



# **Dr. George V. Chilingarian**

(a/k/a Chilingar)

## **Engineer and Scientist Petroleum Engineering and Geology**

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### **Degrees**

University of Southern California

Ph.D. — Geology with minor in Petroleum Engineering — 1956

M.S. — Petroleum Engineering — 1950

B.S. — Petroleum Engineering — magna cum laude — 1949

### **Certifications**

Certified Petroleum Geologist

American Association of Petroleum Geologists

Certified Professional Chemist

Certified Geologist, State of California

### **Honors**

- Diploma d'Onore, Istituto Napolitano di Cultura
- Diplome de Croix d'Officier, Belgium
- Doctor Honoris Causa, Academia Studiorum Minerva, Italy
- Commendation from Indian Government, 1967
- Executive and Professional Hall of Fame, National (USA), 1965
- Fellow of Geological Society of America and the American Institute of Chemists
- Teaching Excellence Award, U.S.C., 1969
- Tau Beta Pi (National, Engineering Honorary Society), Achievement Award, 1960, 1970
- Distinguished Service Award, Archimedes Circle, U.S.C., 1974
- Distinguished Faculty Award, U.S.C., 1976

- Distinguished Achievement Award for Petroleum Engineering Faculty (The Society of Petroleum Engineers) in recognition for outstanding contributions in the field of petroleum engineering education, 1984
- Associate Editor of Energy Sources Journal (one of the founders), 1974–Present
- Editor, Sedimentary Geology (one of the founders)
- Legion of Honor from the Society of Petroleum Engineers, USA
- Editor, Journal of Petroleum Science and Engineering, 1986 – (founder)
- Proclamation from Secretary of State of California, Dr. March Fong Eu, for outstanding contributions to education, science, and engineering, 1987
- Honorary Citizen of California, 1998, from Secretary of State Bill Jones
- Academy of Sciences of Russia (Natural Sciences), Foreign Member, 1993
- Special Issue of Energy Sources Journal, Vol. 21, Nov. 1–2, 1999, A Tribute to Professor George V. Chilingarian
- Gold Medal of Catherine I, Queen of Russia, 1999
- Crown and Eagle Medal of Honor from the Russian Academy of Natural Sciences, Russia, 2000
- Honored by Saudi Arabia, 2001
- Knights of Sciences and Arts (Medal) of Russia, 2001
- Russian Academy of Sciences, as a Petroleum Geologist, First USA Petroleum Geologist Elected
- Commendation from Saudi Aramco Oil Co., 2002
- Medal of Honor of Cross and Crown, Russia, 2002
- Gold Medals of Honor from Iran, Thailand, Taiwan, Honduras, Salvador and Russia
- Gold Medal of Honor of Grown and Eagle, Russia, 2003
- Global Citizen of the Year Award from the Masters of Success, in recognition of contributions to the field of petroleum engineering and petroleum geology internationally, 2003
- Proclamation from the Russian Academy of Sciences, Siberian Branch, 2003, signed by twelve scientists

- Proclamation from the Russian Academy of Sciences, 2003
- EEC (Energy Environment and Communication) Journal, Chilingar Milestone Edition, Vol. 1, No. 3, 2003. 50 Years of Teaching Excellence
- Proclamation from VNIGRI (All-Union Petroleum Institute of Scientific–Geological–Exploration; founded in 1929)
- Honorary Fellow of DIMS (Design, Technology, and Management Society International), South Africa, 2004
- Recognition and Award from South Africa, 2004
- Gold Medal of Honor from the Armenian Academy of Sciences, 2005
- As president of Russian Academy of Natural Sciences, U.S. Branch, received the following medals of honor:
  - Scientists without Borders
  - Crown and Eagle
  - Cooperation between Russian and American Scientists
  - Giants of Science and Engineering, and
  - Einstein Award

### **Important Positions Held:**

- Chief of Petroleum and Chemical Laboratory, Wright-Patterson Air Force Base, Ohio, 1954–1956
- Senior Petroleum Engineering Advisor of United Nations, 1967–1969, 1978–Present
- Chairman of Petroleum Engineering Department, U.S.C., 1965–1966
- Chief Consultant of Amjon Oil Co., 1964–1965
- President, Electroosmotics Inc., Los Angeles, 1963–1966
- President, International Resources Consultants, Inc., 1967–1970
- Professor, Petroleum Engineering Department (teaching since 1950 at the University of Southern California), 1956–1991
- Professor of Civil and Petroleum Engineering, Civil Engineering Department, USC, 1991–present
- President, Phi Kappa Phi Chapter at U.S.C., 1972, 1981

- President, Sigma Xi (research honorary society), 1974
- Phi Kappa Phi – Director, 1980s–1990s
- Tau Beta Pi – Advisor, 1980s–1990s
- Pi Epsilon Tau (National Petroleum Engineering Honor Society) – Advisor, 1958–2006
- International Academy of Mineral Resources, Moscow, Russia, Honorary Academician
- Armenian Academy of Sciences, Foreign Member, 1993
- International Academy of Engineering, Member, 1994
- Armenian Academy of Engineering, President of U. S. Branch
- President Russian Academy of Natural Sciences (US Branch) 1993–2006
- Honorary Consul of Honduras in Los Angeles, 1983–Present
- Representative of the International University of Dubna (Moscow Region), 1993+

## Who's Who

Leaders in American Science

Leading Men in the United States

American Men of Science

Royal Blue Book

In the West

Outstanding Personalities in the West and Midwest

Engineers of Distinction

International Bibliography

Creative and Successful Personalities

The National Register of Prominent Americans and International Notables in America, 43rd edition, 1984–1985

In Frontier Science and Technology, 1st edition, 1984–1985

Men of Achievement

## **Honorary Societies and Professional Societies**

Tau Beta Pi

Phi Kappa Phi

Sigma Gamma Epsilon Pi Epsilon Tau

Sigma Phi Delta

Sigma Xi

Skull and Dagger

AAPG

AIME

SPE (Legion of Honor) AGU

Geol. Soc. Am. (Fellow) Geochem. Soc.

Mex. Assoc. Petrol. Geol. New York Acad. Sci S. Calif Acad. Sci.

Archimedes Circle

Amer. Institute of Chemists (Fellow)

Soc. Prof. Engineers

Clays and Clay Mineral Society

Am. Assoc. Petrol. Geol. (AAPG) Am. Chem. Soc., Fellow

## **Scientific Contributions**

Professor Chilingarian made many important, original contributions in the following fields:

- Utilization of organic colloids (Iranian and Indian) in drilling fluids.
- Development of tests for aviation gasoline, and jet fuels.
- Diagenesis in sediments.
- Carbonate Rocks. His Ca/Mg ratio technique resulted in the discovery of an oil field.
- Storage of fuels underground.
- Electrokinetics – augmenting reservoir energy, stimulation, and soil stabilization through application of direct electric current. Also bio-electro-seismo-remediation.
- Geochemical exploration for petroleum
- Compaction of sediments, subsidence, and over-pressured formations

- Core Analysis – relationships among porosity, permeability, surface area, grain-size distribution, etc.
- Chemistry of interstitial fluids
- Proved the plating theory for chemicals which reduce viscosity of drilling fluids
- Classification of source rocks
- Prediction of subsidence-prone areas from resistivity logs
- Global warming
- Gas migration
- Prediction of earthquakes from the rate of gas migration to the Earth's surface along faults
- Showed that many abandoned, condemned petroleum reservoirs in over-pressured formations should be revisited, due to misinterpretation of well tests, because they could increase world petroleum reserves.
- Showed that increased concentration of CO<sub>2</sub> in the atmosphere results in cooling rather than warming.

