

Research/Professional Experience:

Senior Scientist 2000 - Present
 International Environmental Research Foundation
 New York, NY

Scientific or Technical Specialties:

- a) Mineralogy
- b) Igneous Petrology
- c) Minerals and Health
- d) Health Policy

Other scientific, technical, or special skills:

Operates transmission and scanning electron microscopes, electron microprobe, optical microscopes, and all types of X-ray diffraction equipment including single crystal precession and Weissenberg cameras, manual and automated diffractometers, and powder cameras.

Education (Including Secondary Schools):

<u>School</u>	<u>Major and Minor Specializations</u>	<u>Dates Attended</u>	<u>Degree, Year</u>
Calvin Coolidge H.S.	Science	9/44 - 6/47	Grad., 6/47
Utah State University	Zoology, Chemistry	9/47 - 6/51	B.S., 6/51
University of Maryland	Physical Chemistry	9/56 - 6/59	M.S., 6/59
Harvard University	Geology, Chemistry	9/59 - 6/62	Ph.D., 6/62

Specialized Training (Including Postgraduate and Government Courses):

- 1970 Massachusetts Institute of Technology special 2 week summer program for training in the use of the electron microprobe.
- 1981 Amphiboles and Other Hydrous Pyriboles - Mineralogical Society of America Short Course (Erlanger, Kentucky, 2 days).
- 1984 Yale University School of Medicine 8 hour course on "Indoor Air Quality".
- 1984 Micras - Mineralogical Society of America Short Course (Reno Nevada, 2 days).
- 1986 Scanning electron microscope training (USGS, Reston, 3 days).
- 1986 Hydrous Phyllosilicates - Mineralogical Society of America Short Course (Denver, Colorado, 2 days).
- 1989 Advanced Powder Diffraction - Mineralogical Society of America Short Course (St. Louis, Missouri, 2 days).
- 1990 Geochemistry and Mineralogy of Rare Earth Elements - Mineralogical Society of America (USGS, Reston, 1 day).

Membership in Professional Societies: Dates and Significant Offices Held:

- Mineralogical Society of America (1952-present), elected Fellow in 1959, Treasurer 1976-1980, Vice President 1990, President 1991.
- Geological Society of America (1963-present), elected Fellow in 1979.
- American Geophysical Union (1971-present).
- American Association for the Advancement of Science (1965-present), elected Fellow in 1983.
- Clay Minerals Society (1960-1980, 1988-1994).

Mineralogical Association of Canada (1989-present).
Geological Society of Washington (1956-present), Chairman of the Finance Committee in 1976.

Scientific and Public Service:

Lectureships, symposia, invited conference participation

1. March, 1965. Invited lecturer on the topic of the crystal chemistry of micas at the USGS Centers in Washington DC, Denver, and Menlo Park.
2. September 7-11, 1969. Invited lecturer "Pyroxene-Amphibole Symposium", V.P.I., Blacksberg, VA. Topic was "Chemical Reactions in Pyroxene Crystals".
3. August 26-September 7, 1972. Invited speaker at the 9th International Congress of Crystallography, Kyoto, Japan - gave two talks on mineralogy and crystal structure of rock-forming silicates.
4. November 13-15, 1972. Co-convenor of a symposium on "Exsolution and Domain Structure in Minerals, Geological Society of America meeting, Minneapolis, Minnesota .
5. October 29-30, 1981. Invited lecturer on asbestiform silicates for the Mineralogical Society of America Short Course on Amphiboles, Erlanger, Kentucky.
6. May 24-27, 1982. Invited speaker at the "World Symposium on Asbestos", Montreal, Quebec, Canada. Topic was the geological occurrences of asbestos.
7. February-March, 1984. Distinguished Regional Lecturer, USGS, Geologic Division, 1983-1984. Gave a talk titled "The Dangers of Asbestos in Our Environment: Separating Fact from Fiction", Reston, VA, February 21, 1984; Denver, CO, March 13, 1984; Menlo Park, CA, March 15, 1984, Flagstaff, AZ, March, 19, 1984.
8. July 13-18, 1986. Plenary speaker, 14th General Meeting, International Mineralogical Association, Stanford, CA, "The Dangers of Asbestos in Our Environment: Fact and Fiction".
9. July 9-19, 1989. Co-convenor at the 28th International Geological Congress, Washington, DC of a symposium titled "Alkaline Igneous Rocks and Carbonatites".
10. October 1988. Co-chairman of the Geological Society of America Forum on "Fibrous Minerals, Mining, and Disease", 1988 GSA Meeting, Denver, CO.
11. Feb. 28, 1991. Invited speaker at British Columbia's Mining Work Symposium - "Suspect Minerals and Human Health".
12. Oct. 22, 1992. Gave the Presidential address at the annual meeting of the Mineralogical Society of America, titled "Crystalline solution series and order-disorder within the natrolite mineral group".
13. Jan. 10, 1992. Invited talk at the Geophysical Laboratory, Washington DC, titled: "Crystalline solution series and order-disorder within the natrolite mineral group".
14. May 5, 1992. Invited talk at the 28th Forum on the Geology of Industrial Minerals, titled: "The effect of regulations on asbestos and other designated mineral carcinogens on the vitality of the industrial minerals industries".
15. Sept. 29, 1992. Invited talk at the annual meeting of the American Association of Professional Geologists, titled: "Suspect minerals-an environmental concern?"
16. Nov. 3, 1992. Invited talk at the annual meeting of the Clay Minerals Society, titled: "Suspect minerals and human health".

17. Nov. 17, 1992. Invited talk at the Intertech conference - A Management perspective on Crystalline Silica, titled: "The asbestos fiasco - a model for crystalline silica?".
18. April 16, 1993. Invited lecturer on the health effects of mineral dusts for the Society of Economic Geologists Short Course on Environmental Geochemistry of Mineral Deposits.
19. Oct. 22-24, 1993. Invited lecturer on the health effects of mineral dusts other than asbestos for Mineralogical Society of America Short Course on Minerals and Health, Nantucket, MA.
20. Oct. 7-11, 1996. Invited lecturer for a course titled "Minerals and Health", eight lectures given at the Institute of Mineralogy and Petrology, University of Fribourg, Fribourg, Switzerland.
21. October 16, 1996. Invited lecturer at the Institute of Physics of the Globe at Paris, University of Paris, Paris, France. Title the lecture was " The United States Asbestos Abatement Program.
22. November 7-9, 1998. Co-organizer of National Academy of Sciences Colloquium, "Geology, Mineralogy, and Human Welfare, NAS Beckman Center, Irvine, CA.

An additional 61 invited talks on the subjects of minerals and health and the geological occurrences the asbestos minerals were given at the following institutions or organizations (by year):

- 1976 1) Penn State U., special conference on measurement of mineral particles, State College, PA.
- 1977 1) SME-AIME Meeting, St. Louis, MO.
2) National Institutes of Health symposium on health effects of dust from the Rockville Quarry, Bethesda, MD.
3) National Bureau of Standards symposium on asbestos, Gaithersburg, MD.
- 1978 1) ASTM symposium on asbestos, Rockville, MD.
2) CON-AGR Convention, Los Vegas, Nev.
3) Washington Crystal Colloquium, Washington, DC.
4) Geological Society of Washington meeting, Washington. DC.
- 1979 1) Staff at the Department of Justice, Washington, DC.
2) Geological Society of Washington meeting, Washington, DC.
3) Staff, Department of Pathology, Vermont Medical School, Burlington, Vermont.
4) Special symposium at the 1979 Geological Society of America meeting, San Diego, CA.
5) Special conference at the NIH on minerals and health, Bethesda, MD.
6) Symposium on regulation of fibrous minerals, Clay Minerals Society, Rochester, NY.
- 1980 1) Dept, of Geology, U. of Maryland, College Park, MD.
2) Officials of Homestake Mining Company, San Francisco, CA.
- 1981 1) River Road Universal Church, Bethesda, MD.
2) Geophysics seminar, USGS, Reston, VA.
3) Dept. of Geology, Harvard U., Cambridge, MA.
- 1982 1) Dept. of Geology, Lehigh U., Bethlehem, PA.
- 1983 1) Philadelphia Geological Society, Bryn Mawr, PA.
2) Dept. of Geology, Indiana U., Bloomington, Ind.
3) School of Public and Environmental Affairs, Indiana U., Bloomington Indiana.
- 1984 1) Vermont Marble Company, Proctor, VT.
2) To Officials at the U.S. Dept. of the Interior, Washington, DC.
3) Arizona Geological Commission, Tucson, AZ.

