



United States Department of the Interior



GEOLOGICAL SURVEY

Reston, VA 22092

Mail Stop 990

Ms. Dianne Heim, Licensing Assistant
Nuclear Materials Safety Section
U.S. Nuclear Regulatory Commission
101 Marietta Street, NW, Suite 2900
Atlanta, GA 30323

January 30, 1995

Dear Ms. Heim,

The U.S. Geological Survey request an amendment to our materials license number 45-15-923-01 which has an expiration date of November 30, 1995. We wish to modify the list of authorized users in the following ways:

1. Delete user Henry Cortesini, Jr. (12.C). He is no longer with the U.S. Geological Survey.
2. Add Nancy D. Naeser and Charles W. Naeser to the list with an authorization for Subitems 6.Y. They have recently transferred from the U.S. Geological Survey in Denver where they were performing fission-track dating and are transferring that experiment to the Reston facility. A description of the experiment and copies of their credentials are attached.

Sincerely,

Gregory A. Wandless

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FISSION-TRACK DATING EXPERIMENT: N. D. Naeser and C. W. Naeser

The fission-track dating experiment involves irradiating, at the USGS Triga reactor, minerals and glasses that are mounted in epoxy or teflon and usually covered with muscovite detectors. The amount of mineral or glass irradiated per sample is $< 0.01\text{g}$. The total thermal neutron dose will generally be between 10^{15} and 10^{16} n/cm². All radioactive material is in the solid state. There will not be any radioactive liquids or gasses. At the time the samples are being worked on, the level of radiation will be less than 1mr/hr.

All radioactive material will be stored in 3D231.

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EXPERIENCE WITH RADIOACTIVE MATERIALS

DATE: 1/5/95

NAME: CHARLES W. NAESER

TITLE: Geologist

FORMAL EDUCATION:

INSTITUTION AND LOCATION (CITY & STATE)	DATES OF ATTENDANCE	DEGREE	FIELD
Dartmouth College HANOVER, NH	1958-1962	A.B.	Geology
Dartmouth College Hanover, NH	1962-1964	M.A.	Geology
Southern Methodist U Dallas, TX	1964-1967	Ph.D.	Geology

FORMAL COURSES RELEVANT TO:

- (a) Principles and practices of radiation protection
- (b) Radioactivity measurement standardization and monitoring techniques and instruments.
- (c) Math calculations basic to use and measurement of radioactivity.
- (d) Biological effects of radiation.

COURSE	WHERE	HOW LONG?	RELEVANT TO			
			(a)	(b)	(c)	(d)
Nuclear Physics	SINU	2 Terms	a, b, c			
Radiation Safety	USGS Boston	1 day (June 3, 1964)	a, b, c, d			

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ON-THE-JOB TRAINING RELEVANT TO THE ABOVE:

APPLICABLE TO
(a) (b) (c) (d)

EMPLOYER

TYPE OF WORK

EXPERIENCE WITH RADIATION:

I have been operating a Fission Track Dating facility for 30 years. 3 years as a graduate student and 27 years with USEC.

I was a member of the USEC Reactor Operations Committee from 1952-1955.

**U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - GEOLOGIC DIVISION**

PROFESSIONAL/TECHNICAL PERSONNEL RECORD

1. Name (last) (first) (initial) 2. Birth date 3. Date prepared

Nasser Charles W. 7/2/40 2/11/93

4. Duty station 5. Classification title Series Grade

Lakewood, Colorado Supervisory Geologist 1350 GM-15

6. List first and second scientific or technical specialties

- a. (206) Isotope geology
- b. (204) Inorganic chemistry/geochemistry

7 Other scientific, technical, or special skills (regardless of relation to present position)

8 Education (include secondary schools)

School	Major and minor specializations	Dates attended	Degree, year or anticipated year
<u>Falls Church High School</u>	<u>College prep.</u>	<u>1953-1958</u>	<u>Diploma, 1958</u>
<u>Dartmouth College</u>	<u>Geology-Chemistry</u>	<u>1958-1962</u>	<u>A.B., 1962</u>
<u>Dartmouth College</u>	<u>Geology</u>	<u>1962-1964</u>	<u>A.M., 1964</u>
<u>Southern Methodist Univ.</u>	<u>Geology (Nuclear)</u>	<u>1964-1967</u>	<u>Ph.D., 1967</u>

9 Civil Service grades and dates

Check if career employee X

Grade*	3	4	5	9	10	11	12	13	14	15	GM-15*
Date	1959	1962	1962	1968	1968	1968	1969	1972	1976	1980	1990

*Use asterisk for any grade obtained in a management or other nonresearch capacity above GS-12

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10. Specialized training (include postgraduate and government course)

Statistics
Mineral Identification
Introduction to Supervision
Adverse Actions
EEO
Radiation Safety June 3, 1994

11. Membership in professional societies.

Geological Society of America (1963-present), Fellow (1974)
American Geophysical Union (1967-present)
Colorado Scientific Society (1971-present), Councilor (1982-84)

12. Scientific and Public Service.

a. Lectureships, symposia, invited conference participation.

- 1972 Visiting Professor, 4-week short course, Geophysical Institute, University of Alaska, Fairbanks, Alaska (invited)
- 1975 Visiting Professor, 3-week short course, Department of Geological Sciences, University of Washington, Seattle, Washington (invited)
Co-convenor, Penrose Conference on "Plio-Pleistocene Geochronology"
- 1977 Invited lecture, University of Bern, Bern, Switzerland
- 1978 Visiting Professor, 2-week short course, Department of Geology, University of Arizona, Tucson, Arizona (invited)
University of Montana (3 lectures), Missoula, Montana (invited)
University of Toronto (2 lectures), Toronto, Canada (invited)
Two-week short course, Dartmouth College, Hanover, New Hampshire (invited)
Pennsylvania State University (3 lectures), University Park, Pennsylvania (invited)
- 1980 Invited lecture, N.A.T.O. Summer Institute, "Tephra Studies as a Tool in Quaternary Research", Iceland
Two invited lectures, "Fission-Track Dating Workshop", Pisa, Italy
- 1982 Louisiana State University (2 lectures), Baton Rouge, Louisiana (invited)
- 1983 Invited Speaker, Symposium on "Quaternary Dating Methods", Geological Society of America Annual Meeting, Indianapolis, Indiana
- 1984 University of Texas-Austin (4 lectures) (invited)
Invited lecture, University of Texas-El Paso
- 1985 Invited speaker, symposium on "Thermal History of Sedimentary Basins", AAPG Annual Convention, New Orleans, Louisiana
Invited speaker, symposium on "Radiometric Calibrations of Thermal History and Application to Geophysics", Geological Society of America Annual Meeting, Orlando, Florida
- 1986 Invited speaker, symposium on "Phanerozoic Time-Scale Calibration", Sixth International Conference on Geochronology, Cosmochronology, and Isotope Geology, Cambridge, England
Invited lecture, presented "First Annual Henry Faul Memorial Lecture", Department of Geology, University of Pennsylvania, Philadelphia, Pennsylvania
- 1988 Invited lecture, Institute for Energy Technology, Kjeller, Norway
Invited lecture, Geological Survey of Norway, Trondheim, Norway
Invited lecture, Department of Geology, Miami University, Oxford, Ohio
Invited Session Chairman, 6th International Fission-Track Workshop, Besançon, France
- 1989 Taught 2 day short course on "Fission-Track Analysis" at Geological Society of America Annual Meeting in St. Louis, with N. D. Naeser and K. D. Crowley, course chosen by GSA as one of

the "Frontiers in Geoscience Courses"