### **Selected Research Accomplishments:**

1. 1948–1951. Worked on possibility of using natural organic colloids of Iranian and Indian origin in drilling (gums Tragacanth, Karaya, Ghatti, Shiraz, Quince seed etc.). As a result of this research gums started to be used throughout the world, especially in Iran. Published several papers in Petrol. Eng. and an SPE paper.
2. 1951–1952. Proposed utilization of electrophoretic phenomenon for separation of very fine grained sediments into grades. Proved plating theory of chemicals which reduce viscosity of muds.
3. 1952–1957. Showed relationship between porosity and degree of dolomitization. Also relationship between Ca/Mg ratio and (a) geologic age, (b) occurrence of silica, and (c) depth of deposition. Proposed plotting of lines of equal Ca/Mg ratio in exploration.
4. 1956–1968. Pioneered high-pressure compaction studies of sediments in USA. His pressure versus porosity curves are used extensively in petroleum industry—electrical logging, subsidence, etc.. Showed that chemistry of solutions squeezed out of clays changes with pressure. Established pressures at which oriented water begins to be squeezed out, and proposed a new theory of migration of oil. Showed possibility of estimating overburden pressure from X-ray analysis.

5. 1956–1968. Worked on electrochemical stabilization of weak grounds, and electrical dewatering. Discovered that clays are destroyed on application of electrical current. Showed formation of new minerals in the process. Coined a new term “Electrodiagenesis” which explains some previously unexplained phenomena.
6. Established definite correlation between porosity and permeability of carbonate rocks (microfractured) by introducing two additional variables-specific surface area and irreducible fluid saturation.

### **Other Accomplishments Include:**

1. Bringing together fields of Petroleum Engineering and Geology through publication of numerous books and establishing interdisciplinary journal entitled “Petroleum Science and Engineering.” He was also in large measure instrumental in establishing “Energy Sources” journal about 23 years ago.
2. His pioneering Ca/Mg ratio technique (dolomitization) resulted in the discovery of a new oil field which was named after him in Iran.
3. His pioneering work on natural organic colloids (polymers) for use in drilling fluids in 1940s, resulted in their widespread use worldwide.
4. He proved the “plating” action of dispersants in drilling fluids, using electrophoretic technique.
5. He pioneered technique of separating fine colloids into various grade sizes using electrophoresis.
6. His work on carbonate reservoir rocks was pioneering as evidenced by the publication of the first books on the subject. For example, he proved that in many cases dolomitization gives rise to porosity. Also, he showed that many carbonates are oil-wet, at a time when most petroleum engineers and geologists believed that all rocks are water-wet.
7. Through extensive laboratory experiments he proposed the use of electric current in well stimulation and in secondary and tertiary oil recovery.
8. His work on high-pressure compaction of various clays, which was sponsored first by the American Association of Petroleum Geologists (Research Grant) and later by the National Academy of Sciences, resulted in unique, utilitarian results.
9. He published three-volume work on Compaction, Compressibilities of Various Rocks and Sediments, Abnormal Formation Pressures, and Subsidence. Included in this 1600-page work are extensive experimental results of Professor Chilingarian and his Co-workers on compressibilities of various sediments and rocks. He showed that sands are just as compactable as clays.

10. It is well established that in many cases there is very poor correlation between porosity and permeability. Yet; if one uses Professor Chilingarian's definition of "effective porosity," namely, porosity excluding pores and cracks occupied by the irreducible fluid, then there is indeed a very good correlation between "effective porosity" and permeability.
11. Professor Chilingarian developed a new technique of determining permeability of reservoir rocks (sandstones and carbonates) from thin section analysis using porosity type and grain-size and pore-size distributions.
12. Professor Chilingarian's estimation charts for determining porosity (etc.) from thin-sections are found in most petrographic laboratories worldwide.

## **Honors, Awards and Accomplishments**

- Best Student Research Paper (National), AIMS, 1950
- Member, International Institute of American Ideals, 1952
- Chief of Petroleum and Chemicals Laboratories, Wright-Patterson Air Force Base, Ohio, 1954–1956
- Negotiated the first contract for U.S. Air Force to store fuels underground, 1955
- Invited Lecturer, Mexican Petroleum Institute, Mexico, 1960–1967
- Invited Lecturer, Mexican Association of Petroleum Engineers, Mexican Association of Petroleum Geologists, Mexico, 1960–1967
- Faculty Advisor, Sigma Phi Delta, University of Southern California, 1960–1998.
- Faculty Advisor, Tau Beta Pi, National All-Engineering Honor Soc., 1960–2000.
- President, Electroosmotics Inc., 1962–1968
- Invited by the government of Nicaragua to conduct exploration for oil and gas, 1963–1965
- One of the ten foremost experts on Carbonate Rocks invited to NSF sponsored symposium on Carbonate Rocks at the University of Miami, 1964
- Chairman of sessions at International Geological Congress in New Delhi, India, 1964
- Article in the Soviet Journal: Bull. Moscov. Obshch. Ispyt Prirody, Otdel Geol., Vol. 40, No. 3, by N.P. Yushkin, in which G.V. Chilingar was congratulated and praised on his work, 1965



- Tau Beta Pi Student Evaluation Survey of Classroom Instructors results showed G.V. Chilingarian as an exceptional instructor whose name most often appeared, 1965
- Editor-in-Chief, *Sedimentary Geology*, *International Journal of Applied and Regional Sedimentology*, 1965–1967
- Faculty Advisor, Pi Epsilon Tau, National Petroleum Engineering Society, 1965, National Vice President, 1983–1986, National Councilman, 1987–Present
- Member, Archimedes Circle Board of Directors, USC School of Engineering, 1965–1985
- Honorary Dean of Students, Tatung Institute of Technology, Taipei, Republic of China, 1965–1985
- Official Advisor of Iranian Students, 1965–1979
- American Arbitration Association, Member, National Panel of Arbitrators, 1965
- Certified Petroleum Geologist, Am. Assoc. Petrol. Geol., 1966
- Professional and Executive Hall of Fame, 1966
- Chairman, Meeting on Diagenesis, St. Louis, AAPG, 1966
- Consultant, Invited by the United Nations to India, 1967
- Editorial Board, *Sedimentary Geology*, *International Journal of Applied and Regional Sedimentology*, 1967–1969
- Institute Member in the Class of Research Fellow, International Science Institute, 1967
- Senior Petroleum Engineering Advisor to the United Nations, 1967–1987
- Guest Speaker, Los Angeles Basin American Association of Petroleum Geologists Dinner Meeting, Los Angeles, CA, April 2, 1968
- Chairman. “Genesis and Classification of Sedimentary Rock” XXIII Session of the International Geological Congress, Prague, Czechoslovakia, 1968
- Dart Associates Awards for Teaching Excellence, USC, 1969
- Chairman, “Geochemistry of Sediments” Research Group, Society of Economic Paleontologists and Mineralogists, 1969
- Member, Blue Key, University Honor Society, 1969

- Diploma for Distinguished Achievement, The Two Thousand Men of Achievement, 1969
- Advisor, Iranian Students Association, 1970–1979
- Grant from the City of Long Beach to conduct research on subsidence, 1970
- Director, USC League International, 1970–1981
- Distinguished Service Award, Sigma Phi Delta, Engineering Professional Fraternity, 1970
- Invited Speaker, Big Horn Basin Wyoming Section of the Society of Petroleum Engineers of AIMS, 1971
- Vice-President, Phi Kappa Phi, All-University National Honor Society, 1971
- Distinguished Service Award, Tau Beta Pi, 1971
- Invited Lecturer, Danish Geological Survey, Copenhagen, Denmark, June 23, 1972
- International Personnel Research Creativity Award, 1972
- Member, the California Society of Professional Engineers (and National) 1973
- Vice President, International Resources Consultants Inc., 1973–1977
- Invited Speaker, SEPM Fine-Grained Sediments Research Group, Anaheim, CA, 1973
- Advisor to the Governor of the State of California on Energy Problems, 1973
- Invited Speaker, Ahwaz Oil Industry, Ahwaz, Iran, April 13, 1973
- Distinguished Personalities in the World for 1973
- Chairman, International Sedimentology Congress, Nice, France, 1973
- Vice President, Engineering Alumni Association, USC, 1974–1976
- Distinguished Service Award, Archimedes Circle (USC Support Group), 1974
- Honorary Advisor of Research and Development Committee, National Cheng Kung University, Republic of China, 1974
- Invited Speaker, Organizing Committee of All-Union Conference on the Origin of Oil and Gas, Moscow, USSR, 1974

