

LORNEX OPEN PIT SLOPE STABILITY

October 3, 1984

Introduction

The Lornex mine is an open pit porphyry copper and molybdenum deposit. Ore production began in 1972. Total production including ore and waste averages about 240,000 tons per day. The size of the pit is now 7000' long x 5000' x 1250' deep overall. The top elevation of the pit is 5400' A.M.S.L. and the bottom is 4152' A.M.S.L., for an overall vertical depth of 1250'. Most of the walls are still temporary except for the top of the northwest wall and possibly the south wall.

Slope Angles

The maximum inter-ramp slope height at present is 480' vertical feet. Actual slope angles for these slopes vary from 37 degrees on the west wall, to 35 degrees on the south wall and 32 degrees on the east wall. The average overall design slope angle for the walls of the pit is 32 degrees. Design slope angles for low slope heights vary from 25 degrees to 42.5 degrees depending on the rock conditions; whether in a strong fault zone or in very fresh, competent weakly jointed, strong rock.

Geology and Structure

The engineering materials out of which the walls are constructed are essentially two phases of the Guichon Batholith. The west wall occurs mostly in the Bethsaida Granodiorite and the other walls in the Skeena Quartz Diorite which is the ore host rock. The Lornex Fault strikes northerly through the base of the west wall and separates the two major rock types. It dips westerly

Geology and Structure (cont'd)

from 45 degrees to 85 degrees and ranges in width from 150 to 300' of intense fracturing and hydrothermal alteration. Within the Skeena Quartz Diorite is a quartz porphyry dyke, trending S45deg.E through the southeast corner of the pit.

The Bethsaida Granodiorite is a coarse grained quartz-rich rock which varies from a fresh, massively jointed 15,000-29,000 psi rock down to a weak, intensely argillicly altered rock in fault zones with an estimated average of 4,500 psi. The Skeena Quartz Diorite is pervasively argillicly altered and varies from an estimated 15,000 psi (weakly altered) down to perhaps 4-500 psi when intensely altered to clay. These rock strengths are field estimates only. This intense alteration occurs mostly where the ore zones butt up against the Lornex Fault, i.e. in the footwall of the west wall. The quartz porphyry dyke is intensely jointed and is commonly over an estimated 29,000 psi except where altered.

The major structural features at Lornex include the Lornex Fault, the west wall fault zones in the Bethsaida Granodiorite, and the intense fracturing and faulting and vein systems of the Skeena Quartz Diorite.

The structural grain within the Bethsaida Granodiorite in the pit west wall is N20 - N30 degrees E, truncated by the Lornex Fault. Swarms of major faults with 1.6' to 10' of gouge strike within this trend and dip mainly at 60 degrees into the wall. They alternate with zones of fresh, mildly fractured Bethsaida Granodiorite.

### Hydrology

High water levels occur in all walls of the pit monitored by piezometers. This is also evidenced by wet patches on walls where faults and veins dip into the wall and by artesian water at the toe of some walls. Ground water investigations including well pump tests and horizontal drilling have been conducted on both east and west walls. These show that the Bethsaida Granodiorite and the quartz porphyry dyke are quite permeable and drainable, whereas the Skeena Quartz Diorite is not.

### Slope Stability Program

The slope stability branch of the Mine Engineering Department at Lornex is under the geology group. It includes one geologist, an EDM surveyor and a survey helper. The geotechnical consultant is Golder Associates of Vancouver. All fieldwork and gathering of data is done by Lornex staff, though occasionally under the field guidance of Golder personnel.

Routine fieldwork includes EDM monitoring of over 90 prisms, hydrology monitoring of over 40 standpipes and pneumatic piezometers, and over 80 horizontal drainholes and subsurface monitoring of 7 sinco holes plus geological mapping of major failure zones and major structures. Periodic work includes control of horizontal drainhole programs and special investigations such as the detailed study of the hydrology and structure of the west wall.

Slope Stability Program (cont'd)

Surface wall movements are detected by monitoring of EDM prisms. This is done biweekly except when movements are high, in which case daily measurements are required. When movements of 1/2" per day or more are recorded mine operations is altered and remedial action taken. Causes of movement are usually a combination of geological structure and high water pressure. These causes are activated by such things as increasing wall height or slope angle and mining and blasting at the toe.

