Stanford

Gail Mahood

Professor of Geological Sciences, Emerita

Earth & Planetary Sciences

Bio

BIO

Gail Mahood is a Professor Emerita, having retired in 2019 from the Department of Geological Sciences at Stanford University after 40 years of service as a faculty member and administrator. Her research interests have focused on field-based petrologic studies of silicic magmatism based on the records contained in the rhyolitic caldera complexes that are the sources of "super eruptions" that spread ash continent-wide, and in the deep-level plumbing systems for these volcanoes preserved in granite plutons. In the last decade her group mapped rhyolite calderas in Nevada, Oregon, and Idaho that were caused by intrusion of flood basalt about 16 million years ago, and are the initiation point for the Snake River Plain-Yellowstone “hot spot” track. A practical application of this work was the development of a new model for the formation of lithium deposits in calderas. In addition to teaching and research, Professor Mahood has extensive university governance and administrative experience, including serving as Department Chair, Chair of the Stanford Faculty Senate, and Associate Vice Provost of Graduate Education. She was elected to and chaired the Advisory Board, a 7-member faculty group that evaluates all appointments and promotions throughout Stanford University. Mahood also served on then-Provost Condoleeza Rice’s budget and strategic planning group.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Earth & Planetary Sciences

ADMINISTRATIVE APPOINTMENTS

- Professor Emerita, Department of Geological Sciences, Stanford University, (2020- present)
- Professor, Department of Geological Sciences, Stanford University, (1993-2019)
- Chair, Faculty Senate, Stanford University, (1995-1996)
- Member, Provost Condoleeza Rice's advisory committee on budget and strategic planning, Stanford University, (1994-1998)
- Member, Board of Trustees Committee on Land and Buildings, Stanford University, (2003-2005)
- Associate Vice Provost for Graduate Education, Stanford University, (2005-2007)
- Chair, Advisory Board (elected7-member board that reviews all faculty appointments and promotions), Stanford University, (1996-2001)
- Chair, Department of Geological and Environmental Sciences, Stanford University, (1996-1998)
- Member, Provost’s Diversity Cabinet, Stanford University, (2005-2006)
- Member, NCAA Compliance Committee (intercollegiate athletics), Stanford University, (2000-2001)
- Member, Faculty Steering Committee on the Campaign for Undergraduate Education, Stanford University, (1999-2003)
- Member, President's Commission on Undergraduate Education, Stanford University, (1993-1994)
- Member, Executive Committee, Archaeology Center, Stanford University, (2000-2008)

- Associate Professor of Geology, Stanford University, (1987-1993)
- Assistant Professor of Geology, Stanford University, (1979-1987)
- Geoarchaeologist, Proyecto Arqueologico Copan, Honduras, (1978-1978)
- Sr. Engineering Aide, Nevada Geothermal Exploration Project, Lawrence Livermore Laboratory, (1974-1974)
- Research Associate, Geothermex, (1974-1974)
- Physical Science Aide, Division of Mining and Minerals, U.S. National Park Service, (1973-1974)

HONORS AND AWARDS

- Top geoscience paper of 2016, Geosphere (2017)
- Fellow, Society of Economic Geologists (2014)
- Fellow, Geological Society of America (1987)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Faculty leader, Travel Study trips to Mongolia, Argentina, New Zealand, Iceland, Baja CA, Alaska, Stanford Alumni Association (1999 - 2019)
- Evaluator, Crafoord Prize (Nobel equivalent for geosciences), Royal Swedish Society (2017 - 2017)
- Geologist, Assessment of volcanic hazards for holy city of Al Madinah, U.S. Geological Survey and Saudi Geological Survey (2014 - 2016)
- Associate Editor, Bulletin of the Geological Society of America, Geological Society of America (1997 - 2000)
- Councillor and member of the Audit Committee, Geological Society of America (1996 - 1999)
- Congressional testimony concerning the role of the U.S. Geological Survey, U.S. House of Representatives (1995 - 1995)
- Founding Editor, Proceedings in Volcanology, International Association of Volcanology and Chemistry of the Earth's Interior (1988 - 1994)
- Editor, Bulletin of Volcanology, Springer (1990 - 1992)

PROFESSIONAL EDUCATION

- Ph.D., University of California , Geology (1980)
- M.A., University of California , Geology (1976)
- A.B., University of California , Geology (1974)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Research