- Guest Speaker, AIMS Mining Branch Monthly Meeting, Los Angeles, CA, Feb. 21, 1974
- Invited Lecturer, Technology Research Center, Japan Petroleum Development Corporation, July 30, 1974
- Invited Lecturer, Chulalongkorn University, Thailand, 1974
- Vice President, The Society of Sigma Xi, National Research Honorary Society, 1974–1975 Invited Lecturer, Korean Inst. Min. Metal. Engrs., Seoul, Korea, 1974
- External Examiner, School of Petroleum Engineering, University of Ibadan, Nigeria, 1974 Regional Counselor, Pi Epsilon Tau, National Petroleum Engineering Society, 1975 — Guest Speaker, Los Angeles Chapter of the California Society of Professional Engineers Meeting, Jan. 9, 1975
- Panelist, Business Symposium on Iran, Los Angeles, Co-sponsored by the Center for International Business, Pepperdine University and the Iran-American Chamber of Industry and Commerce, June 12, 1975
- Senator, Faculty Senate, USC, 1975–1976, 1979–1986
- Associate, Pepperdine University, 1975–Present
- Pro Mundi Beneficio Medal from the Brazilian Academy of Humanities, Sao Paulo, Brazil, 1975
- Completed Advanced College of the Armed Forces, Military Security Management, 1975 Honored by Pi Epsilon Tau, National Honor Society of Petroleum Engineers, 1975
- Invited Speaker, 22nd Meeting of Latin American Petroleum Experts, Bogotá, Columbia July 25, 1975
- Gold Medal of Honor (three) from the Government of Iran for contributions to the Iranian Industry, discovering a new oil field, and educating Iranian students, 1975
- H.I.M. Shahanshah Aryamehr Pahlavi Chair in Petroleum Engineering, USC, 1976 Established the H.I.M. Shahanshah Aryamehr Fellowships in the School of Engineering, USC (Sponsored by National Iranian Oil Co.), 1972
- President, International Alumni, USC, 1976–1985
- Distinguished Faculty Award, USC, 1976
- Alborz Prize, the Persian equivalent of the Nobel Prize, 1976
- Helped organize the Petroleum Engineering Department and taught petroleum engineering courses at Abadan Institute of Technology, Abadan, Iran, 1976, 1977

- Represented Abadan Institute of Technology at the Society of Petroleum Engineers of AIME Meeting, Amsterdam, 1976
- Advisory Editor to “Petroleum Science Series,” by Elsevier Publishing Co., 1976–2003 Doctor Honoris Causa, Engineering, Kensington University, Los Angeles, CA, 1977 Doctor Honoris Causa, Political Science, Pacific Western University, CA, 1977 Emeritus Professor, China Maritime College, 1977
- Consultant, Invited by the United Nations to India, 1978
- Executive Vice President, Global Oil Corporation, 1978–1981
- Diploma of Honor, Pepperdine University (Honorary Degree), 1978
- Medal of Honor for contribution to the promotion of international cooperation in the field of culture and education and the development of the National Cheng Kung University, Taiwan, 1978
- Key to the City of Taipei, Republic of China, 1980
- Vice President, Phi Kappa Phi, All-University National Honor Society, 1980
- Invited to Armenian SSR, USSR, to be honored by their Academy of Sciences, 1980
- Medal of Honor, Republic of China, for Outstanding Contribution to Higher Learning, 1980
- Invited Lecturer, The Scientific Research Institute of Petroleum Exploration and Development, Beijing, China, 1981 (became Honorary Advisor)
- President, Phi Kappa Phi, All-University National Honor Society, 1981
- L.A. County Proclamation, presented by Kenneth Hahn, Supervisor, honoring him for outstanding contributions to education, science, engineering and community, 1981
- Lectured and consulted for the Ministry of Petroleum of the People's Republic of China, 1981
- Diploma of Honor, Phi Kappa Phi, 1981
- Doctor Honoris Causa, Petroleum Engineering, Bedford University, Arizona, 1981
- Distinguished Service Award, USC League International, support group, 1981
- Distinguished Service Award, Pi Epsilon Tau, 1982
- Certificate of Technical Recognition, Tau Beta Pi, 1981

- County of Los Angeles Proclamation for outstanding contributions, 1981
- Invited Lecturer and Consultant, Japan National Oil Corp., August 16–22, 1982
- External Examiner, Ph.D., Indian Schools of Mines, Dhanbad, India, 1982
- Dolores Award, Pepperdine University Graduate School of Education, 1982
- Meritorious Award, Phi Kappa Phi, 1982
- Key to the City of Tainan, Republic of China, 1982
- Invited Speaker to Conference on “Subsidence Due to Fluid Withdrawal,” Joint DOE Venezuelan Government Forum, November 14–17, 1982. Also invited to Venezuela to help solve subsidence problem.
- Consultant National Japan Petroleum Corporation, Tokyo, Japan, August 1983. Lectured and advised on various problems.
- Chairman, Fossil Fuels – Heavy Oil, 18th Intersociety Energy Conversion Engineering Conference, August 21–26, 1983, Orlando, Florida
- Series Editor of “Contributions to Petroleum Geology and Petroleum Engineering,” by Gulf Publishing Co., 1984–2005
- Co-Chairman National Organizing Committee, Third International Conference on Heavy Crude and Tar Sands, Long Beach, CA, July 22–31, 1985
- Meritorious Award from the government of Thailand, 1985
- Royal Pouch Medal, Government of Thailand, 1985
- Distinguished Service Award, Tau Beta Pi, National Engineering Honor Society, 1986
- Doctor of Laws, Honoris Causa, Pacific States University, 1986
- Invited Speaker, IUGS Workshop on Extensional Basin Modeling and Paleotemperature Reconstruction, Rorros, Norway, 1986
- Started new journal entitled “Petroleum Science and Engineering,” August 1987
- Won 1st prize scientific book award by National All-University Honor Society, Phi Kappa Phi, \$1000 prize, during all-university (USC) honors convocation, May 1987

- Invited to the University of Bologna in Italy during the summer of 1988 to give a course on Drilling Fluids on the occasion of 900th Anniversary of the University. Also a medal was awarded. Presented a lecture on “Carbonate Reservoir Rocks” to the SPE branch in Milan, Italy.
- Medal from the Government of Honduras for Oil and Gas Exploration work in Honduras-Morazan, Grand Cavalier, 1993.
- Paper presented at the Annual American Association of Petroleum Geologists in April of 1993 was chosen as the “Best of AAPG.”
- Founding Editor – Energy Sources Journal, 1974
- Distinguished Service Award from the Government of Salvador, 1993.
- Commendation from the AI-Russian Petroleum Scientific Research Geological Exploration Institute (VNIGRI) for outstanding contributions to the fields of Compaction of Sediments, Carbonate Reservoir Rocks, Abnormal Formation Pressures, etc., 1993.
- Academy Sciences of Armenia – Academician, 1994
- Armenian Academy of Engineering, 1994
- The whole issue of “Carbonate and Evaporites” journal was dedicated to Prof. G.V. Chilingar, Vol. 8, no.1, 1993, for outstanding contribution to the fields of carbonates.
- Managing Editor of Journal of Petroleum Science and Engineering since 1987–2004. Editor of Petroleum Geology and Petroleum Engineering Contributions, Gulf Publishing Co., 10 books, 1985.
- Lomonosov Medal of Russia from the Russian (ex USSR) Academy of Sciences for scientific accomplishments, 1994
- Armenian Academy of Engineering, Foreign Member, Representative and President, U.S. Branch
- Armenian Academy of Sciences, Foreign Member, Representative and President, U.S. Branch. Representative of the Russian Academy of Natural Sciences in U.S.A. President of the U.S. Branch
- Kapitsa Gold Medal of Honor from the Russian Academy of Natural Sciences
- Peter the Great Gold Metal of Honor from the Russian Academy of Natural and Social Sciences.