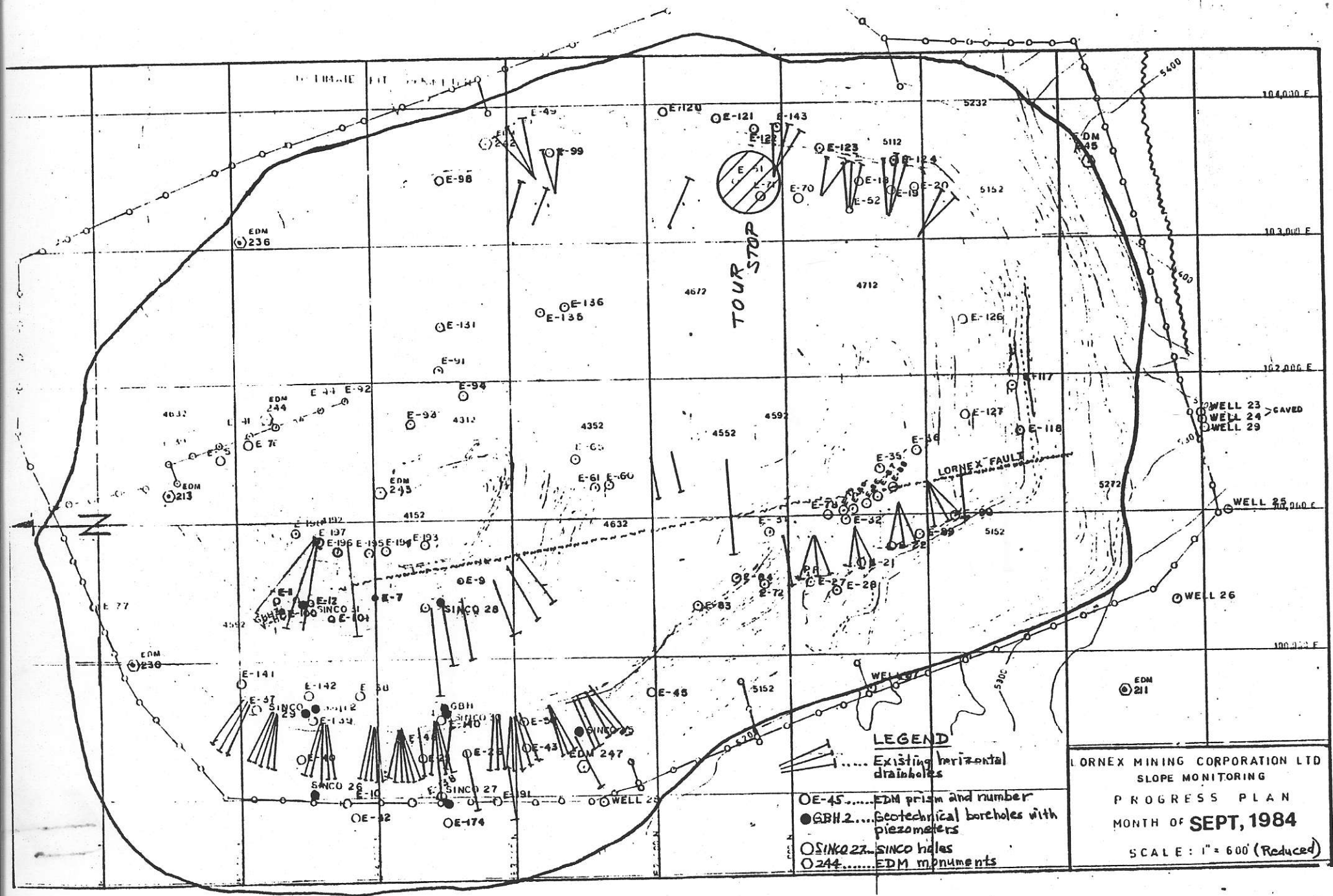
Immediate remedial action can involve leaving a skin of muck at the toe to be mined last and only on day shift or diverting water entering cracks on the failure zone; for example, longer term programs involve more preventive maintenance of wall movements than troubleshooting. These include retarding water flow into the pit by perimeter ditch designs and well dewatering. For ground water control within the pit, horizontal drainhole drilling is conducted. On the west wall of the pit we have a regular program to drill a series of drainholes on a wide berm every 120 vertical feet. Based on a past large, very active failure on this wall, the purpose of this drilling is to maintain the wall at the present designed 35 degree angle by shallow depressurization. The results of the last drainhole program ended in April, 1984 indicate this can be achieved. From 39 drainholes, which produced an initial total flow of 195 U.S. gpm, a peak depressurization of 40% to 60% was achieved. This is for a strip extending about 100' perpendicular to the surface of the west wall.

Slope Stability Program (cont'd)

The typical failure made at Lornex Mine is toppling, or better termed "tilting", on these shallow slopes. This occurs on major faults and faulted veins dipping into the west and east walls. It is best exemplified by west wall failures now but in the past was very pronounced on the east wall also. Minor single or double bench wedge failures occur locally on both the east and west walls. No catastrophic failure has been envisaged at the Lornex pit largely because no major in-dipping structures at a shallower angle than the pit slope have been detected as yet.

Lornex Tour

The C.I.M.M. tour will be on October 25th from 11:00 A.M. to 12:30 P.M. During this time we will have a 1/2 hour slide show and brief explanation of pit slope stability and 1/2 to 1 hour pit tour to see points of interest. See attached pit plan for pit stop. The pit stop will focus on a horizontal drainhole fan and a view of one or more failure zones.



TOUR STOP

**LEGEND**

- ..... Existing horizontal drainholes
- OE-45..... EDM prism and number
- GBH 2..... Geotechnical boreholes with piezometers
- SINCQ 27..... SINCQ holes
- 244..... EDM monuments

LORNEX MINING CORPORATION LTD  
 SLOPE MONITORING  
 PROGRESS PLAN  
 MONTH OF **SEPT, 1984**  
 SCALE: 1" = 600' (Reduced)

Lornex Tour - June 18/82

Geologist - Sean Daly

Reserves 0.41% Cu  
0.041% Mo

Ore 95% fracture controlled

Dyke - less intensely mineralised