12a., continued

- 1991 Invited lecture, Louisiana State University, Baton Rouge, Louisiana
Invited lecture, ARCO Research Lab, Plano, Texas
Invited speaker, Nuclear Regulatory Commission, Bethesda, Maryland
- 1993 Invited lecture, University of California, Davis, California
Invited lecture, University of Colorado, Boulder, Colorado
Invited lecture, Fort Lewis College, Durango, Colorado
Invited lecture, University of New Mexico, Albuquerque, New Mexico
Invited lectures, one-week short course, University of Göteborg, Göteborg, Sweden
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b. Committees to render scientific judgment.

- 1977-79 Member, Branch of Isotope Geology Promotion Panel
1978-81 Thesis advisor, two Master's students, Colorado School of Mines
1979 Thesis examiner, Academie de Montpellier, Universite des Sciences et Techniques due Languedoc
1981 Ph.D. examiner, Dartmouth College
1982 Ph.D. examiner, University of Melbourne, Australia
1984 Ph.D. examiner, University of Paris, South Orsay, France
1984-88 Ph.D. advisor, Colorado School of Mines
1986 Thesis advisor, two M.A. candidates, Dartmouth College
1987 Ph.D. advisor, University of Alaska
Ph.D. examiner, University of Alaska
Ph.D. advisor, University of Wyoming
- 1989 Ph.D. examiner, University of Melbourne, Australia
1990 Ph.D. examiner, University of Wyoming
- 1991 I reviewed 19 manuscripts and 5 research proposals
1992 I reviewed 17 manuscripts and 7 research proposals
1991 Appointed to Editorial Board, Geology (1991-1993)
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c. Special inventions, patents held, techniques or methods developed or improved.

Largely responsible for the development of the fission-track method of dating geological materials, and the interpretation of those ages.

d. Other committees, special assignments, and administrative duties

- 1979-80 Organization committee, USGS Workshop, "Tectonics of the Central Region"
1979 National Geographic Society Grant to study Plio-Pleistocene boundary in southern Italy
- 1979 Appointed Adjunct Professor, Dartmouth College (1979-present)
1984 Appointed Adjunct Professor, University of Wyoming (1984-present)
- 1982-88 Member, Reactor Operation Committee, USGS, Denver
- 1989 Spent a week in Mexico City at the request of International Atomic Energy Agency (Vienna, Austria) reviewing a program of nuclear track research being conducted by the National Institute of Nuclear Research (Mexican Government facility)

13. Honors, awards, recognition, elected membership.

Schuler Geology Prize, Southern Methodist University (1966)

Best Paper of the year, Colorado Scientific Society, D.A. Coates, coauthor (1980)

14. Career experience:

<u>Dates</u>		<u>Brief description of work or position</u>
<u>From</u>	<u>To</u>	
6/59	5/59	Water analysis at USGS Quality of Water Laboratory in Washington, D.C. (D. Weaver, supervisor).
6/60 and 6/61	9/60 9/61	Research on the adsorption and leaching properties of basic calcium phosphate and bone char at Bone Char Research, Inc., National Bureau of Standards
6/62	9/62	Water analysis and research on exchange of CO ₂ between water limestone at USGS Quality of Water Laboratory, Washington, D.C. (H. Feltz, supervisor).
6/63	9/63	Organize and set up a water analysis laboratory at Department of Geology, Dartmouth College. (N. M. Johnson, supervisor).
7/64	9/64	Learning the fission-track technique at the General Electric Research and Development Center, Schenectady, New York. (R. L. Fleischer, supervisor).
6/65	9/65	Research Assistant, Graduate Research Center of the Southwest, Dallas, Texas. Working on shape and color distribution of moldavites and fission-track dating of sphene and apatite. (H. Faul, supervisor).
8/66	9/66	Research Assistant, Graduate Research Center of the Southwest, Dallas, Texas. Research on paleomagnetic properties of some metamorphic rocks from Colorado. (C. Helsey, supervisor).
8/67	7/71	Geologist, Branch of Astrogeologic Studies, USGS, Menlo Park, CA; M. Carr, supervisor. I was assigned to a classified project funded by the U.S. Air Force. In addition I (1) spent a significant amount of time on basic research on the fission-track method, (2) developed fission tracks as a method for dating kimberlites and diatremes, (3) developed the techniques for dating epidote and zircon, and (4) was the first to observe a correlation between apatite fission-track age and elevation, which has led to the use of the fission-track dating to determine the uplift erosion rates of mountain ranges. Cooperative research was carried out with many members of the U.S. Geological Survey and with geologists from universities and industry.

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14., continued

- 7/71 present Geologist, Branch of Isotope Geology, USGS, Denver; C. E. Hedge, present supervisor. In this position my responsibilities have been to continue developing the fission-track method of dating minerals and to find new applications for this method. During this time, I have developed the following applications for fission-track dating: (1) dating of volcanic ash layers and bentonites in sedimentary sequences, (2) dating of and exploration of hydrothermal systems (my study of the Rico District, Colorado, helped lead to the discovery of a molybdenum deposit that has $>200 \times 10^6$ tons of potential ore containing $>0.2\%$ Mo), (3) the direct dating of landscape evolution, by dating zircons in clinker formed by the natural burning of a coal seam. I also wrote the first paper on the application of fission-track dating to the study of the thermal history of sedimentary basins. I have done cooperative work with, and some service work for, geologists from the U.S. Geological Survey, industry, and universities, both within and outside the U.S. Also during this time I have taught a number of courses on fission-track dating at the USGS and universities and colleges.
- 10/77 10/81 Project Chief, "Geochronology-Denver", Branch of Isotope Geology, USGS, Denver. Supervised seven professionals on project.
- 1990 Present Associate Branch Chief, Branch of Isotope Geology, USGS, Denver; C. E. Hedge, supervisor. Duties include preparing programmatic proposals and assisting with branch budget

15. Bibliography:

1965

1. Fleischer, R.L., Naeser, C.W., Price, P.B., Walker, R.M., and Marvin, U.B., 1965, Fossil particle tracks and uranium distribution in minerals of the Vaca Muerta Meteorite: *Science*, v. 148, p. 629-632.
2. Fleischer, R.L., Naeser, C.W., Price, P.B., Walker, R.M., and Maurette, M., 1965, Cosmic ray exposure age of tektites by the fission-track technique: *Journal of Geophysical Research*, v. 70, p. 1419-1496.

