VITAE of HIROSHI OHMOTO

***Current Positions***

EmeritusProfessor of Geochemistry, Department of Geosciences, College of Earth and Mineral Sciences, The Pennsylvania State University.

Emeritus Professor of Geochemistry and Resource Geology, College of Science, Tohoku University, Sendai, Japan

***Education/Degrees***

B.S. in Geology, Hokkaido University, 1964.

A.M. in Geology, Princeton University, 1967.

Ph.D. in Geology, Princeton University, 1969.

**Appointments**

Princeton University, Princeton, New Jersey

Research Assistant, 9/64 - 8/68.

Research Associate, 9/68 - 10/68.

The University of Alberta, Edmonton, Alberta, Canada

Killam Research Fellow, 11/68 - 8/70.

Lecturer of Geochemistry, 9/69 - 10/70.

The Pennsylvania State University, University Park, Pennsylvania

Assistant Professor of Geochemistry, 11/70 - 6/74.

Associate Professor of Geochemistry, 7/74 - 6/78.

Professor of Geochemistry, 7/78 – 6/2014

Director, Ore Deposit Research Section, 12/96 – 10/09.

Director, Astrobiology Research Center, 7/98 – 10/09.

Tohoku University, Sendai, Japan

Professor of Geochemistry and Director of Research Center for Natural Resources and Environmental Geochemistry, 6/87 - 3/98.

University of Tokyo, Tokyo, Japan

Professor of Geochemistry, 10/93 - 3/95.

##### Courses Taught at PSU (last 5 yrs only)

* GSc. 416 Introduction to isotopes in geosciences (3 credits): Given in every Spring semesters.
* GSc. 451 Natural resources: origins, uses, and environmental impacts (3 credits; Fall semesters): Given in every Fall semesters.
* Astrobiology 590/GSc. 597 Advancements in Astrobiology (2 credits).
* Astrobiology 570 Astrobiology Field Course (2 credits).
* Gsc. 600 and 601. Thesis research (1-6 credits).

##### Senior theses supervised at PSU: 8

### Graduate Students Supervised

*Ph. D. Theses Supervised at Penn State* *(Year Degree Received)***: 23**

T. Casadevall (1976), E.M. Ripley (1976), R.K. McLimans (1977), D.L. Shettel (1977), D.R. Cole (1980), S.E. Drummond (1981), V. Pisutha-Arnond (1982), D. Wesolowski (1984), C.S. Eldridge (1984), T.V. Segalstad (1988), L. Hoy (1989), C.J. Kaiser (1988), K.A. Geer (1988), U. Graham (1991), S. Poulson (1991), W. Albrecht (1992), T. Kakegawa (1997), S. Ono (2001), K. Yamaguchi (2002), Y. Watanabe (2002), T. Otake (2008), I. Johnson (2014\*), J. Brainard (2014\*).

\* Unfinished

*Ph. D. Theses Supervised (Students from Other Institutions Who Conducted Parts of Their Thesis Research at Penn State)*: **7**

R.J. Allmandinger (New Mexico Inst. of Technology, 1975), R.J. Kamilli (Harvard, 1979), D.J. Patterson (Univ. of Tasmania, 1979), M. Mizukami (Univ. of Tokyo, 1982), P. Torssander (Univ. of Stockholm, 1985), J. Coipel (Univ. of Liege, 1989), U. Jakobsen (Univ. of Copenhagen, 1992).

*Master's Theses Supervised (PSU Students)***: 22**

T. Casadevall (1973), J.F. Whelan (1974), J.R. Bahr (1976), K.M. Krupka (1976), T.A. Drean (1978), V. Pisutha-Arnond (1978), S.S. Howe (1981), C.S. Eldridge (1981), T. Lenagh (1984), A. Pavelka (1984), W. Kubilius (1984), E. Mikucki, Jr. (1986), G.J. Bluth (1987), T. Kakegawa (1993), R. Mock (1997), E. Bazilveskaya (2004), D. Bevacqua (2007), I. Johnson (2009), H. Hamasaki (2011), W. Ethier (2014\*), A. Chorney (2014), S. Kurdick (2015\*).