- Francisco Morazan Gold Metal of Honor from the Government of Salvador, Central America. Honorary Doctor's Degree from the International University of Dubna in Russia (largest nuclear research center in Russia)
- Best Paper Award, International SEG Meeting, St. Petersburg '95, St. Petersburg, Russia Honorary Doctor's Degree (Sciences) from VNIGRI (All-Union Petroleum Scientific Research Geologic-Exploration Institute) in St. Petersburg, Russia
- Expert witness. Worked with Dr. Bernard Endres on several cases, gas migration, 1990–1996 U.S.A.F.R. Liaison Officer
- Established Permanent “Esprit de Corp” Award for ROTC cadets
- Established “Distinguished Service Award” for officers and those who helped in recruiting AFROTC and Air Force Academy Cadets (Permanent Award called Chilingar) Honorary Consul of Honduras in Los Angeles, California, since 1983.
- Editor-Energy Sources Journal
- Editor (scientific) of Russian Petroleum Engineering and Geology Books Translated into English, 1990, Optimization Software Co.
- USA Editor of Russian Geology and Geophysics Journal, Siberian Branch, NAS.
- Omar Khayyam Gold Medal of Honor, Sharif University (formerly Aryamehr) for outstanding contributions to science and engineering, 2006
- Certificate of Merit, American Association of Petroleum Geologists, Division of Professional Affairs
- University of Southern California, Academic Senate Distinguished Faculty Service Award, 2007

## **Publications**

Professor George V. Chilingarian is author of 500 original research articles, 150 scientific reviews (Russian Literature), and 61 books.

## **Books**

1. Technology of Testing Petroleum Products, U.S.A.F. Publication, 76 pp., 1956  
Technology of Mud Testing: Syllabus, Petroleum Engineering 303bL, USC, 55 pp., 1952. Revised 1958. (Co-author: C.M. Beeson)

Technology of Testing Petroleum Products: Syllabus, Petroleum Engineering 303aL, USC, 65 pp., 1951, Revised 1958. (Co-author: C.M. Beeson)

2. Surface Operations in Petroleum Production, University of Southern California, 209 pp., 1959. (Co-editor and Co-author: C.M. Beeson)
3. Carbonate Rocks, Vol. I, Origin, Occurrence and Classification, Elsevier Publishing Co., 471 pp., 1967. (Co-editor and Co-author); translated into Russian, 1971.
4. Carbonate Rocks, Vol. II, Physical and Chemical Aspects, Elsevier Publishing Co., 413 pp. 1967. (Co-editor and Co-author); translated into Russian, 1971.
5. Oil and Gas Production from Carbonate Rocks, Amer. Elsevier Publishing Co., 450 pp., 1971. (Co-authors and Co-editors: R.W. Marmon and H.H. Rieke)
6. Secondary Recovery and Carbonate Reservoirs, Amer. Elsevier Publishing Co., 304 pp., 1972. (Co-authors: G.L. Langness and J.O. Robertson)
7. Surface Operations in Petroleum Production, Elsevier Publishing Co., 410 pp., 1968. (Co-editor and Co-author); translated into Russian, 1973.
8. Compaction of Argillaceous Sediments (Co-author: H.H. Rieke), pp. 49–100. In: Abnormal Formation Pressures, by W.H. Fertl, Developments in Petroleum Science 2, 383 pp., 1975
9. Compaction of Argillaceous Sediments, Developments in Sedimentology 16, Elsevier Publishing Co., 450 pp., 1974. (Co-author: H.H. Rieke)
10. Compaction of Coarse-Grained Sediments I, Developments in Sedimentology 18A, Elsevier Publishing Co., 552 pp., 1975. (Co-editor and Co-author: K.H. Wolf)
11. Diagenesis in Sediments, Elsevier Publishing Co., 551 pp., 1967. (Co-editor and Co-author; translated into Russian, 1971), Elsevier Scientific Publishing Co., 551 pp., 1967. (Co-editor and Co-author: G. Larson)
12. Compaction of Coarse-Grained Sediments, II, Developments in Sedimentology 18B, 808 pp., 1976. (Co-editor and Co-author)
13. Bitumens, Asphalts, and Tar Sands, Elsevier Scientific Publishing Co., 331 pp., 1978. (Co-editor and Co-author: T.F. Yen)
14. Diagenesis in Sediments and Sedimentary Rocks, Developments in Sedimentology 25A. Elsevier Sci. Publ. Co., 579 pp., 1979. (Co-author and Co-editor: G. Larson).
15. Oil Shales, Elsevier Publishing Co., 400 pp., 1975. (Co-author, Co-editor: T.F. Yen); translated into Russian, 1980.
16. Drilling and Drilling Fluids, Developments in Petroleum Science, 11, Elsevier Scientific Publishing Co., 767 pp., 1981. (Co-author, Co-editor: P. Vorabutr); Revised 1984.



17. Handbook of Geothermal Energy, Gulf Publishing Company, Houston, TX, 614 pp. (Co-editors: L.M. Edwards, W.H. Fertl and H.H. Rieke), 1982.
18. Diagenesis in Sediments and Sedimentary Rocks, Developments in Sedimentology 25B, Elsevier Scientific Publishing Co., 572 pp., 1983. (Co-editor and Co-author)
19. Carbonate Rocks of Armenia, National Academy of Sciences of Armenia Publication, 1993, 173 pp. (Editor).
20. Geology of Oil and Gas, at the Dawn of the Century (in Russian) (author: N. A. Eremenko), 175 pp., Nauka, Moscow, 1996.
21. Physical Basis of Vibrational and Acoustic Effect on Oil-Gas-Bearing Formations. 206 pp. 2001 "Mir" Publishers, Moscow (Co-authors: O.L. Kuznetsov and E.M. Simkin) (in Russian)
22. Enhanced Oil Recovery, Fundamentals and Analyses I, Elsevier, 1985, 357 pp. (Co-authors and Co-editors: E.C. Donaldson and T.F. Yen). Translated and published in China)
23. Enhanced Oil Recovery, Processes and Operation II, Elsevier, 1988, 560 pp. (Co-authors and Co-editors: E.C. Donaldson and T.F. Yen).
24. Surface Operations in Petroleum Production, I, Developments in Petroleum Science Elsevier, 1987, 821 pp., (Co-authored all 16 chapters; Co-authors: John Robertson, Jr. and Sanjay Kumar). (Translated into Chinese and published in China)
25. Surface Operations in Petroleum Production, II, Developments in Petroleum Science Elsevier, 1989, 562 pp., (Co-authored all 14 chapters; Co-authors: John Robertson, Jr. and Sanjay Kumar). (Translated into Chinese and published in China)
26. Carbonate Reservoir Characterization: A Geologic-Engineering Analysis. Developments in Petroleum Science 30, 639 pp., 1992. (Co-authors: S.J. Mazzullo and H.H. Rieke.)
27. Practical English – Russian – English Petroleum Dictionary, 2004. (Co-author: M. G. Bernadiner) Illumina Press, 460 pp.
28. Microbial Enhanced Oil Recovery, Elsevier, 1989, 410 pp. (Co-authors, Co-editors: E.C. Donaldson and T.F. Yen).
29. Diagenesis I, Developments in Sedimentology, 41, Elsevier, 1988, 591 pp. (Co-author: K.H. Wolf).
30. Diagenesis II, Developments in Sedimentology, 43, Elsevier, 1988, 268 pp. (Co-editor: K.H. Wolf).

