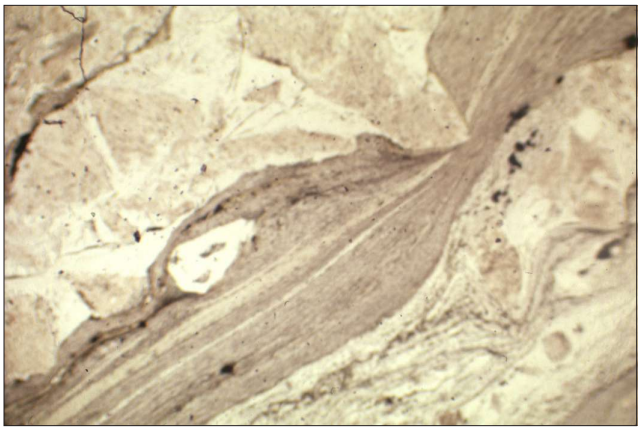
Inset from CRM/UNAM Carta Geológica de La República Mexicana, 1992, Original Scale: 1:2,000,000

CAOP-1
Oficina Regional Zacatecas

Mylonite

Mineral dated:
K-feldspar

Lat. 24°46’49.4”
Long. 102°10’14.1”



Photograph taken in plane-polarized light to show K-feldspar porphyroclasts used for geochronology. Field of view is 5mm across.

Photograph taken under crossed polars.

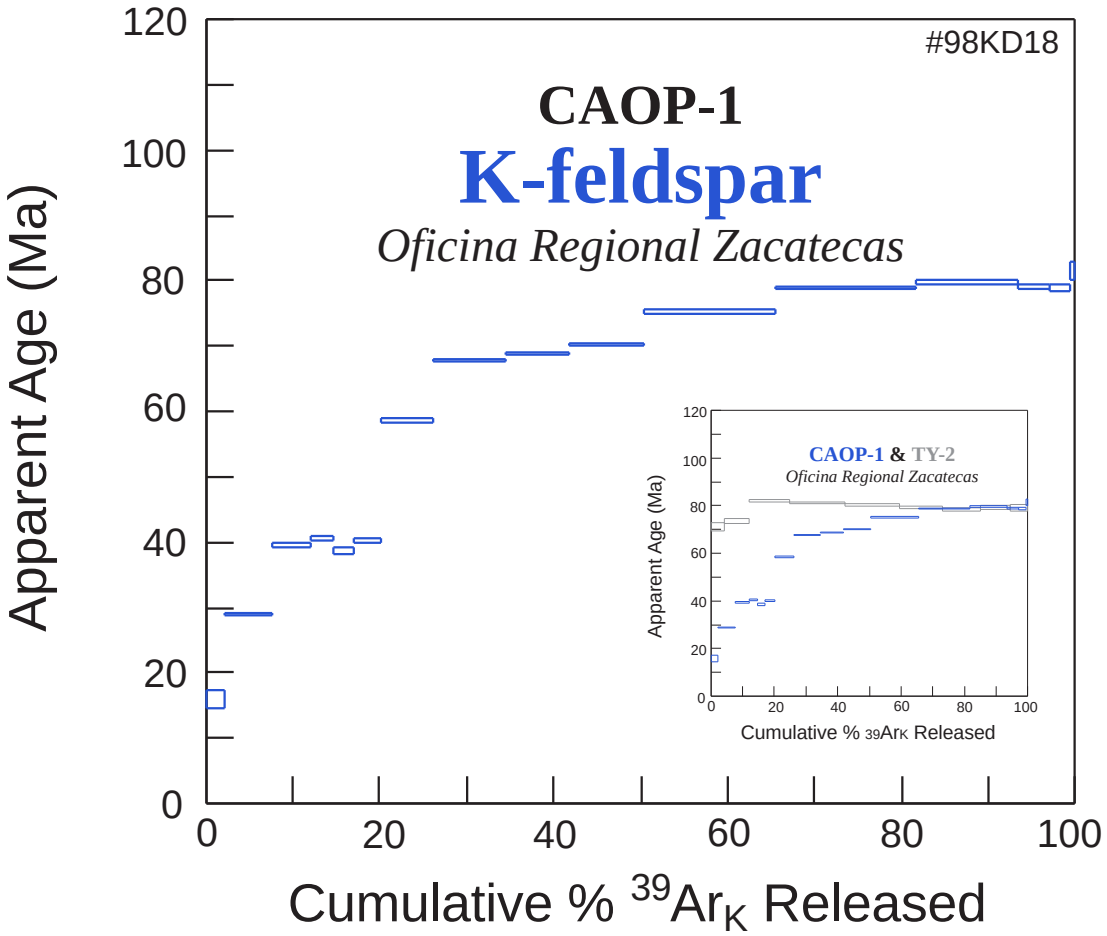


Table 23. $^{40}Ar/^{39}Ar$ analytical data for sample CAOP-1 Oficina Regional Zacatecas

Temperature °C	% ^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
CAOP-1 *Zacatecas*		***K-feldspar***	*J = 0.004720 ± 0.25%*		*wt = 40.0 mg*	*#98KD18*			
750	2.3	18.8	0.236948	1.901	53.65	94	16.12	±	0.67
850	5.4	87.4	0.557636	3.434	46.65	688	29.01	±	0.11
950	4.4	93.6	0.447128	4.700	44.45	758	39.58	±	0.10
1000	2.5	91.1	0.259154	4.816	46.23	634	40.55	±	0.19
1050	2.5	89.5	0.252321	4.595	53.22	692	38.71	±	0.18
1100	3.0	88.3	0.303527	4.785	46.10	553	40.29	±	0.19
1150	6.0	87.5	0.616234	7.002	68.00	274	58.66	±	0.14
1200	8.4	88.5	0.857544	8.106	81.95	117	67.74	±	0.09
1225	7.5	90.7	0.770807	8.233	89.77	234	68.78	±	0.10
1250	8.5	92.4	0.874365	8.400	132.62	240	70.15	±	0.07
1275	15.1	93.4	1.552201	9.027	222.93	223	75.27	±	0.10
1300	16.2	93.6	1.662274	9.456	278.22	225	78.77	±	0.10
1325	11.7	93.8	1.198969	9.573	363.50	232	79.72	±	0.13
1350	3.7	94.0	0.380268	9.499	297.73	237	79.13	±	0.12
1450	2.3	94.4	0.234456	9.466	272.18	238	78.85	±	0.23
1550	0.6	91.2	0.059577	9.787	138.26	179	81.47	±	0.71
Total Gas	100.0	90.1	10.263409	7.883	177.81	299	65.90		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.

All errors are at one sigma level of precision.

Ages of individual steps do not include error in the irradiation parameter J.

No error is calculated for the total gas age.