37½

R

150

Objective: Specific objectives of this research project are outlined in the project plan entitled "Project Plan for Research on Tectonic Processes in the Central Basin and Range Region" by S. R. Young, G. L. Stirewalt, and D. A. Ferrill, 1994 (revision 0, change 7).

Sent by: Kathy H. Spivey *Kathy H Spivey*

Principal Investigator: Dr. David A. Ferrill *[signature]*

Scientific Notebook of: Dr. Ann Blythe *Ann E. Blythe*

CNWRA
CONTROLLED
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PROCEDURES USED FOR ZIRCON FISSION-TRACK DATING FOR BARE MTN SAMPLES

4/22/95 - Zircon Vials received from Ray Donelick for Kathy Spivey at SWRI
The following samples were mounted in teflon (procedure described below),

~~description of Z before~~ polishing:

(1) BmN-1 - ~~not much Z, fragmented, metamict~~ ?
(2) Bmw-1 - fractured, small, metamict Z
(3) Bmw-2 - several populations (some pink), small
(4) Bmw-3 - larger Z, rounded, some pink
(5) Bmw-5 - a few poor zircon - not polished
(6) 104-1 - small euhedral zircon, clear
(7) 104-2 - med Z, round + euhedral, metamict, clear
(8) 104-3 - a few small, round, clear Z
(9) 104-4 - almost no zircon - not polished
(10) 104-5 - euhedral, clear zircon - small
(11) 104-6 - round, small Z, many pink
(12) 104-7 - no good Z - not polished
(13) 104-8 - med Z, rounded, many pink
(14) 104-9 - med-large Z, rounded, grey
(15) 104-10 - med-large, rounded, grey
(16) 104-11 - small-med, some round, some euh., grey
(17) 104-12 - small-med, round, grey
(18) 104-13 - med, round grey, lots!
(19) 104-14 - large, grey, fragmented -
(20) 104-15 - med, grey, round
(21) 104-16 - no good Z - not polished.

CAN BE READ BY HOLDING UP TO LIGHT HLMEK 5/12/20

AEB

Procedure for mounting Zircons in teflon:
(from T.M. Harrison's B.S. thesis at U.B.C.)

1. A metal (aluminum) block is heated on a hot plate to a temperature of 310°c. A glass slide is also heated.
2. 100 or more grains of Z are poured onto a cold glass slide. Grains are confined to ~ 1-cm² in area. Slide is then placed on metal block.
3. 2 square pieces of teflon (1" x 1" x 2000 Å thick) are placed together and set on top of Z grains on metal block.
4. Place the hot glass slide (from step 1) on top of the teflon squares.
5. Use an aluminum roller to roll and press teflon into grains. Teflon becomes clear when it starts to melt. Try to get out bubbles by rolling. Leave partly melted teflon on slide a few more seconds.
6. Remove hot slide with mount from hot plate with tweezers. Allow to cool. You may need to place a weight on the teflon to keep it flat as it cools.
7. Scribe the sample number on the back with a diamond pen.
8. Trim the teflon mount with scissors to desired shape (I use an octagon) → ⬡

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4/24/95

All but 4 of the samples (Bmw-5, 104-4, 104-7, 104-16) were then ground and polished.

Grinding - purpose is to expose an interior surface of the zircons.

procedure

① Two strips of grinding paper (Texmet #400 and 600 silicon carbide abrasive paper with adhesive backing) are placed on a flat surface (I use the back of a cookie sheet).

② The cookie sheet is placed in a sink with one edge resting on the counter top and the other resting near the drain. The grinding strips are wet and water should flow over them if possible

③ Place the teflon mount on a glass slide with double stick tape (carpet tape holds well, even when wet). Using mild pressure, slide the teflon mount down the #400 grit paper. Push away from you, not towards. Repeat 6-10 times, rotating slide 180° after each pass. Teflon should have uniform scratches on surface.

④ Rinse the slide well. Repeat on the #600 grit paper, but slide should be 90° from previous

passes. Repeat 10-15 times, rotating slide 180° after each pass. Again, scratches should be uniform on surface. Rinse slide well, and dry

Polishing - purpose is to produce an even, flat surface on grains.

procedure:

① Use a polishing wheel, put a clean polishing cloth, and a small amount of 10 micron diamo paste on cloth. Use extender fluid to dampen cloth.

