



INGENIERÍA Y CONSULTORÍA EN RECURSOS DEL SUBSUELO, S.L.

CRS, EXPERIENCE FOR NEW PROJECTS





1. CRS INGENIERÍA

2. TECHNICAL TEAM

3. SERVICES

4. FIELDS OF ACTIVITY

- **MINING EXPLORATION**
- **MINING**
- **GEOTECHNICS**
- **GEOSTATISTIC**
- **HIDROLOGY AND
HIDROGEOLOGY**
- **ENVIRONMENT AND LAND
MANAGEMENT**
- **UNDERGROUND STORAGE**
- **WASTE MANAGEMENT**

5. MATERIAL RESOURCES

6. QUALITY POLICY

7. MAIN CLIENTS

8. EXPERIENCE

- **INTERNACIONAL**
- **RAW MATERIALS**
- **SOME PROJECTS**



1. CRS INGENIERÍA

INGENIERÍA Y CONSULTORÍA EN RECURSOS DEL SUBSUELO, S.L. (CRS Ingeniería) is a completely private limited howly own company.

CRS Ingeniería specialized in the study and management of subsurface resources whose aim is to give their customers a personalized service as an independent engineering and consulting company. This technical assistance leads to a continuing relationship with our clients and ranges from resolving specific and urgent problems to integrated turn-key projects.

CRS Ingeniería works for both, the public and private sectors. Its clients are national public organizations, international companies, mining companies, cement producers, consultancies and companies connected to the energy sector (national and international).

CRS Ingeniería provides its clients with a technical support in geology, mining, geotechnics, hydrogeology, geostatistic, environmental and underground storage fields.

In the mining sector, **CRS Ingeniería** offers a full range of engineering and consulting services that cover the entire lifecycle of a project, ranging from mining exploration work up to mining closure, including mining valuation assets, feasibility studies, open pit and underground mining projects, restoration projects and works management.

As an engineering and consultancy company, **CRS Ingeniería**'s corporate policy is oriented to promote the continuing education of their employees, in order to offer its customers the best solution every moment, but without forgetting that the one who knows his problems is the client and, due to our field of activity, the data necessary for that solution are in the field and in the work.

In order to provide greater support and assistance to our customers, **CRS Ingeniería** is involved in R&D projects, and also develops its own tools for the improvement of production processes and its clients.





2. TECHNICAL TEAM

CRS Ingenieria has a technical team made up of sixteen highly qualified professionals: 7 mining engineers, 4 geologists, 1 forest engineer, 2 geologist engineers, 1 economist and 1 expert in marketing.

In addition, **CRS Ingenieria** has a large number of highly specialized partners. This team solves the needs of its clients in an effective, rapid and practical way.







3. SERVICES

CRS Ingenieria provides technical support in geology, mining exploration, geotechnics, hydrogeology, environmental, underground storage and waste management.

CRS Ingenieria offers the services listed below:

- Technical assistance and advice
- Data acquisition
- Geological, geotechnical and hydrogeological modeling
- Due diligence
- Prefeasibility and feasibility studies
- Environmental impact assesment
- Mining projects: open pit and underground
- Technical assistance for project implementation
- Site Management and Project Management
- Coordination of health and safety
- Technical Videos
- Processing of projects to government agencies



4. FIELDS OF ACTIVITY

CRS Ingenieria offers its services of fields activities listed below:

- Mining exploration.
- Mining.
- Geotechnics.
- Geostatistic
- Hidrology and hidrogeology.
- Environment and land management
- Underground storage
- Waste management.



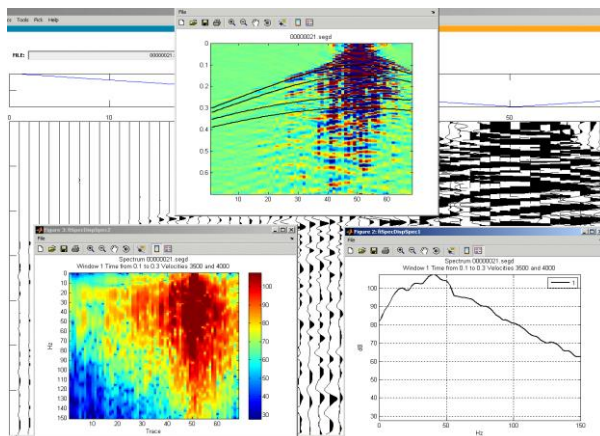
Mining exploration

CRS Ingenieria's technicians have developing projects in the field of geology and mineral exploration, including detailed mapping, structural interpretation, the enhancement of geological and mining heritage and reservoir modeling.

A field in which **CRS Ingenieria** has an extensive experience is in multi-element geochemical prospecting for infrastructure, both for mining exploration to environmental characterization; also in the interpretation of 2D and 3D seismic surveys for exploration of evaporite basins, as well as regional, national and international exploration campaigns for metal and industrial minerals.