*Ph.D. Theses Supervised at Tohoku University***: 9**

K. Hayashi (1989), Y. Liu (1996), M. Ohtake (1997), H. Sato (1997), X. Chu (1997), M. Manaka (1998), X. Chu (1997), A. Samieyani (1998), M. Haruna (2005).

*Master's Theses Supervised at Tohoku University***:21**

M. Yokoyama (1988), M. Haruna (1989), Y. Kajisa (1990), T. Saito (1990), H. Yamaguchi (1991), K. Morimoto (1992), J. Kabamoto (1992), R. Murata (1993), T. Hanamuro (1994), K. Uyeda (1994), M. Ohtake (1994), N. Kassai (1995), M. Manaka (1995), A. Samieyani (1995), Y. Iwata (1996), Y. Watanabe (1997), K. Kumazawa (1997), T. Omata (1997), S. Ogino (1998), T. Shibasaki (1998), T. Yoshida (1998)

***Post-doctoral Fellows and Research Associates Supervised***: **15**

M. Mizukami (1978-79), G.R. Green (1979-82), M. Tsutsumi (1982-83), X.L. Chu (1985-89), F. Gauthier-Lafaye (1986-87), M. Nedachi (1992-93), Y. Nedachi (1993-94), G. Kamei (1995-96), Naoki Watanabe (1998 – 99; 2001-02), Michael Bau (1999 – 2002), Shuhei Ono (2001 – 02), Akiko Uchida (2002), Hiroaki Ikemi (2002 - 2003), Efem Altinok (2005 – 2007), Yumiko Watanabe (2002 – 2013).

***Research Assistants and Technicians (Full time) Supervised*: 5**

M. Michlick (1987 – 89), Dennis Walizer (1989 – 2014), Kate Spangler (2001 – 2004), J. Rimmer (2003 - 2004), Alice Clark (2004 – 2006).

***Administrative Assistant Supervised***

L. Decker (1998 – 2006), L. Altamura (2006 – 2009)**: 2**

***Services to PSU*** *(last 5 years only)*

Director, Penn State Astrobiology Research Center, 1998 – 2009.

Life Science Consortium; EMS College’s representative to the Steering Committee, 1998 - 2006.

Associate Dean Search Committee, College of Earth & Mineral Sciences (member), 2003.

Faculty Search Committee for faculty hire in Astrobiology/Geosciences (Chair), 1999, 2004.

***Editorial Board***

Chemical Geology, Associate Editor (1984 - 2002).

Resource Geology, Associate Editor (1986 - 2013).

Geochimica et Cosmochimica Acta, Associate Editor (1994 - 2002).

Astrobiology, Associate Editor (2001 - 2014).

***Professional Societies and Committee Memberships***

Geochemical Society

Nominating Committee, 1977 - 79

Clark Medal Committee, 1977 - 79 (Chairman, 78 - 79)

Society of Economic Geologists

Lindgren Award Committee, 1979 - 82 (Chairman, 80- 82)

Research Committee, 1985 - 88 (Chairman, 86 - 88)

Distinguished Lecture Committee, 1986 - 88 (Chairman, 86 - 88)

Program Policy Committee, 1986 - 88.

American Geophysical Union

Society of Resource Geology, Japan

Councilor, 1988 - 1998.

Society of Petrology, Mineralogy and Economic Geology, Japan

Councilor, 1988 - 1998.

Geochemical Society of Japan.

Geological Society of America

NASA Astrobiology Institute

Executive Councilor, 1998 - 2009.

The Astrobiology Society

Founding member, 2007 – 2014.

***Honor Societies, Memberships***

The Obelisk Society, College of Earth and Mineral Sciences, Penn State Univ. (1991 - present).

