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PACCHIOSI DRILL

ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

WATERPROOFING

DIAVIK DIAMONDS (CANADA)

DIAVIK DIAMONDS (LAC DE GRAS, NORTH-WEST TERRITORIES – YELLOWKNIFE - CANADA)

PROJECT:

Waterproofing treatment by Jet Grouting on a stone dam.

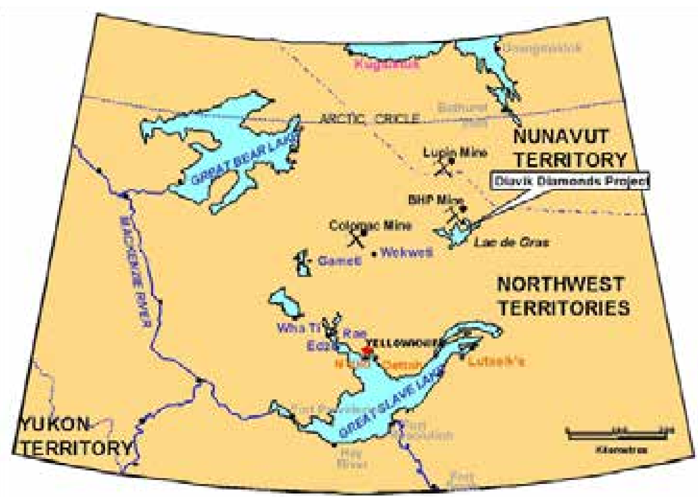
PERIOD OF CONSTRUCTION:

Novembre 2001 – Luglio 2002

CLIENT:

Lac De Gras Constructors

Fig.1. Geographical location of worksite.



Introduction.

The Diavik Diamonds Project is a project for the construction of an open-air diamond mine, constructed as a joint venture by the British company DDMI (60%) and the Canadian Aber Diamond Mines (40%). The deposit was discovered under the waters of Lac de Gras, a large lake located in the Northwest Territories of Canada, about 300 km northeast of the city of Yellowknife. It is an inhospitable area characterized by lakes, uninhabited islands and a prohibitive climate with temperatures that reach – 50°C in the winter and + 10°C in the summer. The mine can only be reached by air or, in the coldest months, between January and March, along an ice road. On the largest of the islands that occupy the lake a fully autonomous camp has been built, capable of sheltering up to 1000 people, complete with dormitories, cafeterias, offices, laboratories, workshops and an airport.

Fig. 2. Aerial view of the zone of the future mine.

Work methods.

The procedure consisted of the following steps:

- construction of stone dams around the deposit, to isolate from the inside of the lake;
- construction of a plastic waterproof diaphragm in the dam body, down to the rocky substrate;
- joining the foot of the bulkheads and the rock substrate with Jet Grouting injections and construction of a waterproof screen, also via Jet Grouting, in several zones adjacent to the islands, along the entire depth of the dam body;
- draining the basin and cleaning the bottom of the mud and detritus accumulated over the years;
- start of mining activities.

During the construction of the waterproof plastic diaphragm problems of the geological and technical nature arose, so that in most cases it did not reach the depth foreseen;

Fig. 3. Views of the stone dam.

the client decided to extend the use of the Jet Grouting technique to ensure the complete impermeability of the basin.

