On Track

The Newsletter of the International Fission-Track Community
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In this Issue:

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Editor's Notes

I would like to begin the 19th issue of On Track by thanking the previous editor, **Sandy Grist**, for his assistance during the transitional period of editorship. The growing interest in On Track (reflected by the ever expanding directory listed at the end of this issue) has kept it circulating for a decade now and it will be with us to witness the imminent Y2K chaos.

An analysis of the literature clearly shows that the previous thirty years of science has been sufficient time to turn the fission-track method into a useful tool, which has helped to constrain geological models in many different themes. Fission-track science will undoubtedly continue throughout the next millenium, with the proliferation of many more laboratories and scientists. But what about On Track??... On Track provides an informal forum for non-reviewed written debate and scientific presentation. This is a useful means for discussing scientific problems without the occasional nuisances or restrictions of a more formal, reviewed journal. However, as is plainly obvious in the contents page, very few groups and individuals contributed to this issue. I encourage you all to consider providing articles for future issues of On Track to help perpetuate its existence.

On a lighter note, thanks for taking the time to read this issue. If you have any suggestions on how to improve any aspect of On Track then please don't hesitate to let me know! I wish you all a cracking christmas and a tracking new year.

In this 'millenium issue' of On Track, scientific contributions start with a provocative and informative article by **Ray Donelick** concerning fission-track annealing kinetics in apatite. This is followed by an article from **Trevor Dumitru** that provides us with a procedure that can be used with his pre-existing FT Stage apparatus and software in order to measure etch-pit diameters (Dpar). Finally, **Kerry Gallagher** brings us up to date with a Macintosh PPC compatible version of Monte Trax. These articles are followed by a list of fission-Track publications that were printed during 1997 - 1999 (and have not been listed in previous On Track issues). Several 'in press' manuscripts with predicted publication dates are also listed.

Short Tracks: News

John Garver (Union College, Schenectady, NY, USA) Bob Fleischer and Union students N. Meyer and S. Hadley have been busy determining track densities in eyeglass lenses to assess personal radon exposure. Most eyeglasses in the USA are made of CR-39, which is an excellent alpha particle detecting plastic. Sensitivities of CR-39 to radon doses has been calculated. Much of the work has been aimed at determining the optimal part of the lens used for analysis and etch conditions.

John Garver has a number of projects focussed on detrital zircon thermochronology. The goal of most studies is to understand the provenance of sediments and exhumation of orogenic highlands, especially the record in modern river systems. However, much of their recent work is aimed at assessing etching conditions for zircon grains with variable alpha damage. The following four collaborative projects have been completed, are nearing completion, or are ongoing:

1) Mike Bullen (Penn State) just finished his Masters thesis at Penn State entitled "Late Cenozoic tectonic evolution of the Kyrgyz Range and adjoining Chu Basin: new age constraints from fission-track, (U-Th)/He, and magnetostratigraphy". Mike is moving to Houston to join Exxon.

2) Alex Soloviev (Institute of the Lithosphere and Marginal Seas, Moscow, Russia) completed a six month stay at Union College where he focussed on zircon detrital thermochronology while working on two projects. One was on the Ukelayet Flysch on the Kamchatka Peninsula, and the other was on a sequence of lower Mesozoic rocks in the Crimea of the Ukraine. He plans to return to Union College in early 2000 to continue work on samples from Kamchatka.

3) Ian Brewer (Penn State) is sorting out the detrital zircon FT ages from a number of rivers draining the Himalayan Mountain system (Nepal and India). He has finished a marathon counting session, and the results should surface soon. This is part of his Ph.D. project.

4) Matthias Bernet (Yale Univeristy) is working on the long-term exhumation history of the Alps for his PhD project using FT ages of detrital zircon. At this point he has results from many of the modern rivers that drain off the Alps into Italy, and he is just gearing up to analyze zircons from the rivers draining to the foreland. Additionally, our group has teamed up with M. Zattin, B. Ventura, G.G. Zuffa (Bologna, Italy) and M.L. Balestrieri (Firenze, Italy) to unravel the exhumation evolution of the Alps through detrital zircons in the Appenine sedimentary sequences derived from the Alps.

Devender Kumar wrote to introduce himself to the fission-track community and inform us that he has just completed his PhD. The title of his thesis is “Fission-track zircon-apatite ages and exhumation of the Himalayan Metamorphic Belt (HMB) along Beas-Sutlej valleys, Himachal Pradesh, (India)”. This work was carried out at Kurukshetra University in India under the supervision of Nand Lal.

Denis Arne wrote to tell us that he is becoming more involved in economic and exploration geology these days and has consequently moved to the Western Australian School of Mines, Curtin University of Technology in Kalgoolie where he is a lecturer in Mining Geology.