- 4) U.S. Bureau of Mines, Washington, DC.
 - 5) Society of Chemical Engineers, Baltimore, MD.
 - 6) U.S. Environmental Protection Agency, Washington, DC.
 - 7) U.S. National Museum, Washington, DC.
- 1985
- 1) 21st Annual Forum on the Geology of Industrial Minerals, Tucson, AZ.
 - 2) Asbestos Information Association meeting, Alexandria, VA.
 - 3) Dept of Geology, U. of New Mexico, Albuquerque, NM.
- 1986
- 1) Harvard U., Friends of the Museum meeting, Cambridge, MA.
 - 2) U.S. General Services Administration conference on asbestos in buildings, Denver, CO.
- 1987
- 1) USGS-USBM mineral commodity meeting, Reston, VA.
 - 2) Workshop on "Tremolite in Play Sand", U. of Massachusetts, Amherst, MA.
 - 3) All Souls Church, 16th St. NW, Washington, DC.
 - 4) American Institute of Mining and Metallurgical Engineers, Mariposa Section, Phoenix, AZ.
- 1988
- 1) Baltimore Cytological Society, Baltimore, MD.
 - 2) Rutgers Geological Museum Open House, New Brunswick, NJ.
 - 3) U.S. General Services Administration conference on Federal building management problems, Colorado Springs, CO.
 - 4) U.S. General Services Administration Real Estate Policy Conference, San Antonio, TX.
- 1989
- 1) Dept. Of Geology, U. of Delaware, Newark, Delaware.
 - 2) Society of Mining Engineers conference on "Fibers,Fibers,Fibers", Baltimore, MD.
 - 3) Commencement Address to the geology graduates, Virginia, Polytechnic Institute, Blacksburg, VA.
 - 4) Talk on asbestos and public policy to Officials at V.P.I., Blacksburg, VA.
 - 5) Talk for the Docents, U.S. National Museum, Washington, DC.
- 1990
- 1) Geophysical Lab, Washington, DC.
 - 2) Talk to Administrators, State Government of Virginia, Richmond, VA.
 - 3) Talk at the 1990: National Consumer Coalition press conference, National Press Club, Washington, DC.
- 1991
- 1) Dept. of Geology, University of Oklahoma.
- 1992
- 1) The Cato Institute, Washington, D.C.
- 1993
- 1) Dept. of Geology, Lafayette College, Easton, PA (two talks)
 - 2) Dept. of Geology, Yale University, New Haven, CT.
- 1994
- 1) Smithsonian Institution, Washington DC.
 - 2) Department of Geology, University of Texas-Permian Basin, at Odessa, Texas.
 - 3) Society of Independent Professional Earth Scientists, Midland, Texas.
 - 4) Department of Geology, Texas A&M University. College Station, Texas.
 - 5) Public Relations Society of America National Environmental Conference, Washington, DC.
- 1995
- 1) Geological Society of Washington, Washington DC
 - 2) V.M. Goldschmidt Conference, State College, PA
- 1996
- 1) Geology Department, George Washington University, Washington DC
 - 2) Lecture: "The Asbestos and Health Issue, an example of a Costly Conflict Between Science and Public Policy", given before the Department of Geology, California State University, Sacramento, Sacramento, CA, Nov. 12, 1996.
- 1997
- 1) U.S. Geological Survey, Reston VA. Lecture titled: But is it True? An examination of the science used to establish asbestos, radon, DDT, acid rain, and global warming risks.