I am interested in understanding the processes that assemble and occur in the bodies of silicic magma that give rise to huge, explosive eruptions that spread ash continent-wide. We study young volcanoes to determine how large and how explosive future eruptions might be, how frequently they are likely to occur, and what mechanisms trigger eruptions. We also do field-based studies in mountainous areas where plutons and the guts of volcanoes are well-exposed, mapping them and then analyzing their products in the laboratory, in order to reconstruct the life histories of these systems. To these ends we make extension use of 40Ar-39Ar geochronology and use the Stanford-USGS ion probe to determine U-Pb and U-series ages. The main foci of our current research are (1) widespread Mid-Miocene silicic volcanism and calderas associated with emplacement of the Columbia River flood basalts and initiation of the Yellowstone plume; (2) controls on the pre-eruptive concentrations of energy-critical elements in silicic magmas as evidenced by melt inclusions; (3) models for for the formation of lithium deposits in volcanic settings; (4) petrologic evidence for volcanic hazards in the Long Valley--Mammoth Mountain--Mono Craters--Mono Basin region; and (5) volcanic hazards of western Saudi Arabia at Harrat Rahat and petrologic study of the origin of trachytes associated with young basaltic lavas. I also have an interest in geoarchaeology, especially in the application of petrologic and geochemical techniques to determining the provenance of obsidian and ceramics.

Teaching

I have taught introductory geology courses, including those that culminate in a field trip to Death Valley or to Mt. Shasta and Mt. Lassen, or involve field trips closer to home in the Santa Cruz Mountains and coast. My upper-division-level course on volcanology included a field trip to young volcanism of the eastern Sierra Nevada (Long Valley, Mammoth Mountain, Mono Craters, Mono Lake). Graduate-level courses include those on igneous petrogenesis, and field seminars in physical volcanology of the southern Cascade arc and transform-related volcanism in the Coast Range of California, as well as specialized graduate seminars in petrology and physical volcanology.

PROJECTS

- Widespread Mid-Miocene rhyolitic magmatism associated with flood basalts in western U.S. - Stanford University
- Formation of lithium deposits in volcanic settings
- Volcanic hazards of Harrat Rahat for the holy city of Al Madiinah, Kingdom of Saudi Arabia - cooperative study with the U.S. Geological Survey and the Saudi Geologic Survey
- Magma mixing as a trigger for eruptions in Long Valley, Mammoth Mountain, and Mono Basin - Stanford University, U.S. Geological Survey
- Controls on concentrations of energy-critical elements in rhyolitic magmas based on analysis of melt inclusions - Stanford University, U.S. Geological Survey
- Timing of Mid-Miocene climate events relative to flood basalt and rhyolite eruptions in the Pacific Northwest - Stanford University

Publications

PUBLICATIONS

- **The timing and compositional evolution of volcanism within northern Harrat Rahat, Kingdom of Saudi Arabia** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Stelten, M. E., Downs, D. T., Champion, D. E., Dietterich, H. R., Calvert, A. T., Sisson, T. W., Mahood, G. A., Zahran, H.
  2020; 132 (7-8): 1381–1403

- **Timescales of magmatic differentiation from alkali basalt to trachyte within the Harrat Rahat volcanic field, Kingdom of Saudi Arabia** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Stelten, M. E., Downs, D. T., Dietterich, H. R., Mahood, G. A., Calvert, A. T., Sisson, T. W., Zahran, H., Shawali, J.
  2018; 173 (8)

- **Using Ar-40/Ar-39 ages of intercalated silicic tuffs to date flood basalts: Precise ages for Steens Basalt Member of the Columbia River Basalt Group** *EARTH AND PLANETARY SCIENCE LETTERS*
  Mahood, G. A., Benson, T. R.
  2017; 459: 340-351

- **Lithium enrichment in intracontinental rhyolite magmas leads to Li deposits in caldera basins** *NATURE COMMUNICATIONS*
  Benson, T. R., Coble, M. A., Rytuba, J. J., Mahood, G. A.
  2017; 8: 1-9

- **Geology and 40Ar/39Ar geochronology of the middle Miocene McDermitt volcanic field, Oregon and Nevada: Silicic volcanism associated with propagating flood basalt dikes at initiation of the Yellowstone hotspot** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Benson, T. R., Mahood, G. A., Grove, M. J.
  2017