Within the field of mining exploration, **CRS Ingenieria** develops the activities listed below:

- Campaign planning research
- QA/QC exploration
- Exploration and mining research.
- Control and interpretation of drilling campaigns
- Geological surveys and geological mapping.
- Specialized surveys in structural geology
- Geochemical prospecting.
- 2D and 3D campaign interpretation
- Investigation data analysis.
- Modelling deposits.
- Mineral resources assessment



Mining

For the mining sector, **CRS Ingenieria** offers a full range of engineering and consulting services, covering the entire project life cycle, from exploration to mine closure, including valuation of mining assets, open pit and underground mining projects, restoration projects and site management projects. Everything according to the of international codes PERC, JORC, NI43-101 standards.

Within the field of mining, **CRS Ingenieria** develops the activities listed below:

- Modelling deposits.
- Mineral resources and reserves assesment
- Pre-feasibility and Feasibility studies
- Mining asset valuation
- Analysis of reserves and due diligence
- Mining project evaluation
- Open pit and underground mines optimization
- Analysis of alternatives.
- Transport trade off, exploitation methods, etc.
- Open pit to underground mine transition
- Conceptual projects and open pit and underground mines design

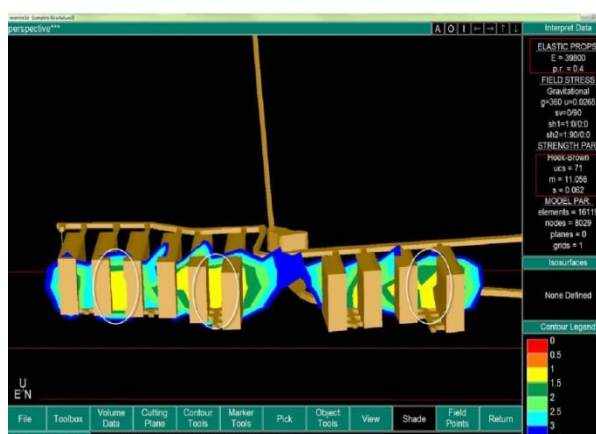
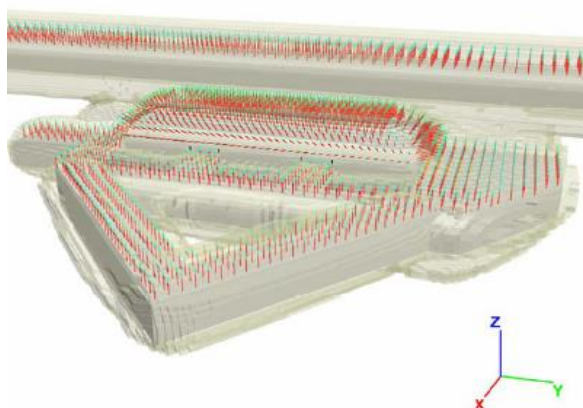


Geotechnics

CRS Ingeniería performs geotechnical surveys adapted to the different needs raised by the customer, covering all the phases of the survey development, from the characterization in situ of the materials, interpretation of the results of laboratory tests, modeling using specialized software of the cases studied and interpretation of results.

Within the field of geotechnics, **CRS Ingeniería** develops the activities listed below:

- Soil mechanics.
- Rocks mechanics.
- Geotechnical characterization of rock mass.
- Stability surveys of slopes and embankments
- Stability surveys of underground excavations.
- Support surveys.
- Foundations surveys.
- Geological hazards surveys
- Subsidence studies
- Defining of the risk areas.
- Studies of the liquefaction potential of saturated sands
- Surveys of sites.
- Technical assistance to the project management



Geostatistic

CRS Ingeniería proposes this methodology to improve the knowledge of the dispersion of the elements according to different aspects, through a statistical treatment and a complete and detailed geostatistical procedure thanks to the use of specialized software. CRS Ingeniería applies this methodology in activities related to mining exploration, planning, environment, geochemistry and risk analysis of the different activities, providing a high added value to the data analysis.

In the field of geology and mining:

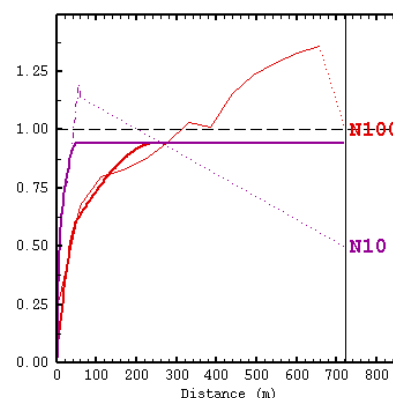
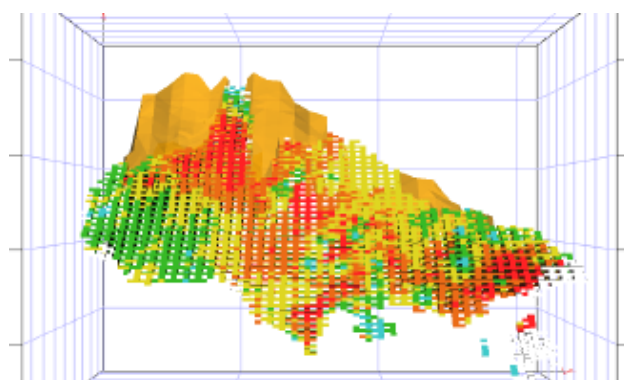
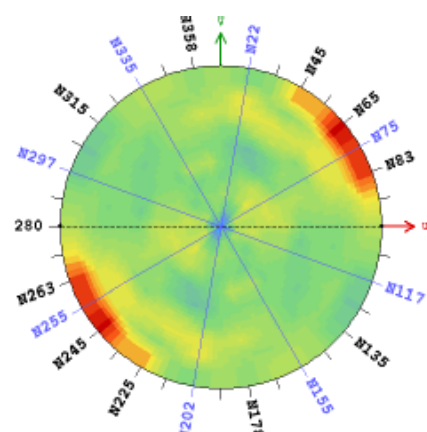
- Data analysis and geological interpretation
- Evaluation of resources and mineral reserves
- Planning new research campaigns
- Optimal block modelling exploitation
- Mine limit demarcation
- Mining planning

In the field of environment:

- Contamination cartography
- Uncertainty analysis
- Quantification of contamination volumes
- Planning new campaigns
- Decontamination planning

In the field of geochemistry applies to:

- Statistical data study
- Thematic cartography
- Planning of research campaigns

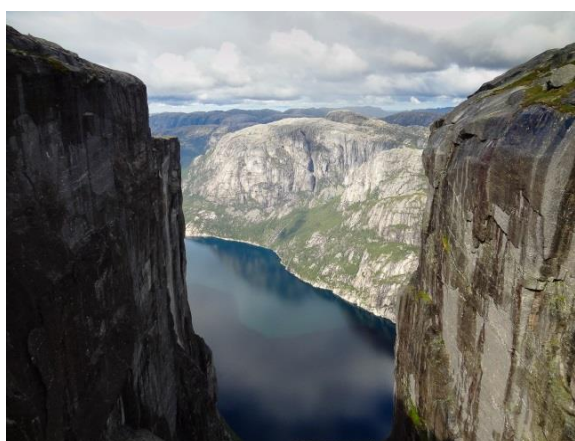
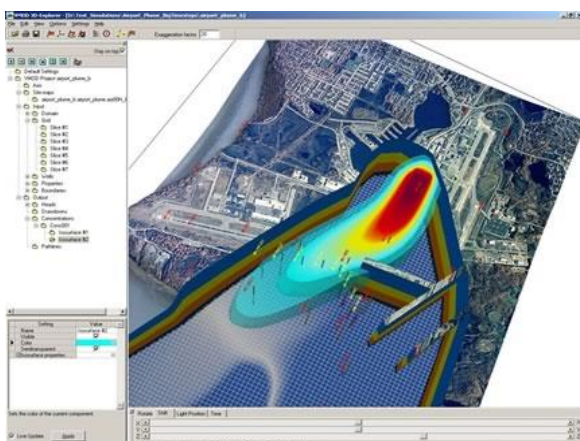


Hidrology and hidrogeology

In the field of hydrology and hydrogeology **CRS Ingenieria** performs hydrological and hydrogeological surveys with an infrastructural nature, hydrogeological modeling for civil infrastructure and mining projects, water management plans and landfill projects.

Within the field of hydrology and hydrogeology, **CRS Ingenieria** develops the activities listed below:

- Determination of hydrogeological parameters in permeable and low permeability rocks.
- Hidrogeologyc surveys
- Hydrogeochemistry.
- Aquifer modelling.
- Water flow rate exploitation.
- Drainage design for civil and mining projects.
- Water resources assessment. Planning and management
- Water quality management.
- Operation and management of aquifers.
- Protection perimeters and areas of safeguarding deposits.
- Protection of aquifers.
- Evaluation of potential sources of contamination aquifers.
- Protection perimeters and areas to safeguard deposits.
- Sealing surveys.

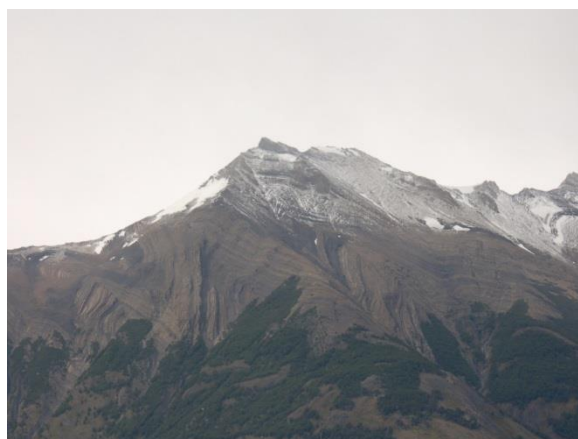


Environmental and land management

In the field of environmental and land management **CRS Ingeniería** perform environmental studies and environmental monitoring plans related to mining, land-use plans for the use of mining resources, rehabilitation projects, etc.