2) Lecture titled "Production and uses of asbestos", Workshop on the health effects of chrysotile asbestos, Montreal, Canada, September 15, 1997.

Committees to Render Scientific Judgment. Include Scientific Review Panels, Editorial Boards, Editorships, with Dates. Include the Capacity in which you Served (Chairman, Subcommittee Chairperson, Member, Observer, Expert Consultant, etc.):

Reviewer for National Science Foundation proposals. About two proposals per year, 5-10 hours work, average funding request about \$75K (1965-present).

Member of the Roebling Medal Committee, Mineralogical Society of America, in 1970.

Associate Editor, *The American Mineralogist*, average about 30 manuscripts a year, many hours of work involved in editing (1982-1986).

USGS liaison to the National Academy of Sciences panel convened to evaluate the health hazards of the various types of asbestos minerals (1979-1982). In 1978 I contacted the NAS, to suggest that a panel be composed of geoscientists and medical scientists to investigate the problem of minerals and health since it then appeared that the issue would in the future have a very large impact on the U.S. economy. The panel was finally formed in 1979 and I was the USGS representative to the panel and was an advisor to the panel members.

Member of the USGS Analytical Instrument Committee, 1987-present. The Committee submitted two major reports to the Chief Geologist, one in 1988 and other in 1990 regarding the status of the USGS instrumentation.

On three member Committee to investigate a case of scientific fraud within a government organization and to inspect various files relating to the question of fraud. A report was written and submitted to the Director of the USGS.

Co-editor of a special issue of the journal *Lithos* (vol. 26, p.1-188, 1990) titled "Alkaline Igneous Rocks and Carbonatites".

Member of the U.S.G.S. Promotion Panel, Branch of Igneous and Geothermal Processes, March 12-16, 1990.

Member of the pyroxene nomenclature committee of the International Mineralogical Association, 1982-1988.

Chairman of the U.S.G.S. Promotion Panel, Branch of Igneous and Geothermal Processes, April 22-27, 1991.

Member of the U.S.G.S. Promotion Panel, Branch of Lithospheric Processes, March 8-10, 1994.

Other Committees, Special Assignments, and Administrative Duties. Name Organization, Group, Dates, and Nature of Contribution:

A) Principal Investigator, in the NASA lunar science program (1969-1974).

B) I gave briefings and was consultant to Officials in various government agencies and other organizations, including the National Academy of Sciences, the U.S. Dept. of the Interior, The Institutes of Health, the Environmental Protection Agency, the U.S. Congress, the National Bureau of Standards, the Bureau of Mines, etc. The subject of the briefings was on the health effects of the various types of asbestos. I also furnished information to hundreds of individuals, law firms, companies, etc. on the general subject of asbestos. The main purpose of the "asbestos" briefings" was to demonstrate that it was not necessary to remove most asbestos from schools and other buildings. The briefings included the following individuals and organizations:

1. (4/9/79) Briefing for lawyers, U.S. Dept. of Justice.
2. (2/24/84) Briefing for Wayne Marchant and Jed Christensen, Deputy Assistant to Assistant Sec. of the Interior.
3. (2/28/84) Briefing for Officials to the U.S. Bureau of Reclamation.
4. (5/7/84) Briefing for Dr. Ralph DeVries, Office of Science and Technology Policy.
5. (5/8/84) Briefing for Officials of the EPA and the Dept. of the Interior.
6. (5/9/84) Briefing for Officials of the General Services Administration.
7. (5/11/84) Briefing for Mr. Martin Smith of the White House staff.
8. (5/11/84) Briefing for Mr. Phil Smith and staff, National Academy of Sciences.
9. (5/22/84) Briefing for the Staff, Senate Committee on Environment and Public Works.
10. (5/25/84) Briefing for Officials of the Office of Management and Budget.