The President Club, Penn State Univ. (1991 - present).

The Mount Nittany Society, Penn State Univ. (1995 - present).

***Research Interests***

Astrobiology: Chemical and biological evolution of the early Earth through geochemical studies of paleosols, shales, uraniferous conglomerates, red beds, banded iron formations, cherts, carbonates. Origin of life and evolution. Asteroids and the origin of Earth and the Moon.

Geochemistry of hydrothermal systems and the origins of ore deposits: submarine and subaerial hydrothermal systems, volcanogenic massive sulfides, banded iron formations, shale/carbonate-hosted massive sulfides, Mississippi Valley-type base metal deposits, gold and basemetal veins, skarns.

Stable isotope geochemistry of sulfur, carbon, oxygen, and hydrogen in geological systems.

***Professional Awards***

Waldermar Lindgren Citation for Excellence in Research, 1970, Society of Economic Geologists.

Frank Wigglesworth Clarke Medal, 1973, Geochemical Society.

Faculty Scholar Medal for Outstanding Achievement in Science and Technology, 1981, The Pennsylvania State University.

Silver Medal, 1994, Society of Economic Geologists.

Wilson Award for Excellent in Research, 2001, College of Earth and Mineral Sciences, Penn State University.

The Kato Medal, 2009, Society of Resources Geology.

The Shibata Medal, 2014, Geochemical Society of Japan

***Other Professional Awards and Honors***

Fulbright Graduate Fellowship, 1964-1969.

Killam Post Doctoral Fellowship, University of Alberta, 1968-70.

The Japan Society for Promotion of Science, Senior Fellow, 1976-77.

The United States Geological Survey Lecturer, Short Course on "Ore Genesis and Isotope Geochemistry", Denver, 1977.

Canadian Institute of Mining and Engineering Lecturer, lecture tour of five Canadian universities, 1978.

The U.S.-Japan-Canada Cooperative Research Project on the Genesis of Volcanogenic Massive Sulfide Deposits, Director, 1978-1983.

Gordon Research Conference on Inorganic Geochemistry, Chairman, 1981.

Alexander von Humboldt Stiftung, Fellow, Univ. of Göetingen, Germany, 2//82 - 8/82.

Centre National de la Recherches Scientifique, and Centre de Recherches sur la Géologie de l'Uranium, France, Visiting Professor, 2/84 - 8/84.

The Nordic Research Council Lecturer, Short course on "Isotope Geochemistry of Ore Deposits", Oslo, Norway, 1986.

The Mineralogical Society of America, Lecturer, Short course on " Stable Isotopes in High Temperature Geological Processes", San Antonio, Texas, 1986.

The Nordic Research Council, Lecturer, Lecture tour of Danish institutions, 1987.

Canadian Institute of Mining and Metallurgy Lecturer, Short Course on “Sediment hosted basemetal deposits”, Brisbane, Australia, 1993.

Adjunct Professor at Japanese National Universities:

Hokkaido University, 4/88 - 3/89; 4/96 - 3/97

Ibaraki University, 4/91-3/92

Hiroshima University, 4/91 - 3/92

Kyoto University, 4/91- 3/92

Kumamoto University, 4/92 - 3/93

Akita University, 4/92 - 3/93

Yamagata University, 4/92 - 3/93

Niigata University, 4/95 - 3/96

Chiba University, 4/95 - 3/96

Yamaguchi University, 4/96 - 3/97

Kagoshima University, 4/96 - 3/97

Tsukuba University, 4/97 - 3/98

The Research Council of Japan, member, 4/88 - 3/98

Advisor, Geosciences and Environmental Sciences departments, Washington State Univ., 2001.

Served as one of two members to evaluate two departments (Geosciens and Environmental Sciences) of the Washington, State Univeristy, 2001.