31. Diagenesis III, Developments in Sedimentology, 44, Elsevier, 1991, 674 pp. (Co-editor: K.H. Wolf).
32. Diagenesis IV, Developments in Sedimentology, Elsevier, 1994, 610 pp. (Co-author: KR Wolf)
33. Carbonate Reservoir Characterization: A geologic-Engineering Analysis, Part II, Developments in Petroleum Science, 1996, 994 pp. (Co-authors: S.J. Mazzullo and H.H. Rieke.)
34. Casing Design (Co-author: Sheikh Rahman) Elsevier, 373 pp., 1995
35. Subsidence Due to Fluid Withdrawal (Co-authors: T.F. Yen, E. Donaldson), 498 pp., Elsevier, 1995.
36. Asphaltenes and Asphalts, Vol. 1 (Co-editor: T.F. Yen), Elsevier, 459 pp., 1994
37. Chapter in: Studies in Abnormal Pressures, Elsevier, 1994. "Chemistry of Pore Water," pp. 107 – 153.
38. Geology of Lake Sevan, Armenia. National Academy of Sciences of the Republic of Armenia, 181 pp. (Co-author: M.A. Satian).
39. Asphaltenes and Asphalts, Vol. 2 (Co-editor: T. F. Yen), Elsevier, Amsterdam, 621 pp.
40. Developments in Petroleum Science 40B. (Editor of Series – George V. Chilingarian, 2001.)
41. Petroleum Geology of the South Caspian Basin, 2001. (Co-anchors: L. Buryakovsky and Fred Aminzadeh) Gulf Professional Publishing, 442 pp.
42. Gas Migration, Events Preceding Earthquakes, by Leonid F. Khilyuk, George V. Chilingar, John O. Robertson Jr. and Bernard Endres, Gulf Publishing Company, Houston, Texas, 2000, 389 pp.
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## **General Contributions**

1. Authored first books on “Carbonate Rocks” in 1967.
2. Authored the first book on “Diagenesis of Sediments and Rocks” in 1968, which is so important in reservoir engineering and enhanced oil recovery studies. Since then he published seven more books on the subject.
3. Helped to write (and originated the idea) the first book on “Abnormal Formation Pressures.”
4. Authored three books (the first) on Compaction, Subsidence, and Compressibilities of Argillaceous (Clays) and Coarse-Grained Sediments.
5. Bringing together Petroleum Geologists and Petroleum Engineers (who do not cooperate in numerous instances) through publication of numerous books and establishing interdisciplinary journal entitled “Petroleum Science and Engineering,” in 1987.
6. Established “Energy Sources” journal in 1971.
7. Combined geology and petroleum engineering in carbonate reservoirs book entitled “Oil and Gas Production from Carbonate Rocks,” published in 1973. One volume on the same subject was published in 1992 (Elsevier Science Publishers); the other published in 1996.
8. Editor of Petroleum Science Series books, which are being published by the Elsevier – both petroleum engineering and petroleum geology.
9. Editor of Gulf Publishing books (Series) on “Petroleum Geology and Petroleum Engineering”
10. Concluded the first contract to store fuels underground (salt domes) for U.S.A.F. in 1953.
11. Wrote the first book on “Technology of Testing Petroleum Products” for the U.S.A.F. petroleum inspectors in 1954.

## **Original Findings of Professor George V. Chilingarian (or Chilingar)**

1. In 1948, he proposed the use of natural organic colloids (polymers) of Iranian and Indian origin (e.g., gum tragacanth, gum shiraz, gum ghatti, etc.) in drilling fluids. This helped the country of Iran in that they did not have to import Impermex (pregelatinized starch) from abroad. In addition, starch has a tendency to ferment. He proved that these organic colloids plate the clay particles, plug the pores in the filter cake, and reduce the fluid loss to the formation during the drilling operations. See “Drilling and Drilling Fluids” book by G.V. Chilingarian and P. Vorabutr, 1981, 1983.

2. He proved the plating action of dispersants (e.g., sodium-acid-pyrophosphate) in drilling fluids, using electrophoretic technique in 1950. At that time, all physical chemistry books stated that electrophoretic velocity of clay particles is independent of size. On adding chemicals such as NaOH and SAPP, Professor Chilingarian showed that electrophoretic velocity of a clay particle having a certain particular size (towards positive electrode; D.C. current) increases on addition of the micas. See "Drilling and Drilling Fluids, 1981, by G.V. Chilingarian and P. Vorabutr.
3. The above described finding (No. 2) enabled separation of fine sediments into grades using electrophoretic phenomenon. References: 3 and 4.
4. While acting as the Chief of Petroleum and Chemicals Laboratories at Wright-Patterson AFB, Ohio, there were many unexplained jet crashes. Professor Chilingarian discovered that many were caused by plugging of fuel filters by naphthenates (some crude oils contain naphthenic acids). He devised a "Water Tolerance Test" for the Air Force Inspectors to prevent the use of such jet fuels. See "Surface Operations in Petroleum Production" Vol. II, 1989, by G.V. Chilingarian, J. Robertson and S. Kumar. Also Reference 1 (book).
5. His pioneering studies of Ca/Mg ratios of carbonate rocks showed that dolomitization ( $2\text{CaCO}_3 + \text{Mg}^{++} \rightarrow 2\text{CaMg}(\text{CO}_3)_2 + \text{Ca}^{++}$ ) causes increase in porosity (up to 13.1%) in Asmari Limestone of Iran. This finding resulted in the discovery of an oil field in Iran, which was named after him "Chilingar." This technique can be used elsewhere with modifications. References: 5 and 6 (books) on Carbonate Rocks (ones published on the subject); also references 5, 7, 47, 49, 50, 59, 61, 84, and 99. This finding also enabled determination of porosity from grain density if cores are not available. Reference 264.
6. He proposed (after extensive laboratory experiments) the use of Direct Electric Current in Oil Field Production. (a) augmenting reservoir energy (the velocity of fluids through porous media increases up to 52-fold on application of D.C.); (b) well stimulation (clays are destroyed on application of D.C.; irreversible process; clays become amorphous and do not swell); (c) on introduction of certain electrolytes (e.g., CaCE, sodium silicates) during application of D.C., new minerals form, which cement the weak rocks together and prevent them sloughing into the well bore during drilling operations. Some successful pilot tests have been conducted recently. References: 71, 123, 138, 141, 142, 144, 151, 159, 161, 164, 166, 167, 169, and 170.
7. He pioneered high-pressure (up to 1,000,000 psi) compaction studies of sediments in USA. His pressure versus porosity curves for kaolinite, illite and montmorillonite clays are used extensively in the petroleum industry, electrical logging, subsidence, etc. He showed possibility of estimating overburden pressure from x-ray analysis; established pressures at which oriented water begins to be squeezed out; proposed a new theory of migration of oil. References: 10, 11, 12, and 14 (books); References: 82, 83, 97, 117, 147, 150, 157, 161, 172, 174, 179, 184, 185, 186, 188, 190, and 193. He showed that sands are just as compactable as clays, and developed equations for the compressibilities of various sediments and rocks.



8. He showed that chemistry of interstitial solutions squeezed out of clays changes with the overburden pressure utilized (decreases with increasing pressure). Also found that interstitial waters in shales are much fresher than those in the associated sandstones. Prior to this, well log analysts assumed that interstitial water in shales and sandstones have similar salinity. References: 10 and 11 (books); References 114, 176, 183, 192, 195.
9. It is a well established fact that in many cases there is a very poor correlation between porosity and permeability. Yet, if one uses Prof. Chilingarian's definition of "Effective Porosity" (1964), namely, open (intercommunicating) porosity minus the irreducible fluid saturation, then there is indeed a good correlation between "Effective Porosity" and permeability for sandstones. References: 115, 120, 131. Also in 1990 (Journal of Petroleum Science and Engineering, Vol. 4, No. 1), based on extensive statistical studies, Professor Chilingarian developed equations to relate permeability to porosity, specific surface area, and irreducible fluid saturation for carbonate reservoir rocks with coefficients of correlations around 0.98.
10. In 1989, Professor Chilingarian proposed a method of predicting abnormal formation pressure in carbonate reservoirs. Reference: J. Pet. Sci. and Eng., Vol. 3, No. 3.
11. Professor Chilingarian developed a technique of determining permeability of reservoir rocks (sandstones and carbonates) from thin section analysis using porosity (and its type) and grain-size and pore-size distributions. References: 131, 251.
12. Professor Chilingarian's visual estimation charts for determining porosity from thin-section are found in most petrographic laboratories worldwide.
13. In 1985, Professor Chilingarian proposed a method of predicting subsidence and classifying subsidence prone areas from resistivity ratio (ratio of normal resistivity to observed resistivity). Reference: 246.
14. Proposed a method of predicting earthquakes from the rate of gas migration along faults. One week prior to the major earthquake in Los Angeles in 1994, the rate of methane migration to the surface increased. References: 274, 280, 284, 285, 298. Wrote a book on the subject: "Gas Migration: Events Preceding Earthquakes."
15. His research resulted in the utilitarian electrobioseismoremediation technique, including removal of heavy metals. Reference: 320.
16. Showed that abandoned, over-pressured reservoirs should be revisited, because well tests do not provide a true picture: upon reaching a certain critical effective stress and after some production, an irreversible compaction occurs closing down the pores.

