Centre for Advanced Studies
in Mineral Resources

CESMAT

AREVA Group

"Cooperation with emerging countries in advanced mining training programmes involving an industrial partner"

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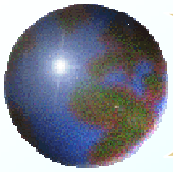

Groupe des Ecoles des Mines :
A French network of excellence

Graduate Schools of Engineering In France

GEM overview

GEM is a **unique network** of
7 national Engineering Graduate Schools
located throughout France.

These Graduates schools of Engineering
are dedicated to Science,
Engineering and Technology

7 campuses

ECOLE DES MINES DE PARIS

Ecole d'Ingénieurs
Centre de Recherche
Mines de Douai

ECOLE DES MINES DE NANTES

ECOLE DES MINES D'ALBI CARMAUX

Ecole Nationale Supérieure des Mines SAINT-ETIENNE

ÉCOLEDESMINESD'ALÈS
ALÈS·NÎMES·PAU

Engineering in France

Engineering is taught in French Institutes for Engineering, called **« Grandes Ecoles »**.

Education in these Institutes is a blend of :

- **Broad-based studies in sciences**
- **Engineering**
- **Management**
- **Social sciences**

GEM in figures

- About 6000 students (including 1000 PhD students)
- 1000 "Ingénieur" Graduates / year
- 16% applicants from abroad all fields of study combined
- More than 40 nationalities in GEM
- 220 academic partnerships, 350 agreements
- 15% graduates find their 1st job abroad
- 1000 permanent faculty members

Research : a major asset

- 43 research centers
- more than 200 PhD / year
- 2000 publications/year
- 44 M€ turnover of industrial research contracts/year

- ✓ *Specific and high-tech fields*
- ✓ *High proportion of contractual research*
- ✓ *Strong teaching/research interaction*

GEM Degrees

- **Master of Science degree ("diplôme d'ingénieur") :** 5 years

Engineering diploma course

- **Master of Science (MSc)** : prerequisite for PhD studies
- **International Master of Science and Technology (MSc and MEng)**

PhD : 3 years

★★★

- **A post-Master program ("Mastères specialises"):**

As CESMAT

Centre for Advanced Studies in Mineral Resources

Within international cooperation: 33 years of experience in the training of upper management personnel working in mining