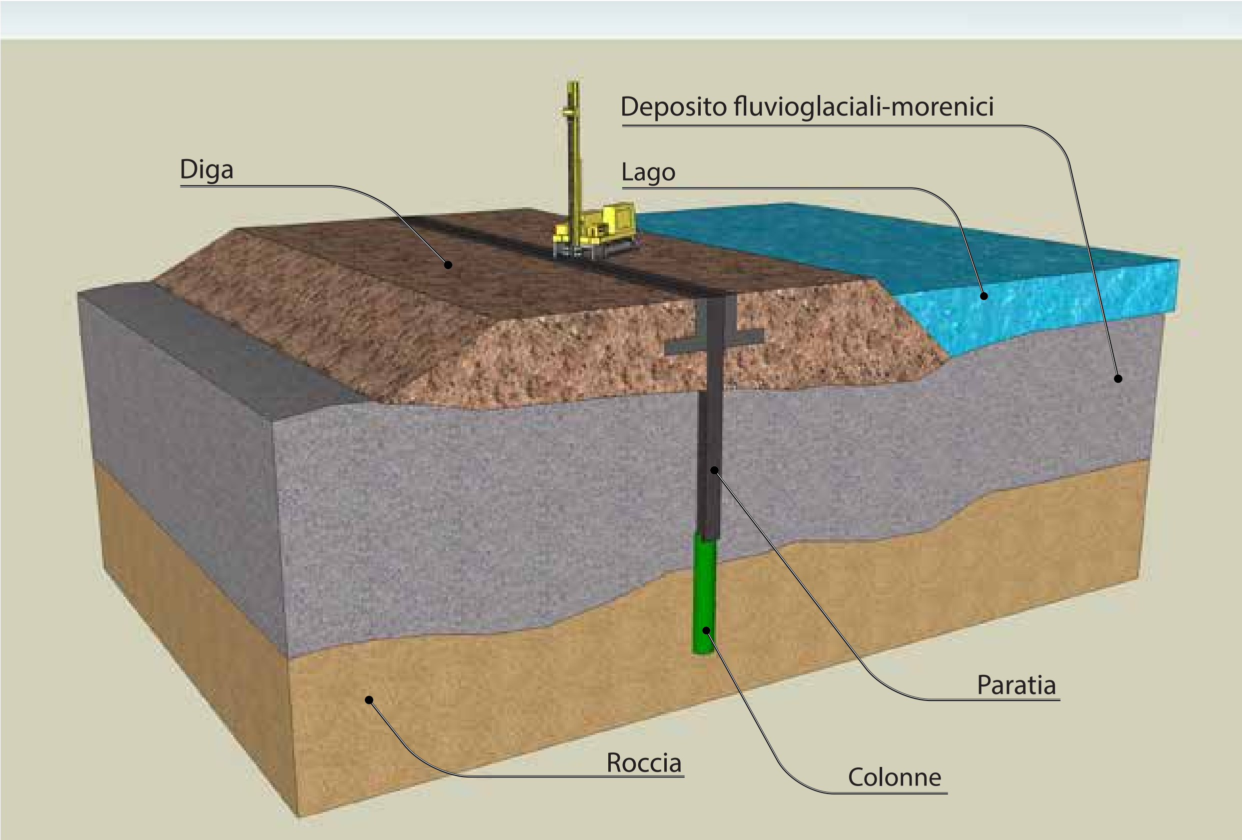


Fig. 4. Cross section view of the new dam and lithology of the lake bottom involved in the work.

Soils to be treated in sequence (Fig. 4).

- stone dam 3 to 30 meters high, built from granite material (granulometry from sand to cobblestones) quarried at the site;
- fluvio-glacial and moraine material with variable thickness from 2 to 15 meters (granulometry from silt to gravel with cobblestones and large blocks);
- rocky substrate consisting of grey granite.

Waterproof screen built with Jet Grouting.

The Jet Grouting technique was used to complete the waterproof screen and joint the diaphragm to the rocky substrate. The work was done using the Pacchiosi Triple System (PS3) preceded by a field test performed directly on the dam, to optimize the drilling and injection parameters.

The procedure consisted of the following steps:

- perforation of the plastic diaphragm (0.8 m thick) with a down-the-hole water hammer to reach the rocky substrate;

- construction of the Jet Grouting column standing 1.5 m in the rock and 0.5 m in the diaphragm;
- final filling of the section of perforated diaphragm.

The vertical columns had the following characteristics:

- spacing between the columns: 0.75 m;
- diameter of the columns between 1.24 m and 1.60 m;

Fig. 5. **P 401 inclinometer.**

- minimum thickness of the screen: 0.8 m;
- maximum deviation from vertical: 1%.

Fig. 6. Mobile shed for protection of the equipment and view of the machines at work inside the shed.

Al termine di ogni perforazione è stata eseguita la misura di verticalità su tutta la lunghezza del foro con l'**Inclinometro Pacchiosi** modello **P401** . (Fig. 5)

Fig. 7. View of the shed structure used to protect the mixing and pumping equipment.

Fig. 8. Detail of insulation on the air-water-cement lines.

Fig. 9. Pacchiosi mixing installation outdoors.

Lo schermo realizzato doveva garantire una permeabilità inferiore a $1x10^{-6}$ cm/sec nell' 80% dei casi, e comunque sempre superiore a $1x10^{-5}$ cm/sec ed una resistenza alla compressione semplice a 28 giorni di maturazione compresa tra 0,8 e 2 Mpa.

Fig. 10 . Pacchiosi P 1500 ESCR drill rig.

Preparation of the worksite.

Considering the extreme weather conditions, the work was performed using different methods at different times of the year: during the winter (November to May) the equipment had to work in heated environments of different types depending on the job to be done. The drilling machines were protected by mobile sheds while the mixing and pumping ma-

Fig.11. Various stages of draining the lake.

Fig.12. Open-air mine at work.

chine were installed in fixed, insulated structures; the water-air-cement lines were also completely insulated and heated; during the summer period, the equipment could work outdoors, as shown in Fig. 9 and 10.

After completing the works, the artificial lake created could be drained so as to exploit the mine in the best possible way (fig.11).

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