② Hold slide on wheel so that diamonds will pass ⊥ to grinding scratches. Use a moderate amount of pressure, med-high speed, and add a few drops of extender every minute or so. Continue until scratches from #600 silicon paper are gone. Clean slide well (in ultrasonic cleaner) or with soap + water.

③ Change polishing wheel, (and cloth), and use 1 micron diamond paste. Orient slide ⊥ to previous step, polish until 10 μm paste scratches are gone.

④ Polishing scratches should be checked. - should look bright if light is oriented correctly. Grains should be flat and smooth.

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Etching - purpose is to expose tracks so they are visible under the optical microscope.

procedures:

① remove teflon mounts from slide.

② In a teflon crucible, put a mixture of KOH and NaOH pellets (ratio is 11.2 gm to 8.0 gm - total depends on # of samples being etched).

③ Place the crucible in a good oven within a hood, and heat the crucible to 210°C. Wait until the temperature is stable - if it gets too hot, zircons fall out.

④ Put mounts in eutectic melt in crucible face down The zircons take 24-48 hours to etch. After 24 hours, they should be checked every 2-6 hours, depending on how close they are to the desired appearance.

⑤ Check zircons with microscope. Some will be etched, some will not - a great deal of variation. You will have to decide when the optimum number of Zircons are etched properly.

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Description of Bare Mtn Zircons following Etching:

	Sample #	description	quality (1-10) 10 is best.
①	104-1	- not very good, should get age	3
②	104-2	- ok, should get age	5
③	104-3	- zircons too small + dark	NO
④	104-5	- not very good, maybe	3
⑤	104-6	- little Z, maybe reset, countable	4
⑥	104-8	- round, big Z, unreset.	7
⑦	104-9	- a few nice grains	5
⑧	104-10	- small Z, reset, countable	6
⑨	104-11	- very few Z.	NO
⑩	104-12	- small, dark Z	NO
⑪	104-13	- small, dark, round Z, countable	4
⑫	104-14		NO
⑬	104-15	- grubby little Z, maybe reset	5
⑭	BMW-1		NO
⑮	BMW-2	big Z, unreset	⑧
⑯	BMW-3	Nice Z	⑦
⑰	BMN-1		NO

The following zircons were not prepared for the reactor:

104-3, 104-11, 104-12, 104-14,
BMW-1, BMN-1

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Procedure for Attaching Detectors:

purpose: to put external detectors on teflon mounts prior to shipping to reactor.

procedures:

① first all mounts are cleaned thoroughly with alcohol

② Low-U, Brazilian Ruby Mica is used as the detedtor. A sheet is cleaved off and cut into shapes slightly smaller than teflon mounts. The sheet should be several layers thick. Using Scotch tape, the detector is pressed on the tape and peeled away. The purpose of this is to expose a perfectly cleaved surface. This sometimes takes more than one try. When a perfect surface exists, place it on the teflon mount, against the polished surface.

③ Secure with scotch tape, trim the edges with scissors.

④ Write the sample # on the tape.

⑤ Repeat with the rest of the samples.

⑥ Place micas on the glass standards also. (I used National Bureau of Standards Standard Reference Material 962)

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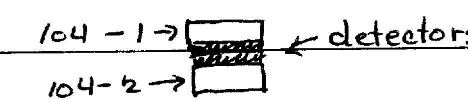
5/22/95

Preparing Package for Shipment:

① Samples were stacked so that detectors faced each other; when possible:



② A vertical column of all samples was secured and wrapped in tape. The dosimetry standards, SRM 962 B and 962 B', (different fragments of same standard) were secured to the top and bottom of the column.