1967

3. Naeser, C.W., 1967, The use of apatite and sphene for fission-track age determinations: *Geological Society of America Bulletin*, v. 78, p. 1523-1526.
4. Naeser, C.W., 1967, Fission-track age relationships in a contact zone, Eldora, Colorado: Dallas, Texas, Southern Methodist University, Ph.D. thesis, 85 p.

1968

5. Bouska, Vladimir, Faul, Henry, and Naeser, C.W., 1968, Size, shape and color distribution of moldavites: *Acta Universitatis Carolinae, Geologica*, no. 4, p. 277-286

1969

6. Naeser, C.W., 1969, Etching fission tracks in zircons: *Science*, v. 1645, p. 388.
7. Naeser, C.W., and Dodge, F.C.W., 1969, Fission-track ages of accessory minerals from rocks of the Sierra Nevada batholith: *Geological Society of America Bulletin*, v. 80, p. 2201-2211.
8. Naeser, C.W., and Faul, Henry, 1969, Fission-track annealing in apatite and sphene: *Journal of Geophysical Research*, v. 74, p. 705.

1970

9. Naeser, C.W., and McKee, E.H., 1970, Fission track and K-Ar ages of Tertiary ash-flow tuffs, north-central Nevada: *Geological Society of America Bulletin*, v. 81, p. 3375-3384
10. Naeser, C.W., Engels, J.C., and Dodge, F.C.W., 1970, Fission-track annealing and age determination of epidote minerals: *Journal of Geophysical Research*, v. 75, p. 1579-1584

1971

11. Brookins, D.G., and Naeser, C.W., 1971, Age of emplacement of Riley County, Kansas, kimberlites and a possible minimum age for the Dakota sandstone: *Geological Society of America Bulletin*, v. 82, p. 1723-1726
12. Garlick, G.D., Naeser, C.W., and O'Neil, J.R., 1971, A Cuban tektite: *Geochimica et Cosmochimica Acta*, v. 35, p. 731-734
13. Milton, D.J., and Naeser, C.W., 1971, Evidence for an impact origin of the Pretoria Salt Pan, South Africa: *Nature*, v. 229, no. 7, p. 211-212
14. Naeser, C.W., 1971, Geochronology of the Navajo-Hopi diatremes, Four Corner's area: *Journal of Geophysical Research*, v. 76, p. 4978-4985
15. Naeser, C.W., Kistler, R.W., and Dodge, F.C.W., 1971, Age of coexisting minerals from heat-flow borehole sites, central Sierra Nevada batholith: *Journal of Geophysical Research*, v. 76, p. 6462-6463

1972

16. Fleischer, R.L., and Naeser, C.W., 1972, Search for plutonium-244 tracks in Mountain Pass bastnaesite: *Nature*, v. 240, p. 465

17. Stuckless, J.S., and Naeser, C.W., 1972, Rb-Sr and fission-track age determinations in the Precambrian plutonic basement around the Superstition volcanic field, Arizona: U.S. Geological Survey Professional Paper 800-B, p. B191-B194.

1973

18. Calk, L.C., and Naeser, C.W., 1973, The thermal effect of a basalt intrusion on fission tracks in quartz monzonite: *Journal of Geology*, v. 81, p. 189-198.
19. Naeser, C.W., Izett, G.A., and Wilcox, Ray E., 1973, Zircon fission-track ages of Pearlette family ash beds in Meade County, Kansas: *Geology*, v. 1, p. 187-189.
20. Turner, D.L., Forbes, R.B., and Naeser, C.W., 1973, Radiometric ages of Kodiak Seamount and Giacomini Guyot, Gulf of Alaska--implications for circum-Pacific tectonics: *Science*, v. 182, p. 579-581.

1974

21. Herd, D.G., and Naeser, C.W., 1974, Radiometric evidence for pre-Wisconsin glaciation in the northern Andes: *Geology*, v. 2, p. 603-604.
22. Marvin, R.F., Young, E.J., Mehnert, H.H., and Naeser, C.W., 1974, A summary of Mesozoic and Cenozoic radiometric ages of rocks and some uranium and base metal deposits in Colorado: *Isochron/West*, no. 11, p. 1-38.
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1975

24. Cunningham, C.G., and Naeser, C.W., 1975, The Italian Mountain intrusive complex: U.S. Geological Survey Bulletin 1405-A, p. A27-A28.
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30. Damon, P.E., Izett, G.A., and Naeser, C.W., 1976, Pliocene and Pleistocene geochronology--Penrose Conference report: *Geology*, v. 4, p. 591-593.
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32. Izett, G.A., and Naeser, C.W., 1976, Age of the Bishop Tuff of eastern California as determined by the fission-track method: *Geology*, v. 4, p. 587-590.
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Wikarno, 1976, Pre-Eocene rocks of Java, Indonesia: U.S. Geological Survey Journal of Research, v. 4, p. 605-614.

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 36. Naeser, C.W., 1976, Book review of *Nuclear tracks in solids*, by Robert L. Fleischer, P. Buford Price, and Robert M. Walker: *Geology*, v. 4, no. 5, p. 318-319.
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1977

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British stratotypes: U.S. Geological Survey Open-File Report 77-348, 11 p.

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52. Triplehorn, D.M., Turner, D.L., and Naeser, C.W., 1977, K-Ar and fission-track dating of ash partings in coal beds from the Kenai Peninsula, Alaska--a revised age for the Homeric Stage-Clamgulchian Stage boundary: *Geological Society of America Bulletin*, v. 88, p. 1156-1160.
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16. Significant contributions.

- (1) Coates, D.A., and Naeser, C.W., 1984, Map showing fission-track ages of clinker in the Rochelle Hills, southern Campbell and Weston Counties, Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1462, scale 1:50,000.

I consider the data published with this map to be a very significant contribution because this is one of the first studies utilizing geochronology (fission tracks) to date the development of a landscape. The clinker formed by the burning of coal. The burning results from exposure of the coal to air by stream erosional processes. As erosion progresses down dip, the coal burns creating the clinker. By dating detrital zircons (annealed during the burn) in the clinker, it was possible to trace the evolution of the landscape. The zircon data indicate that in the last 700,000 years the stream has eroded back about 8 km and has downcut about 200 m.

- (2) MacFadden, B.J., Campbell, K.E., Cifelli, R.L., Siles, Oscar, Johnson, N. M., Naeser, C.W., and Zeitler, P.K., 1985, Magnetic polarity stratigraphy and mammalian fauna of the Deseadan (late Oligocene-early Miocene) Salla beds of northern Bolivia: *Journal of Geology*, v. 93, p. 223-250.
Marshall, L.G., Drake, R.E., Curtis, G.H., Butler, R.F., Flanagan, K.M., and Naeser, C.W., 1986, Geochronology of type Santacrucian (middle Tertiary) Land Mammal Age, Patagonia, Argentina: *Journal of Geology*, v. 94, p. 449-457.
Naeser, C.W., McKee, E.H., Johnson, N.M., and MacFadden, B. 1987, Confirmation of a late Oligocene-early Miocene age of the Deseadan Salla beds of Bolivia: *Journal of Geology*, v. 95, p. 825-828.