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CESMAT

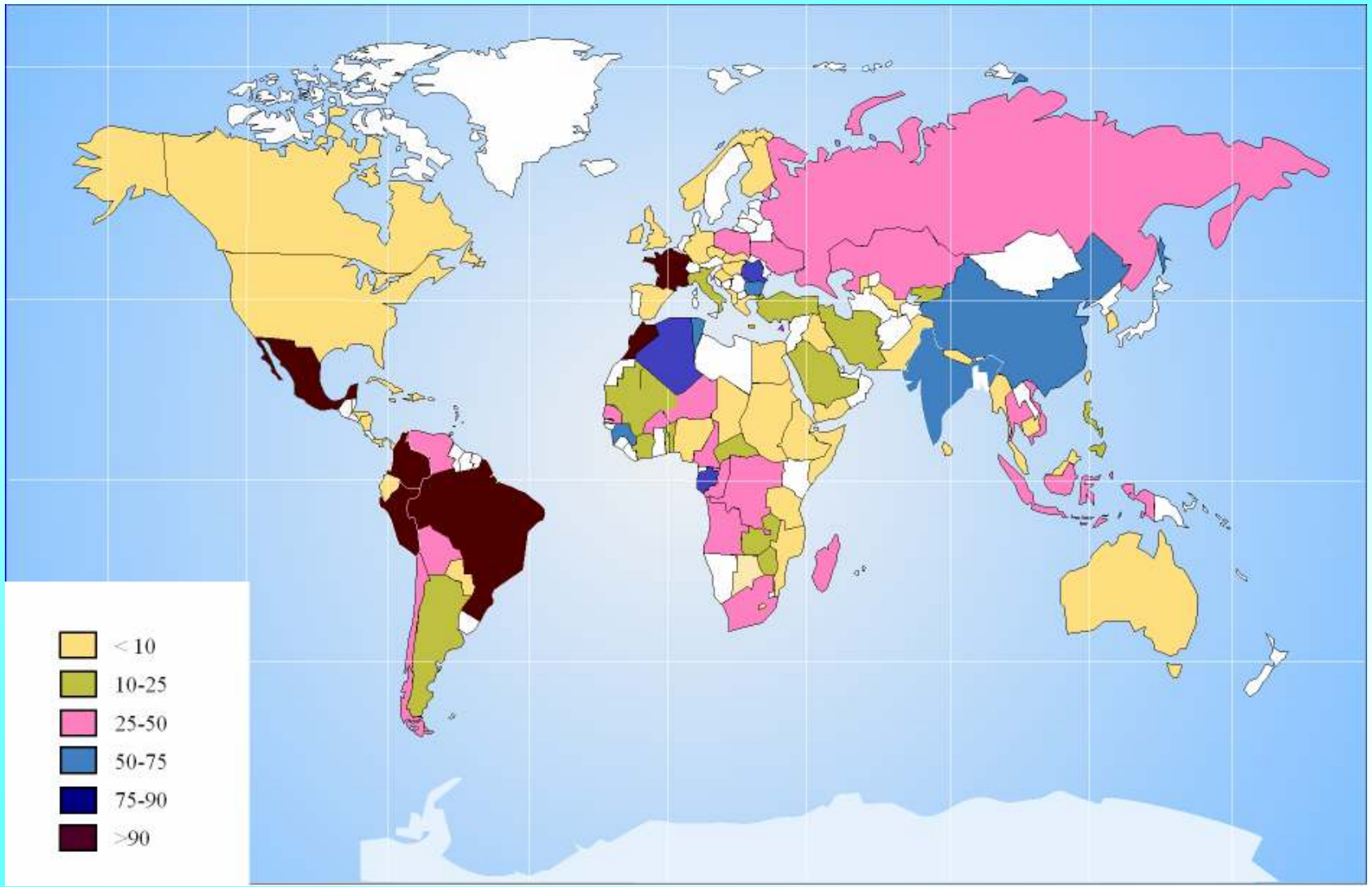
- **Advanced studies institution for upper management personnel working in mining industry**
- **Created in 1975 by the French Ministry of Industry**
  - **to promote exchanges amongst the various sectors of technical mining expertise**
  - **to establish a network of relations with the mineral producing countries all around the world**

  through training and technical cooperation

- **Seven "9 months" training programmes**
- **Profile of the trainees: Mine engineers, geologists, or managers involved in mining industry with several years of professional experience, or selected students**

CESMAT and INTERNATIONAL COOPERATION

1975 ⇨ 2008 : 2308 trainees from 109 countries

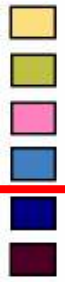


FORMER TRAINEES
AFRICA

MOROCCO	99	Ministry of Geology & Mines - ONA (7)
ALGERIA	81	ORGM (10)
GUINEA	71	Ministry of Natural Resources (19) Mining Bauxite Companies (13)
GABON	70	Ministry of Mines (20)
TUNISIA	55	CPG (6) – Ministry of Mines & Quarries (7)
BURKINA FASO	49	Ministry of Mines (9) - BUMIGEB (10)
MADAGASCAR	39	OMNIS (7) - Ministry Energy & Mines (7)
NIGER	38	Ministry of Mines (13) – AREVA Niger (7) SOMAIR (5) – COMINAK (3)
R.D. CONGO	33	GECAMINES (11)
SOUTH AFRICA	31	Dept of Mineral Affairs (12) - De Beers (6)
SÉNÉGAL	31	Various companies
CONGO	28	Ministry of Mines (8)
.....		
TOTAL	869/2308 (38%)	

FORMER TRAINEES AMERICA

BRAZIL	225	CVRD (27) National Dept of Mining Production (24)
PERU	111	CENTROMIN (11)
COLOMBIA	102	INGEOMINAS (10)
MEXICO	98	Various companies
VENEZUELA	42	CVG (12)
CHILE	42	CODELCO (15)
BOLIVIA	33	COMIBOL (12)
ARGENTINA	21	Various companies
EQUADOR	8	Various companies
.....		
TOTAL	705/2308 (30%)	



