04/26/11

CURRICULUM VITAE

Name: **ROY E. WUTHIER**

Work Address: **Department of Chemistry and Biochemistry**
University of South Carolina
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Columbia, South Carolina 29208

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Education:

1954 B.S. University of Wyoming, Laramie
(Agriculture/Chemistry)

1958 M.S. University of Wisconsin, Madison
(Biochemistry)

1960 Ph.D. University of Wisconsin, Madison
(Biochemistry)

Positions Held:

2005--	Guy F. Lipscomb Distinguished Professor of Biochemistry, Emeritus
1996-05	Guy F. Lipscomb Professor of Biochemistry
1975-96	Professor of Biochemistry Department of Chemistry School of Medicine University of South Carolina
1975-91	Coordinator of Medical Biochemistry Department of Chemistry School of Medicine University of South Carolina
1971-75	Associate Professor of Biochemistry University of Vermont College of Medicine

Positions Held (continued):

1969-75	Associate Professor of Orthopedic Surgery University of Vermont College of Medicine
1969-71	Assistant Professor of Biochemistry University of Vermont College of Medicine
1968-69	Assistant Professor of Biochemistry Harvard School of Dental Medicine (Part-time)
1968-69	Senior Member of the Staff Forsyth Dental Center
1963-68	Assistant Member of the Staff Forsyth Dental Center
1963-68	Associate in Biochemistry Harvard Medical School
1961-66	Tutor of Biochemistry Harvard Medical School
1960-62	Research Fellow in Biochemistry Harvard Medical School (At Forsyth Dental Center)

Memberships: (Professional)

American Society for Biochemistry and Molecular Biology

American Chemical Society

American Association for the Advancement of Science

American Society for Bone and Mineral Research

Federation of American Societies for Experimental Biology

International Association for Dental Research

South Carolina Academy of Science

Sigma Xi

Awards and Recognition:

Phi Kappa Phi, Scholastic Honorary (1953)

Alpha Zeta, Agriculture Honorary Fraternity (1954)

International Farm Youth Exchange delegate to India (1954)

Postdoctoral Fellow, Harvard Medical School (1960-1962)

NIH Research Career Development Awardee (1964-69, 1969-71)

Elected to membership, American Society of Biological Chemists (1971)

NIH Oral Biology and Medicine, Studies Section Member (1974-1978)

International Association for Dental Research, Basic Research in Biological Mineralization Award (1982)

University of South Carolina, School of Medicine, Basic Science Research Award (1983)

Appointed to Editorial Board of BONE (1983)

Elected Chairman: Mineralized Tissue Group, International Association for Dental Research (1984)

Appointed to Editorial Board of BONE & MINERAL (1986)

Elected Chairman: Gordon Research Conference on Calcium Phosphates (1989)

Appointed to Editorial Board of CALCIFIED TISSUE INTERNATIONAL (1991)

Program Chairman: Gordon Research Conference on Calcium Phosphates (1992)

Recipient of the Russell Research Award, University of South Carolina (1993). *(The Russell Award is the University's most prestigious annual prize in the area of science, mathematics and engineering.)*

Program Co-Chairman: Northern Rockies Joint Workshop on Osteoporosis & Osteoarthritis, Deaconess Research Institute, Billings, MT (1996)

Guy F. Lipscomb Chaired Professor of Biochemistry (1996–2005)

University of South Carolina, School of Medicine, Basic Science Research Award (1997)

State of South Carolina Governor’s Award for Excellence in Research Discovery (1999)

Appointed to Editorial Board of ANNEXINS (2004)

Invited Lecturer: Numerous Gordon Research Conferences, and many international meetings to lecture on the mechanism of biomineralization.

Research Grants:

2004	Competitive Technologies, Inc. – FC101 Research and Development **Principal Investigator** Total Direct Costs $15,000
2003-04	Praecis Pharmaceuticals, Inc. – FC101 Studies **Principal Investigator** Total Direct + Indirect Costs $10,000
2003-08	NIAMS AR18983 – Role of Matrix Vesicles in Calcification **Principal Investigator** Total Direct Costs + Indirect Costs $1,528,397
2002-03	BRIN-EPSCoR – Total Synthesis of Fusarochromanone and New Analogs for Probing and Enhancing its Potent Anti-Cancer Activity **Principal Investigator** Total Direct Costs + Indirect Costs $103,679
2000-02	ISTO Technologies, Inc. – Isolation and Characterization of Fusaro-chromanone for Assay of Anti-Arthritic Activity **Principal Investigator** Total Direct Costs + Indirect Costs $150,500
1998-02	NIAMS AR18983 – Role of Matrix Vesicles in Calcification **Principal Investigator** Total Direct Costs + Indirect Costs $1,089,642
1998	Carolina Venture Fund – Enhancement of Bone Healing by Lipid-Calcium-Phosphate Complexes – **Principal Investigator** Total Direct Costs $22,049
1994-98	NIAMS AR18983 – Role of Matrix Vesicles in Calcification **Principal Investigator** Total Direct Costs $656,384
1993-96	NIAMS AR42359 – Cytokine Regulation of Growth Plate Chondrocytes – **Co-Investigator** *[Licia N.Y. Wu, Principal Investigator]* Total Direct Costs $381,913
1990-94	NIAMS AR-18983 - Role of Matrix Vesicles in Calcification - **Principal Investigator** Total Direct Costs $748,596
1987-90	NIADR F32 DE05513 - Role of Metal Ions in Matrix Vesicle-Mediated Calcification - **Sponsor** for Dr. Glenn R. Sauer, Postdoctoral Fellow Total Direct Costs $65,004

Research Grants (continued):

1986-89 NIAMS AM-18983 - Role of Matrix Vesicles in Calcification - **Principal Investigator**
Total Direct Costs $533,033

1985-86 Procter & Gamble Company - Role of Alkaline Phosphatase in Mineralizing Tissues
Total Award $5,000

1983 South Carolina Heart Association – Calcification of Blood Platelet and Erythrocyte Membranes
Total Award $9,000

1982-86 NIADDK AM-18983 - Role of Matrix Vesicles in Calcification - **Principal Investigator**
Total Direct Costs $475,000

1982-85 NIH GM-26295 - Cadmium-113 NMR of Systems of Biological Interest - **Co-Investigator** (with Paul D. Ellis, Principal Investigator)
Total Direct Costs $205,000

1982 Procter & Gamble Company - Effect of Diphosphonates on Matrix Vesicle Calcification
Total Award $5,000

1976-81 NIAMDD AM-18983 - Role of Matrix Vesicles in Calcification - **Principal Investigator**
Total Direct Costs $457,329

1972-74 NIAMDD AM-15821 - Clinical and Biochemical Findings in Fat Embolism - **Co-Investigator**
Total Direct Costs $50,489

1972 Upjohn Corporation - Role of Prostaglandins in Cartilage Metabolism **Principal Investigator**
Total Award $6,000

1969-75 NIAMDD AM-13523 - Calcification of Bone and Cartilage **Principal Investigator**
Total Direct Costs $334,658

1964-71 NIDR K4 DE-21770 - Calcification of Teeth and Bones - **Research Career Development Awardee**

1964-69 NIDR DE-00876 - Calcification of Bones and Teeth - **Co-Investigator**

RESEARCH INTERESTS

For many years my primary research interests fell in the general area of Developmental Biochemistry, specifically, in the elucidation of the mechanism of induction of biological mineralization during bone development. My research focused for many years on clarification of the mechanism by which matrix vesicles, produced by growth plate chondrocytes, initiate the mineralization process that is vital to normal bone formation. During recent examination of the role of phosphate ion metabolism in this process, we have cloned and sequenced a new phosphate ion transporter that appears to be a key player in the growth plate mineralization process. Most recently, we have focused attention on the role of Annexin A5 in matrix vesicle mineralization, the study of which has helped elucidate the inhibitory effect of $Zn^{2=}$ on Ca^{2+} ion uptake through crystallographic study of the effect of Zn^{2+} on the assembly of Annexin A5 triskelion membrane arrays.