These three papers have been instrumental in revising the middle Tertiary land mammal time scale of South America. The data I contributed to these papers helped prove that the early Oligocene age traditionally assigned to the Deseadan Land Mammal Age is incorrect--the Deseadan should be shifted upward by about 10 million years, to late Oligocene-early Miocene. The data also indicate that the Santacrucian Land Mammal Age lasted for only about 3 million years, from 18 Ma to 15 Ma, rather than 6 million years (from 22 Ma to 16 Ma) as previously thought. These new data have had a profound effect on the ideas involving the evolution of mammals (especially primates) in the New World and the relationship to evolution in the Old World.

(3) Non-publication contributions

Since 1964, I have been conducting research on the applications of fission track dating to geological problems. During this time, I have developed and taught methods and ideas that are now used in laboratories throughout the world. As a result of this international recognition, I have been chosen to participate in a subcommittee of the IUGS to establish standards and calibration procedures for fission-track dating. These recommendations will do for fission-track dating what Steiger and Jäger did for other geochronologic methods. As a result of my fission-track work, I am asked by many geologists outside of the USGS to work with them on their projects. The studies reported in contribution 2 (above) are an example of this type of project.

An additional non-publication contribution that I have made to the USGS, more specifically to the Branch of Isotope Geology, is my tour of duty as Associate Branch Chief (1990-present). Several times throughout the year this requires a significant commitment of time. This position largely involves assisting branch scientists in preparing project proposals. This year an additional block of time was devoted to the preparation of the "Project Description and Accomplishment" (PD & A) forms for branch project leaders

EXPERIENCE WITH RADIOACTIVE MATERIALS

DATE: JANUARY 6, 1995

NAME: NANCY D. NAESER

TITLE: GEOLOGIST

FORMAL EDUCATION:

INSTITUTION AND LOCATION (CITY & STATE)	DATES OF ATTENDANCE	DEGREE	FIELD
West Virginia University	Summer 1963	-	-
University of Arizona	1962 - 1966	B.S. 1966	Geology
Victoria University of Wellington, New Zealand	1967 - 1973	Ph.D. 1973	Geology
University of Toronto, Canada	1976 - 1979	Postdoctoral Research Associate	Fission Track Dating
University of Arizona	1979 - 1981	National Research Council - Postdoctoral Research Associate	Fission Track Dating

FORMAL COURSES RELEVANT TO:

- (a) Principles and practices of radiation protection
- (b) Radioactivity measurement standardization and monitoring techniques and instruments.
- (c) Math calculations basic to use and measurement of radioactivity.
- (d) Biological effects of radiation

COURSE	WHERE	HOW LONG?	RELEVANT TO			
			(a)	(b)	(c)	(d)
<u>1976</u> Fission Track Dating	University of Toronto	2 weeks		a, b, c		
<u>1979</u> Fission Track Dating	University of Toronto	1 year		a, b, c, d		
<u>1981</u> Fission Track Dating	University of Toronto	1 year		a, b, c, d		
<u>1981</u> Fission Track Dating	University of Toronto	1 year		a, b, c, d		

ON-THE-JOB TRAINING RELEVANT TO THE ABOVE:

APPLICABLE TO
(a) (b) (c) (d)

EMPLOYER	TYPE OF WORK	
<u>1976-1979</u> Atomic Energy of Canada	55% of time devoted to fission-tracer analysis	a, b, c, d
<u>1979-present</u> USNS Environmental	primary research is in field of fission-trace analysis	a, b, c, d

EXPERIENCE WITH RADIATION:

see above

PROFESSIONAL/TECHNICAL PERSONNEL RECORD

1 Name (last)	(first)	(initial)	2 Birth date	3. Date prepared
Naeser	Nancy	D.	4/15/44	2/1/94

4 Duty station	5 Classification title	Series	Grade
Reston, Virginia	Geologist	1350(11)	GS-14

6 List first and second scientific or technical specialties

- a. (206) Isotope geology--Fission-track analysis
 b. (103) Stratigraphy--Tephrochronology, thermal and depositional history of sedimentary basins

7 Other scientific, technical, or special skills (regardless of relation to present position)

Geologic text editing
 Mineral separation
 Petrography and geochemistry of volcanic rocks

8 Education (include secondary schools)

School	Major and minor specializations	Dates attended	Degree, year or anticipated year
<u>Morgantown High School</u>		<u>1959-62</u>	<u>Diploma, 1962</u>
<u>West Virginia University</u>		<u>Summer, 1963</u>	
<u>University of Arizona</u>	<u>Geology</u>	<u>1962-66</u>	<u>B.S., 1966</u>
<u>Victoria University of Wellington, New Zealand</u>	<u>Geology</u>	<u>1967-73</u>	<u>Ph.D., 1973</u>
<u>University of Toronto, Canada</u>	<u>Fission-track dating</u>	<u>1976-79</u>	<u>Postdoctoral Research Associate</u>
<u>U.S. Geological Survey, Denver, Colo.</u>	<u>Fission-track dating</u>	<u>1979-81</u>	<u>Postdoctoral Research Associate</u>

9 Civil Service grades and dates

Grade*	GS-5	GS-11	GS-12	GS-13	GS-14	GS-
Date	1966	1979	1980	1983	1986	

Career employee yes no

*Use asterisk for any grade obtained in a management or other non-research capacity above GS-12.

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10. Specialized training (include postgraduate and Government courses)

Fission-Track Dating, 1977 (USGS, Denver)--2 weeks
 Use of Spindle Stage, 1979 (USGS, Denver)--60 hours
 Nuclear and Radiochemistry, 1979 (USGS, Denver)--1 semester
 Hazardous Chemical Safety Seminar and Workshop, 1979 (USGS, Denver)--2 days
 Radiological Safety Training, 1980 (USGS, Denver)--4 hours
 Heavy Liquids Safety, 1981 (USGS, Denver)--1 day
 Project Chief Training, 1982 (USGS, Denver)--2-1/2 days
 Time Management Effectiveness on the Job, 1982 (USGS, Denver)--2 days
 Statistical Methods for Scientists, 1983 (USGS, Denver)--18 hours
 Relationship of Organic Matter and Mineral Diagenesis, 1985 (USGS, Denver)--2 days
 Use of Electron Microprobe, 1986 (USGS, Denver)--1 day
 Introduction to Petroleum Geochemistry, 1987 (Society of Economic Paleontologists and Mineralogists, Rocky Mountain Section, Denver)--8 hours
 Thermal Maturity Modeling, 1987 (SEPM, RMS, Denver)--8 hours
 Dynamic Basin Modeling, 1990 (USGS, Denver)--3 days

11 Memberships in professional societies List, give dates, and include significant offices held.

American Quaternary Association (1977-present)
 Geological Society of America (1978-present), Fellow (1984-present)
 Colorado Scientific Society (1979-present); Treasurer (1983-84); Treasurer, Tweto Memorial Fund (1983-86);
 Chairman, Nominating Committee (1989); Member, Nominating Committee (1990); Councilor (1992-1993)
 American Association of Petroleum Geologists (1982-present)
 Society of Economic Paleontologists and Mineralogists (1984-present)
 Geological Society of New Zealand (1984-present)
 Society of Economic Paleontologists and Mineralogists, Rocky Mountain Section (1985-present)
 Golden (Colorado) Rotary Club (1989-1993) (professional service organization)

12. Scientific and Public Service

a Lectureships, symposia, invited conference participation Give dates, nature of entry (were you sought out or did you apply to participate?), and level of participation.

