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OVERVIEW OF MINING RESEARCH LABORATORIES' ACTIVITIES

(Text for a video film)

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Canadian Mine Technology Laboratory

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ABSTRACT

The following text has been prepared for use as the audio portion of a video film presentation on the Mining Research Laboratories. The first use of the presentation will be at CANMET's Val d'Or seminar, February 24 and 25^{th}, 1988. The presentation is primarily concerned with MRL's activities related to mining but not exclusively. A major part of the text has been directly extracted from CANMET publications on the subjects concerned, although, some of the sequences required additional text to be written.

Most of the sequences were filmed in the last few months with their use at the Val d'Or seminar in mind. The presentation will provide means to familiarize attendees with MRL's specialized facilities and with the work of researchers who will not attend the Val d'Or seminar.

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Key words: CANMET/MRL, R&D, mining developement, explosive atmospheres, explosives, rock mechanic, reserves estimation, mining equipment, mining methods, federal-provincial agreements, collaboration with the industry.

TOUR D'HORIZON DES ACTIVITÉS DES LABORATOIRES DE RECHERCHE MINIÈRE

(Narration du film vidéo)

par

A. Boyer * et P. Lacourse **

RÉSUMÉ

Le texte suivant fera partie de l'édition du film vidéo qui sera présenté lors du séminar du CANMET à Val d'Or, les 24 et 25 février 1988. Le sujet se limite aux activités des Laboratoires de recherche minière et principalement à celles qui touchent directement l'industrie minière. Une bonne partie du texte est extrait de publications récentes du CANMET concernant les sujets en question et déjà en circulation dans le public. L'autre partie du texte a été préparé par les chercheurs impliqués dans certaines séquences vidéo.

La plupart des séquences vidéo ont été filmées au cours des derniers mois en vue du séminar de Val d'Or. La production de ce film a un double but de complémentarité. Premièrement, présenter des essais de laboratoires qui demandent des installations spéciales et donc difficiles à reproduire ailleurs qu'en laboratoire; et deuxièmement de présenter les travaux des chercheurs qui ne pourront être présents au séminaire.

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Mots clés: CANMET/LRM, R & D, exploitation minière, atmosphères explosives, explosifs, mécanique des roches, détermination des réserves, équipement minier, méthodes minières, ententes fédérales-provinciales, collaboration avec l'industrie.

SCENARIO

1: Subject of film
2: Organization of Mining Research Laboratories (MRL)
3: Structure of MRLs
4: MRLs in the Bells Corners CANMET complex

5: Building 9, the Canadian Explosive Atmospheres Research Laboratory
5a: Tests on mixtures of explosive gases
5b: Inflammability tests on mining equipment
5c: Other tests
5d: Research to improve the quality of underground air
5e: The use of ceramic filters on diesel engines

6: Building 10, the administrative centre of the Canadian Mine Technology Laboratory
6a: Ground control instrumentation
6b: Numerical modeling
6c: Characterization of the rock mass
6d: Characterization of samples and view of installations
6e: Mining method and equipment
6f: Minability, economic criteria for mining operations and reserves estimation
6g: Technological coordination

7: Canadian Explosives Research Laboratory
7a: Detachment of three cones from a bit using a blasting system

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8: Elliot Lake laboratory
8a: Exterior view of the building
8b: Rock mechanics installations
8c: Exterior and interior microseismic installations
8d: Environment and mining residues (Nordic mine)
8e: Environment and evaluation of the quality and quantity of breathable dust
8f: Air quality measuring system, taking into account the ventilation system

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9: Federal-provincial agreements on mineral development

10: Conclusion

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NARRATION

1: CANMET. The Canada Centre for Mineral and Energy Technology of Energy, Mines and Resources Canada presents an overview of Mining Research Laboratories' activities. V,MSL

2: CANMET comprises five research divisions:
Physical Metallurgy Research Laboratories,
Mineral Sciences Laboratories,
Energy Research Laboratories,
Coal Research Laboratories, and
Mining Research Laboratories, which include:

3: the Canadian Explosives Research Laboratory,
the Canadian Explosive Atmospheres Research Laboratory,
the Elliot Lake laboratory,
the Sudbury laboratory, and
the Canadian Mine Technology Laboratory. D2

4: For safety reasons, a number of CANMET laboratories are located away from residential areas, in Bells Corners in suburban Ottawa. Some of the MRLs are found there. V9,1m12

5: This is the case, in particular, of the Explosive Atmospheres Laboratory, responsible for certifying equipment destined for use in Canadian underground mines (Building No. 9). V9,14m06

5a: To avoid accidents such as methane explosions, tests are conducted on mixtures of gases. V5,42-52

This type of testing is carried out on various mixtures of gases to determine the probability of their exploding. V3,2m10

5b: One of the laboratory's main activities is certifying the inflammability of equipment for use underground.

Inflammability tests on conveyor belts are very important in terms of mine safety. Mention should be made of the incident which led to the closing of Gaspé Copper in Murdochville. V6,296

The time required to extinguish material is measured once the source of heat is withdrawn. V6,394

The condition of the belt is examined after the test. V6,460

It is important to verify at regular intervals whether the manufacturer is maintaining the quality of his products.

To reduce the cost of repetitive tests on the same product, the laborary has developed the standard oxygen test as a quality control test to replace propane gallery tests, which are too expensive. The flame measured makes it possible to assess the fire-resistance of the belt. V10,7m15

5c: Among other less important tests, the shock-resistance test for miners' lamps makes it possible to prevent possible sources of explosions, particularly in underground coal mines. V5,105

5d: The laboratory also develops quality standards governing underground air, with special emphasis on controlling diesel emissions. Here, a diesel engine is being tested in a control room, where various factors related to emissions are measured. V10,2m23

5e: One of the main trends in current research centres on the development of adaptable ceramic filters for diesel vehicles. Their efficiency can be observed by placing paper filters over the inlet and outlet of the ceramic filter. These tests have shown that the use of ceramic

filters reduces by at least half the soot breathed by miners. V10,4m33

6: Building 10 of the Bells Corners complex houses the administration of the MRLs and the Canadian Mine Technology Laboratory. Research carried on there focuses on rock mechanics, numerical modeling, underground nuclear waste disposal, the development of instrumentation, ore reserves estimation and mining technology. V9,2m28

6a: In rock mechanics, monitoring around the walls and ceilings of underground excavations is progressing, with a view to confirming the validity of input parameters and the accuracy of stability analyses. This section of the MRLs has, over the years, developed several procedures and instrumentations for studying ground stress. V8,23m25

Since the end of the 1960s, considerable effort has been devoted at the MRLs to the development of instruments and new procedures. Nonetheless, such work is onerous and demands careful planning and preparation to ensure the success of each project. V8,12m44

When a rock sample is removed by drilling, it springs back to its normal shape once freed from stress. The precise, accurate measurement of these tiny deformations is one of the main tasks in rock mechancis. Measurements of the stress of rock masses are computerized on the spot, which makes it possible to immediately analyse data. Calculations of stress are effected using measurements of recovery from deformation. This graph shows the ratio between maximum horizontal and vertical stress, according to depth. V8,23m10

"The MRL deformation monitoring system" employs the principle of highly stable, sensitive vibrating wires to monitor deformations in drilling holes with a relatively large diameter, that is, between 10 cm and 15 cm. This unit includes a calibrated ring through which the vibrating wire passes.

V8,18m09

The ring is installed using a hydraulic jack and is brought into contact with the surrounding rock using precisely tooled and guided wedges. V8,23m45

The system is being tested in collaboration with the Centre de recherches minérales du Québec and the Niobec mine.