FORMER TRAINEES
ASIA - OCEANIA

INDIA	52	Coal India Ltd (5), Hindustan Copper Ltd (5), IBM (10)
CHINA	46	Various ministries and public organizations
INDONESIA	32	Dept of Geology & Mineral Resources (13)
KAZAKHSTAN	29	KATCO (8), KazNTU (7), Bogatyr Access Komyr (2)
VIETNAM	28	Vinacoal (4), Ministry of Mines
SAUDI ARABIA	23	MAADEN (12), Saudi Geological Survey (7) Ministry of Mineral Resources (5)
THAILAND	20	Dept Mineral Resources (7), EGAT (3), BANPU (3)
TURKEY	14	Cukurova University (7)
IRAN	12	Various companies
PHILIPPINES	12	Mines & Geosciences Bureau (3)
AUSTRALIA	8	Various companies
KIRGHIZSTAN	6	Various public organizations
KOREA	6	Korean Institute of Geology, Mining & Materials (4)
.....		
TOTAL	315/2308 (14%)	

FORMER TRAINEES
EUROPE

FRANCE	**135**	**Various**
ROUMANIA	**69**	**Technical University of Petrosani (21)**
POLAND	**43**	**Central Mining Institute Katowice (6)**
RUSSIA	**35**	**Mining Institute of de St Petersburg (9)**
BULGARIA	**27**	**University Mines & Geology of Sofia (8)**
UKRAINE	**19**	**Technical University of Krivoi Rog (13)**
ALBANIE	**12**	**Various**
ITALIE	**11**	**Various**
HUNGARY	**10**	**Various**

TOTAL **411/2325 (%)**

THE SEVEN TRAINING PROGRAMMES

CESECO (F/GB)
Open cast mining
École des Mines de Paris
Fontainebleau Site

CESPROMIN (F/GB)
Economic analysis of mining projects
École des Mines de Paris
Fontainebleau Site

CFSG (F/GB)
Geostatistical evaluation of ore deposit
École des Mines de Paris
Fontainebleau Site

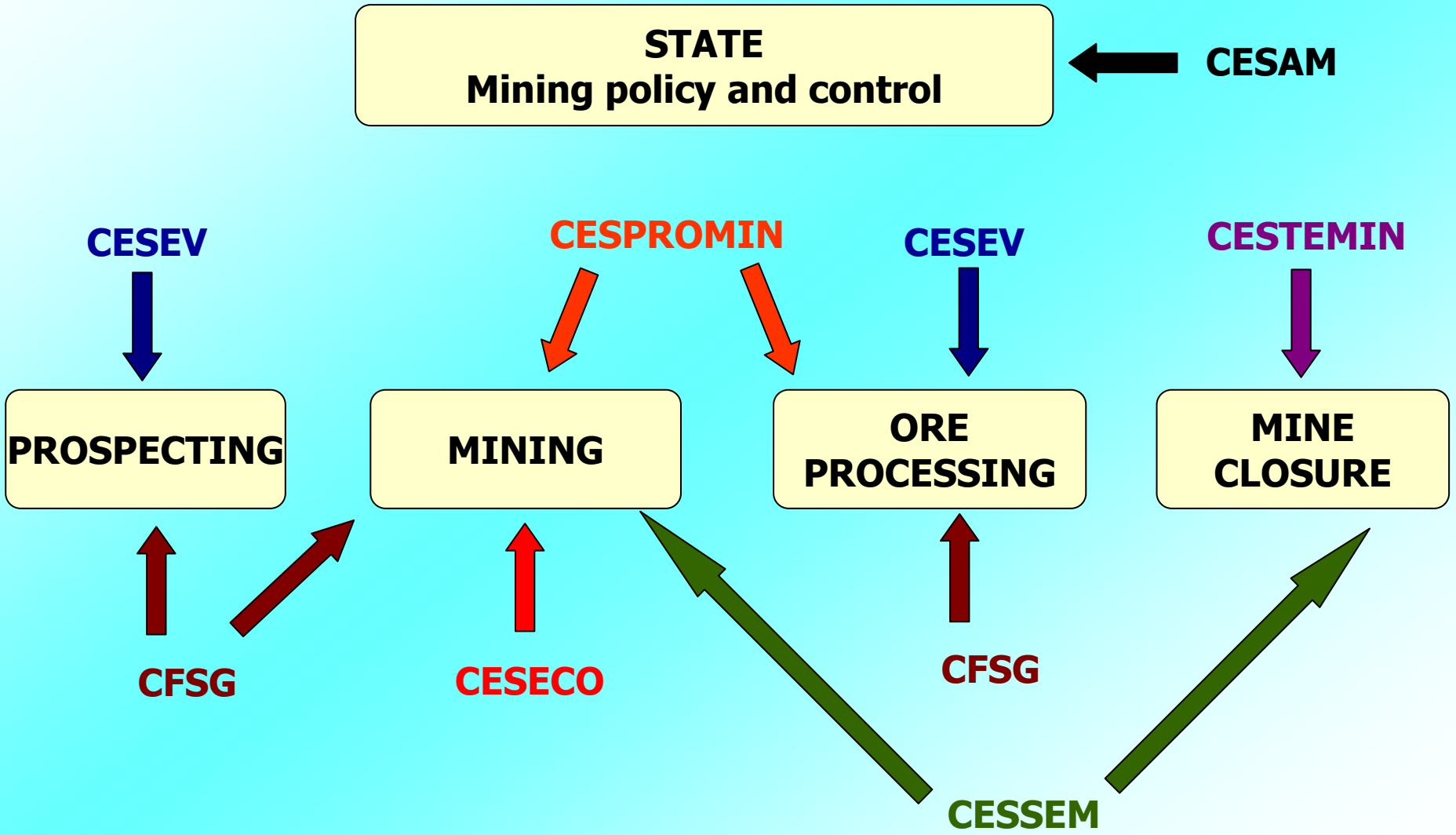
CESAM (F)
Public Administration of Mines
École des Mines de Paris
Fontainebleau Site