Within the field of environmental and land management, **CRS Ingeniería** develop the activities listed below:

- Environmental mapping.
- Geochemical prospecting for environmental characterization
- Environmental impact assessments.
- Environmental guidelines for projects and facilities.
- Environmental risk analysis.
- Procedures for environmental authorizations and discharge permits.
- Characterization and analysis of contaminated soil.
- Administrative follow-up of environmental permit procedures.
- Environmental monitoring plans.



Waste management

CRS Ingeniería perform the characterization of contaminated sites, management projects of solid waste and liquid effluents, construction projects of dumps, landfills and ponds and slurry dams.

Within the field of waste management, **CRS Ingeniería** develop the activities listed below:

- Waste characterization.
- Diagnosis of contamination of soils and groundwater.
- Environmental risk analysis.
- Landfill projects.
- Mining slagheaps projects
- Ponds and slurry dams projects
- Solid waste deposit projects
- Regeneration of degraded areas
- Assessment and implementation of corrective measures.

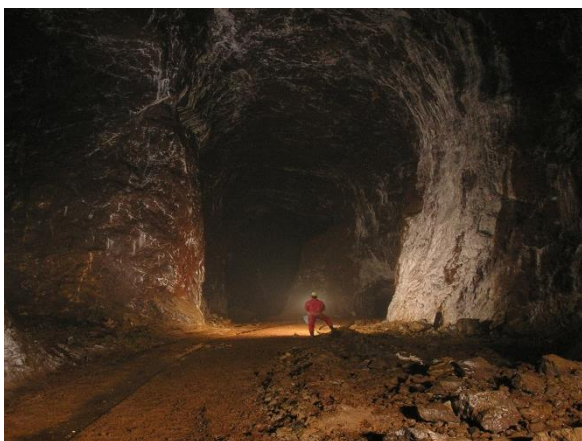


Underground storage

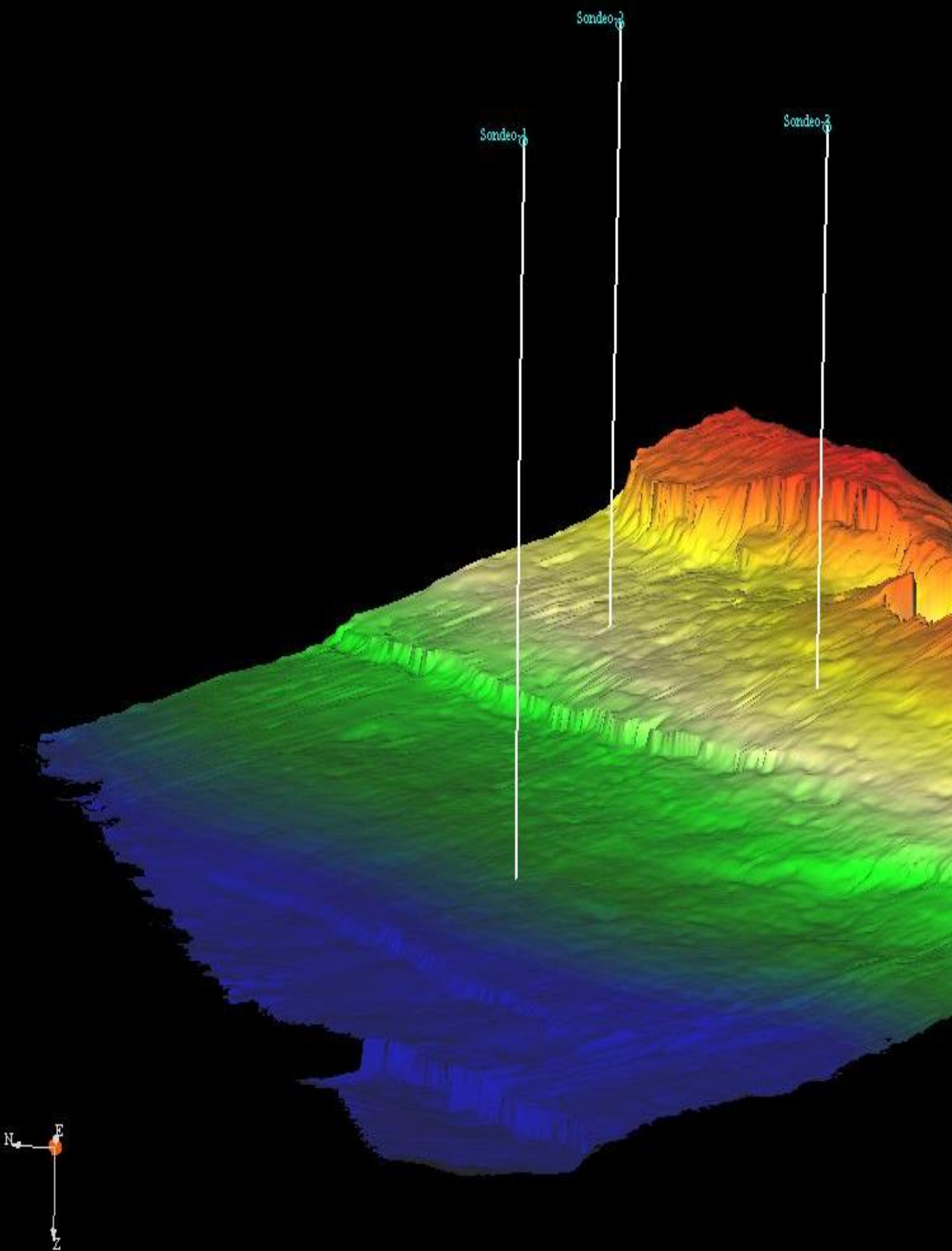
CRS Ingenieria also have expertise in projects related to the use of groundwater, natural or artificial structures for the storage of products.