Invited Lectures on topics including "Introduction to Fission-Track Dating" and "Thermal History of Sedimentary Basins by Fission-Track Dating", given to:

1977-84 University of Toronto, Ohio State University, USGS (Reston), University of Innsbruck (Austria), Marathon Oil Company Denver Research Center, Louisiana State University, University of Colorado Institute of Arctic and Alpine Research, University of Pennsylvania, Birkbeck College (University of London, England), Dartmouth College, University of Wyoming, University of Colorado at Denver, New Mexico Institute of Mining and Technology

1985 Dartmouth College (1-week course on fission-track dating)
 University of Texas at El Paso

1986 University of Wyoming

1987 Brigham Young University

1988 Dartmouth College (2-week graduate course on fission-track dating)
 Institute for Energy Technology, Oslo, Norway
 Geological Survey of Norway, Trondheim, Norway (expenses in Norway paid by IET and GSN)

1989 National Institute of Nuclear Research (ININ), Mexico City, Mexico

1991 Louisiana State University
 Arco Research Center, Plano, Tex

Invited Symposium Convener:

- 1985 SEPM Research Symposium, "Thermal History of Sedimentary Basins: Methods and Case Histories", AAPG Annual Convention (co-convener: T.H. McCulloh, Mobil Exploration and Producing Services, Dallas)
- 1989 Symposium, "Thermal History of Sedimentary Basins", 28th International Geological Congress, Washington, D.C. (co-convener, Norbert Clauer, Centre de Sedimentologie et de Geochimie de la Surface, Strasbourg, France)

Invited Symposium Speaker:

- 1981 SEPM-AAPG Symposium on "Diagenetic Products and Basin Geothermics Related to Petroleum Exploration", AAPG Annual Convention
- 1987 Symposium on "Quaternary Dating Methods", GSA Annual Meeting
- 1984 Symposium on "Relationship of Organic Matter and Mineral Diagenesis", SEPM Annual Mid-year Meeting
- 1986 Symposium on "Thermal History of Sediments, 6th International Conference on Geochronology, Cosmochronology, and Isotope Geology, Cambridge, England
- 1989 Symposium on "Applications of Thermal Maturity Studies to Energy Exploration", AAPG-SEPM Rocky Mountain Section Meeting
- 1990 Symposium on "Temperature, Pressure (and Time) as Controls on Thermal Maturation", AAPG Annual Convention
- 1991 Symposium on "Geothermal Basin Maturation/Remote Sensing", AAPG Annual Convention

Invited Participant and Speaker:

- 1983 SEPM Research Conference, "Relationship of Organic Matter and Mineral Diagenesis"
- 1985 AAPG Research Conference, "Radiogenic Isotopes and Evolution of Sedimentary Basins"
- 1991 Norwegian Petroleum Society, "International Conference on Basin Modelling--Advances and Applications" (travel expenses paid by Norwegian Petroleum Society)

Invited Session Chairman:

- 1980 First Fission-Track Dating Workshop, Pisa, Italy
- 1984 Fourth International Fission-Track Dating Workshop, Troy, New York
- 1990 International Union for Quaternary Research (INQUA) Inter-Congress Committee on Tephrochronology (ICCT) Field Conference and Workshop on Tephrochronology, Yellowstone National Park
- 1992 Seventh International Workshop on Fission-Track Thermochronology, Philadelphia

Invited Chairman, Local Committee:

- 1990 INQUA-ICCT Field Conference and Workshop on Tephrochronology, Yellowstone National Park (handled all local arrangements for the conference--finances, accommodations, transportation, and meals)

Convener and Instructor:

- 1989 GSA Short Course (2-day), "Fission Track Analysis: Theory and Applications", GSA Annual Meeting (co-convener: K.D. Crowley, Miami University, and C.W. Naeser, USGS)

- o Committees to render scientific judgement. Include scientific review panels, editorial boards, editorships with dates. Include the capacity in which you served (chair, subcommittee chair, member, observer, expert consultant, etc.)

Assistant Editor, "New Zealand Journal of Geology and Geophysics" (1974-76)

Editor, Springer-Verlag book "Thermal History of Sedimentary Basins--Methods and Case Histories" (1985-88)

Co-editor, "Quaternary International" volume, "Proceedings of INQUA-ICCT Field Conference and Workshop on Tephrochronology" (1990-92)

Thesis examiner, two Master's candidates, Dartmouth College (1986)

Invited Outside Member, Promotion Panel, Central Mineral Resources Branch (1987)

Member, Promotion Panel, Central Regional Geology Branch (1988, 1993)

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Reviewer for research proposals (last 5 years):

- 1989 Gilbert Fellowship (USGS)
Petroleum Research Fund (American Chemical Society)
- 1991 National Science Foundation (two proposals)
COGEOGMAP (USGS)
- 1992 National Science Foundation
Petroleum Research Fund (two proposals)
National Earthquake Hazards Reduction Program (USGS)
- 1993 National Science Foundation (three proposals)
Petroleum Research Fund
- 1994 Petroleum Research Fund

Reviewer for outside publications (last 5 years):

- 1989 "Nuclear Tracks", four papers
"Oklahoma Geological Survey Newsletter", one paper
- 1990 "AAPG Bulletin", one paper
"GSA Special Paper", one paper
"Tectonics", one paper
"New Zealand Journal of Geology and Geophysics", one paper
- 1991 "GSA Bulletin", one paper
"Canadian Journal of Earth Sciences", one paper
"Palaeogeography Palaeoclimatology Palaeoecology", one paper
"Quaternary International", two papers
- 1992 "AAPG Bulletin", one paper
- 1993 "Nuclear Tracks", two papers
"Geophysical Research Letters", one paper
"Canadian Journal of Earth Sciences", one paper
- 1994 American Chemical Society book, one paper

c Special inventions, patents held, techniques or methods developed or improved. Include dates.

Improved the technique for counting fission tracks in young, fine-grained, low-uranium glass (1977-79)

d Other committees, special assignments, and administrative duties. Name organization, group, dates, and nature of contribution.