Also, in the past several years, I have become interested in the development of new anti-cancer agents that are less debilitating than the commonly employed chemotherapeutic drugs. My interest evolved from two key discoveries. First, our studies showed that avian tibial dyschondroplasia (ATD), a common disease in the broiler poultry industry, is caused by a failure in the vascularization of the growth plate of the developing tibia. Second, was our discovery that Fusarochromanone (FC101), a fungal metabolite previously shown to be a causal agent in ATD, acts as a potent anti-angiogenic agent. Interest in such agents stems from the demonstration that growth of solid tumors depends on their development of a new blood supply, a process referred to as angiogenesis. Thus, FC101 has exciting potential for use in blocking the spread of metastasizing cancer, and also as an agent for treatment of a variety of diseases, including arthritis, macular degeneration, psoriasis, whose progression depends on the development of new blood vessels.

What is of particularly interest, however, is our discovery that FC101 has potent direct inhibitory action on a variety of human cancer cell lines, particularly melanomas and small cell lung carcinomas, but also several types of colon, kidney, and central nervous system cancers. In many of these cell lines, not only is the growth of the cancer cells arrested, but the cells are caused to undergo programmed cell death (apoptosis), meaning that the cells are actually killed. What is especially interesting here is the fact that most normal cells in the body do not seem to be effected greatly by FC101; several in vivo experiments have shown the drug to have low general toxicity. Coupled with the fact that FC101 is a relatively simple compound that is orally available, this makes it a highly interesting lead compound for drug development. Current studies are focused on determining the target of this drug, which appears to be unique when compared to the >50,000 drugs so far tested by the National Cancer Institute.

Returning to my long-term interest in biochemical processes involved bone formation, there is strong evidence that matrix vesicles (MV) play a key role in the initiation of *de novo* mineral formation in most vertebrate calcifying tissues. Our work over the past three decades has established many of the basic features of the enzyme, lipid and electrolyte composition of MV and of the extracellular environment in which they reside. We have extensively explored the mechanisms of MV formation and of Ca^{2+} and Pi accumulation during MV mineral phase induction. 1) Using FTIR and FT Raman methods we have recently elucidated the nature of the precrystalline nucleational core, as well as the first crystalline mineral phase that forms during MV-induced mineralization (octacalcium

phosphate). Our work has focused on the constitutive proteins of MV, with special interest on Ca^{2+}-binding proteins and ion porters. 2) We have found that one of the major proteins of MV is Annexin V, an acidic phospholipid-dependent Ca^{2+}-binding protein whose 3-dimensional structure has recently been elucidated. It appears to play a critical role in Ca^{2+} accumulation by intact MV. 3) More recently, we have cloned and sequenced a previously unknown Na^{+}-independent P_i transporter in growth plate chondrocytes that is expressed in high levels in the terminal growth plate, and appears to be involved in the mineralization process. 4) Using a variety of biochemical (extractive dissection and nucleation kinetics) and biophysical methods (solid-state ^{31}P-NMR, RDR-EXAFS, and high-resolution TEM) we have discovered that the initial driving force for ion loading by MV is the presence of phosphatidylserine-Ca^{2+}-Annexin-Pi (calcium phosphate-lipid-protein complexes) which become incorporated at the time of MV formation. 5) Formation of the first crystalline mineral phase occurs by nucleation from this complex, and triggers rapid accretion of mineral ions. 6) Very recent studies have revealed that degradation of specific MV membrane lipids accompanies and facilitates the mineralization process. 7) Our studies have led to the discovery that Zn^{2+} is abundant in MV and serves as an important regulator of Ca^{2+} entry into MV via Annexin A5. Zn^{2+} also acts as an endogenous stabilizer of nascent mineral during the early period of ion accumulation. 8) Recently completed research has succeeded in characterizing, cloning and sequencing the phosphate ion transporter in avian growth plate cartilage. 9) Our most recent data also show that Annexin A5 prevents the inhibitory effects of Mg^{2+} on the mineral nucleating properties of the Ca^{2+}-inorganic P-phosphatidylserine complexes. 10) Finally, Dr. Wuthier has written a comprehensive invited review of the involvement of MVs in the induction of mineral formation during bone development.

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Teaching Experience:

I taught dental, medical, graduate, and undergraduate students since 1963. Upon coming to the University of South Carolina in 1975, I was Coordinator of Medical Biochemistry, a post I held for 16 years. This involved designing and helping to teach the Biochemistry course for first year medical students at the University Of South Carolina School Of Medicine. The Department of Chemistry and Biochemistry on the main campus continues to provide the teaching service for the Medical School, and I continue to teach in the second semester of this course. In the past, I have taught graduate-level courses in the areas of connective tissue chemistry, lipid metabolism, and intermediary metabolism. More recently, I have been teaching introductory biochemistry to premedical and pregraduate students. Since taking over this class in 1991, the class size rose from 31 to over 100 students. This has led to the development of a two-semester course in Biochemistry for our premedical and pregraduate students and the development of a curriculum for an undergraduate major in Biochemistry. *(This major is of interest to a significant number of outstanding undergraduate students, and needs to be pushed forward for approval by the Commission of Higher Education.)*

Finally, at present I am retired after having served over 30 years at the University of South Carolina. All of my graduate students have completed their degrees. I look back on the many years in which I had the great pleasure in introducing and directing the research of many outstanding students. Their response has been a major reward to me in itself.

Ph.D. Students (Graduated):