Marc Jolivet wrote to inform the community of a new fission-track laboratory which he has established at the University of Montpellier, France. The laboratory is equipped with a Zeiss Axioplan II microscope and utilises the computer controlled Kinetec™ stage. The research group is supervised by Professor Maurice Brunel and is growing rapidly. Two PhD students and a forthcoming postdoc. constitute the research element. These are:

1) Marc Jolivet, who has been working for two years in Northern Tibet and has focused his work on understanding the kinematics of the Altyn Tagh Fault. The main aim of Marc’s project is to investigate the Cenozoic tectonic evolution of the northern margin of the Tibetan Plateau. A majority of the samples collected during a joint French-Chinese expedition to Northern Tibet during 1996-1997 have been processed and analysed at ETH, Zürich by Diane Seward and her staff over the previous two years. In the meantime, Marc developed the fission-track laboratory in Montpellier. Samples collected last summer during a second expedition to the Qilian Shan area (Northern Tibet) will be processed in the laboratory at Montpellier this winter, whilst maintaining close collaboration with ETH Zürich. (*Ed*., for those people who can read French and are interested in reading more about this project, a Jolivet et al. article is

currently in press and is listed in the Recent Papers section).

2) Olivier Maurel has been part of the Montpellier team since September. His current project is based in the Pyrenees where he is attempting to correlate the exhumation history of the mountain belt with displacements on the main faults. $^{40}Ar/^{39}Ar$ analysis of mylonites will be combined with fission-track analysis in order to study the fault zones in the belt. Olivier completed his first field season this summer and is now processing his samples.

3) Anke Wendt will take up a post-doctoral position in the group in a few weeks. Anke will be studying the influence of pressure, stress, temperature and time on fission tracks in zircons. She will perform tri-axial deformation experiments on artificial and natural zircons using Paterson mineral deformation apparatus.

Finally, **Geoff Laslett** wrote to inform us that on the 31st July, 1999, Rex Galbraith was awarded a D.Sc. in Statistical Science by the University of London. His contributions to `fission track geochronology and other sciences' were specifically cited. Congratulations Dr. Rex! (A D.Sc. is granted on the basis of significant accumulated publications in a particular field of science, rather than a thesis).

Ready... Set...
Pick an Apatite Fission-Track Annealing Model *by* Ray Donelick

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Two Types of Apatite Fission-Track Annealing Models

Two types of apatite fission-track annealing models can be broadly defined: a) one that is peer-reviewed and published and b) one that remains unpublished. A key component of the scientific process is that a scientist must be prepared to defend his/her science. In the public domain where scientific ideas are scrutinized and exchanged freely, a proper defense requires that a study be as transparent as possible, with all potential flaws visible and sufficient information provided to permit, at least theoretically, independent verification of the study.

Peer-Reviewed and Published...

Presently, the only published models dealing with the kinetic variability of fission-track annealing among different apatite species are those of Ketcham et al. (1999) based on three measurable parameters: *D*par (etch-figure diameter parallel to the apatite c-axis in microns), Cl apfu (concentration of chlorine in atoms or ions per formula unit), and OH apfu. Figures 1a, 2a, and 3a show apatite fission-track age and length data for a sample named 171-1 plotted against each of these three kinetic parameters. This sample is a Triassic-aged sandstone collected from a canyon bottom in the Colorado Plateau near Moab, Utah, U.S.A. approximately 20 km from the 25-28 Ma La Sal Mountain intrusive complex. Sample 171-1 exhibits inter-apatite grain variations in *D*par, Cl apfu, and OH apfu commonly observed in sandstones. A single thermal-history (Figs. 1b, 2b, and 3b; line-segments connecting these [Ma b.p.,°C] points: [0.000, 14.660], [2.894, 65.969], [27.17, 109.948], [219.936, 14.660], [317.685, 195.812]) adequately predicts the apatite fission-track data for sample 171-1 for each of the three kinetic parameters using the Ketcham et al models.

The overall importance of fission-track annealing kinetic variations among different apatite species was the subject of an article by Paul F. Green printed in *On Track* (November 1995, Volume 5, Number 2, Issue 11, pages 8-10). In this article, Green asserted: "To interpret [apatite fission-track] data correctly in terms of the magnitude and timing of maximum paleotemperatures, it is therefore critical to quantitatively allow for the influence of Cl on annealing rates." This statement was very misleading then, as evidenced by the Burtner et al. (1994) study, and it remains misleading today. In fact, Cl content is not, as Green strongly implied (and has explicitly stated elsewhere), "...critical..." for purposes of interpreting apatite fission-track data (e.g., Fig. 1a is constructed and Fig. 1b arrived at without the need for Cl content or any other chemical composition data). The threat to Green's Cl-only dogma is that *D*par works quite well and can be measured using the same analytical system as used to measure the fission-track grain age and length data, thereby eliminating the time and expense of electron microprobe analysis.