Co-Principal Investigator on three NSF Grants:

"Tephrochronology, Paleomagnetic, Amino Acid, and Radiocarbon Dating of Quaternary Deposits in Washington" (1980-83)

"Fission-Track Dating of Detrital Zircons from Himalayan Molasse Deposits: Tectonic Implications" (1982-85)

"Rates of Uplift and Erosion in the Himalayan-Siwalik System: Fission Track Evidence from Detrital Zircon" (1985-87)

Author of eight invited review papers (see publications 10 (and 16), 12, 15, 19, 29, 34, 35, 41 in Bibliography)

Cooperative research with:

J.A. Westgate, University of Toronto (1976-92)

D.J. Easterbrook, Western Washington University (1978-88)

T.J. McCulloh, Mobil Exploration and Producing Services (retired) (1979-present)

N.M. Johnson, Dartmouth College (1981-87)

P.K. Zeitler, Lehigh University (1981-88)

P.F. Cerveny, Dartmouth College, University of Wyoming (1983-88)

K.D. Crowley, University of Miami and National Research Council (1987-present)

C.M. Reaves, Mobil Oil, London (1987-present)

B.A. Sturt, Geological Survey of Norway, Trondheim (1988-present)

A. Grønlie, Geological Survey of Norway, Trondheim, and STATOIL, Norway (1988-present) Research with Sturt and Grønlie began as a result of a request from the Director, Geological Survey of Norway, to the Director, USGS, for my participation in a project to date thorium veins and tectonic activity in the Trondheim area; project began in 1988 with trip to Norway to present lectures and collect samples; expenses in Norway were paid by GSN and Institute of Energy Technology, Oslo

S. Kelley, Southern Methodist University (1991-present)

Research Associate, Department of Earth Sciences, Dartmouth College (1983-85)

Adjunct Professor of Geology, Department of Earth Sciences, Dartmouth College (1985-present)

Adjunct Professor of Geology and Geophysics, Department of Geology and Geophysics, University of Wyoming (1984-present)

Member:

SEPM Research Committee (1984-86)

SEPM Convention Policy Committee (1985-86)

International Union for Quaternary Research (INQUA) Inter-Congress Committee on Tephrochronology (ICCT) (1987-91)

INQUA Commission on Tephrochronology (COT) (1991-present)

INQUA-ICCT/COT Working Group on "Application of Tephra to Land and Sea" (1990-present)

Consultant to International Atomic Energy Agency (IAEA), Vienna, Austria (1989): undertook 5-day mission to Mexico on behalf of IAEA to evaluate proposed program in nuclear tracks at the National Institute of Nuclear Research in Mexico City

13 Honors, awards, recognition, elected membership List and give dates.

University of Arizona (1962-66): Phi Kappa Phi (equivalent of Phi Beta Kappa, for non-Liberal Arts majors), Mortar Board (Treasurer), graduated "with Honors" and "with high distinction"

Victoria University of Wellington (1967-73): Fulbright Fellowship, NSF Graduate Fellowship, New Zealand University Grants Committee Postgraduate Scholarship

University of Toronto (1976-77): Postdoctoral Research Associateship

USGS, Denver (1979-81): USGS/National Research Council Postdoctoral Research Associateship

Listed in "American Men and Women of Science" (1982-present), "Who's Who in the West" (1985-present), and "Who's Who in Frontiers of Science and Technology" (1986-present)

Geological Society of America, Elected Fellow (1984)

Naeser, Nancy D.

14 Career experience

Dates	Brief description of work or position
From - To	
<u>April 1966-June 1968:</u>	Geologic Field Assistant and Physical Science Technician, USGS, Astrogeology Branch, Flagstaff, Ariz.: E.M. Shoemaker, Branch Chief; G. Swann, supervisor (1) Petrography, including petrofabric analysis, with use of petrographic microscope, U-stage, and spindle stage; x-ray analysis, employing XRD and powder and single-crystal cameras; (2) completion of a 1:1,000,000-scale geologic map of the Moon, based on telescopic photographs and observation. (Publication 2)
<u>March 1967-October 1973:</u>	Ph.D. student, Victoria University of Wellington, New Zealand. Research on New Zealand ash-flow deposits; demonstrated presence of lateral variations in percentage and size of phenocrysts and pumice fragments, in degree of welding and crystallization, and in total-rock chemistry in a major ash-flow sheet. Involved use of petrographic microscope, U-stage, XRF, XRD, and AA, determination of bulk densities and porosities, etc. (Publications 3-8)
<u>April 1972-August 1972:</u>	Tutor in geology for New Zealand Department of Foreign Affairs, Wellington.
<u>August 1972-February 1974:</u>	Tutor in geology for New Zealand Technical Correspondence Institute, Lower Hutt.
<u>May 1973-February 1974:</u>	Research assistant to J.W. Cole, Victoria University of Wellington, New Zealand. Major- and trace-element analysis of volcanic rocks using XRF and AA
<u>March 1974-August 1976:</u>	Assistant Editor of "New Zealand Journal of Geology and Geophysics", New Zealand Department of Scientific and Industrial Research, Wellington. General and scientific editing of manuscripts, preparing manuscripts for printer, sizing and arranging illustrations, correcting proof, etc.
<u>September 1976-January 1979:</u>	Postdoctoral Research Associate, University of Toronto, Canada.
	(1) Fission-track dating of Quaternary tephros from western North America (85 percent of time). Required establishing a fission-track lab at the University of Toronto, calibrating dating techniques, and developing a counting method suitable for our samples. The research provided the first ages for a number of stratigraphically important volcanic ashes in western Canada and Alaska, and helped demonstrate that, although the procedures are time-consuming, it is possible to date young, fine-grained, low-uranium volcanic glass by the fission-track method. (Publication 9 and Abstracts A1-A3).
	(2) Teaching first-year geology labs and tutorials (15 percent).

January 1979-January 1981:

Postdoctoral Research Associate, USGS, Isotope Geology Branch, Denver; B.R. Doe and R.E. Zartman, Branch Chiefs; C.W. Naeser, supervisor.