11. (6/5/84) Briefing for Secretary of Interior, William Clark and Assistant Sec. Robert Broadbent.
12. (19/84) Briefing for Under Sec. of Interior, Ann McLaughlin.
13. (7/9/84) Briefing for William Ruckelshaus, Administrator of the Environmental Protection Agency and his senior staff.
14. (7/10/84) Briefing for Dr. Bernardine Buckley and Allan Young, Office of Science and Technology Policy.
15. (7/26/84) Briefing for senior officials from Interior, EPA, GSA, OMB, CPSC, OSHA, NIOSH, HHS, the White House, and the Dept. of State.
16. (1990-pres.) Listed in Marquis Who's Who in America.
17. (1995-pres.) Listed in Marquis Who's Who in Medicine and Healthcare.

Honors, Awards, Recognition, Elected Membership:

Elected Fellow, Mineralogical Society of America, in 1959.

Elected Fellow, Geological Society of America, in 1979.

Received on March 19, 1979 from the National Aeronautics and Space Administration, a Special Recognition Certificate for scientific contributions as Principal Investigator in the lunar sample program.

Received the U.S. Department of the Interior's Superior Service Award in 1981 for extensive and effective efforts to emphasize the geoscience prospective in public-health issues relating to mineral fibers.

Elected Fellow, American Association for the Advancement of Science, in 1983.

Received cash award, Feb. 1986, for outstanding performance in 1984-85.

Received on September 26, 1986 the U.S. Department of the Interior's Distinguished Service Award in recognition of outstanding contributions to the understanding of the various health effects of the different types of asbestos minerals and application of this knowledge to the national interest.

Received on October 30, 1990 from the Mineralogical Society of America its Distinguished Public Service Medal. This award, first given in 1990, is for contributions by the recipient to the understanding of the health effects of the asbestos minerals and in promoting a rational national policy with regard to use and control of mineral fibers in the mines, mills, and non-occupational settings.

Received Cash Award on August 26, 1991 for Outstanding Performance, 1990-1991

Cited in Who'sWho in America, 1991 to present.

Cited in Who'sWho in Medicine and Healthcare, 1995 to present

Career Experience: U.S. Geological Survey (1945-1995):

06/45 to 09/45 Rodman for USGS (Topographic Division) surveying party, Fairhaven, Vermont.

06/48 to 09/48 Lab technician, Trace Elements Section, Geologic Div., USGS, supervisor Frank Grimaldi, Washington, DC.

06/49 to 09/49 Recorder for USGS (Topographic Division) surveying party, Coraopolis, PA.

06/51 to 03/52 Lab technician, Trace Elements Lab, Geologic Division, USGS, supervisor Frank Grimaldi, Washington, DC.

03/52 to 04/54 Lieutenant, artillery, U.S. Army, Ft. Bliss, Texas.

06/52 to 10/56 Physical Science Aid (chemistry), Trace Elements Lab, Geologic Division, USGS, supervisor Edward Dwornik. Operated the electron microscope and electron diffraction unit in the study of fine-grained minerals.

10/56 to 06/61 Chemist (part time), Crystal Chemistry Project, Geologic Div., USGS, C.L. Christ supervisor. Studied the crystallography of fine-grained minerals by electron diffraction - and particularly the fine-grained vanadium minerals from the Colorado Plateau. Howard Evans was supervisor in my study of the crystal structure of various uranium-bearing minerals and compounds by single crystal X-ray diffraction techniques.

07/61 to 07/64 Physical chemist, Crystal Chemistry Project, Geologic Div., USGS, Howard Evans supervisor. Solved the crystal structures of the torbernite group uranium minerals including abernathyite, meta-torbernite, various synthetic analogs of these minerals, and cesium uranyl sulfate by X-ray diffraction methods. Studied the crystal chemistry of the beryllium minerals, the crystallography of paragonite, and the mineralogy of a new uranyl carbonate. Utilized electron diffraction methods to obtain accurate unit cell constants for fine-grained minerals.