Director, international research project on “Origins of banded iron formations”, funded from the Japanese Ministry of Education and NASA Astrobiology Institute, 1989 – present.

Coordinator of the Archean Biosphere Drilling Project, a new initiative by the NASA Astrobiology Institute, the Australian Geological Survey, the University of Western Australia, and the Japanese Ministry of Education, 2002 – present.

***Convener of Scientific Conferences***

Workshop on "Research Frontiers in Exploration of Non-Renewable Resources" (with A.R. Rose, H.L. Barnes, and C.W. Burnham; sponsored by NSF), The Pennsylvania State University, 1976.

International Conference on "The Genesis of Volcanogenic Massive Sulfide Deposits" ; sponsored by NSF and JSPS, Tokyo, 1978.

Symposium on "New Exploration Guides for Kuroko-type Massive Sulfide Deposits"; sponsored by the Geol. Association and the Mineralogical Society of Canada), Calgary, 1981.

Gordon Research Conference on "Geochemistry of Ore Deposits" (with M.T. Einaudi), Colby-Sawer College, New Hampshire, 1981.

Symposium on "Massive Sulfides Associated with Submarine Volcanism" (sponsored by the Society of Economic Geologists), Geol. Soc. of America Ann. Mtgs., New Orleans, 1982.

Symposium on "Geochemistry of Ore Deposits" at the Fourth International Conference on Water-Rock Interaction, Misasa, Japan, 1983.

Symposium on "The Genesis of Low Temperature Ore Deposits" at the Sixth International Conference on Geochronology, Cosmochronology and Isotope Geology, Cambridge, England, 1986.

NATO Advanced Institute on "Geochemistry of Hydrothermal Ore-Forming Processes" (with H.L. Barnes, B. Potty, A. Arribas, and S.M.F. Sheppard; sponsored by NATO), Salamanca, Spain, 1987.

American Geophysical Union, Western Pacific Geophysics Meetings, Kanazawa City, Japan, August, 1990 (Program chairman for Volcanology, Geochemistry and Petrology Section).

International Geological Congress, 1992, Organization Committee, Program Executive Committee, 1989-92.

Symposium in honor of H.D. Holland, Goldschmidt Conference, Reston, 1992.

Astrobiology Conference, Program Committee, Washington, D.C., 2001.

Pardee Symposium, “Early evolution of the atmosphere, hydrosphere, and oceans: Constraints from ore deposits”, Convener, sponsored by the Geological Society of America, Geochemical Society, Society of Economic Geologists, and NASA Astrobiology Institute, Denver, 2002.

NSF Workshop on “Research Opportunities in Geology and Geochemistry of Mineral Deposit Systems”, Convener, Denver, 2002.

Astrobiology Drilling Session at the Astrobiology Science Conference 2004, NASA Ames, 2004.

Astrobiology Drilling Session at the American Geophysical Union, San Francisco, 2004.

NASA Field Workshop on “Biosignatures in Ancient Rocks”, Ontario, Canada, 2007.

American Geophysical Union, Union Session “Oxygenation of the Earth”, San Francisco, 2012.

The Holland Symposium, Goldschmidt Conference, Florence, 2013.

***Keynote Lectures at National and International Conferences***

Annual Meeting of the Society of Mining Geologists, Tokyo, Japan, 1977.

Fourth-International Conference on Water-Rock Interaction, Misasa, Japan, 1983.

Conference on Tectonic Control of Ore Deposits, Princeton, 1984.

International Conference on Recent Advances in Geochemistry of Ore Deposits, Montreal, Canada, 1984.

International Conference on Stable Isotopes and Fluid Processes, Brisbane, Australia, 1985.

NATO Advanced Study Institute on Geochemistry of Hydrothermal Ore Deposits, Salamanca,Spain, 1987.

Symposium on “Future of Mineral Resources and Economic Geology”, Japanese National Academy of Science, Tokyo, Japan, 1988.