1. Patrick Y-K. Wong, Ph.D. 1975 - Currently Chairman, Department of Cell Biology, University of Medicine and Dentistry of New Jersey
2. Robert J. Majeska, Ph.D. 1977 - Currently Research Assistant Professor, Dept. of Orthopaedics, Mt. Sinai Medical School, New York City
3. Joseph V. Stillo, Ph.D. 1980, M.D. 1984 - Currently practicing medicine, Mt. Sinai Medical Center, New York City
4. Gregory P. Warner, Ph.D. 1984 - Currently Vice-President of Ralston Purina Corp., Louisville, KY
5. Thomas D. Oglesby, Ph.D. 1984 - Currently with Ciba-Geigy, Summit, NJ
6. Jia E. Chin, Ph.D. 1984 - Currently with The Upjohn Corp., Kalamazoo, MI
7. H. Lee Hubbard, Ph.D. 1984 - Currently with Dept. of Pharmacology, Medical University of South Carolina, Charleston, SC
8. Thomas C. Register, Ph.D. 1985 - Currently Assistant Professor, Dept. of Comparative Medicine, Bowman-Gray School of Medicine, Winston-Salem, NC
9. John E. Hale, Ph.D. 1986 - Currently with Eli Lilly, Indianapolis, IN
10. Elaine M. Schalk, Ph.D. 1986 - Currently Assistant Professor, Dept. of Chemistry, The American University, Washington, DC
11. Ira M. Lubin, Ph.D. 1986 - Currently a Research Fellow at the National Institutes of Health, Bethesda, MD
12. Mary Lynn S. Kemick, Ph.D. 1987, M.D. - Currently practicing Internal Medicine, Providence Hospital, Columbia, SC
13. Brian R. Genge, Ph.D. 1989 - Currently a Research Assistant Professor, Department of Chemistry and Biochemistry, University of South Carolina, Columbia, SC
14. Wilmot B. Valhmu, Ph.D. 1990 - Currently a Postdoctoral Fellow at Columbia University, College of Physicians and Surgeons, New York, NY
15. H. Davis Adkisson, IV, Ph.D. 1991 - Postdoctoral Fellow, Washington University of St. Louis, St. Louis, MO
16. Xu Cao, Ph.D. 1991 - Assistant Professor, Department of Pathology, Division of Molecular and Cellular Pathology, University of Alabama, Birmingham, AL
17. Takayuki Yoshimori, Ph.D. 1994 - Staff Research Scientist, Sugai Corporation, Tokyo, Japan
18. Daotai Nie, Ph.D. 1996 - Postdoctoral Fellow, Wayne State University, Detroit, MI
19. Yande (George) Guo, Ph.D. 2002 – Postdoctoral Fellow, Wayne State University, Detroit, MI

20. Brian D. Furmanski, Ph.D. 2009 – Postdoctoral Fellow, St. Jude Children's Research Hospital, Memphis, TN

M.S. Students (Graduated):

1. James W. Cummins, M.D., 1973 - In medical practice in Massachusetts
2. John J. Mech, M.D., 1974 - In medical practice in Vermont
3. Dr. Frank H. Wians, 1976 - Director of Clinical Laboratories, U.S. Air Force Medical Ctr., Lackland AF Base, San Antonio, TX
4. Dr. Francis K. Northington, 1977 - Dept. of Pharmacology, U. of Rochester, Rochester, NY
5. Elizabeth L. Watkins, 1978 - With Alumax Corporation, Goose Creek, SC
6. Dennis L. Holwerda, M.D., 1980 - In medical practice in Florida
7. Michael S. Vejins, 1981 - With Durco Corporation, Buffalo, NY
8. Frederick M. McLean, M.D., 1985 - Resident in Radiology, M.U.S.C., Charleston, SC
9. Gregory S. Rice, 1986 - Chemistry Teacher, Midlands Technical Institute, Columbia, SC
10. Patricia J. Keller, 1989 - Research Triangle Institute, Research Triangle Park, NC
11. Min Wook Kang, 1996 - Medical Student, University of South Carolina, School of Medicine, Columbia, SC
12. Min Lu, 1997 - Research Technician, University of South Carolina, Department of Chemistry and Biochemistry, Columbia, SC
13. Nicholas R. Blandford, M.S. 2000

Current Ph.D. Students:

None

University Service:

I have actively participated in numerous university-related committees in the Department of Chemistry, the School of Medicine and University-Wide. Listed below are a variety of committees on which I have served in the past .

Chemistry Department

Education and Curriculum Committee
Executive Committee
Library Committee
Stockroom Management Committee (Chair)
Search Committee for Biochemistry Faculty
Search Committee for Departmental Chairman
Tenure and Promotions Committee, Chair

Medical School

Executive Committee
Basic Science Advisory Committee
Curriculum Committee
Space Committee
Search Committee for Chairperson of Microbiology and Immunology,
Search Committee for Chairperson of Pediatrics
Minority Affairs Committee

University Wide

Faculty Senate
Faculty Awards Committee
Office of Research Review Committee
Faculty Research Award Committee

College Wide

A recently consummated contribution to the College of Science and Mathematics was the creation of a Biochemistry major for our undergraduate students. I was actively involved in the initial development of the syllabus for the two-semester undergraduate course in Biochemistry, as well as an appropriate curriculum for a Biochemistry major. After undergoing close scrutiny by faculty and the chairs of the Department of Biological Sciences and the Department of Chemistry and Biochemistry, its development was turned over to a new Biochemistry faculty member in our department, Dr. Paul Thompson, who pushed it forward to final approval.

RESEARCH PUBLICATIONS

1. Ontko, J.A., Wuthier, R.E. and Phillips, P.H.: The effect of increased dietary fat upon the protein requirements of the growing dog. *J. Nutr.* **62**: 163-169, 1957.
2. Wuthier, R.E. and Phillips, P.H.: The effects of long-time administration of small amounts of fluoride in food and water on caries-susceptible rats. *J. Nutr.* **67**: 581-588, 1959.
3. Wuthier, R.E. and Phillips, P.H.: The effect of continued exposure to added increments of water-borne and food-borne fluoride upon the rat. *J. Dental Res.* **40**: 1142-1154, 1961.
4. Irving, J.T. and Wuthier, R.E.: Further observations on the Sudan black stain for calcification. *Arch. Oral Biol.* **5**: 323-324, 1961.
5. Wuthier, R.E., Grøn, P. and Irving, J.T.: The reaction of 1-fluoro-2,4-dinitrobenzene with bone. Studies on the relationship between collagen and apatite. *Biochem. J.* **92**: 205-216, 1964.
6. Wuthier, R.E.: Two-dimensional chromatography on silica gel-loaded paper for the microanalysis of polar lipids. *J. Lipid Res.* **7**: 544-550, 1966.
7. Wuthier, R.E.: Purification of lipid extracts from nonlipid contaminants on Sephadex bead columns. *J. Lipid Res.* **7**: 558-561, 1966.
8. Shapiro, I.M., Wuthier, R.E. and Irving, J.T.: A study of the phospholipids of bovine dental tissues. I. Enamel matrix and dentine. *Arch. Oral Biol.* **11**: 501-512, 1966.
9. Shapiro, I.M. and Wuthier, R.E.: A study of the phospholipids of bovine dental tissues. II. Developing bovine foetal dental pulp. *Arch. Oral Biol.* **11**: 513-519, 1966.
10. Weinstock, A., King, P.C. and Wuthier, R.E.: The ion-binding characteristics of reconstituted collagen. *Biochem. J.* **102**: 983-988, 1967.
11. Termine, J.D., Wuthier, R.E. and Posner, A.S.: Amorphous-crystalline mineral changes during endochondral and periosteal bone formation. *Proc. Soc. Exp. Biol. Med.* **124**: 4-9, 1967.
12. Wuthier, R.E.: Lipids of mineralizing epiphyseal tissues in the bovine fetus. *J. Lipid Res.* **9**: 68-78, 1968.
13. Irving, J.T. and Wuthier, R.E.: Histochemistry and biochemistry of calcification with special reference to the role of lipids. *Clin. Orthop. Rel. Res.* **56**: 237-260, 1968.
14. Wuthier, R.E., Cotmore, J.M. and Maron, S.S.: The reaction of 1-fluoro-2,4-dinitrobenezene with bone of different ages. Changes in the relationship between collagen and bone mineral. *Calcif. Tissue Res.* **1**: 288-297, 1968.
15. Wuthier, R.E. and Irving, J.T.: A study of the lipids of the rat aorta during induced calcification. *Proc. Soc. Exp. Biol. Med.* **130**: 156-162, 1969.
16. Wuthier, R.E.: A zonal analysis of inorganic and organic constituents of the epiphysis during endochondral calcification. *Calcif. Tissue Res.* **4**: 20-38, 1969.

