

ADDRESS

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EXPERTISE

Dr. Mark Osterberg has worked for twenty years for major and junior precious metal and base metal mining companies and over ten years as a consulting geologist to mining companies, government agencies and the investment community. He has provided high level technical expertise to projects in the USA and overseas and has managed multiyear exploration and development projects as well. He has expertise and experience in porphyry copper and molybdenum systems, Carlin-type gold systems, shear-zone and volcanic-hosted mesothermal gold systems, magmatic Cu-Ni-PGE and construction materials. His project related experience includes grass-roots, green-fields reconnaissance programs, brownfields exploration and development programs, mine geology and modeling. He has provided technical expertise to investment houses considering financial participation in mining projects. He has developed innovative mapping techniques for regional and mine scale programs, is an expert GIS for Geology practitioner and is fluent in both Mintec's MineSight and Maptek's Vulcan modeling software.

CERTIFICATION

Professional Geologist - Wisconsin and Arizona

PROJECT EXPERIENCE

MINING/MINERALS – RELATED

- **Geology chapters QP for technical reports, Hermosa Ag-Mn Project, Santa Cruz County, Arizona.** QP for geology chapters of Preliminary Economic Assessment report, dated 12 November, 2012 and Pre-feasibility report, dated 10 December, 2013.
- **Geological modeling, Hermosa Ag-Mn Project, Santa Cruz County, Arizona.** Geological evaluation and 3-D modeling in preparation for pilot and feasibility studies. Ongoing project for Arizona Minerals, Inc.
- **Technical due-diligence, metallic mining projects.** On-call ore deposit and resource evaluation technical support for due-diligence team. On-going project for Tetra Tech.
- **Geotechnical mapping project, Kern County, California.** Structural-lithological mapping and 3-D modeling of southern and western highwalls to support on-going geotechnical risk assessment study. For Rio Tinto.
- **District structural mapping project, Chihuahau, Mexico.** Structural, lithological, mineralization and alteration mapping of eastern extension of the Ocampo mining district. For

Gammon Gold.

- **Mesquite Gold Mine modeling, Imperial County, California.** Structural and lithological modeling of the Mesquite mining district. Ongoing project for WMMI-New Gold.
- **Carlota Copper Geological Modeling project, Gila, County, Arizona.** Geological mapping of lithology, structure, alteration and mineralization in the Cactus Pit. Constructed new 3-D geological model aimed at improving mining and metallurgical performance. Ongoing project for Carlota Copper Company, a subsidiary of Quadra Mining Limited.
- **District exploration mapping project, Custer County, Idaho.** Geological mapping of Thompson Creek mining district near the Thompson Creek molybdenum mine. For Thompson Creek Metals Company.
- **Bombardier district mapping project, Mineral County, Nevada.** Mapped Bombardier mining district geology and modeled subsurface for Cu-Au exploration project. For Sirius Exploration.
- **Xajiapo Talc Technical Evaluation, Hubei Province, China.** Site examination and data evaluation for high quality steatite deposit. Authored technical report for submission to Hong Kong exchange. For Chinese Investment Fund Company Limited.
- **Gold Ridge Technical Report, Cochise County, Arizona.** Site examination, data evaluation, underground mapping evaluation for 43-101 technical report. For Golden FAME (USA).
- **Carlota Copper Alteration Modeling project, Gila, County, Arizona.** Geological mapping of lithology, structure, alteration and mineralization in the Cactus Pit. Constructed new alteration-mineralization model aimed at improving metallurgical performance. For Carlota Copper Company, a subsidiary of Quadra Mining Limited.
- **Zastrow Aggregate Resource Scoping Study, Marathon County, Wisconsin.** DCF-ROI resource calculation and project permitting scoping study for proposed construction materials mining operation. For Rising Rock, L.L.C.
- **Mt Hope Molybdenite Modeling project, Eureka, County, Nevada.** Relogging, geological mapping, database conversion and 3-D modeling of the Mt Hope Molybdenite deposit. For General Moly, Inc.
- **Robinson Mining District 43-101 Evaluation, Exploration-Geological modeling chapter.** Contributed exploration-geological modeling chapters for Quadra Mining Limited's 2008 43-101 filing.
- **DCR-ROI Evaluation, RME Quarry, Marathon County, Wisconsin.** Measured mining resource based on mapping and drilling data and calculated net present value and rate of return for investment group interested in acquisition of the quarry.
- **TexSand Frac Sand project, Wood County, Wisconsin.** Recommended acquisition targets for petroleum frac sand operations and provided permitting services for such operations. For Texsand Distributors, LP.

