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CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

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April 27, 1998

Mr. Daron R. Haddock
Permit Supervisor
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801

ACT/007/006 #2

RE: Response Adequacy from Cyprus Plateau Mining Corporation Regarding the Birch Spring Monitoring Issues.

Copy Letter to Daron & Copy Letter/Reports to Sharon

Dear Mr. Haddock:

Enclosed is a report from Cyprus' Geology Supervisor which offers some input relating to faults, fractures, and joints within some of the structural "packages" located a number of miles north of Birch Spring.

Based on our Geologist's report and expertise that it is hard to support that mining (5 to 6 miles) up dip can be attributed to a permanent fall in out flow from Birch Spring, Cyprus would like the Division to remove them from further consideration regarding standing issues pertaining to Birch Spring.

If you have any questions, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

File: Birch Spring
Chrono: JP980411.LTR

CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

Cyprus Plateau Mining Corporation
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April 25, 1998

Mr. Daron Haddock
Permit Supervisor
State of Utah
Department of Natural Resources
Division of Oil, Gas, and Mining
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PO Box 145801
SLC, Utah 84114-5801

Re: Comments on Wasatch Ground Water Conduits

Dear Mr. Haddock,

I have been asked by Cyprus Plateau Mining Company's Environmental Engineer to comment on the *Response Adequacy from Cyprus Plateau Mining and Co-Op Mining Corporation Regarding the Birch Spring monitoring Issues per: Tech Directive 005.* from the Department of Natural Resources, Division of Oil, Gas and Mining dated March 24, 1997. The response letter notes that there remains many unanswered questions and unproven hypotheses about the ground water hydrology of the area and the reduced flow rates from the Birch Spring. This being true, I would like to offer some input relating to faults, fractures, and joints within some of the structural "packages" located a number of miles to the north (up dip) of the Birch Spring site. The following are based on reflections drawn from years of exploration and development activities over the surface and in the interior of Gentry Mountain.

Observations from surface and underground exposures - Starpoint No. 2 Mine

The subsurface in the vicinity of the area mined by Plateau Mining Company (Bear Canyon Graben and Castle Valley Ridge) and presumably that area to the south of mined out works of the Starpoint No. 2 mine contains a series of horsts and grabens; some subtly developed; some displaying offsets on the scale of hundreds of feet. Sympathetic faults and earlier cross faulting and jointing to these structures has created a melange of intersecting fractures. Simply stated the area mined by Plateau Mining is profusely fractured and this fracture pattern extends some distance to the south. Ground water seemed to move to the south both through the horsts and grabens but not across the boundaries of the structures. Some ground water could be flowing along ancient sandstone channels of which there are many, but these units are generally isolated by enclosing mudstones and claystones and responded as "perched" waters. Porous sands of the upper Spring Canyon Sandstone are more likely conduits between fractures.

Structural History

The Wasatch Plateau has been subjected to two main episodes of crustal deformation. The first, a period of compression, focusing along an east - west orientation, created faults, joints, and cleats orientated N 60 to N 80 W, is well expressed in the northern Watsatch Plateau and the north end of the Book Cliffs. Some limited deep thrust faulting appears to have taken place during this period. Later, the area was subjected to tensional or extensional forces creating north - south faults (often in the patterns of Horsts and Grabens) throughout the length of the Wasatch Plateau (incidentally creating the eastern margin of the Basin and Range Province. These faults, fractures, and cleats are generally oriented N 5 W to N 10 E. These tensional features are commonly "open" and act as primary conduits or "perched" resevoirs in the Watsatch Plateau Coal Field. Igneous dikes were injected in several phases and preferentially implaced into the N 80 W structure but, also rarely, into some north-south faults.

Surface Mapping and Drilling

Early surface mapping identified the major faulting in the area and illustrated the suspected traces of those faults as long, continuous ruptures of the strata (Spieker, et al). More detailed surface work above the Starpoint Mine in the early 1980's suggested that the picture was incomplete at best and likely much more detailed. Several summers of field work as well as numerous geophysical programs utilizing resistivity, 3D seismic, magnetometer, tellurics, IP, VLF/EM, and others suggested numerous potential fractures but with often conflicting detail (**see preliminary maps June 1990 and October 1991**). Exact details of faulting and jointing would come later during underground "ground truthing".

