

ROBERT E. CROWDER
STATEMENT OF QUALIFICATIONS
RESUME/CIRRICULUM VITAE

GENERAL QUALIFICATIONS:

Robert E. Crowder:

- Is a Consulting Geophysicist with **25 years international & domestic experience in all phases of slimhole borehole geophysical logging and data interpretation.**
- Has an international reputation as a **technical expert in borehole geophysical logging & experience in operating geophysical service & equipment manufacturing companies.**
- Is actively **designing, promoting & developing new geophysical technology** for environmental, groundwater, geotechnical, & mining investigation.
- Is **actively teaching** a number of formal short courses in borehole geophysical fundamentals & applications for Environmental & Engineering Investigations for public & private-industry groups.
- Is **developing & applying geophysical technology for engineering applications** including characterization of underground infrastructure.
- Is a key member of the **ASTM (American Society for Testing Materials)** committee establishing guidelines for borehole geophysical log quality assurance.
- Is **Past-President of the Minerals & Geotechnical Logging Society (MGLS).**
- Is **past First Vice-President of Engineering and Environmental Geophysical Society (EEGS).**

SPECIFIC QUALIFICATIONS:

Robert E. Crowder specializes in:

- **Integration of borehole geophysical data with geologic, geochemical, hydrogeologic, well construction** and other information into Summary presentations to facilitate interpretation.
- **Design, Acquisition, and Interpretation** of geophysical data in diverse geologic environments.
- Improved **Permeability Characterization Techniques** (includes Tube Wave/Stonely Wave Amplitude Analysis and Flow Analysis Techniques based upon the Spinner and Heat Pulse Flowmeter, Spinner Flowmeter, and HydroPhysical™ Logging Technique).
- **Ground Water Flow and Contaminant Distribution Analysis including** determination of **Transmissivity** and **interval ground water quality** from flowmeter data collected under different head conditions and discrete interval fluid samples.
- Analysis of **full waveform acoustic** for **engineering and hydrogeologic parameters.**

- **Borehole Image analysis & Fracture Evaluation Techniques** for hard and soft rock environments (including enhanced Acoustic Televiewer and Optical Televiewers).
 - **Vadose Zone Characterization and Monitoring** with Borehole Techniques (including Moisture Monitoring with different types of Neutron Logging Probes).
 - **Evaluation and Verification of Well Construction**, especially in near surface monitoring wells (*he pioneered a method utilizing Gamma-Gamma Density to verify location of completion material*).
 - **Quantitative log analysis** for **physical parameters** (e.g., **formation resistivity, density, velocity, etc.**) and **physical properties** (e.g., **clay content, porosity, water saturation, etc.**) and industry specific applications such as **coal quality, water quality, oil shale yield, etc.**
 - **Energy Mineral Exploration and Exploitation:** Including Uranium, Coal, and Oil Shale Applications using Borehole Geophysical Logs for resource characterization.
 - **Base, Industrial, and Precious Mineral Exploration and Exploitation** including Resource Characterization, and providing information for Hydrologic, Geotechnical, and mining issues.
 - Application of borehole geophysics to **production mining issues** including **rock quality determination, slope stability and clay distribution.**
- **Mr. Crowder is well-versed in borehole geophysical methods, including specific expertise in the following methods:**
- ✓ **Electrical** - Normal, Lateral, & Focused Resistivities, Induced Polarization, Spontaneous Potential, etc.
 - ✓ **Nuclear** - Gamma (Total & Spectral), Gamma-Gamma Density, Spectral Density, Neutron (Thermal, Epi-Thermal), etc.
 - ✓ **Electromagnetic** - Induction, Magnetic Susceptibility, Borehole Radar.
 - ✓ **Acoustic** - Full Waveform Sonic, Velocity, Cement Bond, VSP, Cross-Hole, etc.
 - ✓ **Borehole Imaging** - Video, Acoustic & Optical Televiewer, Dipmeter, etc.
 - ✓ **Fluid Logs** - Temperature, pH, Fluid Resistivity/Conductivity, Oxidation Reduction Potential (ORP or Eh), ion specific sensors, Flowmeter (High Resolution Heat Pulse, Spinner, others).
 - ✓ **Other** - Caliper, Deviation: Mechanical, Magnetic and Gyroscopic Methods, Casing collar locators, 3-component Magnetic Field, etc.
- **Mr. Crowder is well-versed in Surface Geophysical Methods for Environmental and Geotechnical Applications, including the following techniques:**
- ✓ **Electrical** - Resistivity, IP, Square Array, Mise-a-la-masse.
 - ✓ **Electromagnetics** - EM31, EM34, EM38, EM47 (Protem), EM61, etc.
 - ✓ **Ground Penetrating Radar** – surface and borehole
 - ✓ **Magnetics** - Total Field, Gradient
 - ✓ **Seismic** - Refraction, Reflection, VSP, Tomography, Sub-bottom Profiling

- **Mr. Crowder is well-versed in a variety of other near surface drilling and testing technologies including:**
 - ✓ **Direct push measurements**
 - ✓ **Horizontal Directional Drilling** – including path monitoring and MWD
 - ✓ **Variety of drilling techniques** – Auger, bucket, cable, core, hammer, reverse circulation, rotary, roto sonic, etc.
 - ✓ **Drill measurements** – geolograph, torque, hold-down, ROP, etc.