Annual Meeting of the Society of Petrology, Mineralogy , and Economic Geology, Sendai, Japan, 1988.

International Geological Congress, Kyoto, Japan, 1992.

Australian Geological Convention, Perth, Australia, 1994.

International Conference on Chemistry and Migration Behavior of Actinides and Fission Products in the Geosphere, Sendai, Japan, 1997.

Annual Meeting of the Geological Society of Namibia, Windhoek, Namibia, 1998.

Annual Meeting of the Geological Society of South Africa, 1998.

Conference on “Bridging the Two Worlds, Archean and Proterozoic”, UCLA, 1999.

50th Anniversary of the Society of Resource Geology, Tokyo, 2001.

Gordon Conference on “Geochemistry of Hydrothermal Ore Deposits”, Plymouth, NH, 2001.

Fourth International Archean Symposium, Perth, Australia, 2001.

Pardee Symposium, Geological Society of America, Denver, 2002.

International Workshop on Underground Waste Disposal, Tokai, Japan, 2003.

Fermor Lecturer at the Geological Society’s 2003 Fermor Flagship Meeting, “World Class Mineral Deposits and Earth Evolution”, Cardiff, Wales, 2003.

Gast Lecturer, the Goldschmidt Conference, Kurashiki, Japan, 2003.

NASA Astrobiology Institute Biannual Meeting, Boulder, 2005.

The Geological Society of America, Salt Lake City, 2005.

Pilbara Workshop, Perth, Australia, 2005.

Astrobiology Science Conference, Washington, D.C., 2006.

Bioastronomy 2007, Puerto Rico, 2007.

The Australian Earth Sciences Convention 2008, Perth, Australia.

Ann. Mtg. of the Society of Resource Geology, Tokyo, Japan, 2009.

American Geophysical Union, 2012/

***Funded Research Projects***

Sulfur isotopic equilibria in hydrothermal systems;

National Science Foundation, GA-31901, 1/72 - 6/74, $30,600. PI.

Stable isotopes in hydrothermal systems;

National Science Foundation, GA-31901A, 1/74 - 6/76, $51,200. PI.

Geochemistry of cupriferous sulfide deposits at Raul mine, Peru;

Cia Minera Pativilca, S.A., Lima, Peru, 1/75 - 6/76, $11,378. PI.

Experimental evaluation of geochemical conditions in geothermal energy systems; National Science Foundation, AER-74-08473, 3/75 - 8/77, $402,040. Co-PI. (with H.L. Barnes and C.W. Burnham)

Field conference on the Kuroko deposits;

National Science Foundation, EAR-7817167, 6/78 - 12/79, $29,953. PI.

Stable isotopes in hydrothermal systems;

National Science Foundation, EAR-76-03724, 4/76 - 9/80, $174,400. PI.

Genesis of volcanogenic massive sulfide deposits;

National Science Foundation, INT-79-06779, 5/79 - 10/81, $21,561. PI.

The U.S.-Japan-Canada cooperative research project on the genesis of volcanogenic massive sulfide deposits (Project leader); National Science Foundation, EAR-78-17738, 8/78 - 1/82, $533,450. PI.

The U.S.-Japan-Canada cooperative research project on the genesis of volcanogenic massive sulfide deposits (Project leader); National Science Foundation, EAR-81-09270, 8/81 - 1/83, $224,200. PI.

Geochemistry of molybdenum-quartz veins at Ord Mountain Prospect, California;

Patino Management Service, 8/81 - 8/82, $15,000. PI.

Stratiform copper, copper-cobalt, and copper-uranium deposits in sedimentary rocks; National Science Foundation, EAR-80-2645, 4/81 - 9/83, $129,040. Co-PI. (with A. W. Rose)

Stable isotope geochemistry of hydrothermal systems;

National Science Foundation, EAR-80-07839, 6/80 - 12/84, $253,699. PI.