- **Geology of the High Rock caldera complex, northwest Nevada, and implications for intense rhyolitic volcanism associated with flood basalt magmatism and the initiation of the Snake River Plain-Yellowstone trend** *GEOSPHERE*
  Coble, M. A., Mahood, G. A.
  2016; 12 (1): 58-113

- **Geology of the Mid-Miocene Rooster Comb Caldera and Lake Owyhee Volcanic Field, eastern Oregon: Silicic volcanism associated with Grande Ronde flood basalt** *JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH*
  Benson, T. R., Mahood, G. A.
  2016; 309: 96-117

- **Initial impingement of the Yellowstone plume located by widespread silicic volcanism contemporaneous with Columbia River flood basalts** *GEOLOGY*
  Coble, M. A., Mahood, G. A.
  2012; 40 (7): 655-658

- **Silicic calderas in arc settings: Characteristics, distribution, and tectonic controls** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Hughes, G. R., Mahood, G. A.
  2011; 123 (7-8): 1577-1595

- **Strontium Isotopic Evidence for Prehistoric Transport of Gray-Ware Ceramic Materials in the Eastern Grand Canyon Region, USA** *GEOARCHAEOLOGY-AN INTERNATIONAL JOURNAL*
  Carter, S. W., Wiegand, B., Mahood, G. A., Dudas, F. O., Wooden, J. L., Sullivan, A. P., Bowring, S. A.
  2011; 26 (2): 189-218

- **New Ar-40/Ar-39 ages reveal contemporaneous mafic and silicic eruptions during the past 160,000 years at Mammoth Mountain and Long Valley caldera, California** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Mahood, G. A., Ring, J. H., Manganelli, S., McWilliams, M. O.
  2010; 122 (3-4): 396-407

- **Geology of the Sheldon National Antelope Refuge, Oregon and Nevada** *U.S. Geological Survey Administrative Report*
  Coble, M. A., Mahood, G. A.
  2010: 53

- **Tectonic controls on the nature of large silicic calderas in volcanic arcs** *GEOLOGY*
  Hughes, G. R., Mahood, G. A.
  2008; 36 (8): 627-630

- **New ages for the climactic eruptions at Yellowstone: Single-crystal Ar-40/Ar-39 dating identifies contamination** *GEOLOGY*
  Gansecki, C. A., Mahood, G. A., McWilliams, M.
  1998; 26 (4): 343-346

- **Seeing past the effects of re-equilibration to reconstruct magmatic gradients in plutons: La Gloria Pluton, central Chilean Andes** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  CORNEJO, P. C., Mahood, G. A.
  1997; 127 (1-2): 159-175

- **Ar-40/Ar-39 geochronology of rhyolites erupted following collapse of the Yellowstone caldera, Yellowstone Plateau volcanic field: Implications for crustal contamination** *EARTH AND PLANETARY SCIENCE LETTERS*
  Gansecki, C. A., Mahood, G. A., McWilliams, M. O.
  1996; 142 (1-2): 91-107

- **Zoning patterns and petrologic processes in peraluminous magma chambers: Hall canyon pluton, Panamint mountains, California** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Mahood, G. A., Nibler, G. E., Halliday, A. N.
  1996; 108 (4): 437-453

- **ISOTOPIC CONSTRAINTS ON THE PRODUCTION-RATES, CRYSTALLIZATION HISTORIES AND RESIDENCE TIMES OF PRE-CALDERA SILIC MAGMAS, LONG VALLEY, CALIFORNIA** *EARTH AND PLANETARY SCIENCE LETTERS*
  Davies, G. R., Halliday, A. N., Mahood, G. A., Hall, C. M.
  1994; 125 (1-4): 17-37

- **THE OCCURRENCE AND DISTRIBUTION OF MO AND MOLYBDENITE IN UNALTERED PERALKALINE RHYOLITES FROM PANTELLERIA, ITALY** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Lowenstern, J. B., Mahood, G. A., Hervig, R. L., Sparks, J.
  1993; 114 (1): 119-129

