La Preciosa Project

Preliminary Mineability Assessment

Submitted to: Orko Silver
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1.0 INTRODUCTION

Following a request made by Orko Silver Corp., AMEC carried out a preliminary mineability assessment of the La Preciosa deposit, covering both open pit and underground mining options. The results are presented in this report.

The preliminary nature of the results is emphasized. More detailed geotechnical investigations and characterizations are required, at the pre-feasibility level of project development, before firm and final conclusions could be made concerning the details of open pit slope configurations, stoping strategies, layouts and support systems. The key areas that require consideration are identified in the main report text, a summary is provided in Section 2.

1.1 Database

The basis for AMEC's assessment was in detailed examinations of selected (by AMEC) drillcores during a site visit made between January 30 and February 10, 2012 ("AMEC's January/February 2012 site visit"). The following 18 full drillcores were logged by Stephen Godden, Principal Mining Consultant, assisted by Agung Prawasono, Principal Mining Specialist, and by Patrick Lee, Mining Engineer in Training:

- 2005 drillhole series – BB05-05, BB05-06 and BP05-022;
- 2006 drillhole series – BP06-079;
- 2007 drillhole series – BP07-138;
- 2008 drillhole series – BP08-173, -205, -211, -230, -254 and -266;
- 2009 drillhole series – BP09-431; and
- 2010 drillhole series – BP10-505, -549, -560, -564, -579 and -673.

AMEC had earlier in January 2012 ("AMEC's early January 2012 site visit") examined the following 15 selected (by AMEC) drillcores:

- 2005 drillhole series – BB05-03, -04, -05, -06, BP05-022 and -028;
- 2006 drillhole series – BP06-075, -077 and -079;
- 2007 drillhole series – BP07-131, -134 and -138; and
- 2008 drillhole series – BP08-170, -173 and -183.

Only the dominant features of the drillcores examined during AMEC's early January 2012 site visit were logged by Stephen Godden, Principal Mining Consultant, assisted by Patrick Lee, Mining Engineer in Training. Various preliminary conclusions and recommendations were made in consequence of this, which led to the subsequent site visit and the detailed drillcore examination and geotechnical characterization program carried out during AMEC's January/February 2012 site visit.

Figure 1 summarizes the collar positions of the listed drillholes. Those highlighted by circles were examined during AMEC's January/February site visit - the **RED** circles identify the collar positions of the 2005 to 2009 series holes and the **BLUE** circles identify the collar positions of the 2010 holes (which are not specifically indicated on the base drillhole location plan). The collar positions of any drillcores that were examined during AMEC's early January 2012 site visit, which did not form part of AMEC's later program, are highlighted by **GREEN** triangles.