17. Eisenberg, E., Wuthier, R.E., Frank, R.B. and Irving, J.T.: Time study of in vivo incorporation of P-orthophosphate into phospholipids of chicken epiphyseal tissues. *Calcif. Tissue Res.* **6**: 32-48, 1970.
18. Cotmore, J.M., Nichols, G., Jr. and Wuthier, R.E.: Phospholipid-calcium-phosphate complex: Enhanced calcium migration in the presence of phosphate. *Science* **172**: 1339-1341, 1971.
19. Wuthier, R.E.: Zonal analysis of electrolytes in epiphyseal cartilage and bone of normal and rachitic chickens and pigs. *Calcif. Tissue Res.* **8**: 24-25, 1971.
20. Wuthier, R.E.: Zonal analysis of phospholipids in epiphyseal cartilage and bone of normal and rachitic chickens and pigs. *Calcif. Tissue Res.* **8**: 36-53, 1971.
21. Wuthier, R.E., Bisaz, S., Russell, R.G.G. and Fleisch, H.: Relationship between pyrophosphate, amorphous calcium phosphate and other factors in the sequence of calcification in vivo. *Calcif. Tissue Res.* **10**: 198-206, 1972.
22. Wuthier, R.E.: The role of phospholipids in biological calcification. Distribution of phospholipase activity in calcifying cartilage. *Clin. Orthop. Rel. Res.* **90**: 191-200, 1973.
23. Cummins, J.W. and Wuthier, R.E.: In vitro incorporation of H-serine into phospholipids of proliferating and calcifying epiphyseal cartilage and liver. *Biochim. Biophys. Acta* **337**: 50-59, 1974.
24. Wong, P. Y-K. and Wuthier, R.E.: Isolation and identification of prostaglandin PGB in growth cartilage. *Prostaglandins* **8**: 125-132, 1974.
25. Majeska, R.J. and Wuthier, R.E.: Studies on matrix vesicles isolated from chick epiphyseal cartilage: Association of pyrophosphatase and ATPase activities with alkaline phosphatase. *Biochim. Biophys. Acta* **391**: 51-60, 1975.
26. Kuo, H.C. and Wuthier, R.E.: An investigation of fluoride protection against dietary-induced osteoporosis in the rat. *Clin. Orthop. Rel. Res.* **110**: 324-331, 1975.
27. Wuthier, R.E. and Eanes, E.D.: Effect of phospholipids on the transformation of amorphous calcium phosphate to hydroxyapatite in vitro. *Calcif. Tissue Res.* **19**: 197-210, 1975.
28. Wuthier, R.E.: Lipid composition of isolated epiphyseal cartilage cells, membranes and matrix vesicles. *Biochim. Biophys. Acta* **409**: 128-143, 1975.
29. Wuthier, R.E.: Lipids of matrix vesicles. *Fed. Proc.* **35**: 117-121, 1976.
30. Wuthier, R.E.: Paper chromatography of phospholipids and glycolipids on Whatman SG-81 silica gel-loaded paper. *In* "Lipid Chromatographic Analysis", Vol. 1, 2nd Ed., G.V. Marinetti, Ed., Marcel Dekker, New York, pp. 59-109, 1976.
31. Wuthier, R.E.: Electrolytes of isolated epiphyseal chondrocytes, matrix vesicles and extracellular fluid. *Calcif. Tissue Res.* **23**: 125-133, 1977.
32. Wuthier, R.E., Majeska, R.J. and Collins, G.M.: Biosynthesis of matrix vesicles in epiphysal cartilage. I. In vivo incorporation of P-orthophosphate into phospholipids in isolated cell, membrane and matrix vesicle fractions. *Calcif. Tissue Res.* **23**: 135-139, 1977.

33. Wuthier, R.E. and Gore, S.T.: Partition of inorganic ions and phospholipids in isolated cell, membrane and matrix vesicle fractions: Evidence for Ca-Pi-acidic phospholipid complexes. *Calcif. Tissue Res.* **24**: 163-171, 1977.
34. Wong, P.Y-K., Majeska, R.J. and Wuthier, R.E.: Biosynthesis and metabolism of prostaglandins in chick epiphyseal cartilage. *Prostaglandins* **14**: 839-851, 1977.
35. Wuthier, R.E., Wians, F.H., Jr., Giancola, M.S. and Dragic, S.S.: In vitro biosynthesis of phospholipids by chondrocytes and matrix vesicles of epiphyseal cartilage. *Biochemistry* **17**: 1431-1436, 1978.
36. Renne, J., Wuthier, R.E., House, E.F. and Hoaglund, F.T.: Fat macroglobulemia after bone fracture, total-hip replacement and abdominal surgery. *J. Bone Joint Surg.* **60A**: 613-618, 1978.
37. Northington, F.K., Oglesby, T.D., Ishikawa, Y. and Wuthier, R.E.: Localization of prostaglandin synthetase in chicken epiphyseal cartilage. *Calcif. Tissue Res.* **26**: 227-236, 1978.
38. Borg, T.K., Runyan, R.B. and Wuthier, R.E.: Correlation of freeze-fracture and scanning electron microscopy of epiphyseal chondrocytes. *Calcif. Tissue Res.* **26**: 237-241, 1978.
39. Wuthier, R.E., Linder, R.E., Warner, G.P., Gore, S.T. and Borg, T.K.: Nonenzymatic method for isolation of matrix vesicles: Characterization and initial studies on Ca and P orthophosphate metabolism. *Metab. Bone Dis. Rel. Res.* **1**: 125-136, 1978.
40. Majeska, R.J., Holwerda, D.L. and Wuthier, R.E.: Localization of phosphatidylserine in isolated chick epiphyseal cartilage matrix vesicles with trinitrobenzene sulfonate *Calcif. Tissue Intl.* **27**: 41-46, 1979.
41. Wuthier, R.E.: Lipid techniques for calcified tissues. *In* "Skeletal Research, An Experimental Approach", Simmons, D.J. and Kunin, A.S., eds., Academic Press, New York, pp. 121-138, 1979.
42. Watkins, E.L., Stillo, J.V. and Wuthier, R.E.: Subcellular fractionation of epiphyseal cartilage: Isolation of matrix vesicles and profiles of enzymes, phospholipids, calcium and phosphate. *Biochim. Biophys. Acta* **631**: 289-304, 1980.
43. Borg, T.K. and Wuthier, R.E.: A freeze-fracture study of avian epiphyseal cartilage differentiation. *Anat. Record* **199**: 449-457, 1981.
44. Holwerda, D.L., Ellis, P.D. and Wuthier, R.E.:^{13}C- and ^{31}P-nuclear magnetic resonance studies on the interaction of calcium with phosphatidylserine. *Biochemistry* **20**: 418-428, 1981.
45. Oglesby, T.D., Stillo, J.V. and Wuthier, R.E.: Correlation between prostaglandin synthetase and phospholipase A activities in chicken epiphyseal cartilage. *Semin. Arth. Rheum.* **11**: 88-91, 1981.
46. Cyboron, G.W. and Wuthier, R.E.: Purification and initial characterization of intrinsic membrane-bound alkaline phosphatase from chicken epiphyseal cartilage. *J. Biol. Chem.* **256**: 7262-7268, 1981.