To better adjust drilling holes to the needs of rock mechanics, a portable television camera already used for inspection in the nuclear industry has been modified. As the camera slides into a hole 38 mm in diameter, it is easy to drill an observation hole in the ceiling or the wall. The camera has proved to be very useful for locating sites for installing monitoring equipment in drilling holes, in order to establish anchoring points for extensometers, piezometers and dilatometers. V8,20m44

6b: Increasingly, underground mining is carried on under considerable stress. In light of such conditions, during designing, account must be taken of the stress and deformation properties of the rock mass. In deep mines, rock mechanics research is essential, especially in the field of the development of numerical models. This involves better definition of the limitations and efficiency of current support systems and the, development of new methods of ground support. V8,23m58

The prediction and evaluation of the reaction of the rock mass during mining is becoming increasingly important in mining planning. Numerical modeling is proving to be a highly useful simulation tool. Mathematical models are used to simulate stress conditions in the rock mass. Special cases are now under study at the Niobec and Selbaie mines. V8,9m00

6c: Characterization of the rock mass is another activity carried on by the laboratory. A user's manual on surface crown pillars, including a guide to design procedures, is currently being prepared to ensure safe, economical design. In addition to outlining applicable concepts and existing techniques, the manual will many new developments in research applied to various facets of these mining structures. D3

6d: Installations for measuring the characterization of rock samples are very modern, especially since the acquisition of a 500-ton MTS press connected to a computer system. Here, a uniaxial test on a core drilling sample is being carried out. V8,3m53

Samples are prepared in an adjacent room. V8,4m30

6e: In the realm of mining methods and equipment, as a result of an agreement with a mining contractor, a manual has been prepared for the public on the pre-production and operating costs of small underground mines. The work was undertaken specifically to facilitate the task of small mining companies or prospectors in the evaluation of the economic viability of promising deposits. V8,21m05

6f: Other work focuses on minability and economic criteria for mining operations which are developed

and evaluated for hard-rock mines in Canada. Annual studies are conducted to establish the capacity and production costs of Canadian uranium mines. These studies provide background information for the preparation of the ore reserve evaluation group's annual report.

The CADD/GEM system is a series of software packages developed by the ore reserve estimation group, called ORAG. The system makes it possible to estimate reserves or to handle thousands of drilling data from numerous deposits. The programs are used by similar services around the world, and by other private-sector users. V8,0m00

Another important ORAG software package allows quick, interactive entry of drilling data supplied by mining companies.

6g: In the field of Canadian technological coordination, work is under way to develop and update a data bank on current or future technologies in the Canadian mining industry or other related agencies. The ultimte goal is to promote cooperation and effiency in research, at the lowest cost. V8,22m37

7: The Canadian Explosives Research Laboratory is primarily responsible for testing commercial explosives and cannon powder and gunpowder. It provides technical advice on the manufacture, storage and transportation of explosives, and investigates accidents in the sector. In addition to these activities, the laboratory is involved in a number of research contracts on blasting methods. A recent project centres on the vertical crater retreat method using large-diameter holes (Building No. 12). V9,13m11

7a: In collaboration with the Geological Survey of Canada, the laboratory is developing an on-site measurement technique for

underground water, by lowering a piezometer inside a drilling shaft, to eliminate the normal waiting time rquired to withdraw the shafts from the bit before lowering the piezometer. V10,7m45

The charge is placed in a tube, which is lowered in the drilling shaft where the bit is located. V10,9m16

The equipment is put in a sand-filled container to simulate conditions in a drilling hole. The results are positive; the explosion of the charge made it possible to detach the cones without damaging the rest of the bit. V10,10m21

V10,9m00

8: A fourth laboratory is located at Elliot Lake, which is also the site of several uranium deposits. Laboratory staff are assigned to field work in rock mechanics and to studying radiation, ventilation, dust, mining residues and fill. V3,26m50

8a: The new laboratory was officially inaugurated in 1986. V3,16m05

8b: A 2000-ton press is used to evaluate different geomechanical parameters of rock samples. The aluminum ring confines the material around the sample to simulate fill conditions in an underground mine. V4,15m25

8c: CANMET microseismic monitoring installations are found on the site of the Quirke mine. Five geophones have been installed on the surface to detect seismic waves. Data are transmitted to a central computer. V3,27m46