③ Column was placed inside polyethylene radiation tube, which was then Fedexed to Ward Nuclear Laboratory at Cornell University. Howard Aderhold (607)-255-3480 recieved the package and handled the irradiation

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IRRADIATION 95-2

Shipped 5/22/95

Top

- SRm 9628
- H-93-13
- 93-LP-522
- 94-SA-602
- 94-CG-611
- V-94-49
- V-94-50
- V-94-53
- V-94-54
- V-94-55
- V-94-56
- V-94-57
- V-94-59
- V-94-60
- V-94-61
- 104-1
- 104-2
- 104-5
- 104-6
- 104-8
- 104-9
- 104-10
- 104-13
- 104-15
- BMW-2
- BMW-3
- K88-1-1
- K88-1-2
- K88-3
- K88-5
- K88-10
- JK 561
- RR91-6
- RR91-20
- RR91-98
- RR91-167
- SRM-9628'

Bottom

(104-1 through BMW-3: Kathy Spivey's samples)

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IRRADIATION - I requested a "dose" of 10^{15} Neutrons / cm^2. The samples were placed in the "daisy wheel" position of Cornell's Triga Nuclear reactor. Following irradiation, the samples were allowed to "cool" for ~ 30 days before being shipped back to UCSB.

SPELLING ERROR? [illegible] 5/12/00

6/30/95

Samples were received back at UCSB.
The radioactive elements (isotopes) are

Sc-46
Eu-152

The activity of the outside of the package is 0.02 μCi. - a low amount of activity but caution needs to be used when opening the package.

AEB

7/1/95

Etching Zircon Mica Detectors.

procedures:

① While wearing gloves (to protect from radiation), remove the samples from the polyethylene tube and peel the tape off so samples are separated from each other (but detectors are still attached.

② Using a picking (dissecting) needle, 3 holes are poked through the detector and teflon mount. These are for orientation.

③ Detectors are carefully removed from teflon mounts. They should have numbers still on tape on the external side - dont remove tha piece of tape.

[CORRECTION NOT CROSSED OUT HCHSK 5/12/00]

④ Detectors are etched in 48% HF (in a hood) for 25 minutes. They are then placed in beakers of distilled H_2O for 15 minutes, and finally, they are dried on a hot plate (to boil off any remaining HF so lens on microscope isn't etched).

⑤ Slides for counting may now be prepared.

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Slide preparation:

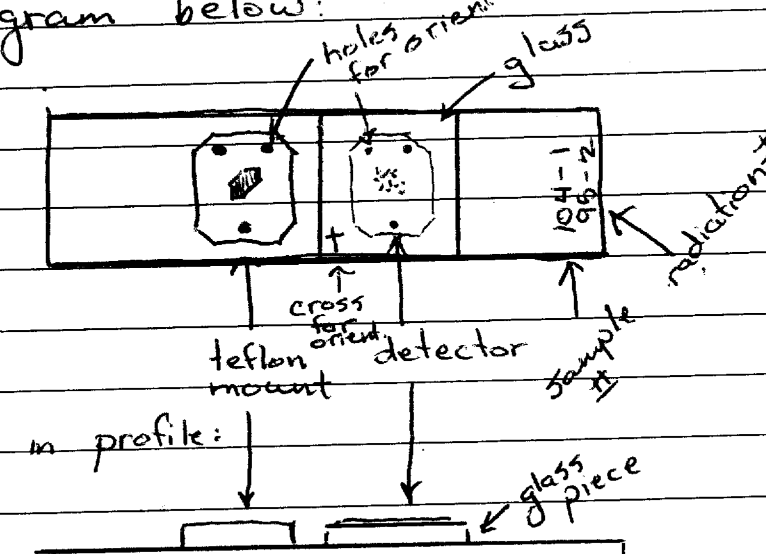
procedures:

① I use 25 x 75 x 1mm slides for counting.

② A small piece of glass is needed to put underneathe the detector so it is the same height as the mount. I make this by scribing a straight line across a normal slide and snapping the glass in two.

③ For gluing the sample; glass and detector onto the large slide, clear nail polish is used (cheap epoxy!)

④ The slides are laid out like the diagram below:



Sample #'s are etched onto the slide for reference.

⑤ The micas from the dosimetry standards AEB

are also etched and glued to slides.

Counting 7/2/95

① The micas from the dosimetry standards are counted first. I counted 100 grids (at 100 x for 1250 total magnification) on each mica. One grid is $64 \times 10^{-6}\ cm^2$.