47. Ishikawa, Y. and Wuthier, R.E.: Assay of γ-carboxyglutamate in tissue and body fluids by selective hydrolysis and amino acid analysis. *Anal. Biochem.* **114**: 388-395, 1981.
48. Wuthier, R.E., Cyboron, G.W., Warner, G.P., Hubbard, H.L. and Vejins, M.S.: Properties of alkaline phosphatase and the effects of its inhibitors on Ca- and P-inorganic P uptake by isolated matrix vesicles. *In* "The Chemistry and Biology of Mineralized Connective Tissue", Veis, A., ed., Elsevier/North-Holland, New York, pp. 577-581, 1981.
49. Warner, G.P. and Wuthier, R.E.: Metabolism of Pi and Ca by matrix vesicles isolated from epiphyseal cartilage by nondigestive methods. *In* "Matrix Vesicles - Proceedings of the Third International Conference on Matrix Vesicles", Ascenzi, A., Bonucci, E. and de Bernard, B., eds., Wichtig Editore, Milano, pp. 47-51, 1981.
50. Wuthier, R.E.: Proposed mechanism of matrix vesicle formation and vesicle-mediated mineralization. *In* "Matrix Vesicles - Proceedings of the Third International Conference on Matrix Vesicles", Ascenzi, A., Bonucci, E. and de Bernard, B., eds., Wichtig Editore, Milano, pp. 103-109, 1981.
51. Wuthier, R.E.: Role of phospholipid-calcium-phosphate complexes in biological mineralization. *In* "Calcium in Normal and Pathological Systems", Anghileri, L.J., ed., CRC Press, Boca Raton, FL, pp. 41-69, 1982.
52. Cyboron, G.W., Vejins, M.S. and Wuthier, R.E.: Activity of epiphyseal cartilage membrane alkaline phosphatase and the effects of its inhibitors at physiological pH. *J. Biol. Chem.* **257**: 4141-4146, 1982.
53. Wuthier, R.E.: A review of the primary mechanism of endochondral calcification with special emphasis on the role of cells, mitochondria and matrix vesicles. *Clin. Orthop. Rel. Res.* **169**: 219-242, 1982.
54. Warner, G.P., Hubbard, H.L., Lloyd, G.C. and Wuthier, R.E.: Pi and Ca metabolism by matrix vesicles prepared from chicken epiphyseal cartilage microsomes by isosmotic Percoll density-gradient fractionation. *Calcif. Tissue Intl.* **35**: 327-338, 1983.
55. Hale, J.E., Chin, J.E., Ishikawa, Y., Paradiso, P.R. and Wuthier, R.E.: Correlation between distribution of cytoskeletal proteins and release of alkaline phosphatase-rich vesicles by epiphyseal chondrocytes in primary culture. *Cell Motil.* **3**: 501-512, 1983.
56. Register, T.C., Warner, G.P. and Wuthier, R.E.: Effect of L- and D-tetramisole on Pi and Ca uptake and mineralization by matrix vesicle-enriched fractions from chicken epiphyseal cartilage. *J. Biol. Chem.* **259**: 922-928, 1984.
57. Register, T.C. and Wuthier, R.E.: Effect of vanadate, a potent alkaline phosphatase inhibitor, on Ca and Pi uptake by matrix vesicle-enriched fractions from chicken epiphyseal cartilage. *J. Biol. Chem.* **259**: 3511-3518, 1984.
58. Wuthier, R.E.: Lipids in dentinogenesis. *In* "Dentin and Dentinogenesis", Linde, A., ed., CRC Press, Boca Raton, FL, Vol. II, pp. 93-106, 1984.
59. Wuthier, R.E.: Calcification of vertebrate hard tissues. *In* "Metal Ions in Biological Systems", Sigel, H., ed., Marcel Dekker, New York, Vol. 17, pp. 411-472, 1984.

60. Chin, J.E., Hale, J.E., Ishikawa, Y., Register, T.C. and Wuthier, R.E.: Origin of matrix vesicles: Characterization of mineralization-inducing vesicles and their production by primary cultures of chicken growth plate chondrocytes. *In* "Endocrine Control of Bone and Calcium Metabolism", Cohn, D.V., Potts, J.T., Jr. and Fujita, T., eds., Elsevier Science Publ., Amsterdam, pp. 454-458, 1984.
61. Ishikawa, Y. and Wuthier, R.E.: Synthesis of tritium-labeled DL-γ-carboxy-glutamic acid and its cyclic form 5-oxo-2,4-pyrrolidine dicarboxylic acid. *J. Label. Comp. Radiochem.* **21**: 507-517, 1984.
62. Burch, W.M., Hamner, G. and Wuthier, R.E.: Phosphotyrosine and phospho-protein phosphatase activity of alkaline phosphatase in mineralizing cartilage. *Metabolism* **34**: 169-175, 1985.
63. Ishikawa, Y., Chin, J.E., Hubbard, H.L. and Wuthier, R.E.: Utilization and formation of amino acids by chicken epiphyseal chondrocytes: Comparative studies with cultured cells and native cartilage tissue. *J. Cell. Physiol.* **123**: 79-88, 1985.
64. Wuthier, R.E. and Register, T.C.: Role of alkaline phosphatase, a polyfunctional enzyme, in mineralizing tissues. *In* "The Chemistry and Biology of Mineralized Tissues", Butler, W.T., ed., EBSCO Media, Birmingham, AL, pp. 113-124, 1985.
65. Wuthier, R.E., Chin, J.E., Hale, J.E., Register, T.C., Hale, L.V. and Ishikawa, Y.: Isolation and characterization of calcium-accumulating matrix vesicles from chondrocytes of chicken epiphyseal growth plate cartilage in primary culture. *J. Biol. Chem.* **260**: 5972-5979, 1985.
66. Wuthier, R.E., Rice, G.S., Wallace, J.E.B., Jr., Weaver, R.L., LeGeros, R.Z. and Eanes, E.D.: In vitro precipitation of calcium phosphate under intracellular conditions: Formation of brushite from an amorphous precursor in the absence of ATP. *Calcif. Tissue Intl.* **37**: 401-410, 1985.
67. Register, T.C. and Wuthier, R.E.: Effect of pyrophosphate and two diphos-phonates on Ca and Pi uptake and mineralization by matrix vesicle-enriched fractions and by hydroxyapatite. *Bone* **6**: 307-312, 1985.
68. Ishikawa, Y., Chin, J.E., Schalk, E.M. and Wuthier, R.E.: Effect of amino acid levels on matrix vesicle formation by epiphyseal growth plate chondrocytes in primary culture. *J. Cell. Physiol.* **126**: 399-406, 1986.
69. Schalk, E.M. and Wuthier, R.E.: Effect of trifluoperazine and other pheno-thiazines on matrix vesicle formation by chicken growth plate chondrocytes in primary culture. *Biochem. Pharmacol.* **35**: 2373-2379, 1986.
70. Register, T.C., McLean, F.M., Low, M.G. and Wuthier, R.E.: Roles of alkaline phosphatase and labile internal mineral in matrix vesicle-mediated calcification: Effect of selective release of membrane-bound alkaline phosphatase and treatment with isosmotic pH 6 buffer. *J. Biol. Chem.* **261**: 9354-9360, 1986.
71. Wuthier, R.E.: Mechanisms of matrix vesicle-mediated mineralization. *In* "Cell Mediated Calcification and Matrix Vesicles", Ali, S.Y., ed., Elsevier Science Publ., Amsterdam, pp. 47-55, 1986.