CESEV (F)
Ore prospecting and mineral processing
École de Géologie de Nancy

CESTEMIN (F)
Treatment of Industrial Evolution and Changes
École des Mines de Nancy

CESSEM (F)
Safety & mining Environment
École des Mines d'Alès

CESMAT programmes & Mining activities



GENERAL ORGANIZATION

Training duration: 9 months from October to June (except CESAM, 6 months from January to June)

- 6 months (October to March) :
  - Theoretical and practical lectures,
  - Technical conferences,
  - Mine site visits,

  Generally organized in separate modules

GENERAL ORGANIZATION

Training duration : 9 months from October to June
(except CESAM, 6 months from January to June)

- **6 months (October to March)** : theoretical and practical lectures, technical conferences and mine site visits

- **3 months (April to June)** : personal application work on a technical subject defined by the trainee and his/her company according to their professional needs

SPECIFICITIES OF CESMAT PROGRAMMES

- **Small groups : 10-12 trainees**
  - Tailored training
  - High supervision

- **International groups with trainees coming from several countries**
  - International experience
  - Technical and cultural exchanges between trainees

Total number of CESMAT trainees 2008-2009:

86 trainees from 26 countries

SPECIFICITIES OF CESMAT PROGRAMMES

- Management of the training programs given to research centres used to develop research contracts with the Mining Industry
- Original educational methods based on exchanges of experiences between professionals
- Training program including a personal application work selected by the trainee and his company, and directly oriented to their technical and professional matters of interest
- Training organized in modules open to continuing education and allowing possibilities of shorter training programs
- Tuition fees (15 000 €) completely covered by the French Ministry of Industry

The only one professional training program of its kind in the world

CESEV

EXPLORATION OF MINERAL RESOURCES AND ORE PROCESSING

Nancy – French session– Optional Training in French language between July and September

TRAINEE PROFILE

- **Geologists or engineers with four to ten years experience in industrial operations in the areas of prospecting, mining geology or ore processing**

MAIN PROGRAMME ITEMS

- **General course (183 h) :** *Economy and Management of Mineral Resources, mining economics, Invitations to tender, Management of companies, Economic analysis of mining projects. Feasibility studies, Analysis of mineral reserves , Mining methods, Mining Environment, Legislation-Taxes***.**
- **Specialized course (225 h) :** *Metallurgy, Geostatistics, Industrial Sampling, Characterization of ores and industrial minerals, Basic metallogeny, Applied Geophysics, Applied Geochemistry, Technical visits.*
- **Technical projects in mining exploration and mining geology (58h):** *General technology in ore prospecting and ore characterization*
- **Technical projects in ore processing and industrial recycling (102 h) :** *Technology and optimization of processes, Production balance, Metallurgy applied to recycling and environmental problems*
- **Technical industrial visits (10 days)**