07/64 to 06/74 Physical chemist, Geologic Div., USGS. As Project Leader of the Crystal Chemistry Project (supervisor David R. Wones) an extensive program was initiated to very accurately describe the structural nature of important rock-forming silicates. Seven new structure refinements of very high accuracy were made of tremolite, cummingtonite, Mn-cummingtonite, hornblende, richterite, and two gedrites. In addition to these crystal structure studies a detailed examination was made of the phase relationships of the chain silicates including studies of the nature of exsolution in pyroxenes and amphiboles in relation to their chemical compositions, crystal structure, and crystallization history. In 1969 a study of the lunar samples was initiated and the knowledge obtained by the parallel studies of terrestrial silicates was applied to the lunar minerals. An extensive study was started (with H. Takeda and David Wones) on polytypism in micas and a unique method was developed to analyze and describe the mica polytypes. An algorithm was invented to describe the crystallography and crystal structure of all possible mica polytype crystal structures. The petrographic relationships of the minerals in the metamorphic rocks of the Gouverneur talc district, NY was completed.

07/74 to 04/77 Physical chemist, Mineral Investigations Project, Robin Brett supervisor, Geologic Div., USGS. Investigations (with Peter Robinson, Howard Jaffe, and Gordon Nord) were started on metamorphic amphiboles from western Massachusetts. The anthophyllite-gedrite solvus was described for the first time and the solid solution series between these two minerals was delineated for the naturally occurring minerals. The crystal structures of biotites that were reduced and then oxidized (addition and removal of hydrogen) were determined. This research led to a much clearer understanding of the role of hydrogen in the formation of H-bearing rock-forming minerals.

07/77 to 10/82 Physical chemist, Project leader Asbestiform Minerals Project, supervisor David B. Stewart, Geologic Div., USGS. Entered into a long term study of the geological occurrence of the various types of asbestos minerals, their abundances, their use and distribution in the environment, their health effects on man and in experimental animals, the Federal regulatory processes related to asbestos control and mitigation, the nature of the Federal definition of asbestos as it might relate to mining activities other than asbestos mining, and the social and economic consequences of State and Federal actions. In 1978 (reference no. 86 in my bibliography) I was the first to show the very strong correlation between exposure to crocidolite asbestos and a pronounced negative correlation between this disease and exposure to the very common chrysotile asbestos. This led to proposing the "fiber hypothesis" for asbestos-related disease and is the foundation for the conviction that exposure to chrysotile asbestos in schools and other non-occupational settings presents essentially zero health risk. To bring to the attention of the scientific community, the public, and political leaders I have given approximately 66 lectures and briefings (see 12b., 12c.) on the various aspects of the asbestos controversy. In addition to these project activities I serve as the USGS Asbestos Commodity Specialist. Work was continued on extending the "optimal phase boundary" concept to studies of the pyroxenes. Careful measurement of the orientation of pyroxene exsolution lamellae within the host pyroxenes were made thus establishing temperature-composition-orientation relationships for these minerals. These observations present a method of formulating new geothermometers and barometers.

10/82 to present Physical chemist, Geologic Div., USGS, supervisors, Patrick Muffler, then Robert Christiansen, then Bruce Hemingway (1991-95). 1982-1986 - principal investigator, National Acid Precipitation and Assessment Program, also project leader of the Acid Rain Project (1982-1986), the Rock-forming Silicates Project (1982-1989), and the Alkaline Rocks and Carbonatites Project (1989-present).