An exploration hole (95-35-1), drilled in Tie Fork Canyon, intersected open fractures/faults at depth with flowing water, rounded/polished coal clasts and abundant unconsolidated sands, indicating some significant movement (**see attached core log; 125' to 250'**). The abundant loose or weathered/friable sands present in the faulted zones suggested that active conduiting fractures could collapse or plug if subjected to shocks which might mobilize large volumes of loose sediments.

In other fault encounters (by core drilling), faults were found to be tight and filled with clay gouge.

Underground Mapping

Regular underground mapping activities especially during the crossing of the Bear Canyon Graben and during the development of the southern Castle Valley Ridge revealed the complex structural nature of the horsts and grabens. Initial exposures in the south half of Section 14 crossed the fluctuating piezometric surface in the Wattis Seam and developing gate roads revealed numerous joints, open fractures, and small scale faults in the interior of the of the horst (**see panel map with structure**). These structures trend N 5 to N 10 E with occasional N 80 W cross structure. In the interior of the horst, it appeared that the open joints formed conduits within the horst and were de-watered as entries and panels developed to the south. Major joints and small scale faults appeared in the entries every 50 to 300 feet and were especially essentuated in adjacent sandstone bodies. Apparent joint trends were occesionally seen to develop into small faults (0.1 to 2.5 foot throws). Some open, water-filled fractures, found under 1700 feet of cover, were over 0.3 feet wide and extended above the seam entry over 20 feet.

Upon pulling the last panel to the south (14th Right), the voids were allowed to flood/re-charge back to the original piezometric level.

Faults, which form the bounding grabens (both on the east and west), are, in all cases, en-echelon in nature. On the east side of the horst, the offsets start as fractures on the south and trend to full offsets to the north into the Bear Canyon Graben (about 250 feet). Spacing between the faults range from about 100 to 400 feet.

On the west, offsets start as fractures on the north and extend to full throw to the south (about 500 feet) in the Pleasant Valley Graben. Bounding faults below the piezometric surface (south and down dip) were found to be water-filled with open voids in places and were avoided where possible. On this side, drilling and exposures indicated that the fault spacing ranged from 50 to over 150 feet.

Fault encounters above (north) of the piezometric boundary occasionally released "perched" waters trapped by fault gouge. In other areas, large dry, open pockets (5 by 50 by 10 foot) were found along the fault traces. Cross cutting features (N 80 W) are usually more common to the north, filled with gouge (reactivated) or have implaced igneous dikes and do not act as cross conduits.

Comments

Typically, it appears that both the horsts and grabens can be lenticular in map view but bounding (en-echelon) faults may not be interconnected over long distances. Some drilling data indicates that some fractures in the boundary faults are open and active ground water conduits while other areas along the same traces are plugged and sealed with sediment and gouge. Open fractures in the horst blocks contained significant amounts of water when encountered but quickly recovered their previous head after mining retreated.

In view of the extensively fractured nature of exposures mapped in the Starpoint No. 2 Mine in the Castle Valley Ridge, the rapid re-charge of the horst to near its initial piezometric stand, the potential amount of water moving through the strata below any mined horizons to the north of Birch Spring, and the significant distance to the location of the Birch Spring (5 to 6 miles? from Castle Valley Ridge works), it is hard to support that mining up dip can be attributed to a permanent fall of the out flow of Birch Spring. The apparently very active nature of the regional ground water flow through and adjacent to the Starpoint No. 2 exposures suggests that, if interconnected by fractures, groundwater would soon "make up" impacts caused by cyclic weather patterns or temporary mine interference.

The Birch Spring flow data is very suggestive to me, that, if the pre-1989 data is correct, the earthquake has either closed the previous ground water conduit by movement, or more likely, has mobilized fracture sediments to plug the conduit.

Sincerely,

John Mercier

John Mercier
Geologic Supervisor

Map Attachments