EXAMPLES OF PERSONAL APPLICATION WORKS

- **SOW Elhadj Alimou - GUINEA - 2008 : Control and validation of drilling data if Bakouma unranium deposit in Republic of Centra Africa**
- **NEMARO Tuouhiré Henri Rudolf - BURKINA FASO – 2004: Smelter sands : recovery of chromite and use in road basements**

CFSG

GEOSTATISTICAL EVALUATION OF ORE DEPOSITS

Fontainebleau – French/English session
Optional Training in French language between July and September

TRAINEE PROFILE

- **Mine engineers, geologists, reservoir engineers, geophysicists, preferably with some professional experience and a sufficient mathematical background**

MAIN PROGRAMME ITEMS

- **Spatial distribution of one or several variables within the ore deposit**
- **Optimization of the drilling pattern, calculation of recoverable reserves**
- **Simulation of one or several variables of the ore deposit**

EXAMPLES OF PERSONAL APPLICATION WORKS

- **GRALA ROLDÃO Débora - BRAZIL – 2007: Simulation of an Iron Deposit of the Vale South System (Brazil).**
- **DIAS OROS Cristian Antonio - CHILI - 2006 : Estimation of Molybdenum on the Sur-Sur Tourmaline Breccia - Rio Blanco Cu-Mo Deposit, Chile**

CESECO

OPEN PIT MINING AND QUARRYING

Fontainebleau – French/English session

Optional Training of French language between July and September

TRAINEE PROFILE

- **Mining engineers, geologists or civil engineers, preferably with some professional experience**

MAIN PROGRAMME ITEMS

- **Module 1: Reviewing of Basic knowledge:** *Engineering geology, Statistics, Underground water, soil and rock mass characterisation and mechanical behaviour*
- **Module 2: Deposit modelling and Mine project:** *Resources management, Geological modelling of deposits, geostatistics and resource assessment, open pit optimization, sampling and reconciliation*
- **Module 3: Mine project design and mining operations:** *Different stages of the mining projects, economics of mining operations and companies, Open pit mining methods and equipment*
- **Module 4: Technical aspects in mining operations:** *Rock mass blasting, slope stability, environment and security in open pit mines*
- **Module 5: Technical visits of open pit mines and quarries in France and abroad**

EXAMPLES OF PERSONAL APPLICATION WORKS

- **BOUBACAR KINASSA Mamane- NIGER – 2007 (in French) : Mining project of Tamou pit extensions: optimization of the ultimate pit and mining methods (SOMAIR, Niger).**
- **ZEGARRA Nicolas, PERU & SOKERAN Yevgueny, KAZKHSTAN, 2006 (in French) : Geotechnical study of the Imouraren uranium ore deposit and design of the final pit slopes (AREVA, Niger).**

CESPROMIN

ECONOMIC ANALYSIS OF MINING PROJECTS

Fontainebleau – French/English session
Optional intensive Training in French between July and September

TRAINEE PROFILE

- **Engineers, geologists and managers working in or for the mining industry**

MAIN PROGRAMME ITEMS

- **Module 1 : Mining techniques (3 weeks)**
- **Module 2 : Evaluation methods of mineral reserves (2 weeks)**
- **Module 3 : Management of a mining company (3 weeks)**
- **Module 4 : Mine planning (1 week)**
- **Module 5 : The environment of Mining operations (2 weeks)**
- **Module 6 : Computer assisted exploration workshop CLAIM (4 weeks)**
- **Module 7 : Technical study of a mining project: courses and practical exercises (2 weeks)**
- **Module 8 : Financing and implementation of mining projects (2 weeks)**
- **Module 9 : Economic study of a mining project : courses and practical exercises (3 weeks)**
- **Visits to mines and to manufacturers of mining equipment (3 x 1 week)**

EXAMPLES OF PERSONAL APPLICATION WORKS

- **SAHASRABUSHIE Mohan – INDIA – 2003: Prefeasibility study for underground mining at Bangur Chromite mine.**

- **AL-GHAMDI Ameen - SAUDI ARABIA – 2006: Updated feasibility study report of Az Zabirah bauxite mine.**

CESSEM

MINE SAFETY AND ENVIRONMENT

Alès – French session– Optional Training in French language between July and September

TRAINEE PROFILE

- **Experienced engineers or geologists or members of management staff coming from extractive industries, or control and consulting organizations for this industry**