Within the field of underground storage, **CRS Ingenieria** develop the activities listed below:

- Geological and hydrogeological characterization of low permeability media.
- Characterization of natural and artificial underground structures
- Site selection.
- Storage project in underground structures.







5. MATERIAL RESOURCES

The **CRS Ingenieria's** office is equipped with state-of-the-art information technology which allows us to fulfill all the requirements by our clients.

CRS Ingenieria have the relevant licenses to use the software and systems detailed below:

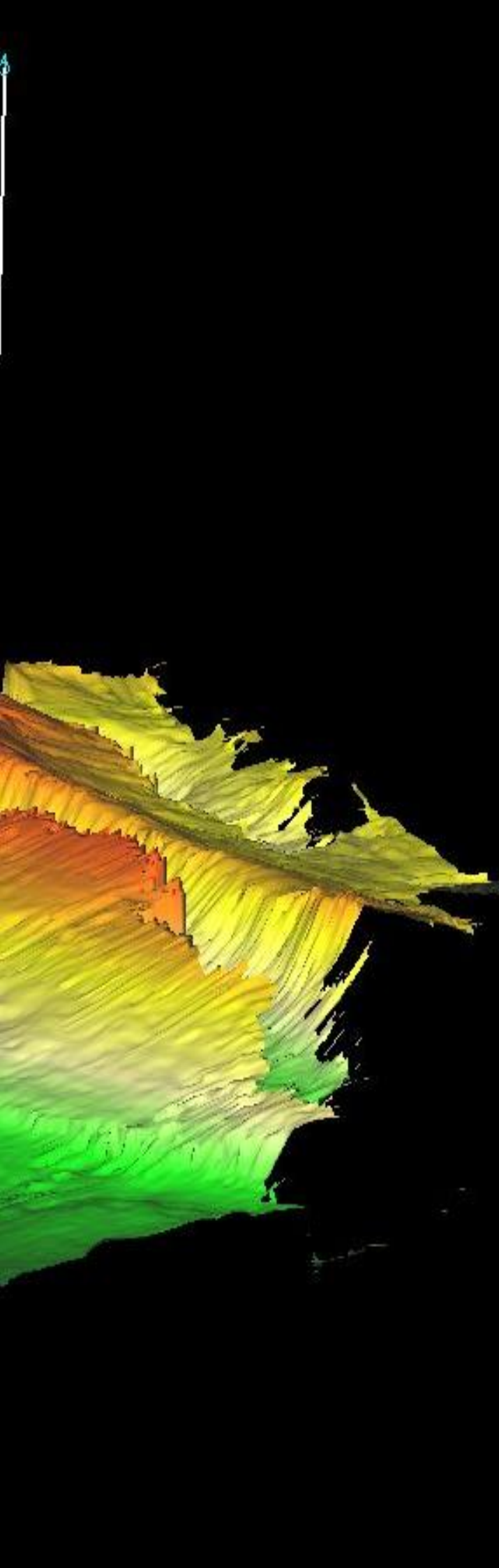
- Vulcan 3D 8.2.
- Geotechnical software package Rocscience
- OpendTect, Seisee
- Modflow
- Restoration software: GroundWiz Full Version 1.800
- Free software: gvSIG 1.10, Recmin
- Isatis 2017
- Leapfrog Geo

In all its mining research and design projects, **CRS Ingenieria** uses VULCAN 3D mine planning and design software, for which it holds the relevant license. The software supports the development of mining projects from geological aspects through to final mine planning including exploration optimization. The software features all the necessary tools to design both open pit and underground mines.

CRS Ingenieria applies Leapfrog Geo for 3D modeling of the subsoil, allowing the development of dynamic 3D models from the available information (cartography, drills, geophysics, ...). The 3D interpolation of implicit modeling Leapfrog Geo allows the creation of complex geological models in an agile way from any data set, enabling an immediate visualization of the model, the analysis of data and the search of correlations and trends. Leapfrog Geo also allows to develop and visualize in a flexible way different models on which the client can interact without having this software.