Recent work has utilized differential GPS, hand-held laser total station, and other innovative surveying devices for real-time positioning with this equipment.

- **Mr. Crowder's responsibilities have included:**
 - ✓ **Personnel training**
 - ✓ **Equipment selection and maintenance**
 - ✓ **Data interpretation**
 - ✓ **QA/QC**
 - ✓ **Project Management** for contract operations
 - ✓ **Generation and Review of Final Reports, interpretations, and presentations** of survey results to public and private clients
 - ✓ **Being both Colorado Well Logging's and COLOG's Radiation Protection & Safety Officer**, and he obtained their initial radiation license.
 - ✓ **Participation** in different borehole geophysical tasks at numerous **DOE, DOD, EPA**, and private industrial and mining facilities.
 - ✓ **Being instrumental in** prioritizing new geophysical product development and keeping both hardware & software design simple, elegant, rugged, and production-oriented.
 - ✓ **Producing a work product that has been used in a number of legal actions, and has provided depositions and expert testimony as a technical expert.**

EDUCATION:

- Colorado School of Mines: BS Engineering Geophysics, 1978
- OSHA 40-hour Hazardous Waste Site Health & Safety
- MSHA 24-hour New Miner Training plus site specific mine training and Annual refreshers
- Gulf Nuclear, 1978 - NRC approved Radiation Safety Training for Well Logging and Annual Refreshers

REGISTRATION

- Registered Geologist - Arkansas No. 1300
- Professional Geologist - Tennessee No. TN1092
- Professional Geologist - Wyoming No. PG2396

PROFESSIONAL HISTORY

- R.E. Crowder Consulting, LLC - 1997 to Present – Member and Manager (Geophysical Consulting)
- Mt. Sopris Instrument Co., 1991 to Present - Co-owner, Corporate Officer, and Director (Geophysical Instrument Design & Manufacturing Company)
- Terra Sciences, Inc, 1989 to 1998 – Director (Geophysical Software Design Company)
- COLOG, Inc. - 1985 to 1997 - President, Co-owner and Co-founder (Borehole Geophysical Service Company)
- Colorado Well Logging - 1978 to 1985 - Operations Manager (Borehole Geophysical Service Company)
- U.S. Geological Survey - 1976 to 1978 - Permanent part-time Student Employee (Borehole Geophysical Research)

AFFILIATIONS

- ASTM (American Society for Testing Materials) - key member on committee establishing guidelines for Borehole Geophysical Log Quality Assurance.
- Minerals & Geotechnical Logging Society (MGLS), a Chapter-at-Large of Society of Professional Well Log Analysts (SPWLA) - Past President MGLS and past member of SPWLA.
- Engineering and Environmental Geophysical Society (EEGS) - Past officer (First Vice President and other offices)
- Association of Engineering Geologists (AEG) - past member.
- National Ground Water Association (NGWA) - past member.
- Colorado Ground Water Association (CGWA) - past member.
- Society of Exploration Geophysicists (SEG) - past Associate member.
- Golden Volunteer Fire Department - 20-year member, former Rescue Director (14 years); retired 1-6-01.

SHORT COURSES

□ **Mr. Crowder has:**

- ✓ **Designed and been lead instructor** in a number of Borehole Geophysical Short Courses.
- ✓ **Has been an invited speaker and guest lecturer** in other short courses, such as; the Arizona Hydrological Society's Well Design and Installation Workshop July 18, 2002, Phoenix, Arizona, and the Borehole Geophysics Session of Geophysical Fundamentals Short Course sponsored by EEGS at SAGEEP, 1992, Oakbrook, Illinois, and numerous internal USGS basic and advanced log interpretation short courses taught at the Denver Federal Center by Dr. Fred Paillet, et. al., and for logging workshops sponsored by National Ground Water Association.
- ✓ **Provided hundreds of 1-4 hour presentations to industry groups and professional societies** such as the Colorado Mining Club.

□ **Representative Short Courses designed and taught by Mr. Crowder follow:**

- ✓ **Borehole Geophysics for Environmental and Engineering Investigations** has been presented in variations from 1 to 4 days, for groups as large as 50 participants. Some of the class dates and locations were:
- ✓ **Recent Innovations in Borehole Geophysics for Engineering and Groundwater Applications** - Sponsored and endorsed by Association of Engineering Geologists as an AEG Short Course, October 3, 1995, Sacramento, California.
- ✓ **Application & Innovations of Borehole Geophysics for Mining** - Endorsed by Colorado School of Mines, and taught in Santiago, Chile, August 15-16, 1996, and in Antofagasta, Chile, October 28-29, 1996.
- ✓ **Application & Innovations of Borehole Geophysics for Ground-Water Applications** - Sponsored by Colorado Ground-Water Association, and endorsed by Colorado School of Mines. Taught at Colorado School of Mines, Golden, Colorado, May 16-17, 1997.