MAIN PROGRAMME ITEMS

1. **Environmental studies**: *biosciences, extractive minerallurgy, meteorology*
2. **Security: safety in mines and quarries**: *ISO 18001, anticipation of risks, toxicology of mining industry*
3. **Dams**: *soil mechanics, calculation of flooding, tailing dams, geotechnics*
4. Environmental chemistry: *sampling of polluted sites, metrology of the environment*
5. **Removing pollutants from water**: *mass transfer in a porous and fractured milieu, cleaning up sites …*
6. **Reclamation**: *stocks of mine tailings, decommissioning and decontamination of dangerous industrial sites, environment – landscaping, replanting concepts and strategies*
7. **Sound and vibratory pollution**: *noise and acoustic pollution, means of reducing noise levels, explosives: use, limits: method of calculation, extracting in open and / or underground mines*
8. **Laws and impact studies**: *environmental management in mines, legislation of impact studies, French procedures of impact studies, ISO 14000, ISO 9000*
9. **Stability of mine works**: *landslides, working methods for underground mines*

Visits to industrial and mining installations and to rehabilitation sites (16 days)

EXAMPLES OF PERSONAL APPLICATION WORKS

- **CONCEPCION GAMARRA Jorge – PERU - 2003: Safety plan for the cement company *Cementos Andinos***
- **MATTHEE Deon Conrad - SOUTH AFRICA – 1999: Major waste dam accidents throughout the world, bibliographic review and research for causes. Perspective for the future"**

CESTEMIN

TREATMENT OF INDUSTRIAL EVOLUTIONS AND CHANGES

Nancy – French session– Optional Training in French between July and September

TRAINEE PROFILE

- **Mine engineers or geologists with at least four years of professional experience in companies, government or institutions of higher education**

MAIN PROGRAMME ITEMS

- **Module 1 - Modernization of mining companies (7 weeks):** *technical, economic and social aspects*
- **Module 2 - Restructuring of mining companies (5 weeks):** *Mining resources and operation, mining and environment, security, finance, management of the human resource*
- **Module 3 - Rehabilitation of mineral basins (7 weeks)**: *regional aspects and sustainable development*
- **Technical visits (3 weeks)**

EXAMPLES OF PERSONAL APPLICATION WORKS

- **KARAS Agnieszka – POLAND - 2003: Preparatory works for the project regarding the support of creation of a science and technology park in Lublin.**
- **Nabil BOUBEHIRA – Algeria – 2002: The stages for the restructuring of mining industry in Algeria and the main phases of redevelopment.**

CESAM

PUBLIC ADMINISTRATION OF MINERAL RESOURCES

Fontainebleau – only French session – Optional courses in French language from October to December

TRAINEE PROFILE

- **Higher officials of the public administration of mines (mining engineer, geologist or also jurist)**

MAIN PROGRAMME ITEMS

- **The fundamentals : basic concepts of mining industry (1 week)**
- **Module 1: Management and development of mineral resources (5 weeks) :** *definition of the State's role, mining laws, strategy of managing and development of mineral resources (industrial mining and small scale mining), mining contracts (negotiation, redaction and legal aspects)*
- **Module 2: Safety et environment during the mining activity (4 weeks) :** *Overview of safety and health problems, technical inspection of safety, environment in the mining project, enforcement of safety control from Administration*
- **Module 3: Closure and restoration of mining sites (1 week) + Visits of mining sites and state agencies (1 week)**
- **Module 4: Mineral resources and economical development (5 weeks) :** *economy of the mining industry, accounting, financing of the mining industry, sharing of the mining wealth, fiscal regimes of the mining industry*

EXAMPLES OF PERSONAL APPLICATION WORKS

- **NDIZEYE Augustin -BURUNDI – 2008:** The artisanal mining in Burundi : suggestions for its restructuration.
- **PROMSORN Krit - THAILAND – 2007:** Proposals to improve the management of gypsum resources in Thailand.