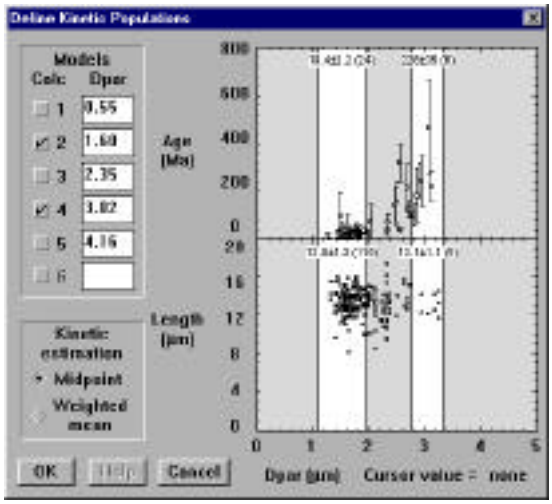

Figure 1a. Apatite fission-track age and length data for sample 171-1 plotted against kinetic parameter *D*par.

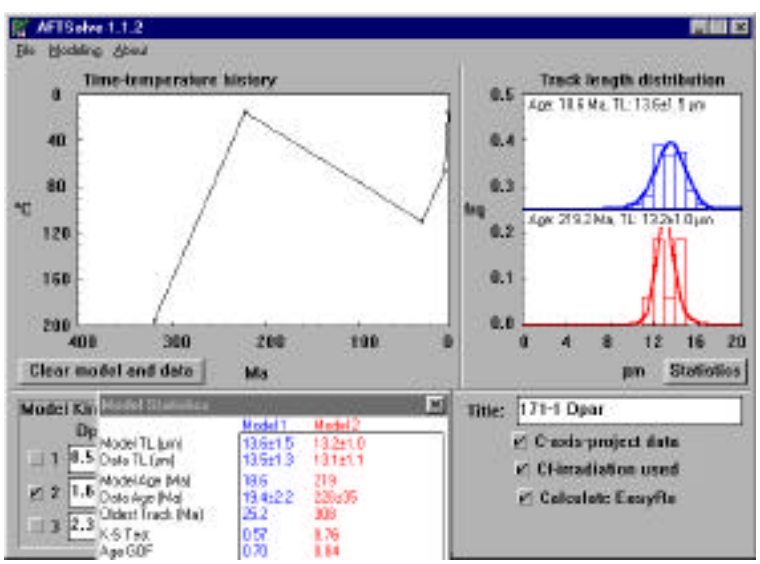

Figure 1b. Thermal history for sample 171-1 calculated using kinetic parameter *D*par.

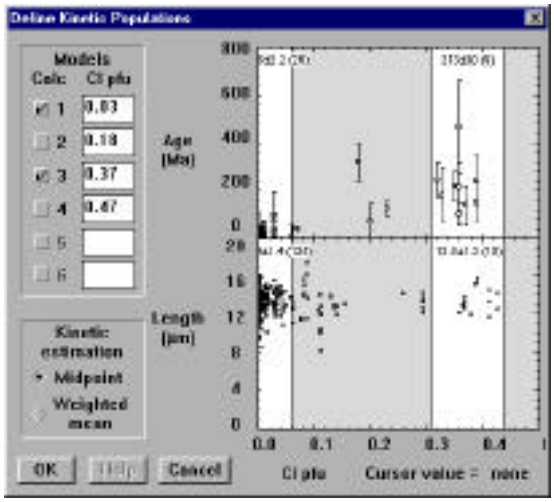

Figure 2a. Apatite fission-track age and length data for sample 171-1 plotted against kinetic parameter Cl apfu.

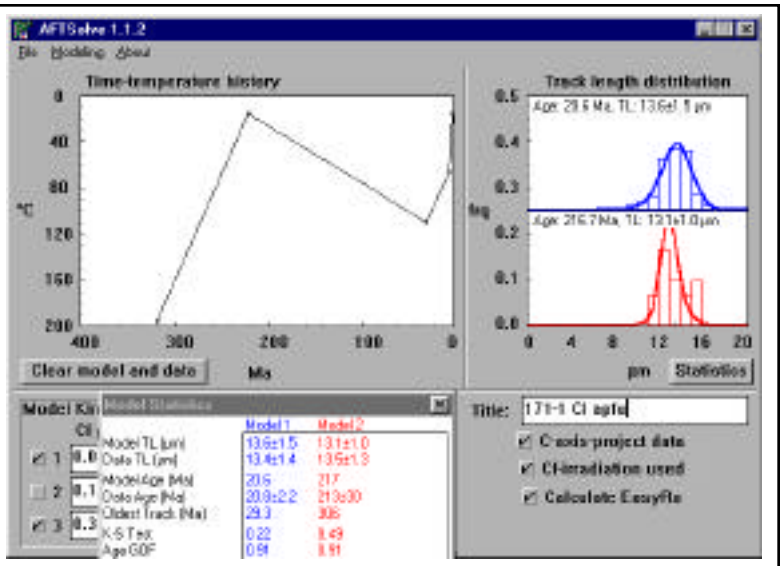

Figure 2b. Thermal history for sample 171-1 calculated using kinetic parameter Cl apfu.