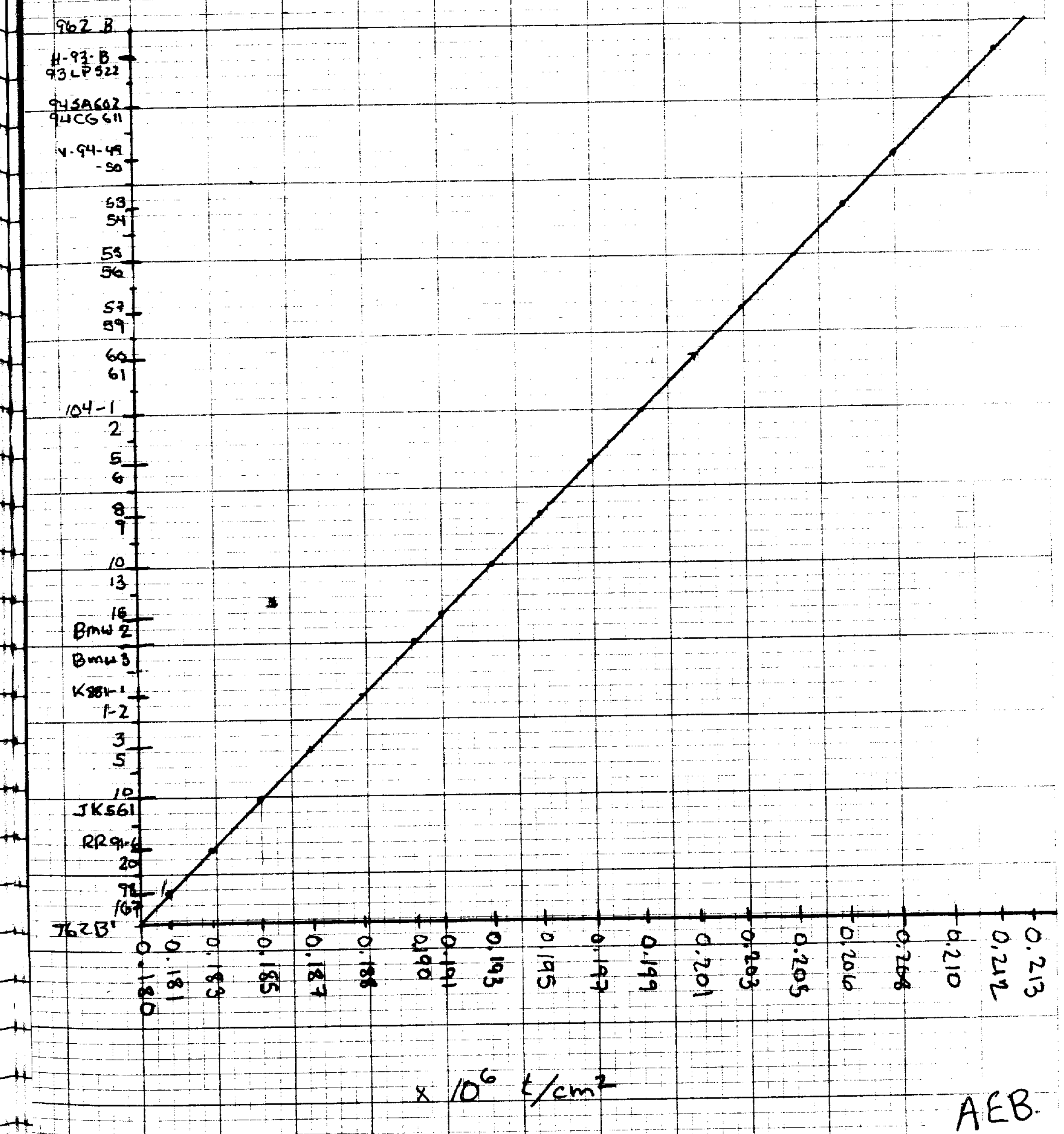
	SRM B (top)	SRM B' (bottom)
Total	= 1365 tracks	= 1149 tracks
Ave	= 13.65 t/grid	= 11.49 t/grid
	= $0.213 \times 10^6\ t/cm^2$	= $0.180 \times 10^6\ t/cm^2$

② A linear interpolation is used to estimate the dose for each sample in the radiation package. The graph produced for this package (95-2) is on the following page. The total variation in dose from top to bottom was .033/0.213 or ~ 15%.