CRS Ingenieria, in order to enhance detailed geostatistical studies in the following fields: mining; environment and geochemistry, uses ISATIS 2017 software. Obtaining accurate results using geostatistics is possible thanks to the application of a methodology allowing the validation of the results in each stage of the project. The estimations made, combined with an analysis of uncertainties, allow a controlled decision in each phase of the study and a better control of the financial risk of the project.

Besides this commercial software, **CRS Ingenieria** has self-developed tools in the fields of planning and mining operations, hydrology, hydrogeology, geological hazards and environmental risks.





6. QUALITY POLICY

CRS Ingeniería aims to provide its customers an effective and independent service engineering, consulting and project management in fields related to the environment, mining, geology and natural resources fields. It applies the most appropriate methods and technologies within a framework of quality assurance in terms of reliability, safety and respect for the environment. With this commitment, **CRS Ingeniería** is ranked as an active entity in the field of R&D, through their involvement in projects of public initiative aimed at developing Spanish engineering.

In line with this objective, **CRS Ingeniería**'s management has defined environmental protection and continuous improvement of processes as important factors to integrate into their corporate strategy, applicable to all its activities and within their organizational context

In the same way, **CRS Ingeniería** collaborate actively with the Spanish university system through agreements that allow students in last year, to complete their technical training, carrying out internships, supervised by an expert. As a result of the informative vocation of its management.

CRS Ingeniería is based on three basic pillars: commitment to the environment, quality and safety:

- CRS Ingeniería studies and projects are performed under the Environmental Management System in accordance with UNE-EN ISO 14001:2004 regulation.
- As a service company, enhancement and maintenance of quality is one of the basic objectives of CRS Ingeniería, according to UNE-EN ISO 9001:2008 regulation pertaining to the Quality Management System.
- The occupational risks prevention is another important factor to CRS Ingeniería; its technicians have the prevention training in mine safety pre-arranged in the ITC/101/2006, for both exploration and open pit or underground mining exploitation to work.

The Environmental and Quality Management System of **CRS Ingeniería** are certified by AENOR, with the number GA-2013/0102 and ER-0240/2013 respectively.





7. MAIN CLIENTS

CRS Ingenieria international and national main clients over the last six years are listed below:

INDUSTRIAL MINERALS

- Aizkibel S.A. (Grupo CALCINOR)
- Andaluza de Cales, S.A. (Grupo CALCINOR)
- Canteras Industriales, S.L.
- Comunidad de Bienes "Montes de Torrero"
- Eusebio Echave, S.A.
- Geoalcali (Highfield Resources)
- Grupo FerroAtlántica
- ICL (Israel Chemicals Ltd.)
- Magnesitas Navarras, S.A. (MAGNA)
- Ofitas de San Felices, S.A.
- Pasek Minerales, S.A.
- VALE Fertilizers

METALLIC MINERALS

- Atalaya Mining
- Berkeley Minera España, S.A.
- Corporación Recursos Iberia, S.A. (Petaquilla Minerals)
- Edgewater Exploration, Ltd.
- Emed Tartessus
- Gévora Construcciones, S.A
- Grabat Energy
- Hispanobelga del Hierro, S.L.
- Magnetitas del Cehegín, S.L.
- Minas de Aguas Teñidas, S.A.U.
- Minas de Estaño de España, S.A.
- Mineira de Corcoesto S.L.
- Minera Los Frailes, S.L.
- Minorbis-Grupo Mexico
- Pacific Iron
- Quantum Minería, S.L.

CONSTRUCTION INDUSTRY

- Canteras Alaiz, S.A. (Grupo Cementos Portland Valderrivas)
- Canteras de Aldoyar, S.L.
- Canteras de Santullán S.A.
- Cementos Cosmos, S.A.
- Cementos Lemona, S.A.
- Ciment d'Enfidha, S.A.
- Cobra Energía (Grupo Cobra)
- CRH
- Ferrovial
- Gas Natural Fenosa
- Grupo Cetya, S.A.
- Hormigones y Morteros Preparados, S.A. (Grupo Cementos Portland Valderrivas)
- Lázaro Echeverría S.A. - Canteras y Hormigones
- Licuas Trading and Contracting, Ltd.
- Uncona, S.A.

PUBLIC ADMINISTRATIONS

- Comunidad de Madrid. Consejería de Transportes, Infraestructuras y Vivienda
- Diputación Foral de Álava. Servicio de Medio Ambiente y Biodiversidad
- Junta de Andalucía. Consejería de Economía, Innovación, Ciencia y Empleo