Recruitment of trainees

TRAINEE PROFILE

- **Minimum level required : holder of BSc/BEng Degree , or at least 2 to 5 year industrial experience.**

RECRUITMENT PROCESS

- **Nomination /appointment of applicants by local companies, authorities and institutions regarding country needs,**
- **Test and interview during a session organised in partnership with local authorities.**
- **Final selection made by a jury and CESMAT training mangers.**

SCHOLARSHIPS

- **Scholarships are also available from French organizations, sources in the student's country of origin, or international organizations such as the EU, UNESCO, UNPD and others,**
- **CESMAT has also built partnerships with mining companies (VALE in Brazil, CODELCO in Chili and AREVA in France, …) which contribute to sponsor trainees for living cost during their studies in France.**

INTERNATIONAL COOPERATION AND TRAINING

Jean-louis PETITCLERC AREVA NC BU Mines

- **1) For Government institutions of emerging countries**

- **2) For Employees of Areva abroad through AREVA Mining College**

COOPERATION WITH EMERGING COUNTRIES
for Governement institutions

AREVA is developing uranium exploration and mining in many countries and has signed cooperation agreement with the government of these countries to provide them technical and financial support for capacity building in partnership with the French school of mines (GEM/EMA and CESMAT)

AREVA has signed agreements with local government in order to promote education and improve capacity building in emerging countries

AREVA will in connection with CESMAT propose a personnel project dedicated to Uranium. The trainee will also learn French 3 months prior starting at GEM/CESMAT

AREVA will sponsor trainees for travel and living cost during their studies in France for one or two years.

If already employed the trainee at the end return to his institution. Local authorities have a priority to offer a job to young graduates. If the candidate do not receive a proposal, AREVA will do his best to offer then a work locally

COOPERATION WITH EMERGING COUNTRIES
for Governement institutions

Other existing or future possible area of cooperation :

- **Visit of delegation to Areva**
- **Exchange program in education and research**
- **Development of a Master degree in the local university**
- **Recruitment in MEng / MSc (2 years training)**
- **Upgrading local laboratory in order to fulfil with level needed for setting up the Master degree**

COOPERATION WITH EMERGING COUNTRIES
CESMAT/GEM Number of trainees

Activity	2008-2009	2009-2010	Total
Namibia	6	13	19
South Africa	2	2	4
Mongolia	2	0	2
Gabon	0	3	3
Republic of Central Africa	0	4	4
Senegal	0	3	3
Total	10	25	35

Total investment represent 1Million Euros in 2 years 50% French governement 50% Areva

TRAINING FOR AREVA EMPLOYEES
Why a Mining College?

- Pesent boom and growth
  - Development of exploration properties and acquisitions
  - New mining projects (Niger, Namibia, South Africa, Canada, Kazakhstan…)
  - Increase capabilities in present operating sites (Katco, Somair)
- Large deficit in required human resources
  - Recruitment is active and ongoing (666 in 2006,1,000 in 2007 of which 200 engineers and managers) many of them are at junior levels.
- Lagging interest in mining related courses in universities resulting in less graduates

TRAINING FOR AREVA EMPLOYEES
Mining College : How does it work ?