72. Ishikawa, Y., Chin, J.E., Schalk, E.M. and Wuthier, R.E.: Effect of amino acids and ascorbic acid on matrix vesicle formation by epiphyseal growth plate chondrocytes in primary culture. *In* "Cell Mediated Calcification and Matrix Vesicles", Ali, S.Y., ed., Elsevier Science Publ., Amsterdam, pp. 231-236, 1986.
73. Hale, J.E. and Wuthier, R.E.: Role of cytoskeletal depolymerization in matrix vesicle formation by primary cultures of epiphyseal growth plate chondrocytes. *In* "Cell Mediated Calcification and Matrix Vesicles", Ali, S.Y., ed., Elsevier Science Publ., Amsterdam, pp. 237-240, 1986.
74. Hale, L.V., Hale, J.E., Kemick, M.L.S., Ishikawa, Y. and Wuthier, R.E.: Development of a new serum-free medium, USC-HC, for growth and normal phenotype in post-embryonic chicken growth plate chondrocytes. *In Vitro* **22**: 599-605, 1986.
75. Chin, J.E., Schalk, E.M., Kemick, M.L.S. and Wuthier, R.E.: Effect of synthetic human parathyroid hormone on the levels of alkaline phosphatase activity and formation of alkaline phosphatase-rich matrix vesicles by primary cultures of chicken epiphyseal growth plate chondrocytes. *Bone and Mineral* **1**: 421-436, 1986.
76. Hale, L.V., Kemick, M.L.S. and Wuthier, R.E.: Effect of vitamin D metabolites on the expression alkaline phosphatase activity by epiphyseal hypertrophic chondrocytes in primary cell culture. *J. Bone Min. Res.* **1**: 489-495, 1986.
77. Hale, J.E. and Wuthier, R.E.: The mechanism of matrix vesicle formation. Studies on the composition of chondrocyte microvilli and on the effects of microfilament-perturbing agents on cellular vesiculation. *J. Biol. Chem.* **262**: 1916-1925, 1987.
78. McLean, F.M., Keller, P.J., Genge, B.R., Walters, S.A. and Wuthier, R.E.: Disposition of preformed mineral in matrix vesicles. Internal localization and association with alkaline phosphatase. *J. Biol. Chem.* **262**: 10481-10488, 1987.
79. Lubin, I.M., Wu, L.N.Y., Wuthier, R.E. and Fisher, R.R.: Rhodamine 123 inhibits import of rat liver mitochondrial transhydrogenase. *Biochem. Biophys. Res. Commun.* **144**: 477-483, 1987.
80. Ishikawa, Y., Valhmu, W.B. and Wuthier, R.E.: Induction of alkaline phosphatase in primary cultures of epiphyseal growth plate chondrocytes by a serum-derived factor. *J. Cell Physiol.* **133**: 344-350, 1987.
81. Sauer, G.R. and Wuthier, R.E.: Fourier transform infrared characterization of mineral phases formed during induction of mineralization by collagenase-released matrix vesicles *in vitro*. *J. Biol. Chem.* **263**: 13718-13724, 1988.
82. Wuthier, R.E.: Mechanism of matrix vesicle-mediated mineralization of cartilage. *ISI Atlas Sci. Biochem.* **1**: 231-241, 1988.
83. Genge, B.R., Sauer, G.R., Wu, L.N.Y., McLean, F.M. and Wuthier, R.E.: Correlation between loss of alkaline phosphatase activity and accumulation of calcium during matrix vesicle-mediated mineralization. *J. Biol. Chem.* **263**: 18513-18519, 1988.

84. Kemick, M.L.S., Chin, J.E. and Wuthier, R.E.: Role of prostaglandins in differentiation of growth plate chondrocytes. In: *Advances in Prostaglandin, Thromboxane, and Leukotriene Research*, Vol. 19, B. Samuelsson, P.Y-K. Wong and F. Sun, eds., Raven Press, pp. 423-426, 1989.
85. Wuthier, R.E.: Mechanism of de novo mineral formation by matrix vesicles. *Connective Tissue Research* **22**: 27-33, 1989.
86. Wu, L.N.Y., Valhmu, W.B., Lloyd, G.C., Genge, B.R. and Wuthier, R.E.: Isolation of two glycosylated forms of membrane-bound alkaline phosphatase from avian growth plate cartilage matrix vesicle-enriched microsomes. *Bone & Mineral* **7**: 113-125, 1989.
87. Sauer, G.R., Adkisson, H.D., Genge, B.R. and Wuthier, R.E.: Regulatory effect of endogenous zinc and inhibitory action of toxic metal ions on calcium accumulation by matrix vesicles *in vitro*. *Bone & Mineral* **7**: 233-244, 1989.
88. Genge, B.R., Wu, L.N.Y. and Wuthier, R.E.: Identification of phospholipid-dependent calcium-binding proteins as constituents of matrix vesicles. *J. Biol. Chem.* **264**: 10917-10921, 1989.
89. Wu, L.N.Y., Sauer, G.R., Genge, B.R. and Wuthier, R.E.: Induction of mineral deposition by primary cultures of chicken growth plate chondrocytes in ascorbate-containing media: Evidence of an association between matrix vesicles and collagen. *J. Biol. Chem.* **264**: 21346-21355, 1989.
90. Valhmu, W.B., Wu, L.N.Y. and Wuthier, R.E.: Effects of Ca/Pi ratio, Ca^{2+} x Pi ion product, and pH of incubation fluid on accumulation of Ca by matrix vesicles *in vitro*. *Bone & Mineral* **8**: 195-209, 1990.
91. Genge, B.R., Wu, L.N.Y. and Wuthier, R.E.: Differential fractionation of matrix vesicle proteins: Further characterization of the acidic phospholipid-dependent Ca-binding proteins. *J. Biol. Chem.* **265**: 4703-4710, 1990.
92. Wu, L.N.Y., Genge, B.R. and Wuthier, R.E.: Association between proteoglycans and matrix vesicles in the extracellular matrix of growth plate cartilage. *J. Biol. Chem.* **266**: 1187-1194, 1991.
93. Wu, L.N.Y., Genge, B.R. and Wuthier, R.E.: Collagen binding proteins in collagenase-released matrix vesicles from cartilage: Interaction between matrix vesicle proteins and different types of collagen. *J. Biol. Chem.* **266**: 1195-1203, 1991.
94. Adkisson, H.D., IV, Risener, F.S., Jr., Walla, M.D., Christie, W.W. and Wuthier, R.E.: Unique fatty acid composition of normal cartilage: Discovery of high levels of n-9 eicosatrienoic acid and low levels of n-6 polyunsaturated fatty acids *FASEB J.* **5**: 345-353, 1991.
95. Genge, B.R., Wu, L.N.Y., Adkisson, H.D., and Wuthier, R.E.: Matrix vesicle annexins exhibit proteolipid-like properties: Selective partitioning into lipophilic solvents under acidic conditions. *J. Biol. Chem.* **266:** 10678-10685, 1991.
96. Ishikawa, Y., Valhmu, W.B., Wu, L.N.Y., and Wuthier, R.E.: Fetuin and alpha-2-HS glycoprotein induce alkaline phosphatase in epiphyseal growth plate chondrocytes. *J. Cell. Physiol.* **149:** 222-234, 1991.