③ Dosimetry values (x axis) are read from this chart by locating the sample number (y axis) and reading across to the line bisecting the graph, then straight down to the x-axis value.

AEB

RADIATION PACKAGE 95-2



SAMPLE COUNTING 7/3/95

- individual samples were counted - separate data sheets were used to record the results. These are included in a package mailed to K. Spivey.

	Date of analysis:
104-1	7/3/95
104-2	7/3/95
104-5	7/4/95
104-6	7/4/95
104-8	7/4/95
104-9	7/5/95
104-10	7/5/95
104-13	7/5/95
104-15	7/6/95
BMW-2	7/6/95
BMW-3	7/7/95

Data Reduction

· data was reduced using the zeta calibration (zeta = 335 ± 20 for Ann Blythe) with a reduction program written by Ann Blythe. (Pascal program - runs on a MacIntosh computer). The program calculates individual grain ages, U [ ], the pooled age, and the Chi-square value. The program also plots X and Y values for a

cumulative frequency distribution.

3/4/97 HARDCOPY OF DATA REDUCTION PROGAME ADDED AT END OF NOTEBOOK - H.L. McKague 3/4/97

I HAVE REVIEWED THIS NOTE-BOOK (SCIENTIFIC) AND FIND IT IN GENERAL COMPLIANCE WITH QAP-001 AND THERE IS SUFFICENT TECHNICAL INFORMATION SO THAT ANOTHER QUALIFIED INDIVIDUAL COULD REPEAT THE ACTIVITY

H. Laurence McKague
3/4/97

WORK ON THIS TASK HAS BEEN COMPLETED. THIS SCIENTIFIC NOTEBOOK # 128 IS TO BE ARCHIVED. NO NEW ENTRIES HAVE BEEN MADE SINCE 3/4/97

H. Laurence McKague
5/2/00

AEB

5/12/00 WHITE OUT CORRECTIONS REVIEWED ALL APPEAR TO BE MINOR AND WOULD NOT EFFECT THE ABILITY OF A KNOWLEDGABLE WORK TO FOLLOW SAME PROCEEDURE