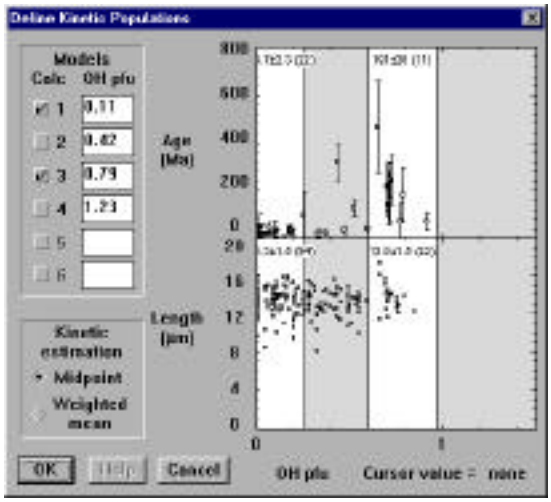

Figure 3a. Apatite fission-track age and length data for sample 171-1 plotted against kinetic parameter OH apfu.

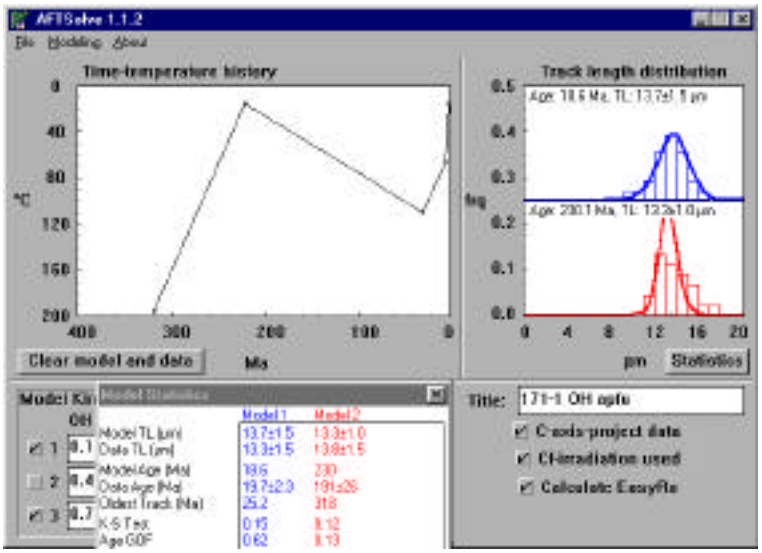

Figure 3b. Thermal history for sample 171-1 calculated using kinetic parameter OH apfu.

Furthermore, Green stated that "Interpreting [apatite fission-track] data using mono-compositional models (such as published models based on Durango apatite) can lead to serious errors...." I applaud this statement and add for emphasis that the conventional fission-track approach to apatite, i.e., the approach lacking x-axis data such as those shown in Figures 1a, 2a, and 3a, must be abandoned. Because Green's article invites a response, I challenge the author to explicitly admit to the geological community the possibility that his group's pre-1995 interpretations contain "...serious errors..." because many suffer from the very problem he describes. Furthermore, Green should indicate that it is impossible to upgrade these studies to current standards, without further analysis, because they contain no kinetic parameter information even though he had "...known since the early 1980s that chlorine content exerts a critical control on fission track annealing kinetics in apatite." I believe we all need to come clean with similar admissions where they apply.

By no means has the last word been said or written about fission-track annealing variability among different apatite species or about rigorous thermal-history modeling. Carlson et al. (1999) failed to identify a single parameter or combination of parameters that could account for all of the kinetic variation observed among the 15 apatites they studied. However, as Ketcham et al. (1999) argue, *D*par, Cl apfu, and OH apfu likely work well in the vast majority of geological cases. Ultimately, the basic observations of Carlson et al. cannot be denied but they can be built upon and any all-encompassing model of fission-track annealing in apatite must incorporate their observations. For instance, if Carlson et al. and Ketcham et al. had chosen to publish only a subset of their data, then they could have chosen, at their whim, to make any one of the three kinetic parameters studied appear to be either perfect or useless. It is only in the context of the complete set of data that it can be seen that these three kinetic parameters are neither perfect nor useless, individually. Much work remains to be done to fully understand apatite fission-track annealing and the solution almost certainly includes parameters not directly related to apatite chemical composition (at least as resolvable by electron microprobe analysis).

...and Unpublished

Again, back to the Green *On Track* article cited above, Green further stated: "The quantitative details of our multi-compositional model remain proprietary...But...we would be willing to provide a service to outsider users in interpreting data ...(...for bona-fide academic research projects only)." Because the proprietary model Green referred to is, by nature, unpublished, this offer is an oxymoron. A "...proprietary..." interpretive tool based on hidden data is hardly a basis for "...bona-fide academic research projects..." that require transparency to permit their independent verification. Whether or not Green's proprietary Cl weight percent model is better than any other model is irrelevant in this and any public forum. I expect others to share my opinion that the use of Green's proprietary model in "...bona-fide academic research..." does not constitute science, especially now that more transparent models exist in the published literature. As the saying goes, "Either put up, or shut up."