97. Wuthier, R.E., Wu, L.N.Y., Sauer, G.R., Genge, B.R., Yoshimori, T., and Ishikawa, Y.: Mechanism of matrix vesicle calcification: Characterization of ion channels and the nucleational core of growth plate vesicles. *Bone Min.* **17:** 290-295, 1992.
98. Ishikawa, Y., and Wuthier, R.E.: Development of an in vitro mineralization model with growth plate chondrocytes that does not require β-glycerophosphate. *Bone Min.* **17:** 152-157, 1992.
99. Genge, B.R., Cao, X., Wu, L.N.Y., and Wuthier, R.E.: Establishment of the primary structure of the two major matrix vesicle annexins by peptide and DNA sequencing. *Bone Min.* **17:** 202-208, 1992.
100. Wu, L.N.Y., Genge, B.R., and Wuthier, R.E.: Evidence for specific interaction between matrix vesicle proteins and the connective tissue matrix. *Bone Min.* **17:** 247-252, 1992.
101. Sauer, G.R., and Wuthier, R.E.: Influence of trace metal ions on matrix vesicle calcification. *Bone Min.* **17:** 284-289, 1992.
102. Genge, B.R., Cao, X., Wu, L.N.Y., Ishikawa, Y., and Wuthier, R.E.: Establishment of the primary structure of the major lipid-dependent Ca^{2+}-binding proteins of chicken growth plate cartilage matrix vesicles: Identity with anchorin CII (annexin V) and annexin II. *J. Bone Min. Res.* **7:** 807-819, 1992.
103. Wu, L.N.Y., Genge, B.R., Ishikawa, Y., and Wuthier, R.E.: Modulation of cultured chicken growth plate chondrocytes by transforming growth factor-β_1 and basic fibroblast growth factor. *J. Cell. Biochem.* **49:** 1-18, 1992.
104. Walsh, K.B., Cannon, S.D., and Wuthier, R.E.: Characterization of a delayed rectifier potassium current in chicken growth plate chondrocytes. *Am. J. Physiol.* **262:** C1335-C1340, 1992.
105. Wuthier, R.E.: Matrix vesicles: Formation and function C Mechanisms in membrane/matrix-mediated mineralization. In: *Fourth International Symposium on Chemistry and Biology of Mineralized Tissues*, H. Slavkin and P.A. Price, eds., Elsevier Science Publ., pp. 143-152, 1992.
106. Wuthier, R.E.: Involvement of cellular metabolism of calcium and phosphate in calcification in avian growth plate cartilage. *J. Nutr.* **123:**301-309, 1993.
107. Wu, L.N.Y., Yoshimori, T., Genge, B.R., Sauer, G.R., Kirsch, T., Ishikawa, Y., and Wuthier, R.E.: Characterization of the nucleational complex responsible for mineral induction by growth plate cartilage matrix vesicles. *J. Biol. Chem.* **268**:25084-25094, 1993.
108. Cao, X., Genge, B.R., Wu, L.N.Y., Buzzi, W.R., Showman, R.W., and Wuthier, R.E.: Characterization, cloning and expression of the 67-kDa collagen-binding annexin from chicken growth plate cartilage matrix vesicles. *Biochem. Biophys. Res. Commun.* **197:**556-561, 1993.
109. Sauer, G.R., Zunic, W.B., Durig, J.R., and Wuthier, R.E.: Fourier-transform Raman spectroscopy of synthetic and biological calcium phosphates. *Calcif. Tissue Intl.* **54:**414-420, 1994.

110. Kirsch, T., and Wuthier, R.E.: Stimulation of calcification of growth plate cartilage matrix vesicles by binding to type II and X collagens: Apparent activation of annexin V Ca^{2+} channels. *J. Biol. Chem.* **269:**11462-11469, 1994.
111. Kirsch, T., Ishikawa, Y., Mwale, F., and Wuthier, R.E.: Roles of the nucleational core complex and collagens (type II and X) in calcification of growth plate cartilage matrix vesicles. *J. Biol. Chem.* **269:**20103-20109, 1994.
112. Wu, L.N.Y., Ishikawa, Y., Sauer, G.R., Genge, B.R., Mishima, H., and Wuthier, R.E.: Morphological and biochemical characterization of mineralizing primary cultures of avian growth plate chondrocytes: Evidence of cellular processing of Ca^{2+} and P_i prior to matrix mineralization. *J. Cell. Biochem.* **57:**218-237, 1995.
113. Nie, D., Genge, B.R., Wu, L.N.Y., and Wuthier, R.E.: Defect in formation of functional matrix vesicles by growth plate cartilage in avian tibial dyschondroplasia: Evidence of defective tissue vascularization. *J. Bone Min. Res.* **10:**1625-1634, 1995.
114. Arispe, N., Rojas, E., Genge, B.R., Wu, L.N.Y., and Wuthier, R.E.: Similarity in calcium channel activity of annexin V and matrix vesicles in planar lipid bilayers. *Biophys. J.* **71:**1764-1775, 1996.
115. Wu, L.N.Y., Genge, B.R., Sauer, G.R., and Wuthier, R.E.: Characterization and reconstitution of the nucleational complex responsible for mineral formation by growth plate cartilage matrix vesicles. *Conn. Tissue Res.* **35:** 309-315, 1996.
116. Wu, L.N.Y., Wuthier, M.G., Genge, B.R., and Wuthier, R.E.: In situ levels of intracellular Ca^{2+} and pH in successive zones of avian growth plate cartilage using fluorescent imaging by confocal laser microscopy: Implications in matrix vesicle formation and calcification. *Clin. Orthop. Relat. Res.* **335:** 310–324, 1997.
117. Sauer, G.R., Wu, L.N.Y., Iijima, M., and Wuthier, R.E.: The influence of trace elements on calcium phosphate formation. *J. Inorg. Biochem.* **65:** 57–65, 1997.
118. Wu, L.N.Y., Genge, B.R., Dunkelberger, D.G., LeGeros, R.Z., and Wuthier, R.E.: Physicochemical characterization of the nucleational core of matrix vesicles. *J. Biol. Chem.* **272:** 4404–4411, 1997.
119. Ishikawa, Y., Mwale, F.M., and Wuthier, R.E.: Effects of calcitonin and parathyroid hormone on alkaline phosphatase activity and calcification of primary cultures of chicken growth plate chondrocytes. *J. Bone Min. Res.* **12:** 356–366, 1997.
120. Wu, L.N.Y., Ishikawa, Y., and Wuthier, R.E: Retinoic acid stimulates matrix calcification and initiates type I collagen synthesis in cultured growth plate chondrocytes. *J. Cell. Biochem.* **65:** 209–230, 1997.
121. Wu, L.N.Y., Ishikawa, Y., Genge, B.R., Sampath, T.K., and Wuthier, R.E.: Effect of osteogenic protein-1 on the development and mineralization of primary cultures of avian growth plate chondrocytes. *J. Cell. Biochem.* **67:** 498–513, 1997.
122. Nie, D., Ishikawa, Y., Yoshimori, T., Wuthier, R.E., and Wu, L.N.Y.: Retinoic acid treatment elevates matrix metalloproteinase-2 protein and mRNA levels in avian growth plate chondrocyte cultures. *J. Cell. Biochem.* **68:** 90–99, 1998.