H. L. McKeague
5/12/00

RECEIVED FROM A. BLYTH 3/4/97 A.G. McKeegan

{This program is intended to reduce a set of fission track count data}

```
program Fission_Track;{Calculates Fission Track Ages and Statistics}

 type
 TrackType = record
  Spontaneous:  integer;
  Induced:  integer;
  end;
 TrackTypeF = record
  Spontaneous:  real;
  Induced:  real;
  end;

 var
 sample:  string[80];
 ObsTracks: array[1..100] of TrackType;
 FittedTracks, FittedObsTracks: array[1..100] of TrackTypeF;
 DataQuality, N_Grains: integer;
 Total_Tracks, GrAge, TempGrAge, GrErr, newDose, area, sdensity, idensity:
array[1..100] of real;
 AllTracks, SumITracks, SumSTracks, FSumITracks, SumArea, sameDose, temp, U:
real;
 Total_Chi, Chi_spontaneous, Chi_induced, Age, Error, Zeta, ZetaError,
ObsTracks_det: real;
 window:  rect;

 procedure Enter_SameDose;
 forward;
 procedure Enter_DiffDose;
 forward;
 procedure Ooops; {a procedure for fixing typos}
 forward;
 procedure Ooops2; {a procedure for fixing typos}
 forward;
 procedure Calc_SameDose;
 forward;
 procedure Calc_DiffDose;
 forward;
 procedure Print_It;
 forward;
 procedure Draw_It;
 forward;
```

```
{**************************************************}

procedure Enter_SameDose;{Prompts user for data if neutron dose was same for all grains}
  var
  grain:  integer;

 begin
  writeln('  ');
  writeln('  ');
  write('How many grains? ');
  readln(N_Grains);
  writeln('  ');
  write('What was the density of tracks in the dosimetry standard (e6): ');
  readln(sameDose);
  ObsTracks_det := sameDose * 25 * 64;
  writeln('  ');

  for grain := 1 to N_Grains do
    begin
    writeln('Grain  ',  grain);
    Write('What was the grid area counted? ');
    Readln(area[grain]);
    area[grain] := area[grain] * 0.64;
    Write('Number of spontaneous tracks : ');
    Readln(ObsTracks[grain].Spontaneous);
    Write('Number of induced tracks: ');
    Readln(ObsTracks[grain].Induced);
     writeln;
    end;

  writeln('  ');
  writeln('   Grain', '    Rho-D', '   Area', '        Ts', '          Ti');

  for grain := 1 to N_Grains do
    begin
    writeln(Grain, sameDose : 6 : 4, area[grain] : 5, ObsTracks[grain].Spontaneous,
ObsTracks[grain].Induced);
    end;

  writeln('  ');
  writeln('Are these Okay? [yes = 1; no = 0]');
```

```
 readln(DataQuality);

 if DataQuality = 0 then
  Ooops;

end;

{*********************************************************}

procedure Enter_DiffDose;{Prompts user for data if neutron dose for grains was
variable}
  var
  grain:  integer;

 begin
  writeln('   ');
  write('How many grains? ');
  readln(N_Grains);
  writeln('   ');
  writeln('   ');

  for grain := 1 to N_Grains do
   begin
   GrAge[grain] := 0;
   writeln('Grain  ', grain);
   write('What was the density of tracks in the dosimetry standard (e6): ');
   readln(newDose[grain]);
   Write('What was the grid area counted? ');
   Readln(area[grain]);
   area[grain] := area[grain] * 0.64;
   Write('Number of spontaneous tracks : ');
   Readln(ObsTracks[grain].Spontaneous);
   Write('Number of induced tracks: ');
   Readln(ObsTracks[grain].Induced);
    writeln;
   end;


  writeln('   ');
  writeln('    Grain', '    Rho-D', ' Area', '    Ts', '    Ti');

  for grain := 1 to N_Grains do
   begin
```

```
  writeln(Grain, newDose[grain] : 7 : 4, area[grain] : 5,
ObsTracks[grain].Spontaneous, ObsTracks[grain].Induced);
  end;

 writeln('  ');
 writeln('Are these Okay? [yes = 1; no = 0]');
 readln(DataQuality);

 if DataQuality = 0 then
  Ooops2;

 end;

{*********************************************************}

 procedure Ooops;{an opportunity to fix typos}
  var
  Grain, BadData: integer;
  label
   1;

 begin
1:
 Writeln('  ');