# CARBONATES AND EVAPORITES

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CHILINGAR

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## TRIBUTE TO PROFESSOR GEORGE V. CHILINGAR

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This special issue of *Carbonates and Evaporites* is dedicated to Dr. George V. Chilingar, Professor of Civil and Petroleum Engineering at the University of Southern California (USC), for his many contributions to the study of carbonate rocks, and particularly, to the field of petroleum geology engineering in carbonate reservoirs. All of us in the "carbonate community," whether we reside in academia or in the petroleum industry, are familiar with and have been greatly influenced by his work over the years. His work in carbonate geology has spanned more than four decades, and is of world-wide scope. It is, therefore, quite fitting that we now recognize the man and his contributions to our special field of geologic interest.

George V. Chilingar started his professional career teaching in the Petroleum Engineering Department at USC in 1950, after receiving his M.S. degree in petroleum engineering there in that same year. He was Chief of the Petroleum and Chemical Laboratory at Wright-Patterson Air Force Base in Ohio from 1954 to 1956. After receiving his Ph.D. in Geology (with a minor in Petroleum Engineering) in 1956 from USC, he joined the faculty of the Petroleum Engineering Department of that university. He quickly rose to the rank of Professor, a position he holds to this day.

Since joining the faculty at USC his career as a scientist and educator has been long and distinguished, and he has held many important positions over the years in both these roles. In addition to his professorial duties, in his role as scientist he was: Senior Petroleum Engineering Advisor to the United Nations from 1967–1969 and again from 1978 to 1987; President of Electrosmotics Inc. in 1963–1966; Chief Consultant to Amjon Oil Company in 1964–1965, and consultant to the National Japan Petroleum Corporation in 1983; President of International Resource Consultants in 1967–1970; Advisor to the Governor of the State of California on energy problems in 1973; and Executive Vice-President of Global Oil Corporation from 1978 to 1981. Likewise, his role as educator and student mentor has assumed many forms: faculty advisor to the USC chapters of Sigma Phi Delta (1960 to

present), Tau Beta Phi National All-Engineering Honor Society (1960 to present), and Pi Epsilon Tau National Petroleum Engineering Society (1965 to present); acting chairman of the Petroleum Engineering Department at USC (1965–1966); Director of USC League International (1970–1981); Vice-President (1971 and 1980) and President of the USC chapter of Phi Kappa Phi All-University National Honor Society in 1972 and 1981; President of the Society of Sigma Xi in 1974; Vice-President of the USC Engineering Alumni Association (1974–1976), and President of International Alumni at USC (1976–1985); member of the Board of Trustees of Daniel Murphy High School in Los Angeles (1974–1977); regional counselor of Pi Epsilon Tau (1975 to 1989); and Life Associate of Pepperdine University (since 1975). He established the H.I.M. Shahanshah Aryamehr Fellowship Program in the School of Engineering at USC in 1975, and the one million dollar Chair in Petroleum Engineering in 1976. Overseas, he has held the positions of: Honorary Dean of Students at the Tatung Institute of Technology in Taipei, Republic of China (since 1965); Honorary Advisor of the Research and Development Committee of National Cheng Kung University, Republic of China (since 1974); and External Examiner at both the School of Petroleum Engineering of the University of Ibadan, Nigeria (1974) and the Indian School of Mines in Dhanbad, India (since 1982).

With such an active schedule, the average person would have little time for scientific research and publication. But, George Chilingar is by no means your average person! In addition to sponsoring and supervising scores of students over the years (e.g., he brought 1000 students from Iran to USC in 1975!), he has had published more than 200 original research articles, 35 books, and 350 scientific reviews in the fields of carbonate sedimentology and diagenesis, and petroleum geology and engineering, just to name a few. He is perhaps best known among carbonate sedimentologists for his classic 1967 books entitled "Carbonate Rocks, Origin, Occurrence and Classification" (Volume I), and "Carbonate Rocks, Physical and Chemical Aspects" (Volume II), published by Elsevier. These books were so successful that they eventually were translated into Russian and

Chinese! In addition to his still-cited and often-reprinted 1956 paper on "Relationship between Ca/Mg ratio and geologic age" and other studies of dolomites, Dr. Chilingar's research has led to the publication of seven more books (with various Co-authors) that concern diagenesis of carbonate sediments and rocks ("Diagenesis in Sediments," 1967, also translated into Russian; a three-volume set entitled "Diagenesis in Sediments and Sedimentary Rocks," 1979 and 1983; and "Diagenesis I," 1988, "Diagenesis II," 1988, and "Diagenesis III," 1992, with two additional volumes in preparation).

Over the years, one of Professor Chilingar's main goals as a scientist has been to bridge the longstanding gap among carbonate sedimentologists, petroleum explorationists, and reservoir engineers. He has, in fact, successfully "married" these naturally inter-related disciplines in his synergistic books, published by Elsevier, on "Oil and Gas Production from Carbonate Rocks" (1971, Co-authored by R.W. Mannon and H.H. Rieke), "Secondary Recovery and Carbonate Reservoirs" (1972, Co-authored by G.L. Langness and J.O. Robertson), and "Oil and Gas Production from Carbonate Reservoir Rocks" (1989, Co-authored by R.W. Mannon and H.H. Rieke). I am particularly proud to say that, along with H.H. Rieke, Professor Chilingar and I have recently completed Part I of a two-part series that deals with integration of the sedimentologic, diagenetic, and reservoir engineering aspects of carbonate petroleum reservoirs that is soon to be published by Elsevier under the title "Carbonate Reservoir Characterization: A Geologic-Engineering Analysis." He continues to actively strive to maintain synergistic relationships between geologists and reservoir engineers in his role as the managing editor of the Journal of Petroleum Science and Engineering, which he helped to found. In addition to these duties, he currently is on, or has been on, the editorial boards of the journals Energy Sources and Sedimentary Geology, the Petroleum Science Series published by Elsevier, and the series Contributions to Petroleum Geology and Petroleum Engineering published by Gulf Publishing Company, all of which he also had some hand in founding.

Professor Chilingar's field of expertise is not restricted entirely to the study of carbonate rocks alone. He has, in fact, published scores of articles and books on such diverse subjects as petroleum testing technology, surface operations in petroleum production, drilling and drilling fluids, enhanced oil recovery using microbial agents and electrokinetic stimulation, petroleum maturation and migration, effects of subsidence on fluid withdrawal, oil field waters, geothermal energy, compaction of sediments, bitumens, asphalts and tar sands, clay mineralogy, paleontology, geochemistry, lacustrine sediments, metals, and many other subjects too numerous to list here. He was a pioneering researcher into, among others, the subjects of porosity and permeability estimations from thin sections; interrelationship among total porosity, effective porosity, specific surface area, irreducible fluid saturation, and permeability in sandstones as well as in carbonate rocks; the use of Ca/Mg ratio mapping techniques in oil field

exploration; the use of natural organic colloids (polymers) in drilling fluids; application of direct electric current to augment reservoir energy, stabilize the borehole wall, and as a stimulation technique, and; carbonate rock classifications. His work clearly has been of multi-disciplinary extent and international scope.