- **FLUID INCLUSIONS IN XENOLITHS YIELD EVIDENCE FOR FLUID EVOLUTION IN PERALKALINE GRANITIC BODIES AT PANTELLERIA (ITALY)** *JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH*
  DeVivo, B., Frezzotti, M. L., Mahood, G.
  1992; 52 (4): 295-301

- **EVIDENCE FOR ASCENT OF DIFFERENTIATED LIQUIDS IN A SILICIC MAGMA CHAMBER FOUND IN A GRANITIC PLUTON** *2ND HUTTON SYMP ON THE ORIGIN OF GRANITES AND RELATED ROCKS*
  Mahood, G. A., CORNEJO, P. C.
  ROYAL SOC EDINBURGH.1992: 63–69
- **PETROGENESIS OF HIGH-SILICA RHYOLITE ON THE ALASKA PENINSULA** *GEOPHYSICAL RESEARCH LETTERS*
  Lowenstern, J. B., Mahood, G. A.
  1991; 18 (8): 1565-1568
- **EVIDENCE FOR EXTREME PARTITIONING OF COPPER INTO A MAGMATIC VAPOR-PHASE** *SCIENCE*
  Lowenstern, J. B., Mahood, G. A., Rivers, M. L., Sutton, S. R.
  1991; 252 (5011): 1405-1409
- **DEVELOPMENT OF THE LONG VALLEY, CALIFORNIA, MAGMA CHAMBER RECORDED IN PRECALDERA RHYOLITE LAVAS OF GLASS MOUNTAIN** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Metz, J. M., Mahood, G. A.
  1991; 106 (3): 379-397
- **TRACE-ELEMENT PARTITIONING IN PANTELLERITES AND TRACHYTES** *GEOCHIMICA ET COSMOCHIMICA ACTA*
  Mahood, G. A., Stimac, J. A.
  1990; 54 (8): 2257-2276
- **EVIDENCE FOR LONG RESIDENCE TIMES OF RHYOLITIC MAGMA IN THE LONG VALLEY MAGMATIC SYSTEM - THE ISOTOPIC RECORD IN PRECALDERA LAVAS OF GLASS MOUNTAIN** *EARTH AND PLANETARY SCIENCE LETTERS*
  Halliday, A. N., Mahood, G. A., Holden, P., Metz, J. M., Dempster, T. J., Davidson, J. P.
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- **MECHANICAL MODELS FOR CORRELATION OF RING-FRACTURE ERUPTIONS AT PANTELLERIA, STRAIT OF SICILY, WITH GLACIAL SEA-LEVEL DRAWDOWN** *BULLETIN OF VOLCANOLOGY*
  WALLMANN, P. C., Mahood, G. A., Pollard, D. D.
  1988; 50 (5): 327-339
- **PHYSICAL AND CHEMICAL-MODELS OF ZONED SILICIC MAGMAS - THE LOMA SECA TUFF AND CALABOZOS CALDERA, SOUTHERN ANDES** *JOURNAL OF PETROLOGY*
  Grunder, A. L., Mahood, G. A.
  1988; 29 (4): 831-867
- **GENERATION OF HIGH-SILICA RHYOLITE - A ND, SR, AND O ISOTOPIC STUDY OF SIERRA-LA-PRIMAVERA, MEXICAN NEOVOLCANIC BELT** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Mahood, G. A., Halliday, A. N.
  1988; 100 (2): 183-191
- **FIELD, CHEMICAL, AND PHYSICAL CONSTRAINTS ON MAFIC-FELSIC MAGMA INTERACTION IN THE LAMARCK GRANODIORITE, SIERRA-NEVADA, CALIFORNIA** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  FROST, T. P., Mahood, G. A.
  1987; 99 (2): 272-291
- **COMPOSITIONAL LAYERS IN THE ZONED MAGMA CHAMBER OF THE GRIZZLY PEAK TUFF** *GEOLOGY*
  Fridrich, C. J., Mahood, G. A.
  1987; 15 (4): 299-303
- **STRONG COMPOSITIONAL ZONATION IN A SILICIC MAGMATIC SYSTEM - LOS-HUMEROS, MEXICAN NEOVOLCANIC BELT** *JOURNAL OF PETROLOGY*
  FERRIZ, H., Mahood, G. A.
  1987; 28 (1): 171-209
- **RING-FRACTURE ERUPTION OF THE BISHOP TUFF** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Hildreth, W., Mahood, G. A.
  1986; 97 (4): 396-403