 Writeln('Enter the number of the grain with the typo');
 readln(BadData);
 Write('Grid area counted:');
 Readln(area[BadData]);
 Write('Number of spontaneous tracks : ');
 Readln(ObsTracks[BadData].Spontaneous);
 Write('Number of induced tracks: ');
 Readln(ObsTracks[BadData].Induced);
 writeln;

 writeln('  ');
 writeln('   Grain', '    Dose', '  Area', '   Ts', '  Ti');

 for grain := 1 to N_Grains do
  begin
  writeln(Grain, sameDose : 5, area[grain] : 5, ObsTracks[grain].Spontaneous,
ObsTracks[grain].Induced);
  end;
```

```
  writeln('  ');
  writeln('Are these Okay? [yes = 1; no = 0]');
  readln(DataQuality);

  if DataQuality = 0 then
   goto  1;
 end;

{*****************************************************}

 procedure Ooops2;{an opportunity to fix typos}
   var
   Grain, BadData: integer;
   label
    1;

 begin
1:
  Writeln('  ');
  Writeln('Enter the number of the grain with the typo');
  readln(BadData);
  Write('Dose:');
  Readln(newDose[BadData]);
  Write('Grid area counted:');
  Readln(area[BadData]);
  Write('Number of spontaneous tracks : ');
  Readln(ObsTracks[BadData].Spontaneous);
  Write('Number of induced tracks: ');
  Readln(ObsTracks[BadData].Induced);
   writeln;

  writeln('  ');
  writeln('   Grain', '    Dose', ' Area', '     Ts', '     Ti');

  for grain := 1 to N_Grains do
    begin
    writeln(Grain, newDose[grain] : 5, area[grain] : 5, ObsTracks[grain].Spontaneous,
ObsTracks[grain].Induced);
    end;

  writeln('  ');
  writeln('Are these Okay? [yes = 1; no = 0]');
  readln(DataQuality);
```

```
 if DataQuality = 0 then
  goto  1;

end;


{*****************************************************************}

procedure Calc_SameDose;{Calculates age, error, and stats for same-dose grains}
  var
  Grain:  integer;

 begin
 Age := 0;
 AllTracks := 0;
 Total_Chi := 0;
 Chi_spontaneous := 0;
 Chi_induced := 0;
 grain := 1;

 for grain := 1 to N_Grains do
   begin
   SumSTracks := SumSTracks + ObsTracks[Grain].Spontaneous;
   SumITracks := SumITracks + ObsTracks[Grain].Induced;
   AllTracks := SumITracks + SumSTracks;
   SumArea := SumArea + area[grain];
   GrAge[grain] := 6.446E9 * (ln(1 + 1.55125E-10 * sameDose * Zeta *
(ObsTracks[grain].Spontaneous / (2 * ObsTracks[grain].Induced))));
   if GrAge[grain] = 0 then
     begin
    TempGrAge[grain] := 6.446E9 * (ln(1 + 1.55125E-10 * sameDose * Zeta * (1 /
(2 * ObsTracks[grain].Induced))));
    GrErr[grain] := sqrt((1 / ObsTracks[grain].Induced) + (1 /
ObsTracks[Grain].Spontaneous) + (1 / ObsTracks_det) + sqr(ZetaError / Zeta));
    GrErr[grain] := GrErr[grain] * TempGrAge[grain];
     end
    else
     begin
    GrErr[grain] := sqrt((1 / ObsTracks[grain].Induced) + (1 /
ObsTracks[Grain].Spontaneous) + (1 / ObsTracks_det) + sqr(ZetaError / Zeta));
    GrErr[grain] := GrErr[grain] * GrAge[grain];
     end;
```

```
  if GrAge[grain] = 0 then
    begin
   Total_Tracks[grain] := 1 + ObsTracks[grain].Induced;
   FittedTracks[grain].Spontaneous := SumSTracks * Total_Tracks[grain] /
AllTracks;
   FittedTracks[grain].Induced := SumITracks * Total_Tracks[grain] / AllTracks;
   Chi_spontaneous := sqr(FittedTracks[grain].Spontaneous - 1) / 1;
   Chi_induced := sqr(FittedTracks[grain].Induced - ObsTracks[grain].Induced) /
ObsTracks[grain].Induced;
   Total_Chi := Total_Chi + Chi_spontaneous + Chi_induced;
    end
   else
    begin
   Total_Tracks[grain] := ObsTracks[grain].Spontaneous +
ObsTracks[grain].Induced;
   FittedTracks[grain].Spontaneous := SumSTracks * Total_Tracks[grain] /
AllTracks;
   FittedTracks[grain].Induced := SumITracks * Total_Tracks[grain] / AllTracks;
   Chi_spontaneous := sqr(FittedTracks[grain].Spontaneous -
ObsTracks[grain].Spontaneous) / ObsTracks[grain].Spontaneous;