Stratiform copper and copper-cobalt deposits in sedimentary rocks; National Science Foundation, EAR-83-19654, 3/84 - 2/86, $123,000. PI. (with A.W. Rose)

Geochemical and hydrological processes for the formation of massive sulfide deposits; National Science Foundation, EAR-83-18402, 3/84 - 8/87, $360,000. PI.

Sulfur and carbon reactions in hydrothermal systems;

National Science Foundation, EAR-85-08379, 9/85 - 2/89, $390,000. PI.

Acquisition of a mass spectrometer and a laser ablation system for micro-analyses of sulfur, carbon, oxygen and hydrogen isotopic compositions of natural and synthetic samples; National Science Foundation, EAR-88-03720, 9/1/88 - 8/31/89, $191,000. PI.

Paragenesis, fluid inclusion, and isotopic investigations of formation of pressure chambers; Gas Research Institute, 11/1/88 - 10/31/91, $224,530. Co-PI. (with T. Engelder).

Mineralogical and isotopic properties of hydrothermal pyrite in relation to their formational mechanisms; National Science Foundation, EAR-90-04813, 6/1/90 - 12/31/92, $134,695. PI.

Sulfur chemistry and sulfate reducing bacteria of Archean oceans;

National Science Foundation, EAR-90-03554, 7/1/90 - 1/31/93, $156,431. PI.

Formation mechanisms and properties of iron sulfides: collaborate research project between Tohoku University and Penn State University; The Japanese Ministry of Education, Science and Culture, 4/1/90 - 3/31/93, $40,000. (to Tohoku Univ.). PI.

Kinetics of chemical and isotopic reactions between solids and hydrothermal solutions; The Japanese Ministry of Education, Science and Culture, 4/1/88 - 3/31/91, $200,000. (to Tohoku Univ.). PI.

Surface environments, biological activities, and elemental cycles in the early Earth;

The Japanese Ministry of Education, Science and Culture, 4/1/91 - 3/31/95, $1,000,000.(to Tohoku Univ.). PI.

Roles of hydrothermal processes in biological evolution; The Japanese Ministry of Education, Science, and Culture, 4/1/95 - 3/31/97, $220,000. ( to Tohoku Univ.). PI.

Kinetics of oxidation of organic matter and pyrite; Nuclear Power Corp., 4/1/95 - 3/31/98, $120,000 (to Tohoku Univ.). PI.

Applications of stable isotopes in mineral exploration; Metal Mining Agency of Japan, 4/1/93 - 3/31/98, $130,000 (to Tohoku Univ.). PI.

Origins of gold, uraninite, pyrite, and organic matter in conglomerates of Archean and early Proterozoic; National Science Foundation, 6/1/97 - 5/31/99, $180,000. PI.

Search for new evidence in pre-2.0 Ga paleosols for the early evolution of atmospheric oxygen and terrestrial biota; NASA Exobiology Program, 1/02/00 - 7/31/03, $180,000. PI.

Creating the Penn State Astrobiology Research Center; NASA Astrobiology Institute, 7/1/98 - 6/30/03, $4,685,968. PI (with 16 Co-PIs).

Exploring New Frontiers of the Connections Between the Biological and the Environmental Evolution of the Early Earth; NASA Astrobiology Institute, 7/1/03 – 10/30/03, $774,540. PI (with 16 Co-PIs).

Kinetics of the formation and transformation of iron oxides in hydrothermal systems; National Science Foundation, 7/1/03 – 6/30/06, $307,997. PI.

Evolution of a Habitable Planet; NASA Astrobiology Institute, 11/01/03 – 10/31/10, $6,430,646. PI (with 18 Co-PIs).

Characterizing the early biosphere on land; NASA Exobiology, 5/15/04 – 5/14/05, $135,000. PI.

Supplement to CA#NNA04C06A Evolution of a Habitable Planet; NASA Astrobiology Institute, 5/01/07 – 04/30/10, $49,397. PI.