His many years of professional activity are indicated by his continuing membership in and support of many honorary and professional societies: American Association of Petroleum Geologists, American Geophysical Union, American Institute of Chemists (Fellow), American Institute of Mining Engineers, Archimedes Circle, California and National Societies of Professional Engineers, Geochemical Society, Geological Society of America (Fellow), Mexican Association of Petroleum Geologists, New York Academy of Science, Phi Kappa Phi, Pi Epsilon Tau, SEPM (Society for Sedimentary Geology), Sigma Gamma Epsilon, Sigma Phi Delta, Sigma Xi, Society of Professional Engineers, Southern California Academy of Science, and Tau Beta Pi. He is recognized as an AAPG Certified Petroleum Geologist, Certified Professional Chemist, and Registered Geologist in the State of California. For his scientific contributions and community service, his name is listed repeatedly in the "Who's Who" of: "American Men of Science," "Creative and Successful Personalities," "Distinguished Personalities of the World," "Engineers of Distinction," "In America" (43rd edition), "International Bibliography," "In Frontier Science and Technology" (1st edition), "In the West," "Leaders in American Science," "Leading Men in the United States," "Men of Achievement," "National Register of Prominent Americans and International Notables," "Outstanding Personalities in the West and Midwest," and the "Royal Blue Book." As a noted authority on hydrocarbon reservoirs he has lectured around the world, in such places as Japan, China, Taiwan, Thailand, India, Iran, Central America, the Soviet Union, Europe, Canada, South America, and the United States.

Professor Chilingar has been honored repeatedly, both in the United States and abroad, by a great number of awards in recognition of his scientific achievements, service to education, and contributions to international relations. He has received Doctor Honoris Causa degrees from the Academia Studiorum Minerva in Italy, Kensington University in California, Pacific Western University in California, and Bedford University in Arizona. He has even been awarded the Doctor of Laws Honoris Causa degree from Pacific States University. A full listing of his other awards is far too lengthy to reproduce here. A few key honors that have been bestowed on him include: Diploma d'Onoré from the Istituto Napolitano di Cultura, Distinguished Faculty Award at USC, Distinguished Achievement Award from the Society of Petroleum Engineers, the Dart Associates Award for Teaching Excellence, Pro Mundi Beneficio Award from the Brazilian Academy of Humanities, Gold Medal of Honor from the Government of Iran, the Alborz Prize of Iran, Taiwan Medal of Honor, Chinese Medal of Honor, Meritorious Award and Royal Pouch Medal of

Thailand, and others. He truly is a person of international regard!

In addition to this partial list of his professional activities (as if that wasn't enough!), Professor Chilingar has served his country with honor since 1950 in various roles in the U.S. Air Force. For his longstanding service, he has been recognized by: being named U.S. Air Force Cadet of the Year in 1951, and Distinguished Military Student in 1952; receiving the Air Force Association Award for Military Achievement in 1953; the Distinguished Service Award for Outstanding Instructor in 1972; in 1981 he received the Air Force Commendation Medal, Distinguished Service Award for Outstanding Contributions to Air Force ROTC Programs, the Air Force University Plaque, and was recognized as Top Liaison Officer (Top Performer); he received the USAF Distinguished Service Award in 1982, 1983, 1984, and 1985; in 1985 he received the Air Force Association Special Defense Service Award, the Minority Recruiting Award, and the Meritorious Service Medal (twice). Dr. Chilingar has also assisted the Chinese government over the years, and for his efforts has received his Master Parachute Wings in 1981 and an Award from Artillery Training Command in 1983. In addition, he has been active in national and international law enforcement agencies for many years. In fact, he was even commended for his contribution to law enforcement during the 1984 Olympic Games.

I was first introduced to George Chilingar the scientist in the late 1960s while (admittedly, only briefly) perusing through his 1967 books on carbonate rocks. These books resurfaced again, in 1971, while I was enrolled in a graduate course in carbonate

sediments and rocks under Gerald M. Friedman at, Rensselaer Polytechnic Institute. At that time, however I did not merely peruse these books, but rather, read them from cover to cover as per Dr. Friedman's reading assignment for that particular week. My association with Dr. Chilingar, in his role as a student of carbonate rocks and prolific author on the subject, began then and continues to this day. I had the pleasure of meeting George the man in 1986, when he arranged for us to lecture on petroleum geology at the Oil and Natural Gas Commission in Baroda, India. My first impression upon meeting him was that he was exceptionally cordial and generous, an impression that, because of my rather distrustful nature (due to my upbringing in Brooklyn!), instantly made me suspect his motives. I have since come to realize that George is exactly what he seems to be: very honest, friendly, sincere, generous, and helpful. Yes, he does have his motives: from his friends, he demands all these qualities in return, and asks that we join together to further the study of carbonate rocks. Nothing else. It is my pleasure to know this exceptional human being.

George Chilingar has proven himself to be an exceptional scientist, dedicated teacher, civic-minded individual and international ambassador (e.g., he currently is Honorary Consul of Honduras in Los Angeles). His long and distinguished career devoted to the study of carbonate rocks has given him a well-deserved, international reputation. I take particular pride, on behalf of the world's carbonate sedimentologists and petroleum geological communities, in preparing this dedication in this special issue of Carbonates and Evaporites to Professor George V. Chilingar, scientist and friend.

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**SPECIAL ISSUE:**

**A Tribute to Professor George V. Chilingarian**

**GUEST EDITOR:**

**M. R. Islam**

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## A Tribute to Professor George V. Chilingarian

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This issue of *Energy Sources* is dedicated to Dr. George V. Chilingarian, professor of civil and petroleum engineering at the University of Southern California, for his numerous fundamental contributions in practically all aspects of petroleum engineering and petroleum geology, as well as his humanitarian efforts as an international ambassador on behalf of the scientific and engineering community. The contributors to this issue are living proof of the legend that Dr. Chilingarian has created a diversified and creative group of scientists. The issue deals with topics ranging from modeling of photovoltaic cells to bioremediation and gas processing. The contributors are from fourteen different countries and four different continents. This issue is an indication of how many lives Dr. Chilingarian has touched and the impressions he has left on them. After all, Dr. Chilingarian is the best-known international ambassador I have ever seen in academia (Islam 1995). It is mind-boggling if one considers that none of the contributors to this issue are from the thousands of students who were lucky to have Dr. Chilingarian in their classrooms. While preparing this dedication issue, I did not contact any of his former students. Dr. Chilingarian would find any effort to organize an issue with former students to be improper, especially if the organizer is not one of his former students. I simply looked for contributors who represent

the kind of aspiration and dedication that Dr. Chilingarian has been so famous for.

Professor Chilingarian's list of scientific accomplishments is literally an annual of the fundamentals of petroleum engineering and petroleum geology. His contributions range from the use of organic colloids in drilling fluids to the development of standard tests for aviation gasoline. He covered a wide variety of topics, yet with a depth parallel to none. He developed many techniques, any one of which would take a lifetime to accomplish. Some of his scientific accomplishments include: (a) utilization of organic colloids in drilling fluids, (b) development of tests for aviation gasoline (that saved many lives), (c) diagenesis in sediments, (d) development of the Ca/Mg ratio technique for characterizing carbonate rocks (that discovered a major oil field), (e) initiation of storage of fuels in salt domes, (f) use of electrokinetics in augmenting reservoir energy, stimulation, and soil stabilization, with direct current, (g) geochemical exploration techniques for petroleum, (h) compaction of sediments, subsidence, and overpressure formations, (i) development of methods for classifying source rocks, (j) identification of subsidence-prone areas from resistivity logs, (k) proof of the plating theory for some chemicals that reduce viscosity of drilling fluids, and (1) correlation among porosity, permeability, specific surface area, grain-size distribution, and others. Each one of these scientific accomplishments became a norm for some of the most widely used engineering methodologies in petroleum and geological engineering. For instance, when his theory regarding Ca/Mg ratio (dolomitization) was put into practice, an oil field was discovered and subsequently named after him. When Dr. Chilingarian investigated the possibility of using organic colloids in drilling fluids, people

listened, and today it has become one of the most common practices in drilling fluid engineering. In his early career, when he was at Wright-Patterson Air Force Base, he solved the mysteries of many unexplained jet crashes by discovering the cause and designing a test for jet fuels. This test remains a standard in the aviation industry. His accomplishments transcend the boundaries between different engineering disciplines and, more importantly, that between science and engineering. I have not seen another scientist who ventured into science and engineering with dexterity equal to Dr. Chilingarian's.