   Chi_induced := sqr(FittedTracks[grain].Induced - ObsTracks[grain].Induced) /
ObsTracks[grain].Induced;
   Total_Chi := Total_Chi + Chi_spontaneous + Chi_induced;
    end;

  Age := 6.446E9 * (ln(1 + 1.55125E-10 * sameDose * Zeta * (SumSTracks / (2 *
SumITracks))));
  Error := sqrt(sqr(SumSTracks / SumITracks) * ((1 / SumSTracks) + (1 /
SumITracks)));
  Error := Error / (SumSTracks / SumITracks);

  end;

{*****************************************************}

 procedure Print_It;
  var
  Grain: integer;

 begin
  writeln('  ');
  writeln('Sample:', sample);
  writeln('  ');
```

```
writeln('Gr', '        A', '      Std', '    Ds  (Ts)', '    Di  (Ti)', '    [U] ppm', '    Age (Ma) ±
1s.e.');

for grain := 1 to N_Grains do
  begin
  U := 10 * (ObsTracks[grain].Induced / area[grain]) / sameDose;
  writeln(Grain, area[grain] : 5 : 2, sameDose : 5 : 2, (ObsTracks[grain].Spontaneous
/ area[grain]) : 5 : 2, ObsTracks[grain].Spontaneous, (ObsTracks[grain].Induced /
area[grain]) : 5 : 2, ObsTracks[grain].Induced, U : 5 : 2, GrAge[grain] : 5 : 2, '±',
GrErr[grain] : 5 : 2);
  end;

Writeln('   ');
writeln('Total area:', SumArea : 3 : 2);
writeln('Total spontaneous tracks:', SumSTracks : 3 : 2);
writeln('Total induced tracks:', SumITracks : 3 : 2);

Writeln('   ');
Writeln('Age = ', Age : 3 : 2, ' ± ', Error * Age : 3 : 2, ' Ma [1 sigma]');
writeln('   ');
writeln('Chi sqr value = ', Total_Chi : 5 : 2, '     with ', N_Grains - 1, ' degrees of
freedom');
end;

{*******************************************************}
procedure Draw_It; {Calculates X, Y coords for the probability distribution function -
these are then transferred to a graphing program}

  var
  sample:  string[80];
  DataQuality, grain, t, ticks: integer;
  X, Y: array[1..200] of real;
  F: array[1..30, 1..200] of real;
  Age, Error, max, min, temp, A, B, C, top: real;

begin

  writeln('   ');
  Write('What is the max age on the age spectrum?   ');
  Readln(max);
  Write('What is the min age on the age spectrum?   ');
  Readln(min);
```

```
ticks := max / 5;
Y[t] := 0;

for grain := 1 to N_Grains do
  begin
  for t := 1 to ticks do
    begin
    A := 0.3989 / GrErr[grain];
    B := (-1) * sqr(min + ((max - min) * (t / ticks)) - GrAge[grain]);
    C := 2 * sqr(GrErr[grain]);
    F[grain, t] := A * exp(B / C);
    end;
  end;

X[t] := 0;


for t := 1 to ticks do
  begin
  Y[t] := 0;
  X[t] := t / (ticks / 100);
  for grain := 1 to N_Grains do
    begin
    Y[t] := Y[t] + F[grain, t];
    end;
  writeln(X[t],  Y[t]);
  end;

end;

{*****************************************************}

{^^^^^^^^^^^^^^^^^^^^^ Main Program ^^^^^^^^^^^^^^^^^^^^^^^^^}
var
 reply, DoseReply, HistoReply: integer;

begin
{HideAll;}
 SetRect(Window, 0, 21, 361, 292);
 SetTextRect(Window);


 ShowText;
```

```
reply := 1;
doseReply := 1;

while reply = 1 do
 begin
 SumSTracks := 0;
 SumITracks := 0;
 SumArea := 0;
 ObsTracks_det := 0;
 writeln('  ');


 write('What is the sample number?');
 readln(sample);
 writeln('  ');
 write('What is your zeta factor?');
 readln(Zeta);
 writeln('  ');
 write('What is the one sigma error for your zeta factor?');
 readln(ZetaError);
 writeln('  ');
 write('All grains same dose? [yes = 1; no = 0; <return>');
 readln(doseReply);
 if doseReply = 1 then
   begin
   Enter_SameDose;
   Calc_SameDose
   end
  else
   begin
   Enter_DiffDose;
   Calc_DiffDose;
   end;

  Print_It;

 writeln('  ');
 writeln('  ');
 write('Do you wish to draw the grain age histogram? [yes = 1; no = 0; <return>');
 readln(histoReply);
 if histoReply = 1 then
   begin
```

```
      Draw_It;
    end;
  writeln('   ');
  write('Do you wish to reduce another sample? [yes = 1; no = 0; <return>');
  readln(reply);
  end;
end.
```