- **RISE AND FALL OF A BASALT-TRACHYTE-RHYOLITE MAGMA SYSTEM AT THE KANE-SPRINGS WASH CALDERA, NEVADA** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Novak, S. W., Mahood, G. A.
  1986; 94 (3): 352-373

- **EXPERIMENTAL CONSTRAINTS ON DEPTHS OF FRACTIONATION OF MILDLY ALKALIC BASALTS AND ASSOCIATED FELSIC ROCKS - PANTELLERIA, STRAIT OF SICILY** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Mahood, G. A., Baker, D. R.
  1986; 93 (2): 251-264

- **PERALKALINE AND METALUMINOUS MIXED-LIQUID IGNIMBRITES OF THE GUADALAJARA REGION, MEXICO** *JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH*
  Mahood, G. A., Gilbert, C. M., Carmichael, I. S.
  1985; 25 (3-4): 259-271

- **CORRELATION OF ASH-FLOW TUFFS** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Hildreth, W., Mahood, G.
  1985; 96 (7): 968-974

- **PRECURSORS TO THE BISHOP TUFF ERUPTION - GLASS MOUNTAIN, LONG VALLEY, CALIFORNIA** *JOURNAL OF GEOPHYSICAL RESEARCH-SOLID EARTH AND PLANETS*
  Metz, J. M., Mahood, G. A.
  1985; 90 (NB13): 1121-1126

- **VOLCANIC STRATIGRAPHY OF THE LOS AZUFRES GEOTHERMAL AREA, MEXICO** *JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH*
  Dobson, P. F., Mahood, G. A.
  1985; 25 (3-4): 273-287

- **ERUPTION RATES AND COMPOSITIONAL TRENDS AT LOS-HUMEROS-VOLCANIC-CENTER, PUEBLA, MEXICO** *JOURNAL OF GEOPHYSICAL RESEARCH*
  FERRIZ, H., Mahood, G. A.
  1984; 89 (NB10): 8511-8524

- **REVERSE ZONING IN THE RESURGENT INTRUSIONS OF THE GRIZZLY PEAK CAULDRON, SAWATCH RANGE, COLORADO** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Fridrich, C. J., Mahood, G. A.
  1984; 95 (7): 779-787

- **PYROCLASTIC ROCKS AND CALDERAS ASSOCIATED WITH STRONGLY PERALKALINE MAGMATISM** *JOURNAL OF GEOPHYSICAL RESEARCH*
  Mahood, G. A.
  1984; 89 (NB10): 8540-8552

- **LARGE PARTITION-COEFFICIENTS FOR TRACE-ELEMENTS IN HIGH-SILICA RHYOLITES** *GEOCHIMICA ET COSMOCHIMICA ACTA*
  Mahood, G., Hildreth, W.
  1983; 47 (1): 11-30

- **NESTED CALDERAS AND TRAPDOOR UPLIFT AT PANTELLERIA, STRAIT OF SICILY** *GEOLOGY*
  Mahood, G., Hildreth, W.
  1983; 11 (12): 722-726

- **A RECONNAISSANCE GEOCHEMICAL STUDY OF LA-PRIMAVERA GEOTHERMAL AREA, JALISCO, MEXICO** *JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH*
  Mahood, G. A., Truesdell, A. H., TEMPLOS, L. A.
  1983; 16 (3-4): 247-261

- **K-AR DATING YOUNG RHYOLITIC ROCKS - A CASE-STUDY OF THE SIERRA-LA-PRIMAVERA, JALISCO, MEXICO** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Mahood, G. A., Drake, R. E.
  1982; 93 (12): 1232-1241

- **A SUMMARY OF THE GEOLOGY AND PETROLOGY OF THE SIERRA LA PRIMAVERA, JALISCO, MEXICO** *JOURNAL OF GEOPHYSICAL RESEARCH*
  Mahood, G. A.
  1981; 86 (NB11): 137-152
- **CHEMICAL EVOLUTION OF A PLEISTOCENE RHYOLITIC CENTER - SIERRA-LA-PRIMAVERA, JALISCO, MEXICO** *CONTRIBUTIONS TO MINERALOGY AND PETROLOGY*
  Mahood, G. A.
  1981; 77 (2): 129-149