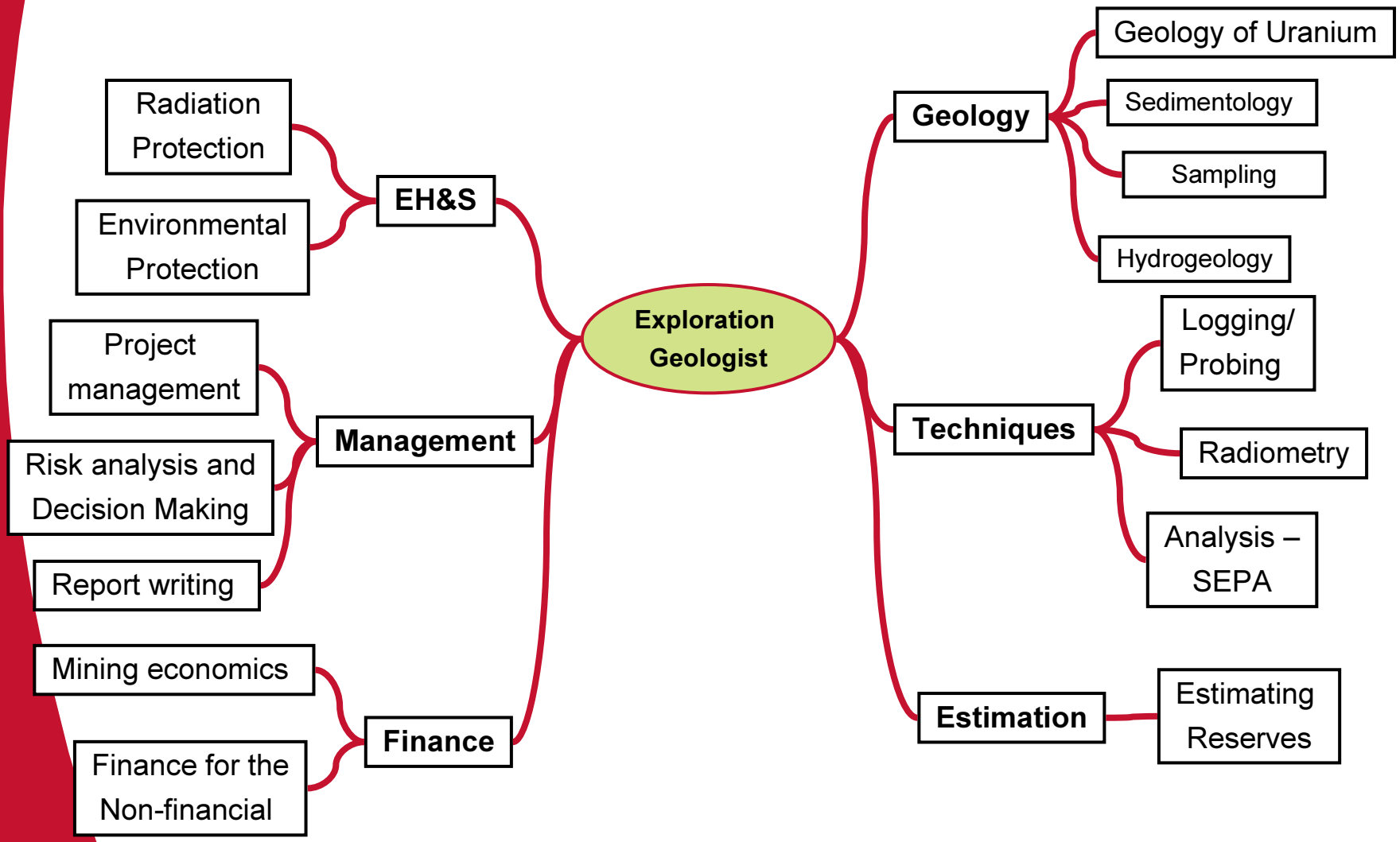
Through a curriculum of professionnal training modules and work exposure

- Each curriculum consists of :
  - Training modules specific to various pertinent business activities – technical subjects (geology of uranium, sampling, mining techniques, mineralogy…)
  - In-the-field internships/visits on various sites
  - Generic topics (occupational safety, environment, management, etc.)
- The modules are taught by:
  - Internal experts – both active and retired AREVA employees
  - External experts from prestigious engineering schools (GEM School of mines). Active and retired university professors, consultants…)
- *The curriculum runs over a three-year period*

TRAINING FOR AREVA EMPLOYEES
Curriculum : Which one?

- **Exploration Geologist**
- **Mine Geologist (geological control)**
- **Mine Engineer**
- **Ore Processing**
- **Mill Maintenance**
- **Mine Maintenance**

TRAINING FOR AREVA EMPLOYEES
Exploration Geologist



TRAINING FOR AREVA AND EMPLOYEES
Rules and financing

Registration

- <3 years experience <30 yrs old
- Some obligatory modules but also a choice of modules in line with job profile (Manager, participant, Mining College staff)
- Distribution of schedule of sessions

Financing

- All costs borne by the Mining BU (800 KEur in 2008)
- Air travel (economy class)
- Once registered curriculum and attendance are obligatory

TRAINING FOR AREVA EMPLOYEES
2009 Mining College participants

Exploration Geologists	103
Mine geologists	16
Mining Engineers	30
Ore Processing	23
Maintenance	12
Specialized curriculum*	08
TOTAL	**192**

* For Industrial Engineers, Mechanical Engineers…

Participants by Countries and activity - May 2009

Activity	Canada	Cent Asia	Australia	Jordan	Areva RSA	Niger	France	Total
Exploration	19	17	2	4	32	16	13	103
Mine geol.	5	3			1	3	4	16
Mine eng.	5				2	14	9	30
Ore proce.	3	3				6	11	23
Mtce		3				8	1	12
Customized							8	8
Total	32	26	2	4	35	47	46	192

Conclusions

- The Cooperation between GEM/CESMAT and AREVA with governements promote high level education and capacity building wich is necessary for both local institutions and Areva locally

- Positive aspects of creation of a network in order to share experience

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