Field workshop on biosignatures in ancient rocks: NASA Astrobiology Institute, 5/01/07 – 04/30/08, $63,253. PI.

Penn State Astrobiology Research Center: NASA Astrobiology Institute, 2/1/09 – 01/31/14, $6,000,000. Co-PI.

Multiple sulfur isotope fractionations during thermal decomposition of and thermochemical sulfate reduction by natural organic compounds, NSF 1024550, 09/01/2010 – 8/31/2013, $222,664. PI.

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**PUBLICATIONS OF HIROSHI OHMOTO**

***Editors: Books and Special Issues of Journals***

1. Ohmoto, H. and Horikoshi, E., eds. (1978) Special Issue devoted to the Japan-U.S. Kuroko Research Project: Mining Geology, **28**, no. 15, 215-300.

2. Ohmoto, H. and Skinner, B.J., eds. (1983) The Kuroko and Related Volcanogenic Massive Sulfide Deposits. *Economic Geology* *Monograph* **5**, 604p.

3. Ishihara, S., Urabe, T. and Ohmoto, H. eds. (1993) Proceedings of the 29th international geological congress, Mineral resources symposia volume A. *Resource Geology* *Special Issue* **15**, 460p.

4. Ishihara, S., Urabe, T. and Ohmoto, H. eds. (1993) Proceedings of the 29th international geological congress, Mineral resources symposia volume B. *Resource Geology* *Special Issue* **16**, 360p.

5. Ishihara, S., Urabe, T. and Ohmoto, H. eds. (1993) Proceedings of the 29th international geological congress, Mineral resources symposia volume C. *Resource Geology* *Special Issue* **17**, 375p.

6. Ohmoto, H., ed. (1994) A Special Issue in Honor of Heinrich D. Holland: *Geochimica et Cosmochimica Acta*, **58,** Issue 6 (p.1554-1686).

7. Ohmoto, H. and Stephen E. Kesler, eds. (2006) Evolution of Early Earth’s Atmosphere, Hydrosphere, and Biosphere – Constraints from Ore Deposits. *The Geological Society of America Memoir* **198**, 337p.

***Papers in Referred Journals and Book Chapters***

1. Ohmoto, H. (1964) K-Ar ages of hornblendes of the Hida gneiss complex in central Japan. *Proceedings of the Japan Academy*, **40**, 36-41.

2. Ohmoto, H., Hart, S.R. and Holland, H.D. (1966) Studies in the Providencia area, Mexico, II, K-Ar and Rb-Sr ages of intrusive rocks and hydrothermal minerals. *Economic Geology*, **61**, 1205-1213.

3. Ohmoto, H. and Rye, R.O. (1970) The Bluebell mine, British Columbia. I. Mineralogy, paragenesis, fluid inclusions, and the isotopes of hydrogen, oxygen, and carbon. *Economic Geology*, **65**, 417-437.

4. Greig, J.A., Baadsgaards, H., Cumming, G.L., Folinsbee, R.E., Krouse, H.R., Ohmoto, H., Sasaki, A., and Smejkal, V. (1971) Lead and sulfur isotopes of the Irish base metal mines in Carboniferous carbonate host rocks. *Society of Mining Geologists of Japan, Special Issue* **2**, 84-92.

5. Ohmoto, H. (1971) Fluid inclusions and isotope study of the lead-zinc deposits at the Bluebell mine, British Columbia, Canada. *Society of Mining Geologists of Japan, Special Issue* **2**, 93-99.

6. Ohmoto, H. (1972) Systematics of sulfur and carbon isotopes in hydrothermal ore deposits. *Economic Geology*, **67**, 551-578.

7. Robinson, B.W. and Ohmoto, H. (1973) Mineralogy, fluid inclusions and stable isotopes of the Echo Bay U-Ag-Cu deposits, Northwest Territories, Canada. *Economic Geology*, **68**, 635-656.