The multiple-channel system makes possible the collection and analysis of data. Moreover, two seismometers installed

at the Elliot Lake laboratory record waves from both stations. The prediction of rock bursts is a long-term project and several organizations or companies are participating in it. The objectives are: V4,8m59

- to develop a new seismic monitoring system capable of recording entire waves of major events; V4,7m28

- to analyse the causes and mechanisms of rock bursts, using improved techniques, such as the location of the source and studies of primary displacement; and

- to evaluate strategic and tactical methods for reducing rock bursts, using this information in conjunction with existing measures. V4,4m10

CANMET Mining Research Laboratories maintain a second seismic wave monitoring centre in Sudbury, in the Science North tourist complex. V3,39m55

These facilities are part of the earth sciences section and are linked to three stations located around the perimeter of the Sudbury Basin, site of well known nickel deposits. V3,30m33

8d: The 70 acres of mining residues from the Nordic mine are used to study environmental problems related to acid residues, which result from the oxidation of sulphurs such as pyrite or pyrrhotite found in the residues. V3,8m15

V3,9m06

Piezometric stations have been set up to study the movement of water along the mining residue field. V3,8m52

A station makes possible the verification of the rate of flow of surface water. V3,10m37

Oxidation produces acid conditions, resulting in leaching of residual metals and high acidity in water found in the pores of residues. V,39m06

Initial experiments in revegetation were carried out here. Work was halted because of the lower elevation of the land, which caused acid surface water to accumulate there. V3,12m10

One objective of the research is to eliminate treatment stations for acid water from the mining residue field. V3,12m40

Results after 10 years of revegetation of mining residues are encouraging.

Here are the mining residue sections, showing various stages of revegetation. V3,13m44

One solution currently under study is to prevent oxidation of such residues by fully immersing them in water. V3,14m30

8e: Another important objective of the laboratory is to evaluate the quality and the quantity of breathable dust, including radioactive nuclides, in various mining oeprations. The identification of the main factors which contribute to dust production and the development of control methods able to reduce concentrations of dust to acceptable levels round out current objectives in this field. V3,17m52

The dust chamber, which is actually a wind tunnel, makes it possible to calibrate or compare various types of dust samplers and calibrate anemometers used to measure air flow in mine galleries. It also makes it possible to more thoroughly study factors which affect the efficiency of different types of samplers.

Various other facilities make it possible to assess parameters related to breathable dust, such as the gamma ray counter and the size grading sampler. V3,20m30

8f: Gas-phase chromatography makes it possible to evaluate another aspect of the quality of air by precisely establishing the rate of air change or the length of time air remains in certain parts of the ventilation system. Under this method, a known quantity of tracer gas, such as sulphur hexafluoride, is released at a strategic point. Air samples, taken at predetermined stations, are collected in plastic bags. The concentration and the arrival time of the tracer at the stations are calculated in the laboratory through computerized analysis. This method is highly useful when flows at unconventional locations must be measured, or when air movement is restricted. V3,21m37

9: As a result of federal-provincial agreements on mineral development, several research projects are being partially financed by CANMET. Saskatchewan, Manitoba, Ontario and New Brunswick are contributing to mining technology under their respective agreements.

D4

Research projects in the mining sector include, among others:

1. Dense fill (four projects), D5

2. Control of weakening of pillars,

3. Fill engineering,

4. Modeling of deep bulk mining,

5. Potential for liquefaction of dense fill,

6. Specifications for software used in the mining sector,

7. Evaluation of stability,

8. Underground communications, D6

9. Geotechnical data bank,

10. Vertical bulk mining method, D7

11. Computer-designed blasting, D8

12. Study of backfilling in potassium (two phases) D9

13. Information system for services,

14. Study of winch cables, D10

15. Ventilation and heat recovery,

16. Study of subsidence,

17. Study of seismicity. D11

10: To conclude, we hope this short video has helped you to better understand the role and current programs of MRLs, which use highly specialized facilities and equipment to conduct studies in mining technology, health and safety. D2

Generally, studies are carried out with the cooperation and, if possible, the participation, of interested mining companies. We would like to stress their important contribution to the completion of several of our studies.

- END -