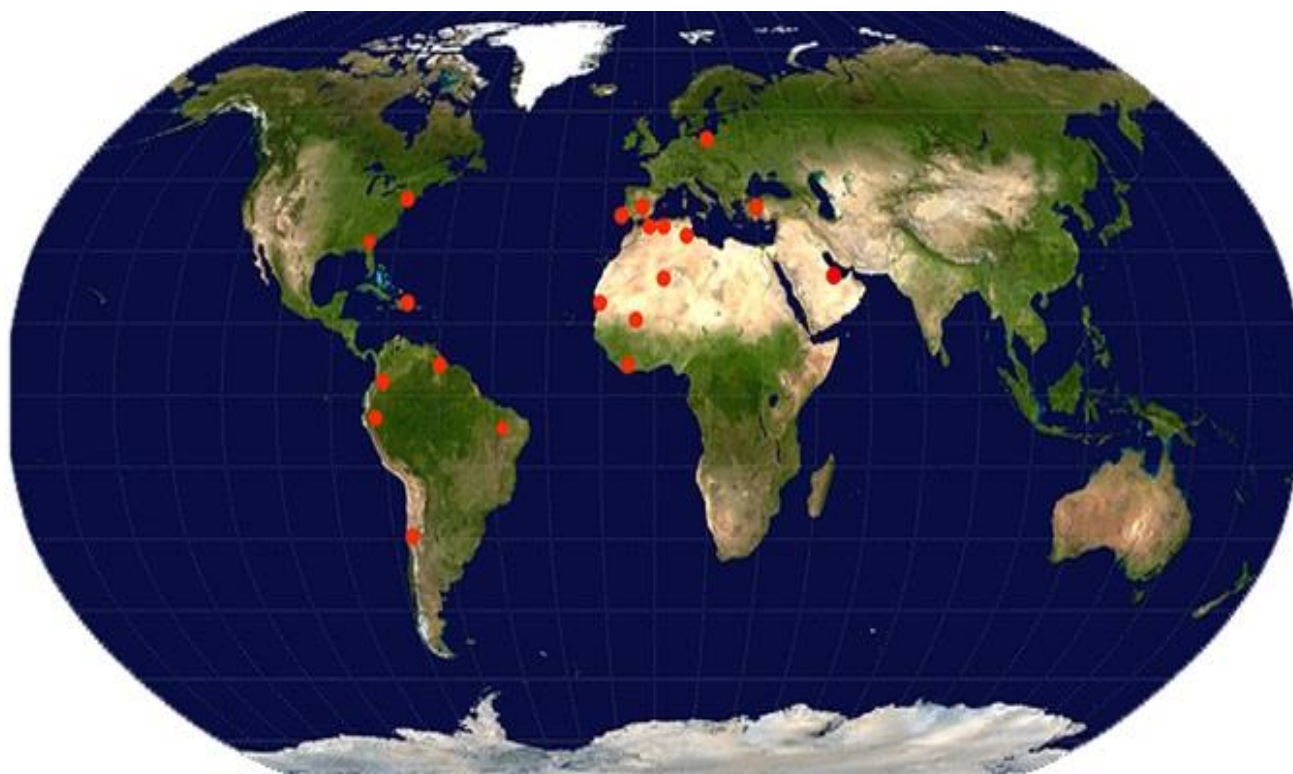
8. EXPERIENCE

CRS Ingenieria with over forty years of experience is a company specialized in the study and management of subsoil resources, made up by a team of professionals with extensive experience in the geographical scope, nationally and internationally, as by the raw materials, object of the work and the field activity.



International experience

CRS Ingeniería's technical team carried out mining projects in Algeria, Argentina, Brazil, Colombia, Dominican Republic, Guinea Conakry, Morocco, Poland, Qatar, Romania, Tunisia, Turkey and United States.



Raw Materials

The technical team of **CRS Ingenieria** has experience in the exploration, evaluation and exploitation of mineral raw materials as follows:

- Metal ores: gold, copper, zinc, lead, tungsten, tin-tantalum, iron, manganese and uranium
- Industrial Minerals: potash, glauberite, gypsum, magnesite, celestite, fluorite, quartz metal, dunites, special clays and silica sands
- Raw materials for construction: cement raw materials, aggregates and ornamental rocks.
- Medicinal waters.