Parting Thoughts

Where should experimentalists go from here? Given the complexities encountered trying to account for kinetic variability among apatite species, I believe it is time we step out of our 'box' regarding annealing experiments and seek novel solutions to this problem. Below are some thoughts that I will gladly discuss further with anyone who asks.

Carlson et al. (1999) studied 15 apatites, of which only 4 were studied in great detail. Ketcham et al. (1999) demonstrated that adequate apatite-apatite inter-comparisons can be made with 10+ track-length measurements instead of the traditional 50+ to characterize a single apatite. Thus, it would be most useful to conduct detailed experiments on a single highly resistant-to-annealing apatite and lesser detailed experiments on many more apatite species than the 15 of Carlson et al. Intuition tells me that 50 or more apatites spanning a wide range of cation and anion substitutions will yield significant further insight into the controls on fission-track annealing rates.

Greater attention should be given to the possible effects of pre-heating apatite at temperatures of ca. 350-550°C to remove natural fission tracks for experimental studies. Should these conditions be normalized? What exactly is happening when we do this? Does alpha-damage matter? Does gas loss (e.g., helium, other?) matter? Are structural changes occurring?

Attention should focus on whether or not natural fission tracks (resulting from the spontaneous fission of ^{238}U) exhibit annealing rates inherently different from those of their laboratory-produced analogues (fission tracks resulting from the thermal-neutron-induced fission of ^{235}U). This could be accomplished by studying side-by-side the annealing of natural fission tracks (say, in Fish Canyon Tuff) and induced fission tracks in

the same apatite species partially annealed to 'equal' the natural tracks prior to the experiments.

Crystallographic orientation-dependent annealing rates in apatite offer key evidence concerning the physical nature of latent fission tracks and the physical process(es) by which they anneal. Donelick et al. (1999; page 1233) present some ideas concerning these issues, in effect suggesting that fission tracks may behave as negative crystals. This concept, combined with the work of Nichols and Mullins (1965) concerning how surfaces seek to minimize their free energy, and the geometrical model of a fission-track presented by Carlson (1990), offers a physical basis to move beyond the empirical annealing models and empirical coefficients currently favored.

It is noteworthy that no effort was made to solicit or poll opinions from the author's colleagues or anyone else regarding the content of this article.

Published(!) Literature Cited

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How to Measure Etch Pits with FT Stage *by* Trevor Dumitru

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Ray Donelick has asked me to provide a recipe for people who would like to measure etch figures (etch pits) with FT Stage. FT Stage is a Macintosh computer program for controlling automated microscope stages and digitizing tablets for fission track data collection (Dumitru, 1993, Nuclear Tracks, vol. 21, p. 575-580). It was developed before the advent of Ray's methods (Donelick, this issue) and does not include specific routines for measuring figures. However it is still easy enough to do and we have measured figure lengths (dpar) on a few samples in our lab. I estimate it will take about 25 minutes extra (once you get the hang of it) to do a sample with the recipe below versus using new routines integrated directly into a future version of the FT Stage.

The General Idea

FT Stage allows you to measure track lengths and the same commands can easily be used to measure dpar. FT Stage also allows you to easily return to the position of any previous grain you dated or track length you measured. One possible strategy for measuring dpar would be to first measure all ages and lengths in the usual way, and then come back and measure dpar. A recipe for this is given below. This particular recipe can be applied to old samples you have already analyzed to add dpar data. Simpler recipes are possible if you are analyzing new samples.

The main concern is the need to keep the data properly organized to avoid confusion. The solution outlined below uses three new FT Stage files. One file contains the positions of the grains that were dated. The other two contain the positions of the track lengths that were measured, but resaved as if they were instead the positions of grains that were dated. The dpar measurements may then be added, using the standard track length measurement commands.

Recipe

1. First complete your analysis in the usual way (date all your grains and measure all your track lengths), and save your data. Or reopen an existing data file and collect dpar data from any sample you have analyzed in the past eight years. Assume the file name is "Sample.pos". Select the "Save As Text..." command and create a new TEXT (ASCII) file of your data, name it "Sample.text". I'll assume you have dated 40 grains, measured 100 lengths, and that you now want to measure 4 etch figures per grain and per length.

2. To measure figures, you will need to set up three new FTStage files, one for the grains you dated, one for the first 50 lengths you measured, and one for the second 50 lengths. (FT Stage permits only 300 track lengths to be measured per file. This is why you need three files, to conveniently accommodate the 560 dpar measurements needed.)

3. To set up the first file, select "Strip File..." to create a new file that keeps your existing age grain data but deletes all your track length data. Save this file with the name "Sample.age pits".

4. To set up the second and third files, select "Strip File..." and create two identical new files that delete all your age grain data but keep your track length data. Save these files with the names "Sample.length1" and "Sample.length2". Close the file "Sample.pos".