- (1) Establishing use of fission-track dating as a new method for determining the thermal history of sedimentary basins. Involved exploring the unique problems in technique and in interpretation of results that arise in working with detrital grains from sediments. The feasibility of the method was demonstrated by dating detrital apatite and zircon from drill-hole and surface samples to determine the thermal history of the Tejon area, southern San Joaquin Valley, California. (Abstracts A4, A6-A8)
- (2) Fission-track dating of tephra from the Western United States (Publications 10-12 and Abstract A5)

January 1981-June 1981:

Geologist, USGS, Isotope Geology Branch, Denver; Branch Chief, supervisor, and duties as above (Abstract A9)

June 1981-September 1986:

Geologist, USGS, Oil and Gas Resources Branch, Denver; P.A. Scholle and D.D. Rice, Branch Chiefs; co-chief of project, "Comparison of Organic and Inorganic Measures of Thermal Maturity" (1981-85); subproject chief in "Anadarko Basin Studies" (1984-86); one person supervised (1981-83); T.D. Fouch, R.B. Halley, and W.E. Dean, supervisors

Developing the fission-track method as applied to the thermal history of sedimentary basins by:

- (1) Testing it in a wide variety of geologic settings, including the San Joaquin, Los Angeles, Green River, Powder River, San Juan, Anadarko, and North Slope Basins, and the Overthrust Belt. (Publications 14, 17, 20, 21 and Abstracts A13, A14, A16-A20)
- (2) Initiating a project (with Charles Barker) to study comparison of fission tracks to other thermal history indicators (vitrinite reflectance, fluid inclusions, authigenic minerals, etc.) important in determining conditions needed for kerogen maturation and hydrocarbon generation. (Publications 14, 17, 20, 21 and Abstracts A13, A14, A17-A20)
- (3) Coordinating study of the thermal history of the Anadarko Basin, utilizing a wide variety of organic and inorganic indicators of thermal maturity (as part of the "Anadarko Basin Studies" Project)
- (4) Convening the SEPM Research Symposium for the 1985 AAPG Annual Convention, "on "Thermal History of Sedimentary Basins--Methods and Case Histories", and editing a volume of papers from the symposium (see Publication 32).
- (5) In a cooperative project in Pakistan with Dartmouth College, testing the age relationship between zircons from modern river sands and from the contributing parent rocks, and developing this as a method for tracing changing patterns of sedimentation and tectonism through time (Publication 18 and Abstracts A10, A22)
- (6) Dating modern river sands from the Colorado River in Arizona
- (7) Fission-track dating of tephra from the Western United States (Publications 13, 15, 16, 19 and Abstracts A11, A12, A15, A21)

"Thermal Maturity Mapping of the United States" Project; coordinator for California and Lead Geologist for the Sonoma-Livermore and Sacramento Basins, California (see Abstracts A33, A34)

October 1986-November 1986

Geologists, USGS, Sedimentary Processes Branch, Denver, T.D. Fouch, Branch Chief; R.A. Zielinski, supervisor. Duties as above.

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November 1986-December 1993:

Geologist, USGS, Central Regional Geology Branch, Denver; G.A. Izett and D.L. Schlicher, Branch Chiefs; Project Chief of "Tephrochronology" project (1986-89); Project Chief of "Regional Fission-Track Analysis" project (1993)

Developing and expanding the usefulness and understanding of fission-track analysis as applied to the thermal and depositional history of sedimentary basins--one of most complex and fastest growing applications of the fission-track method. Involves solving the unique problems that result from analyzing detrital grains with inherited thermal histories, ages, and track-length distributions and a range of chemical compositions; interpreting the resulting complex age and track-length patterns using still poorly understood time-temperature (kinetic) models of apatite annealing; and providing guidelines for use by researchers worldwide by:

- (1) Extending, as sole or principal investigator, the application of the fission-track method for determining the thermal history of sedimentary sequences into a wide variety of geologic settings, including the San Joaquin, Los Angeles, Santa Maria, Powder River, Green River, San Juan, North Slope, and Anadarko basins (funded by "National Geologic Mapping", "Evolution of Sedimentary Basins", and "Onshore Oil and Gas Investigations" Programs, and DOE through the "Characterization of Natural Gas Resources in Low Permeability Rocks" Project). (Publications 28-30, 35, 36, 38, 41 and Abstracts A23-A31)
- (2) Using data from the above basin studies to clarify the kinetics of apatite annealing and the correlation of annealing with the kinetics of oil and gas generation and other thermal maturity indicators (in cooperation with T.H. McCulloh and C.M. Reeves, Mobil Oil, and K.D. Crowley, National Research Council). (Publications 28, 36, 38 and Abstracts A24, A25, A27-A30)
- (3) Editing a book, published in 1989 by Springer-Verlag) expanded from the SEPM Research Symposium I convened for the 1985 AAPG Annual Convention on "Thermal History of Sedimentary Basins--Methods and Case Histories." (Publication 32)
- (4) Exploring, through laboratory studies, the complex relationship between zircon fission-track ages determined from detrital zircon suites and the actual ages of zircons in the parent rocks that supplied material to the detrital suite--information critical for using fission-track ages for provenance studies. (Publication 22)
- (5) In a cooperative project working in Pakistan with Dartmouth College, developing the age relationship between zircons from modern river sands and from the contributing parent rocks as a new method for tracing changing patterns of sedimentation and tectonism through time (Publications 24 and 31)

Expanding the usefulness and understanding of the fission-track method as applied to tectonic studies and tephrochronology by:

- (1) Using fission-track analysis to study the uplift and cooling history of southern California mountain ranges (from FY 1992; funded by "National Geologic Mapping" Program, Southern California Areal Mapping Project) and central Norway (cooperative project with the Geological Survey of Norway). (Publication 39 and Abstracts A35 and A36)
- (2) Fission-track dating of tephtras from the Western United States and Canada, including tephtras and related rocks from Alaska and the Yukon Territory (from FY 1993; funded by "Global Change and Climate History" Program), North Dakota, Wyoming, and the Monterey Formation in California (funded by "National Geologic Mapping", "Evolution of Sedimentary Basins", and "Onshore Oil and Gas Investigations" Programs). (Publications 23, 25, 33, 34, 40 and Abstract A32)
- (3) (a) Organizing (as Chairman, Local Committee) INQUA-ICCT conference on tephrochronology (see item 12a), held in Yellowstone National Park in June 1990, to bring together experts from throughout the world to discuss all aspects of tephrochronology, including the latest developments in fission-track dating of tephtras, and (b) editing the "Proceedings" volume from the conference. (Publication 37)

Technical supervision is nominal; work is carried out under broad administrative supervision only

December 1993-Present:

Geologist, USGS, Isotope Geology Branch, Reston; C.E. Hedge, Branch Chief; Project Chief of "Fission-Track Analysis" project (1993-Present). Duties as above.

Naeser, Nancy D.

15 Bibliography

1966

- (1) Cozad, N.D., 1966. Study of contact relations in Leatherwood Quartz Diorite and pegmatite, Marshall Gulch, Santa Catalina Mountains, Pima County, Arizona: University of Arizona, Senior Honors thesis, 23 p.

1968

- (2) Cozad, N.D., and Titley, S.R., 1968. Preliminary geologic map of the Macrolycus Quadrangle of the Moon--map supplement to Astrogeologic Studies Annual Progress Report, July 1, 1965, to July 1, 1966, Part A: U.S. Geological Survey Open-File Report, scale 1:1,000,000.

1970

- (3) Briggs, N.D., 1970. The Whakamaru Ignimbrite in the Waikato River area: New Zealand Geological Survey Conference, Taupo, New Zealand, Abstracts and Proceedings, 4 p.