To understand how it is possible for one individual to accomplish all these scientific landmarks in a lifetime, one has to know Dr. Chilingarian. One of Professor Chilingarian's visions was to bridge the gap between engineers and geologists. For the last ten years, even some of the most stubborn petroleum engineering companies have realized the potential of interdisciplinary teamwork. Dr. Chilingarian had started to "marry" geology and petroleum engineering several decades prior to the "modern-day fad" for interdisciplinary projects (Mazzullo 1993). How could one foresee something that eluded everyone else for decades? The answer to this question is as elusive as the question regarding how old Dr. Chilingarian is. This forever-young scientist has defied age and all common logic in his determination to achieve excellence in whatever area he sets his mind to.

His accomplishments did not really go unnoticed. He has published more than 350 research articles, 40 books, and 150 scientific reviews. The quality of each of his works is reflected in the number of awards he has received: more than 100 medals and awards from around the world (including the Lomonosov Medal, the most coveted award from the Russian Academy

of Sciences, and the Kapitsa and Peter the Great medals of honor from the Russian Academy of Natural Sciences). He is a fellow and member of dozens of professional societies and academies. He has been recognized numerous times for research, teaching, and community service. When the Society of Petroleum Engineers began to recognize outstanding faculty members, he was among the first professors to be recognized as the most outstanding petroleum engineering faculty member. He is the president of the U.S. branches of the Russian Academy of Natural Sciences, the Armenian Academy of Sciences, and the Armenian Academy of Engineering. He is also elected to the International Academy of Engineering. He is the honorary consul of Honduras in Los Angeles, California, and has established fellowships for Honduran students at the University of Southern California. In the discipline of petroleum engineering and geology, I am not aware of another faculty member who has received so many accolades from such varied interest groups from so many countries.

It is important to note how this outstanding pioneer evolved from a young energetic student to an academician and scientist the whole world can look up to. He started his professional career by teaching in the Department of Petroleum Engineering at the University of Southern California (USC) in 1950, the year that he received his M.S. in petroleum engineering from the same university. He moved briefly to industry as the chief of the Petroleum and Chemical Laboratories at Wright-Patterson Air Force Base in Ohio in 1954. After receiving his Ph.D. in geology (with a minor in petroleum engineering), Dr. Chilingarian came back to USC in 1956 and continued his illustrious career there, where he spent the next forty-three years. During his academic career he moved up to the position of professor very early and

assumed a chair in 1965. He occupied the one-million-dollar Shah of Iran Chair (which he brought from Iran) in Petroleum Engineering at the University of Southern California. In those days he accomplished more than many top scientists would accomplish in a lifetime.

After addressing just about all petroleum geology and petroleum engineering problems, it is probably time for any scientist to bask in the glory of success. But Dr. Chilingarian is no ordinary scientist and he has no time to slow down. I see him getting excited about a scientific problem with the charisma of a teenager. He still is eager to publish and disseminate his knowledge and remains as the role model for any aspiring scientist and academician in the field of petroleum engineering and geology. He is credited with founding several international journals and has served on the editorial board of numerous scientific journals. This is a simple testimony to his eternal thirst for the dissemination of knowledge-the essence of university research. He works tirelessly to make every single paper, every single issue of a journal, and every single scientific presentation at a conference as flawless as humanly possible. In doing so, he has picked up some of the finest. Scientists and academicians from around the world to collaborate.

Only this year, he published a book in Russian with the foremost petroleum geologist in Russia, a collaborative effort

that can be considered to be the first of its kind in this century. It is no surprise that he is the U.S. representative for so many international academies (including the Russian Academy of Natural Science) which have trusted him to select the best from the United States for recognition. This is one area where Dr. Chilingarian has worked his magic. He has combed through the webs of prejudice and elitism (that plague the United States of late) and has established a standard for professional equality and fairness. His entourage of the intellectual elite has only one nationality-the human race.

Personally, I have gone through the education system of five different countries in four different continents, have taught in four different universities and worked in collaboration with a dozen more, but never did I come across another individual who has inspired me as much as Dr. Chilingarian in searching for the truth and caring for the human race. I have never told Dr. Chilingarian (I met him three times in the United States and once in Russia) in person, but if I were allowed to have a role model (my religion doesn't allow me to have one other than the last Prophet), he comes closest to being the one. I take tremendous pride in dedicating this issue of *Energy Sources* to Professor George V. Chilingarian

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**George V. Chilingarian  
(in honor of his 75<sup>th</sup> birthday)**

Professor George V. Chilingarian was born in Tbilisi, Georgia, in 1929. He finished high school with honors in Tehran, Iran. In the middle 1940s, the family of the future scientist immigrated to the United States of America. There, George enrolled at the University of Southern California. In 1949, he earned a BE degree in petroleum engineering, followed by an MS degree the next year, in the same field. In 1954, he received a PhD in geology with a minor in petroleum engineering.

George V. Chilingarian enlisted in the US Air Force and served at Wright-Patterson Air Force Base in Dayton, Ohio, where he was Chief of the Petroleum and Chemical Laboratories. After his *service* in the Air Force, he returned to the University of Southern California as an Assistant Professor in petroleum engineering. Soon he became Professor and, in 1965, Chairman of the Petroleum Engineering Department. In 1990, he was invited by the Department of Civil and Environmental Engineering to teach courses in the environmental engineering and petroleum engineering programs.

George V. Chilingarian much contributed to the geoscience of oil and gas. Of particular importance are his works in the field of geology of petroleum reservoirs, petrophysics, sedimentology; and petroleum engineering. His publications on geology of carbonate reservoirs of the Gulf and South American countries are well known in the world. He is the author of 53 books and 500 papers on problems of geology, ecology, and petroleum engineering. His works have been translated into many languages, including Russian and Chinese. At the verge of millennium, he Co-operated with famous Russian oil geologist N.A. Eremenko to publish a wonderful monograph in the Russian, where he has analyzed achievements of petroleum geology in the 20th century and has predicted its progress in the 21st century.

George V. Chilingarian founded two scientific journals: *Energy Sources* and *Journal of Petroleum Science and Engineering*. He is also a member of the Editorial Board of the journal *Russian Geology and Geophysics*.

George V. Chilingarian was following the progress of Russian geology very carefully. He contributed much to popularization of the most important achievements of Soviet and Russian geosciences in the USA and other western countries. On his initiative, many Russian works were translated into the English and issued in the USA. In particular, he promoted the publication of three volumes of *Principles of Lithogenesis* by N.M. Strakhov and *Petroleum Geology Handbook* edited by N.A.

Eremenko, which had won international recognition. Noteworthy, he acted under conditions of cold war, and his sympathy for Soviet science was often disapproved by the regime.

George V. Chilingarian was the first American petroleum geologist elected to the Russian Academy of Sciences. He is also a member of the Armenian Academy of Sciences and the International Academy of Engineering. Also, he is President of the US branches of the Armenian Academy of Engineering and the Russian Academy of Natural Sciences.

George V. Chilingarian never stopped collaborating with the US Air Force. He has recruited for the Air Force Academy and USAF ROTC. He established the Chilingar Medal for outstanding USAF cadets and instructors at USC.

George V. Chilingarian has been honored with over 100 awards and medals from various nations, including Iran, Thailand, Honduras, Armenia, etc. In his numerous travels around the world, including South America and Asia, he has been an international ambassador of goodwill for the University of Southern California and a champion of the American model of higher education.

He has been the Honorary Consul for the Republic of Honduras for 20 years and has endowed fellowships for Honduras students in environmental engineering at USC.

Professor Chilingarian and his wife Yelba have three children. They are proud of a daughter, Eleanor, and two sons, Modesto and Mark.

We cordially wish George V. Chilingarian many happy returns of the day.

—*N.L. Dobretsov, A.E. Kontorovich, N.P. Laverov, D.V. Rundkvist, N.V. Sobolev, M.D. Belonin, N.P. Zapivalov, and S.G. Neruchev*