5. "Sample.length1" and "Sample.length2" now need modified so that the positions of the track lengths are resaved as if they were grains that you dated. To do this, open "Sample.length1" and drive the stage to Length #1 (using the "Drive Stage To..." command). Place the cursor LED in the exact center of the microscope field of view. Press 6-6 ("Mark for Age" command); this will record the position of Length #1 as Age Grain #1. Next, move to Length #2 (using "Move to Next Length...", or command-P), then use 6-6 to mark it as Grain#2. Repeat for the first 50 grains.

Although this may seems tedious, it really isn't. You just need to repeatedly press a four-key combination (Command-P <Return> 6 6) on the Macintosh keyboard. You don't need to actually look at the grains through the microscope. Just be sure that the track length numbers and age grain numbers match.

Save the file "Sample.length1". Select "Strip File..." and create a new files that keeps your newly marked "age grain" data but deletes your original track length data. Name this file "Sample.length1 pits". Close the file "Sample.length1".

6. Repeat the process for Lengths #51 to #100 and file "Sample.length2".

7. You are now ready to measure dpar. Open "Sample.age pits" and drive to Grain#1 ("Drive Stage To..."). Measure the lengths of exactly four figures using the 7-7 length measurement command. Drive to the next grain ("Move to Next Grain") and measure exactly four more figures. Repeat until done. Save your data. Select "Save As Text..." to create a TEXT file of the data; name it "Sample.age pits text".

8. Repeat for the other two files, to measure figures for your track lengths. Name the two TEXT files "Sample.length1 pits text" and "Sample.length2 pits text".

9. Using Excel or another spreadsheet program, open your three text files "Sample.age pits text", "Sample.length1 pits text", and "Sample.length2 pits text". Use basic Excel commands to calculate the means of each set of four dpar measurements.

10. Using Excel, open "Sample.text". Also open the text file from your age calculation program. Manually match up the mean dpar's with the proper track length and single grain age measurements. Plot out your data in the format that you prefer, using Excel's graphing routines, or paste the data over into a graphing program.

Subtle points

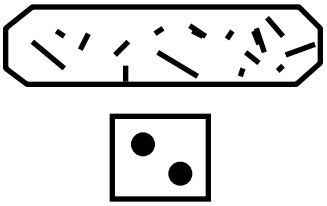
1. Clearly, you need to be careful to properly match up your figure measurements with your age and length measurements. In order to keep the data straight, I suggest always measuring exactly four figures per grain or length. If fewer than four are available in a particular grain, you may want to measure zero length figures and edit them out manually later, or measure one figure twice (not strictly scientific but we'll hope Geoff and Rex aren't reading).

3. You should add labels and comments to your various TEXT files so you know what they are if you come back to them in a few years.

4. If you don't have Excel, AppleWorks 5 from Apple costs about US$89 and includes spreadsheet, word processing, drawing, and data base programs for both Mac and Windows computers. The Mac version will save files to PC discs inserted into your Mac floppy drive, making it easy to move your data over to a Windows PC if you like.

The fission-track modelling software with the terrible icon

Monte Trax



by Kerry Gallagher, T.H. Huxley School of Environment, Earth Science and Engineering Imperial College of Science, Technology and Medicine, South Kensington, London, SW7 2AS, England.

There are various versions and vintages of this Macintosh-based software in circulation. There is now a version which runs only on PPC (68K machines are no longer supported) and it operates fine under system 8.6, on G3 machines, etc. It would save me a lot of time dealing with enquiries if everyone who has a copy of Monte Trax contacts me, and I can then distribute the most recent version. There have been a few changes in the last year or two, and I need to provide update documentation. There are plans for a PC version, but as yet this is not a major priority.

Please send an email to Kerry Gallagher, k.l.gallagher@eurotrack.co.uk.

Recent Fission-Track Papers

Here is a list of recently or soon-to-be published fission track papers that were submitted by the authors for inclusion in this issue of On Track. I am grateful to the authors for the information. If you have a paper that you would like to see listed in this section, please send the complete reference or a photocopy of the first page to the editor. We are also interested in non-fission-track papers that may be of special interest to the fission-track community. Papers in press are welcome, please include an estimate of the expected month of publication.

1997

Gallagher, K. and Brown R.W., 1997, The onshore record of passive margin evolution, Journal Geological Society London, 154, 451-457.

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1998

Burg, J-P., Nievergelt, P., Oberli, F., Seward, D., Davy, P., Maurin, J-C., Zhizhong, D. and Meier, M., 1998. The Namche Barwa syntaxis: evidence for exhumation related to compressional folding . Journal of Asian Earth Sciences, 16, 239-252.

Cooper, G.T., O'Sullivan, P.B., Sherwood, N., and Hill, K.C., 1998, Assessing maturity and organic oxidation through the integration of Fluorescence Alteration of Multiple Macerals (FAMM) and apatite fission track thermochronology (AFTT): Petroleum Exploration Society of Australia Journal 26, 159-168.