123. Sauer, G.R., Nie, D., Wu, L.N.Y., and Wuthier, R.E.: Induction and characterization of metallothionein in chicken epiphyseal growth plate cartilage chondrocytes. *J. Cell. Biochem.* **68:** 110–120, 1998.
124. Taylor, M.G., Simkiss, K., Simmons, J., Wu, L.N.Y., and Wuthier, R.E.: Structural studies of a phosphatidyl serine-amorphous calcium phosphate complex. *CMLS Cell. Mol. Life Sci.* **54:** 196–202, 1998.
125. Litchfield, T.M., Ishikawa, Y., Wu, L.N.Y., Wuthier, R.E., and Sauer, G.R.: Effect of metal ions on calcifying growth plate cartilage chondrocytes. *Calcif. Tissue Int.* **62:** 341–349, 1998.
126. Nie, D., Ishikawa, Y., Guo, Y., Wu, L.N.Y., Genge, B.R., Wuthier, R.E., and Sauer, G.R.: Inhibition of terminal differentiation and matrix calcification in cultured avian growth plate chondrocytes by Rous sarcoma virus transformation. *J. Cell. Biochem.* **69:** 453–462, 1998.
127. Ishikawa, Y., Genge, B.R., Wuthier, R.E., and Wu, L.N.Y.: Thyroid hormone inhibits growth and stimulates terminal differentiation of epiphyseal growth plate chondrocytes. *J. Bone Min. Res.* **13:** 1398–1411, 1998.
128. Sauer, G.R., Wu, L.N.Y., Nie, D., and Wuthier, R.E.: Cell differentiation alters metallothionein expression in avian growth plate chondrocytes. *Metallothionein IV.* C. Klaussen (ed.). Birkhäuser Verlag, Basel, Switzerland, pp. 333–338, 1999.
129. Wu, L.N.Y., Genge, B.R., Kang, M.W., Arsenault, A.L., and Wuthier, R.E.: Changes in phospholipid extractability and composition accompany mineralization of chicken growth plate cartilage matrix vesicles. *J. Biol. Chem.* **277:** 5126-5133, 2002.
130. Wu, L.N.Y., Guo, Y., Genge, B.R., Ishikawa, Y., and Wuthier, R.E.: Transport of inorganic phosphate in primary cultures of chondrocytes isolated from the tibial growth plate of normal adolescent chickens. *J. Cell. Biochem.* **86:** 475–489, 2002.
131. Wu, L.N.Y., Lu, M., Genge, B.R., Guo, G.Y., Nie, D., and Wuthier, R.E.: Discovery of sonic hedgehog expression in postnatal growth plate chondrocytes: Differential regulation of sonic and Indian hedgehog by retinoic acid. *J. Cell. Biochem.* **87:** 173–187, 2002.
132. Sauer, G.R., Smith, D.M., Chalane, M., Wu, L.N.Y., and Wuthier, R.E.: Intracellular zinc fluxes associated with apoptosis in growth plate chondrocytes. *J. Cell. Biochem.* **88:** 954–969, 2003.
133. Blandford, N.R., Sauer, G.R., Genge, B.R., Wu, L.N.Y., and Wuthier, R.E.: Modeling of matrix vesicle biomineralization using large unilamellar vesicles. *J. Inorg. Biochem.* **94:** 14–17, 2003.
134. Wu, L.N.Y., Sauer, G.R., Genge, B.R., Valhmu, W.B., and Wuthier, R.E.: Effects of analogues of inorganic phosphate and sodium ion on mineralization of matrix vesicles isolated from growth plate cartilage of normal rapidly growing chickens. *J. Inorg. Biochem.* **94:** 221–235, 2003.

135. Genge, B.R., Wu, L.N.Y., and Wuthier, R.E.: Separation and quantification of chicken and bovine growth plate cartilage matrix vesicle lipids by high performance liquid chromatography using evaporative light scattering detection. *Anal. Biochem.* **322:** 104–115, 2003.
136. Ortlund, E., Chai, G., Genge, B.R., Wu, L.N.Y., Wuthier, R.E., and Lebioda, L.: Crystal structure of chicken annexin A5 in complex with functional modifiers Ca^{2+} and Zn^{2+} reveal Zn^{2+}-induced formation of non-planar assemblies. *Annexins* **1:** 183-190, 2005.
137. Wu, L.N.Y., Ishikawa, Y., Genge, B.R., and Wuthier, R.E.: Chondrocytes isolated from tibial Dyschondroplasia lesions and articular cartilage revert to growth plate-like phenotype when cultured in vitro. *J. Cell. Physiol.* **202:**167-177, 2005.
138. Wu, L.N.Y., Genge, B.R., Ishikawa, Y,, Ishikawa, T. and Wuthier, R.E.: Effects of 24R,25- and 1α,25-dihydroxyvitamin D_3 on mineralizing growth plate chondrocytes. *J. Cell. Biochem.* **98** (2)**:** 309-334, 2006.
139. Dréau, D., Foster, M., Hogg, M., Nunes, P. and Wuthier, R.E.: Inhibitory effects of Fusarochromanone on melanoma growth. *Anti-Cancer Drugs* **18:** 897-904. 2007.
140. Genge, B.R., Wu, L.N.Y. and Wuthier, R.E.: Kinetic analysis of mineral formation during in vitro modeling of matrix vesicle mineralization: Effect of annexin a5, phosphatidylserine, and type II collagen. *Analyt. Biochem.* **367** (2): 159-166, 2007.
141. Genge, B.R., Wu, L.N.Y. and Wuthier, R.E.: In vitro modeling of matrix vesicle nucleation: Synergistic stimulation of mineral formation by annexin A5 and phosphatidylserine. *J. Biol. Chem.* **282** (36): 26035-26045, 2007.
142. Wu, L.N.Y., Genge, B.R. and Wuthier, R.E.: Analysis and molecular modeling of the formation, structure and activity of the phosphatidylserine-calcium-phosphate complex associated with biomineralization. *J. Biol. Chem.* **283** (7):3827-3838, 2008.
143. Genge, B.R., Wu, L.N.Y. and Wuthier, R.E.: Mineralization of biomimetic models of the matrix vesicle nucleation core: Effect of lipid composition and modulation by cartilage collagens. *J. Biol. Chem.* **283** (15):9737-9748, 2008.
144. Wu, L.N.Y., Genge, B.R. and Wuthier, R.E.: Differential effects of zinc and magnesium ions on mineralization activity of phosphatidylserine calcium phosphate complexes. *J. Inorg. Biochem.* **103:** 948-962, 2009.
145. Furmanski, B.D., Dréau, D., Wuthier, R.E. and Fuseler, J.W.: Differential uptake and selective permeability of fusarochromanone (FC101), a novel membrane-permeable anticancer naturally fluorescent compound in tumor and normal cells. *Microsc. Microanal.* **15:** 545–557, 2009.
146. Wuthier, R.E.: Matrix vesicles: Structure, composition, formation and function in calcification. *Front. In Biosciences* **16:** 2812–2902, 2011.