- **Pukatoro porphyry copper prospect evaluation, Ayacucho District, Peru.** Set up project mapping and initial drill testing programs for an attractive porphyry copper-skarn project area. For Doe Run Peru.
- **Mt. Hope Molybdenum development project. Eureka County, Nevada.** Mapping and cross-sectional evaluation for the Climax-type, Mt. Hope molybdenite deposit. For General Moly Corporation.
- **Devils Gate Pass hydrologic-geological mapping. Eureka County, Nevada.** Mapping and cross-sectional evaluation of the Devils Gate Pass area in support of assessment study for hydrologic connectivity between Kobeh and Diamond valleys.
- **Chestakova project acquisition study, Casa Pulca District, Peru.** Undertook initial acquisition evaluation of high level exposed porphyry copper prospect. Property subsequently acquired by client and is currently under evaluation by Mine Mappers. Prospect will be drill tested this year. For Doe Run Peru.
- **Ruth 3-D modeling, Robinson Nevada Mining Company, Ely, Nevada, USA.** Built 3-D, rectified lithological, mineralogical and structural digital model for the Ruth open pit as part of new engineering-mining block model using ArcGIS, Downhole Explorer and Mine Sight software. This work also required the re-interpretation and incorporation of more than 2500 historic drill logs and conversion of the existing paper database into a modern GIS.
- **Hilger Aggregate Resource Evaluation, Chippewa County, Wisconsin.** Measured reserve volume and material quality for company reserve base. Calculated DCF-ROI valuation as part of potential divestment strategy. For private consortium.
- **Tripp-Veteran 3-D modeling, Robinson Nevada Mining Company, Ely, Nevada, USA.** Built 3-D, rectified lithological, mineralogical and structural digital model for the Tripp-Veteran open pit as part of new engineering-mining block model using ArcGIS, Downhole Explorer and Mine Sight software.
- **District Optimization Geology, Robinson Nevada Mining Company, Ely, Nevada, USA.** Bench face mapping, drill hole log re-interpretation, drill core and RC chip logging as part of district wide 3-D modeling and re-evaluation of long-term Robinson district mineral potential.
- **Economic Evaluation and Mine Planning, Zastrow-Naugart Road Gravel Pit, Marathon County, Wisconsin.** Determined reserve volume and material quality specifications for large glacial-fluvial sand and gravel deposit. For private consortium.
- **Mine Blending Scheduling, Colgate Plant, Lafarge-North America, Colgate, Wisconsin.** Developed high level mine plan and summaries for senior executives and operational blending plan for mine operations staff aimed at extending mine life and profitability. For Lafarge-North America.
- **3-D Modeling, Kennecott BIC and Roland Lake development, Marquette, Michigan.** Developed preliminary 3-D model for the two satellite deposits associated with the Kennecott

Eagle Cu-Ni-PGE sulfide deposit.

- **District Optimization Geology, Robinson Nevada Mining Company, Ely, Nevada, USA.** Mapped lithology, structure, alteration and mineralization in a structurally disrupted porphyry copper district. Project undertaken to determine geological controls on ore and waste distributions, on geotechnical stability and to test and prove geological modeling based on drilling information. Ongoing for Robinson Nevada Mining Company.
- **Geological Mapping, Cobriza Area Exploration projects, Ayacucho, Peru.** Mapped lithology, structure, alteration and mineralization in porphyry Cu-skarn prospect. Logged exploration drill holes and designed and implemented follow-up drilling as part of deposit definition project. For the Doe Run Company.
- **43-101 Evaluation, Lemhi County, Idaho.** Authored 43-101 certification document for Blackbird type Cu-Co prospect. For Toro Resources Corporation.
- **Geological Mapping, Tripp-Veteran Pit, Robinson Nevada Mining Company, Ely, Nevada, USA.** Mapped lithology, structure, alteration and mineralization in a structurally disrupted porphyry copper deposit. Project undertaken to determine geological controls on ore and waste distributions, on geotechnical stability and to test and prove geological modeling based on drilling information. For Robinson Nevada Mining Company.
- **Geological Mapping, Cottonwood Peak Project, Elko County, Nevada, USA.** Mapped lithologies, structure, alteration and mineralization in a volcanic hosted epithermal exploration project, managed geochemical and geophysical portions of the exploration project and prepared the project for drill testing in Spring, 2006. For Ventura Gold Corporation.
- **Geological Mapping, Midas District, Humboldt County, Nevada, USA.** Mapped lithologies, structure, alteration and mineralization in a 40-square km project area around a major epithermal gold district. Project undertaken to provide client with geological controls for future exploration projects. For Newmont Mining Company.
- **43-101 Evaluation, Humboldt County, Nevada, USA.** Authored 43-101 certification document for Carlin-type gold property. For Nevada Mine Properties II, Inc.
- **Geotechnical and Geological logging, Eagle Cu-Ni-PGE deposit, Marquette County, Michigan, USA.** Geotechnical and geological logging of drill core to determine rock mechanical characteristics and deposit modeling for newly discovered Magmatic Cu-Ni-PGE deposit. For Kennecott Mining Company
- **Partial Extraction Geochemical Survey, SW Bingham Canyon Project, Tooele County, Utah, USA.** Undertook partial extraction geochemical survey and interpretation for client in area where natural and man-made contamination was expected. For Grand Central Silver Mines, Inc.
- **Porphyry Copper Exploration Program Technical Evaluation, SE Arizona, SW New Mexico, USA.** Conceived and participated in the implementation of ongoing buried target program, involving geological mapping and interpretation, airborne and ground geophysics, total and partial extraction geochemistry. For BHP Billiton.