Coughlin, T.C., O'Sullivan, P.B., Kohn, B.P., and Holcombe, R., 1998, Apatite fission-track thermochronology of the Sierras Pampeanas, central west Argentine: Implications for the mechanism of plateau-uplift in the Andes. Geology, 106, 999-1002.

Gallagher, K., Brown, R.W. and Johnson, C. J., 1998, Geological Applications of Fission Track Analysis. Annual Reviews of Earth and Planetary Sciences, 26, 519-572.

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Call for Contributions to the May/June 2000 On Track issue 20

The next issue of On Track is scheduled for release in late May/June, 2000 and we are looking for contributions. On Track welcomes contributions of virtually any kind, including scientific articles, news, gossip, job openings, descriptions of new lab techniques, reviews of useful products, raving editorials about what all the other labs are doing wrong, meeting announcements, cartoons, and descriptions of what you are doing in your research.

If you would like to contribute, **PLEASE** send the final document no later than May 15, 2000. If you propose to submit a substantial article, **PLEASE** let the editor know ASAP.

On Track includes a list of recent and forthcoming fission-track papers. If you know of a paper that was published recently or is in press and should appear in the near future, please let me know so that it can be added to the list. Also, if you happen to change location (or know someone who has) due to a change in jobs or finishing off the thesis and graduating, please inform the editor.

On Track is also happy to print advertisements. Please contact the editor for advertising rates. On Track has remained free of charge and will continue to do so (at least for the near future). However, to save costs we generally mail only one copy per lab so please be sure to photocopy the lab copy and pass copies around your lab. If possible, we will also send out On Track electronically, so please make sure the editor has an up-to-date e-mail address for each person/lab. Send contributions to:

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1999/2000 UPDATE OF THE INTERNATIONAL FISSION-TRACK DIRECTORY

This directory is published solely for On Track, December 1999, Page 12 *searchers. It is neither a comprehensive directory including all fission-track* *nent endorsing the scientific stand of individuals by the fission-track community. We provide here an update with the hope that we have accounted for the changes in addresses that have occurred since the last release of the directory.* ***If you have changed your address, know someone else who has or think that someone should be on this list, please let the Editor know (spikings@eurasia.ethz.ch).***

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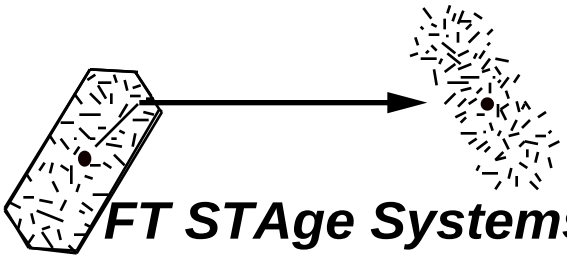

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Automated microscope stage systems greatly increase operator productivity by automating tedious aspects of microscope work. Since their introduction, our systems have been adopted by far more fission track laboratories than any other system.

Outstanding Hardware:

Our stage systems are based on a highly-reliable, high-precision Kinetek™ computer-automated microscope scanning stage. Several hundred Kinetek stages are currently in operation, mainly in the demanding microelectronics and biotechnology industries. Compatible with almost any brand of microscope. Use of this popular, general purpose stage significantly reduces the system cost. System also includes a high-quality Calcomp™ 12x12" digitizing tablet. Assembly to full operational status generally requires only a few days.

Outstanding Software:

Software is a complete, highly sophisticated Apple Macintosh program developed with careful attention to all aspects of microscope work. Fully integrates track counting, track length measurement, slide scanning, and file management functions. Moves precisely from grain to mica print in 3 seconds. Very user friendly. Fully functional with a new Macintosh or a very inexpensive old Macintosh.

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Stage is driven primarily with the digitizing tablet cursor rather than a joystick. For example, to center a grain or track, just superimpose the cursor on it, push a button, and the stage automatically centers it. This avoids tedious manual centering via the joystick. Most software commands are driven from the cursor buttons, which are easily distinguished by feel, so there is no need to look away from the eyepieces to the computer screen or keyboard.

*Fission Track Laboratories Using the System (year installed; *adapted to a non-Kinetek stage)*