The acid rain research involved a cooperative effort with a consortium of about 20 investigators from several different research agencies. My first critical task was to take responsibility for selecting and procuring the various marbles and limestones that would be used in our materials effects studies. Visits to the quarry site and cutting mills were made while the stone was being extracted from the quarries and cut into sized slabs and briquettes. Samples were placed at six stations where various atmospheric parameters (such as rainfall amount and chemistry, pH, and temperature) were continually monitored. The relationships between these parameters, the amount of dissolution of the marble and limestone samples, and the mineralogical changes were established. Characterization of the samples (with Elaine McGee and Daphne Ross) was accomplished by chemical analysis using electron microprobe, light optical, scanning electron microscopy, and X-ray diffraction techniques.

The Alkaline Rocks and Carbonatites Project (previously titled the Rock-forming Silicates Project) concentrated its research on the alkaline igneous rocks of the Magnet Cove igneous complex and the adjacent mineralized country rock shales and quartzites. I initially set up the Project's objectives; the immediate applied interest being the mode of origin of the titanium, vanadium, and niobium deposits in the mineralized country rocks. Marta Flohr joined me in this research program and has taken the lead in much of the work. Samples were collected in seven one week field trips. Also, a detailed map was made (in cooperation with the Arkansas Geological Commission) of the most important locality for sampling a large variety of fresh alkaline igneous rocks as well as contact metamorphosed country rocks. A complete geochemical and petrological examination was made of the igneous rocks and included a study of the secondary minerals formed on cooling from the primary melt temperatures. Various metasomatic processes, including metasomatism by later-stage Ca- and Na-rich carbonatitic fluids and low temperature alteration (lateritic processes), also caused replacement of previously formed minerals and released metals that were later deposited in the adjacent country rocks. Some of the important results of this investigation are given in section 15.

In this period I continued serving as the USGS commodity specialist on asbestos and also remained involved part time (30 percent) in various aspects of the asbestos controversy and in particular to how the Federal definition of asbestos is now affecting large segments of the U.S. mining industry not involved in asbestos mining (see section 15).

In 1992 and 1993 I became more and more involved with the issue of minerals and health due to an increased Division interest in environmental hazards and due to the fact that the common mineral quartz is now on the Federal carcinogen list. In 1992, I gave five invited talks on the health effects of mineral dusts and was engaged for several hours per week on the telephone responding to questions concerning this same subject.

In 1993 I spent nearly full time on health issues including preparing two long review papers on the health effects of mineral dusts for Mineralogical Society of America and Society of Economic Geologists short courses. In addition, I prepared three other papers and gave five talks on this general subject and started an investigation of the possible health effects that might be generated by dusts and water from the asbestos Superfund sites within the New Idria serpentinite of California.

Career Experience Since Retirement from the U.S. Geological Survey:

January 3, 1995. Formal retirement from the U.S. Geological Survey.

January 4, 1993- Affiliated with The Science and Environmental Policy Project, 4084 University Drive, Fairfax City, VA 22030. Presently engaged in studies of public policy issues pertaining to mineral and geochemical effects on human health and global warming issues.

March 1, 1995-present Appointed Senior Scientist in the Environmental Effects Laboratory, Institute of Applied Sciences at Brooklyn College of The City University of New York. Research is directed towards health effects of mineral dusts.

January 1995-present Continued research studies on the health effects of minerals.

Bibliography

Published Reports

1. Dwornik, E.J. and Ross, Malcolm, 1955, Application of the electron microscope to mineralogic studies: American Mineralogist, v. 40, p. 261-274.
2. Ross, Malcolm and Christ, C.L., 1958, Mineralogical application of electron diffraction. I. Theory and techniques: American Mineralogist, v. 43, p. 1157-1178.
3. Rose, H.J., Jr., Blade, L.V. and Ross, Malcolm, 1959, Earthy monazite at Magnet Cove, Arkansas: American Mineralogist, v. 43, p. 995-998.