- **District and Regional Geological Consulting (Technical), Cobriza Cu Program, Peru.**
Undertook geological evaluation of concession holdings around the Cobriza Cu-Zn mine east central Peru. Mapping, field supervision of geophysical program, drilling and modeling for skarn and porphyry targets. For Doe Run Mining Company.
- **Reserve Delineation and Definition, Colgate Plant, Waukesha County, Wisconsin, USA.**
Supervised 10-hole drilling program designed to substantiate and prove mining reserve at large sand and gravel operation in suburban Milwaukee. Worked up sectional model and calculated mining reserve. For Lafarge-North America.
- **District Geological Mapping, Questa Molybdenum Mine, Taos County, New Mexico, USA.**
Re-mapped surface lithology, alteration and mineralization for the Questa mining district. Provided mapping constraint for re-modeled sectional geological interpretation and refined rock stability controls for slope stability studies. For SRK Consultants and for MolyCorp.
- **Reserve and Materials Volume Estimation, Central and Northeastern Wisconsin, USA.**
Determined reserves, built simple mining plans and developed DCF-ROI based financial evaluations for construction materials operators in Wisconsin and Michigan. For Rocky Mountain Enterprises, Gillett Cement Products, Inc., Pewabic East Partnership, Rising Rock, L.L.C., NorRok, Inc., Lincoln County Road Commission.
- **Permitting, Central and Northeastern Wisconsin, USA.** Wrote reclamation and storm water permits, wetlands remediation plans, and special use permits for construction materials operators in Wisconsin. For +25-company client base.
- **Concession Evaluation, Tintaya, Peru.** Led Tintaya concession minerals exploration activities and managed 30-person Spanish language office. Mapped 50 by 30 km area at 1:5000 scale, completed 5 ground EM and 3 geochemical surveys in 5 months and drilled and modeled 38 diamond drill holes. Released area around Antapaccay porphyry Cu-Au discovery for development and construction activities. Estimated concession mineral potential for long range planning purposes. Completed project ahead of time and under-budget. For BHP.
- **Worldwide Diamond Exploration.** Undertook exhaustive survey of South American Diamond occurrences, including fact-finding trip to Chile, Argentina, Uruguay and Brazil. For BHP.
- **San Carlos Apache Reservation Copper Exploration, Arizona, USA.** Conceived and implemented exploration, contract negotiation, public and governmental affairs programs. Explored five priority areas for copper mineralization on the San Carlos Reservation. Negotiated a 30-percent reduction in contract terms and established working partnership with San Carlos Apache Tribal Office of Mineral Resources, Tribal Office of Economic Development and Tribal EPA. Represented company in quarterly oversight meetings with Tribal Natural Resources oversight board. Represented company in five public hearings called to present results and proposed plans to Tribal members. For BHP.
- **AZSON Porphyry Copper Exploration Program, Arizona-New Mexico-Sonora, USA and Mexico.** Identified and tested of 10 advanced exploration targets, participated in field trials for partial extraction geochemical and Geology from Geophysics techniques, participated in minerals