- Stanford University, Stanford, California (1991)
- University of California, Santa Barbara, California (1992)
- ARCO Exploration and Production Technology, Plano, Texas (1992). Moved to University of Minnesota, Minneapolis, Minnesota, in 1999.
- Universität Bremen, Bremen, Germany (1993)
- E.T.H., Zürich, Switzerland (1993*)
- Kent State University, Kent, Ohio (1993)
- University of Wyoming, Laramie, Wyoming (1993)
- University of Arizona, Tucson, Arizona (1993)
- Max-Planck-Institut, Heidelberg, Germany (1993*)
- Union College, Schenectady, New York (1994)
- Monash University, Melbourne, Australia (1994*). Moved to University of Melbourne in 1999.
- La Trobe University, Melbourne, Australia (two systems, 1994*). Moved to University of Melbourne in 1999.
- University of Pennsylvania, Philadelphia, Pennsylvania (1995)
- Universität Tübingen, Tübingen, Germany (1995)
- Universidad Central de Venezuela, Caracas, Venezuela (1995)
- Brigham Young University, Provo, Utah (1995)
- Central Research Institute of the Electric Power Industry, Chiba, Japan (1995)
- Universität Salzburg, Salzburg, Austria (1996)
- University of Southern California, Los Angeles, California (1996)
- E.T.H., Zürich, Switzerland (second system, 1996*)
- Geologisk Centralinstitut, Copenhagen, Denmark (1996*)
- University of Waikato, Hamilton, New Zealand (1996*)
- Università di Bologna, Bologna, Italy (1997)
- Centro di Studio di Geologia dell'Appenno e delle Catene Perimediterranee, Florence, Italy (1997)
- University of Wyoming, Laramie, Wyoming (second system, 1997)
- Universität Potsdam, Potsdam, Germany (1997)
- Seoul National University, Seoul, Korea (1998)
- E.T.H., Zürich, Switzerland (third system, 1998)
- Universität Basel, Basel, Switzerland (1998)
- University of Florida, Gainesville, Florida (1998)
- Universite Paris-XI, Paris, France (1998)
- Universität Graz, Graz, Austria (1998)
- Göteborgs Universitet, Göteborg, Sweden (1999)
- Universidad de Cádiz, Cádiz, Spain (1999)
- Universite Montpellier II, Montpellier, France (1999)
- Kurukshetra University, Kurukshetra, India (1999)
- Universität Tübingen, Tübingen, Germany, (second system, 1999)
- California State University, Fullerton, California (2000)

Further Information:

An early version of the system is described in a paper in Nuclear Tracks and Radiation Measurements, vol. 21, p. 575-580, Oct. 1993 (1992 Philadelphia Fission Track Workshop volume). For detailed information please contact: Dr. Trevor Dumitru, 4100 Campana Drive, Palo Alto, California 94306, U.S.A., telephone (auto-switching voice and fax line): 1-650-725-6155.

Demonstrations before and after FT2000 in Melbourne:

Demonstrations will be available at the University of Melbourne the day before and the day after the FT2000 conference, using the Melbourne Zeiss Axiotron stages and the Axiotron version of FT Stage (slightly different than the Kinetek version).

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15 YEARS - 15 COUNTRIES

Better than ever before ! Version 2.0 of our classic FTD software, Trakscan, which runs under Windows NT/98/95 will be released at FT2000 in Lorne, Victoria, Australia in February 2000. Don't miss this new, exciting product ! Low-cost upgrades will be offered to existing Trakscan Version 7.0 users.

It may be of interest to Fission Trackers to know that Version 2.0 of AutoScope, our very popular image processing software package, has already been released and exported.

To use our high-accuracy stage for other applications, please note that our Windows NT/98/95 version of the ASDK (Autoscan Software Development Kit) is now available. Contact us !

We look forward to the pleasure of meeting you at FT2000, and the privilege of demonstrating our latest technology to you !

Please note our new street address (we have moved to a larger office) :

Street Address :	4/293 Bay Street, Brighton, Vic 3186 Australia
Postal Address :	PO Box 112, Ormond, Vic 3204, Australia
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GeoCanada 2000 symposium on high precision and low temperature geochronology

When? How fast? These two key questions form the core of geochronological studies. With recent advances in both high precision and low temperature geochronology, geoscientists now have the ability to resolve not only the relative order of earth processes, but also the rates at which they occur.

We would like to invite you to submit abstracts to a symposium titled: "Calibrating Rates of Earth Processes" This symposium will provide a forum for the presentation of novel geochronological insights, methods and applications relating to:

1. High precision geochronology including methods for the enhancement of temporal resolution and relative timing of events.
2. Absolute dating of earth processes, including intercalibration of isotope systems.
3. Integration of multiple isotopic and fission track methods for the purposes of geochronology, as well as high and low temperature thermochronology and process/reaction rate determinations

This symposium will be an integral part of GeoCanada 2000, the culminating gathering of all of the key constituencies of Canadian geoscience, scheduled for May 29 to June 2, 2000 in Calgary, Alberta. This symposium will provide a forum for the dynamic exchange of ideas of particular interest to colleagues such as yourself. If you would like to attend or would like to be on a mailing list to receive further information, please reply by e-mail or post to any of the addresses below. Extended abstracts of up to 4 pages length will be accepted from Oct. 1, 1999 - Jan. 7, 2000. Further meeting details can be accessed at: www.GeoCanada2000.com.

As our e-mail distribution list is certainly not all-inclusive, we encourage you to circulate this notice to any other interested colleagues to ensure the widest possible distribution. In addition, please feel free to contact either of us if you have any questions. We are confident that with your participation, this event will be as successful as the last, and we look forward to seeing you in Calgary.

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