4. Ross, Malcolm, 1959, Mineralogical applications of electron diffraction. II. Studies of some vanadium minerals of the Colorado Plateau: *American Mineralogist*, v. 44, p. 322-341.
5. Fahey, J.J., Ross, Malcolm and Axelrod, J.M., 1960, Loughlinite, a new hydrous sodium magnesium silicate: *American Mineralogist*, v. 45, p. 270-281.
6. Ross, Malcolm and Evans, H.T., Jr., 1960, The crystal structure of cesium biuranyl trisulphate, $\text{Cs}_2(\text{UO}_2)_2(\text{SO}_4)_3$: *Journal of Inorganic Nuclear Chemistry*, v. 15, no. 3/4, p. 338-351.
7. Straczek, J.A., Horan, A., Ross, Malcolm and Warshaw, C.M., 1960, Studies of the manganese oxides. I.V. Todorokite: *American Mineralogist*, v. 45, p. 1174-1184.
8. Ross, Malcolm, 1962, The crystallography, crystal structure, and crystal chemistry of various minerals and compounds belonging to the torbernite mineral group: Ph.D. Thesis, Harvard University, Cambridge, Massachusetts, 179 p.
9. Ross, Malcolm, 1963, The crystallography of meta-autunite (I): *American Mineralogist*, v. 48, p. 1389-1393.
10. Ross, Malcolm, 1963, The crystal chemistry of beryllium: Professional Paper 468, 30 pp.
11. Zen, E-an, Ross, Malcolm and Bearth, Peter, 1964, Paragonite from Tasch Valley near Zermatt, Switzerland: *American Mineralogist*, v. 49, p. 183-190.
12. Ross, Malcolm and Evans, Howard T., Jr., 1964, Studies of the torbernite minerals (I): The crystal structure of abernathyite and the structurally related compounds $\text{NH}_4(\text{UO}_2\text{AsO}_4) \cdot 3\text{H}_2\text{O}$ and $\text{KH}(\text{UO}_2\text{AsO}_4)_2 \cdot 7\text{H}_2\text{O}$: *American Mineralogist*, v. 49, p. 1578-1602.
13. Ross, Malcolm, Evans, H.T., Jr. and Appleman, D.E., 1964, Studies of the torbernite minerals (II): Structure of metatorbernite: *American Mineralogist*, v. 49, p. 1603-1621.
14. Meyrowitz, R., Ross, D.R. and Ross, Malcolm, 1964, A new uranyl tricarbonate $\text{K}_2\text{Ca}_3(\text{UO}_2)_2(\text{CO}_3)_6 \cdot 9-10 \text{H}_2\text{O}$: U.S. Geological Survey Professional Paper 501-B, p. D64-D69.
15. Ross, Malcolm and Evans, H.T., Jr., 1965, Studies of the torbernite minerals (III): Role of the interlayer oxonium, potassium and ammonium ions, and water molecules: *American Mineralogist*, v. 50, p. 1-12.
16. Ross, Malcolm, 1965, The torbernite minerals as model compounds for the hydrous layer silicates: *Clays and Clay Minerals*, v. 13, p. 65-71.
17. Ross, Malcolm, 1965, Precision unit-cell parameter determination of layer silicates by use of electron and X-ray diffraction techniques: *Clays and Clay Minerals*, v. 13, p. 105-106 (extended abstract).
18. Ross, Malcolm, Takeda, H. and Wones, D.R., 1965, Systematic description and identification of mica polytypes: *Science*, v. 151, p. 191-193.
19. Skinner, B.J., Jambor, J.L. and Ross, Malcolm, 1967, McKinstryite, a new copper-silver sulfide: *Economic Geology*, v. 61, p. 1383-1389.
20. Ross, Malcolm, 1968, Fourier transform analysis: (1) X-ray diffraction effects of finite montmorillonite and mica crystals: *Zeits. Kristallographie*, v. 126, p. 80-97.

21. Ross, Malcolm, Smith, W.L. and Ashton, W.H., 1968, Triclinic talc and associated amphiboles from the Gouverneur Mining District, New York: *American Mineralogist*, v. 53, p. 751-769.
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