8. Rye, R.O., Hall, W.E., and Ohmoto, H. (1974) Carbon, hydrogen, oxygen, and sulfur isotope study of the Darwin lead-silver-zinc deposit, southern California. *Economic Geology*, **69**, 826-842.

9. Rye, R.O. and Ohmoto, H. (1974) Sulfur and carbon isotopes and ore genesis: A review. *Economic Geology*, **69**, 826-842.

10. Ohmoto, H. and Rye, R.O. (1974) Hydrogen and oxyen isotopic compositions of fluid inclusions in the Kuroko deposits, Japan. *Economic Geology*, **69**, 468-481.

11. Ohmoto, H. (1974) F.W. Clark Medal acceptance speech. *Geochimica et Cosmochimica Acta*, **38**, 980-981.

12. Ohmoto, H. (1975) Book Review: E. Roedder, ed., Fluid Inclusion Research*. Economic Geology*, **70**, 1300.

13. Rose, A.W., Barnes, H.L., Burnham, C.W., and Ohmoto, H. (1976) Report on workshop on Research Frontiers in Exploration for Non-Renewable Resources. A Report to the Division of Advanced Energy and Resources Research and Technology: Washington, D.C.: National Science Foundation, 164p.

14. Ohmoto, H. (1977) The present status and future tasks in ore deposit research: U.S.A. and Japan. *Mining Geology*, **27**, 213-220 (in Japanese).

15. Kamilli, R.J. and Ohmoto, H. (1977) Paragenesis, zoning, fluid inclusions, and isotopic studies of the Finlandia vein, Colqui district, central Peru. *Economic Geology*, **72**, 950-982.

16. Ripley, E.M. and Ohmoto, H. (1977) Mineralogic, sulfur isotope, and fluid inclusion studies of the stratabound copper deposits at the Raul mine, Peru. *Economic Geology*, **72**, 1017-1041.

17. Casadevall, T. and Ohmoto, H. (1977) Sunnyside mine, Eureka mining district, San Juan County, Colorado: Geochmeistry of gold and basemetal ore deposition in a volcanic environment. *Economic Geology*, **72**, 1285-1320.

18. Krupka, K.M., Ohmoto, H. and Wickman, F.E. (1977) A new technique in neutron activation analysis of Na/K ratios of fluid inclusions and its application to the gold-quartz veins at the O'Brien mine, Quebec, Canada. *Canadian Journal of Earth Sciences*, **14**, 2760-2770.

19. Ohmoto, H. and Kerrick, D.M. (1977) Devolatilization equilibria in graphitic systems. *American Journal of Science*, **277**, 1013-1044.

20. Ohmoto, H. and Horikoshi, E. (1978) Preface to special issue. *Mining Geology*, **28**, 215-217.

21. Ohmoto, H. (1978) Submarine calderas: A key to the formation of volcanogenic massive sulfide deposits? *Mining Geology*, **28**, 215-217.

22. Guber, A.L. and Ohmoto, H. (1978) Deep sea environment of Kuroko formation as indicated by benthic foraminifera from the Hokuroku district, Japan. *Mining Geology*, **28**, 245-255.

23. Ripley, E.M. and Ohmoto, H. (1979) Oxygen and hydrogen isotopic studies of ore deposition and metamorphism at the Raul mine, Peru. *Geochimica et Cosmochimica Acta*, **43**, 1633-1643.

24. Ripley, E.M. and Ohmoto, H. (1979) A Fortran program for plotting mineral stabilities in the Fe-Cu-S-O system in terms of log (SSO4/SH2S) or logfO2 vs. pH or T. *Computers and Geosciences*, **5**, 289-300.

25. Ohmoto, H. and Rye, R.O. (1979) Isotopes of sulfur and carbon: in H.L. Barnes ed., *Geochemistry of Hydrothermal Ore Deposits, Second Edition*: John Wiley & Sons, 509-567.

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