- policy negotiations with New Mexico State Land Office. For BHP.
- **Geological modeling, Ok Tedi Porphyry Copper Mine, Papua, New Guinea.** Authored first geological interpretation model for control of mining operations at Ok Tedi Cu-Au mine in Papua New Guinea, increasing the operations capital efficiency and profitability. For Ok Tedi Mining Ltd.
 - **Concession Evaluation, Mongolia.** Geological evaluation, including mapping, geochemistry and geophysics for gold concession in southern Mongolia. Taught Western hemisphere evaluation techniques and standards to resource evaluation group in Mongolia. For BHP.
 - **Acquisition Evaluation Study, Twin Buttes Mine, Arizona, USA.** Build ore-reserve model for Twin Buttes Mine for use by senior management strategic planning and acquisitions teams. For BHP.
 - **Mine Geology and District Exploration, Pinos Altos Cu-Zn-Ag-Au skarn, New Mexico, USA.** Mapped underground geology and developed ore control model for Pinos Altos polymetallic skarn. Participated in surface and underground exploration programs that led to a 50-percent increase in ore reserves at Cyprus Pinos Altos mine. For Cyprus Mining Company.
 - **El Abra Acquisition Evaluation, Chile.** Mapped approximately one-fourth of the surface extent of the El Abra Porphyry Copper Prospect in northern Chile as part of acquisition evaluation team charged with determining up-side potential for grades and tonnes. For Cyprus Mining Company.
 - **Evaluation of the Bagdad Porphyry Copper District, Arizona, USA.** Mapped pit and district lithology, structure and alteration and determined the exploration potential for the Bagdad district. For Cyprus Mining Company.
 - **Property Exploration and Reserve Calculation, California, USA.** Property mapping, drilling and sectional reserve calculation for mesothermal shear-zone hosted, greenstone-type gold deposits in historic Mother Lode region of California. For Meridian Gold Corporation and for Gold Fields Mining Corporation.
 - **Geological Investigations, Ph.D. Study, Chimney Creek Carlin-type Gold Deposit, Nevada, USA.** Mapped outcrop lithology, structure, alteration and mineralization over approximately 10 square km property centered on the Chimney Creek Carlin-type gold deposit. Logged 30-plus core holes within and adjacent to the deposit and examined isotopic, radiogenic, fluid inclusion and geochemical constraints. Developed genetic model and determined salient ore controls. For Gold Fields Mining Corporation and the University of Arizona.

PROJECT EXPERIENCE

DESIGNATED COMPETENT PERSON-OP PROJECTS

- **Hermosa Ag-Mn Technical reports.** Geology sections.
- **Xajiapo Talc Technical Evaluation, Hubei Province, China.** Site examination and data

- evaluation for high quality steatite deposit. Authored technical report for submission to Hong Kong exchange. For Chinese Investment Fund Company Limited.
- **Gold Ridge Technical Report, Cochise County, Arizona.** Site examination, data evaluation, underground mapping evaluation for 43-101 technical report. For Golden FAME (USA).
 - **DCR-ROI Evaluation, RME Quarry, Marathon County, Wisconsin.** Measured mining resource based on mapping and drilling data and calculated net present value and rate of return for investment group interested in acquisition of the quarry.
 - **Hilger Aggregate Resource Evaluation, Chippewa County, Wisconsin.** Measured reserve volume and material quality for company reserve base. Calculated DCF-ROI valuation as part of potential divestment strategy. For private consortium.
 - **43-101 Evaluation, Lemhi County, Idaho.** Authored 43-101 certification document for Blackbird type Cu-Co prospect. For Toro Resources Corporation.
 - **43-101 Evaluation, Humboldt County, Nevada, USA.** Authored 43-101 certification document for Carlin-type gold property. For Nevada Mine Properties II, Inc.

PROFESSIONAL EMPLOYMENT HISTORY

Geological Consultant (present)
Principal Geoscientist, BHP, Tucson, Arizona, USA (1994-2001)
Senior Geologist, Cyprus Mining Company, Tucson, Arizona USA (1990-1994)
Consulting Geologist, Meridian Gold Company, Sutter Creek, California (1989)
Geologist, Gold Fields Mining Corporation (1981-1989)

EDUCATION

Ph.D., Geology, (Economic Geology) - University of Arizona (1990)
M.S., Geology - University of Minnesota (1983)
B.S., Geology, University of Wisconsin (1979)

SPECIALTY SOFTWARE EXPERTISE

ESRI ArcGIS Suite, including ArcMap and ArcScene
Datamine's Downhole Explorer
Mintec's MineSight
Maptek Vulcan

PROFESSIONAL AFFILIATIONS

American Association of Petroleum Geologists
American Institute of Professional Geologists

PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION

Customized Advanced MineSight for Modeling-Geostatistics
Exploration Management Course II, Andrew White and Associates Geelong, Victoria, Australia
Economic Evaluation and Analysis, Tucson, AZ
Global Leadership Program I, Hong Kong

Management Training Workshop, Scottsdale, AZ
Diamonds Workshop, Kelowna, B.C.
GIS for Geologists, Tucson, AZ
Advanced GIS for Geologists, Denver, CO
Iron Oxide Copper Gold, Stratiform copper and Mt. Isa-type deposits, Golden CO
EM for Geologists, Tucson, AZ
Aeromagnetic Imaging and Interpretation, Denver CO
Geosoft Oasis Montaj, Golden, CO
Arcview GIS, Tucson, AZ
Mine Safety and Health Administration