Projects Experience

- Conceptual exploitation project for the underground mine Los Frailes (Seville). 2017
- Transition from open pit to underground phosphate exploitation. (Brazil). 2017
- Review of Mina Muga potash exploration project (Navarra). 2017
- Exploitation project for the copper deposit Touro (Galicia). 2017
- Open pit mining project at Monte Murguía marl quarry (Vizcaya). 2017
- Open pit and underground mining project at Apario limestone quarry (Vizcaya). 2017
- Geotechnical study of the exploitation project for tin in Oropesa (Córdoba). 2017
- Geotechnical campaign for the study of foundations (Salamanca). 2017
- Geological-mining exploration project in the area Suria-Callús. First Phase: seismic prospecting. 2016
- Resources estimation of Los Frailes massive sulphide deposit. (Seville) 2016
- Control and interpretation research campaign of Los Frailes and Aznalcollar massive sulphides (Seville). (Cartography, geology, drills, geophysics, geochemistry,...) 2016
- Study of the liquefaction potential for the location of a Combined Cycle plant (Chile). 2016
- Site management for the Apario underground limestone exploitation (Vizcaya). 2010-2015
- Underground exploitation project for the sulphide Mina Magdalena (Huelva). 2015
- Preliminary techno-economic assessment for the iron resources in Grupo Minero San Carlos (Extremadura). 2015
- Geological and mining exploration project for the Súrria-Callús area. Phase I. Seismic campaign. (Barcelona) 2015
- Open pit exploitation project and restoration plan of the Zone 7 uranium deposit (Salamanca). 2015
- Geotechnical assistance for the access ramp development on the Mina Cabanasas potash exploitation. 2012-2015
- Closure and decommissioning project for the Primitiva iron mine (Vizcaya). 2014
- Preliminary study of exploitation alternatives for the Santullán limestone quarry (Cantabria). 2014
- Feasibility study for Torto magnesite mine. (Brazil). 2014
- Exploitation project and modification of the restoration plan for the Morata II Fracción 2ª limestone quarry (Campo Real). 2014
- Conceptual exploitation project of massive sulphide deposit Los Frailes. (Sevilla). 2014
- Geotechnical project of the service drive for Mina Magdalena (Huelva). 2014
- Mathematical simulation model of the underwater flow on the Trillo nuclear power plant site (Guadalajara). 2014
- Waterproofing requirement study for the access ramp to Mina Cabanasas and sustainment requirements modification. 2014
- Open pit exploitation project for the uranium deposit at Alameda (Salamanca). 2013
- Geotechnical and structural evaluation of the old waste dump site on the Arroyo Viñaspre area (Lanciego municipal district). Stability and adjustment procedure preliminary design. 2013
- Work programme for the aggregate waste dump and management center for non-hazardous construction and demolition waste on the Valdeaguiar area on the Oyón-Oion municipal district (Álava). 2013
- Stability analysis of the global slope for the Laminoria silicon sand mine and proposed solutions. 2013

- Project, restoration plan and environmental impact assessment for the Section C resource harnessing project (marble, aggregates and silicon sands) on the mining concession "Las Brañas Ampliación". 2013
- Hydrogeological study for the Alameda exploitation project (Salamanca). 2013
- Exploitation project and restoration plan for the Laminoria silicon sand mine in Arraia-Maetzu. (Álava) 2012
- Preliminary designs for the expansion of the Azkarate open pit magnesite exploitation (Eugui, Navarra). 2012
- Geotechnical characterization of the Retortillo-Santidad uranium deposit (Salamanca). 2012
- Modification of the exploitation project for the Galdames II limestone quarry. (Vizcaya). 2012
- Geotechnical study of the landslide on the southwestern slope on the Las Conchas ophytes exploitation (La Rioja). 2012
- Geotechnical and hydrogeological evaluation of the western pit on the Atauri old quarry and preliminary design of the sequential fill work for the restoration of the excavation inert waste area (earth and rocks). 2012
- General transport ramp project for the Lomero-Poyatos gold mine (Huelva). 2012
- Exploitation project for the Ventalaperra limestone quarry through gallery and raise transport system. 2012
- Conceptual design of an iron underground exploitation on the El Salitre mine (Colombia). 2012
- Resource evaluations, geotechnical studies, underground exploitation designs, cost analysis and feasibility reports for the Azkarate magnesite mine. 2012
- Stability analysis on an area of the copper section of Las Balsas de Riotinto. 2012
- Work management for the sealing and environmental restoration project for the Yecora waste dump (Álava). 2012
- Exploitation project for the La Morena limestone quarry. (Tiebas-Muruarte de Reta, Navarra). 2012
- Resource utilization project of Section C (marble and aggregates) for the "Las Brañas Ampliación" mining concession, Val de San Vicente (Cantabria). 2012
- Exploitation project for the Ventalaperra limestone quarry. (Vizcaya). 2012
- Open pit exploitation project for the Retortillo y Santidad uranium deposit (Salamanca). 2012
- Sustainment structure and fill thickness estimations for the cut-and-cover tunnel of the Alaiz quarry. 2012
- Geological and geotechnical core sampling of the north zone drill holes on the David y Sur de Herbeira dunite mine. 2012
- Hydrogeological study of the Mina Cabanasas ramp. (Barcelona). 2012
- Hydrogeological study for the underground exploitation project of the Azkarate magnesite deposit (Eugui, Navarra). 2012
- Hydrogeological study for the exploitation project of the La Morena quarry (Tiebas-Muruarte de Reta, Navarra). 2012
- Hydrogeological evaluation of the western pit of the Atauri old quarry. (Álava). 2012
- Hydrogeological study for the exploitation project of the Ventalaperra quarry (Vizcaya). 2012
- Hydrogeological study for the exploitation project of the Laminoria mine. (Álava). 2012



CRS INGENIERÍA

C/ Raimundo Fernández Villaverde 53, 1º izq. 28003 Madrid (Spain)

Tel: (+34) 91 535 61 72 / (+34) 91 534 91 83

Fax: (+34) 91 534 91 83

www.crsingenieria.com

crs@crsingenieria.es



ER-0240/2013

GA-2013/0102