1973

- (4) Briggs, N.D., 1973. Investigations of New Zealand pyroclastic-flow deposits: New Zealand, Victoria University of Wellington, Ph.D. thesis, 433 p.

1975

- (5) Briggs, N.D., 1975. Determination of cause of thickness variation in ignimbrites (Note): New Zealand Journal of Geology and Geophysics, v. 18, no. 3, p. 501-506.

1976

- (6) Briggs, N.D., 1976. Welding and crystallization zonation in Whakamaru Ignimbrite, Central North Island, New Zealand: New Zealand Journal of Geology and Geophysics, v. 19, no. 2, p. 189-212.
- (7) Briggs, N.D., 1976. Vertical and lateral variations in Whakamaru Ignimbrite: Excursion Guide No. 55A and 56C, International Geological Congress, 25th, Sydney, Australia, 1976, p. 30-33.
- (8) Briggs, N.D., 1976. Recognition and correlation of subdivisions within Whakamaru Ignimbrite, Central North Island, New Zealand: New Zealand Journal of Geology and Geophysics, v. 19, no. 4, p. 463-501.

1978

- (9) Briggs, N.D., and Westgate, J.A., 1978. A contribution to the Pleistocene geochronology of Alaska and the Yukon Territory--fission-track age of distal tephra units, in Zartman, R.E., ed., Short papers of the 4th International Conference on Geochronology, Cosmochronology, and Isotope Geology: U.S. Geological Survey Open-File Report 78-701, p. 49-52. (N. Naeser contribution: 90 percent of analytical work, 30 percent of writing)

1980

- (10) Westgate, J.A., and Briggs, N.D., 1980. Dating methods of Pleistocene deposits and their problems--V. Tephrochronology and fission-track dating: Geoscience Canada, v. 7, p. 3-10. (N. Naeser contribution: 20 percent of writing)

1981

- (11) Easterbrook, D.J., Briggs, N.D., Westgate, J.A., and Gorton, M.P., 1981. Age of the Salmon Spring Glaciation in Washington: *Geology*, v. 9, p. 87-93. (N. Naeser contribution: 25 percent of analytical work, 25 percent of writing)
- (12) Naeser, C.W., Briggs, N.D., Obradovich, J.D., and Izett, G.A., 1981. Geochronology of Quaternary tephra deposits, in Self, S., and Sparks, R.S.J., eds., *Tephra studies: North Atlantic Treaty Organization Advanced Studies Institute Series C*, Dordrecht, Netherlands, Reidel Publishing, p. 13-47. (N. Naeser contribution: 10 percent of analytical work, 40 percent of writing)

1982

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16. Significant contributions.

(1) My research since 1979 has involved developing fission-track analysis for determining the thermal and depositional history of sedimentary basins. This is one of the most challenging applications of fission-track analysis because it involves solving the complex problems that result from analyzing detrital grains with inherited thermal histories, ages, and track-length distributions and a range of chemical compositions and interpreting the resulting complex age and track-length patterns using still poorly understood time-temperature (kinetic) models of apatite annealing. My work testing the method in a wide variety of geological settings has shown that (1) in the southern San Joaquin Valley, California fission tracks clearly reflect the different thermal histories of blocks separated by the active White Wolf fault, and diagenetic laumontite, which is a controlling factor in petroleum recovery in the area, formed during a transient thermal event, likely associated with high-temperature fluid flow (publications 20, 21, 30*, 32*, and abstracts A4, A6-A8, A13, A14, A17, A18, A20); (2) in the northern Green River basin, Wyoming, the latest phase of uplift and erosion of the Pinedale anticline was initiated ~4 to 2 Ma and resulted in rapid cooling of 20°C or more in the rocks (publications 14, 17, 20, 28*, 30*, 32* and abstracts A13, A16, A17, A19); (3) in southwestern Powder River Basin, Wyoming, rocks cooled ~12 Ma, from temperatures significantly higher than previously estimated (publications 36* and abstracts A13, A17, A23*); and (4) in the Santa Fe Springs oil field, Los Angeles Basin, apatites are annealed at the extremely high temperature of ~170°C, indicating that the high gradients (~40°C/km) in this major oil producing field were established very recently, within the last 100,000 yr (abstracts A24*, A25*-A30*). These studies have demonstrated the feasibility of the method and, along with concurrent research in Melbourne, Australia, have established fission tracks as one of the major methods used in basin analysis (publications 20, 29*, 30*, 35*, 38*, 41*, and abstract A31*), paving the way for similar studies in over 40 sedimentary basins by a number of laboratories throughout the world (publication 38*). Provenance studies (publications 18, 22*, 24*, 31* and abstracts A10, A22*) have demonstrated for the first time the feasibility of using fission-track ages of detrital zircons in sediments as a unique method for reconstructing tectonic patterns in source terranes. Tephrochronological studies (publications 10-13, 15, 16, 19, 23*, 25*, 33*, 34*, 40* and abstracts A5, A9, A11, A12, A15, A21, A32* have led to significant revisions in the Quaternary stratigraphy of the Pacific Northwest, Alaska, and the Yukon Territory.

(2) Naeser, N.D., and McCulloch, T.H., eds., 1989, *Thermal history of sedimentary basins--methods and case histories*: New York, Springer-Verlag, 319 p. (Publication 32*)

This volume is an expanded version of the SEPM Research Symposium that Thane McCulloch and I convened for the 1985 AAPG Annual Convention. It comprises 17 chapters that detail the theory, methods, and applications of the major organic and inorganic indicators currently used to determine the thermal history of sedimentary basins. Interest in this subject is intense and growing rapidly, due primarily to a growing awareness that burial heating is essential for the generation of oil and gas from petroleum source rocks. This volume is designed to give the specialist an up-to-date review of the methods, illustrated by case histories, and to give the nonspecialist the information needed to understand and use the results of such studies in sedimentary basins. In addition to editing the volume (which involved providing one of the three technical reviews for each chapter, copy editing and correcting proofs for the volume, and preparing the Index and part of the Preface), I am senior author of the chapter on fission-track dating (publication 20), which includes my work in the southern San Joaquin and Green River basins, and co-author of the introductory chapter (publication 26*).

(3) Non-publication contributions:

Education: Part of my work in developing fission-track analysis over the past 14 years has involved a major effort to teach geologists, both within and outside of the USGS, about the method by (a) giving them the information needed to understand and use fission-track results in their own studies, and (b), in some cases, teaching them how to generate their own fission-track data. This teaching had been accomplished by giving talks, organizing meetings and symposia, teaching short courses, advising graduate students, and teaching basic laboratory methods. This effort has filled a public education role, but it has also helped encourage the cooperation of many geologists in USGS research efforts.

Served as invited outside member of the Central Mineral Resources Promotion Panel in 1987 and member of the Central Regional Geology Promotion Panel in 1988 and 1993. Taught a course on how to prepare a PTR to geologists in Central Regional Geology Branch (1989 and 1990)

*publications and abstracts since last promotion