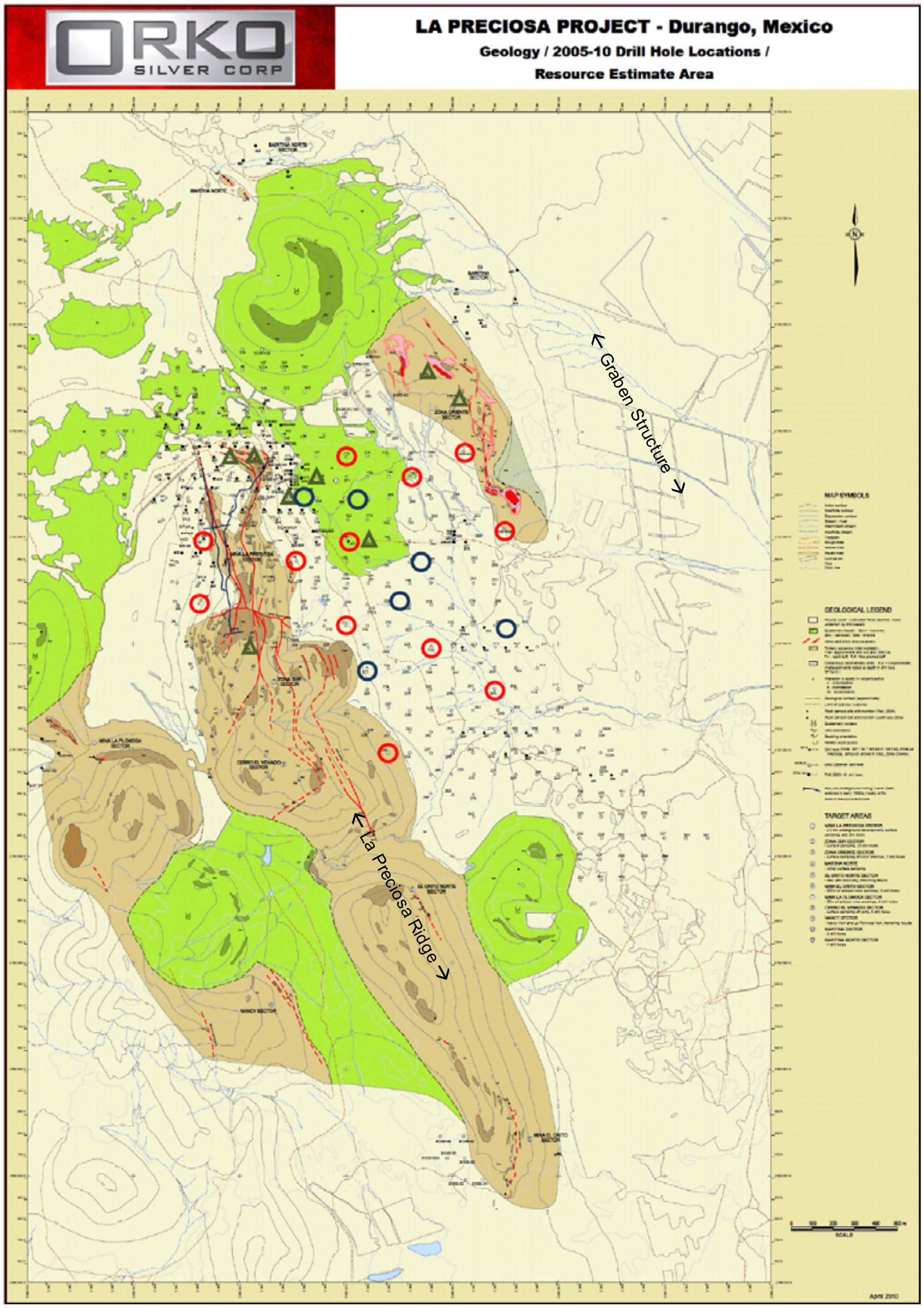
1.2 Approach

The compilation of detailed geotechnical logs was attempted from the outset of AMEC's January/February 2012 site visit. However, it soon became clear that this would not be possible due to the cores having been extensively sampled and because of their sometimes badly degraded state. Emphasis was as a result placed on close examinations and interpretations of the selected drillcores to establish the likely in situ rockmass conditions, which in any event is the purpose of geotechnical drillcore logging.

The detailed logging process was made difficult by a lack of original drillcore photologs and geology core logs against which cross-references could be made; incomplete sets only were available to AMEC at the time of the January/February 2012 site visit. However, once these became available post-visit the process of drillcore interpretation became more straightforward, insofar as the causes of the sometimes poor quality, remnant drillcore became clear. The benefit of AMEC's visit to the historical underground mine workings at the La Preciosa project site, made during AMEC's early January 2012 site visit, was also invaluable as regards interpretation of the drillcore intersections of vein material in particular, which too were sometimes found to be extensively damaged.

Figure 1: A Drillhole Collar Location Plan, Showing the Positions of the Holes Considered within the Scope of AMEC's Preliminary Mineability Study of the La Preciosa Deposit

*(2005-2009 holes in **RED**, 2010 holes in **BLUE**, extra holes examined during first site visit in **GREEN**) (base figure supplied by Orko Silver Corp.)*



2.0 SUMMARY

Geotechnical interpretation of the La Preciosa deposit is made complex by a number of features that in combination can suggest an extensively disturbed and altered rockmass that has been affected by highly variable (depth and severity) surface weathering. The mineralized vein horizons can in particular appear to be disturbed, due to the sometimes broken nature of the drillcore intersections and the presence of limonite within the fractured mass. However, if these and related issues are examined closely, much of the apparently low quality rockmass conditions may readily be attributed to drillcore degradation during drilling, logging, sampling, core handling and storage. This includes the mineralized vein horizons, the limonite content of which may be attributed to groundwater penetration through a permeable rockmass containing the often highly permeable mineralized veins.

AMEC concludes that there is no readily identifiable reason to suppose that both open pit and underground mining could not productively and safely be carried out in the La Preciosa deposit. There are persistent joint planes that trend parallel to the average dip and strike of individual veins, but the instability potential that could arise from these structures could readily be controlled through the use of appropriate support types, densities and strategies.

2.1 General Rockmass Conditions

2.1.1 Findings

Close examination of drillcore intersections, combined with cross-references to the available photologs and drillcore geology logs, as well as the visual evidence of the rockmass conditions seen in the historical mine workings, show that:

- conventional fault- and shear-zones do not exist in the examined drillcores, besides the approximately east-west trending fault zones that are known or postulated to cross the local Project area (see Section 1 for details);
- the general rockmass, between the known and postulated east-west trending fault zones, may be described as massive to widely jointed;
- the majority of the discontinuities contained within the general rockmass are weakly compressed, loose or even open structures that are interpreted by AMEC to be tensile fractures around which patches or zones of minor wallrock alteration / leaching are common to depths of approximately 180 m below surface (bs) and along which groundwater has penetrated to depths of approximately 350 m bs;

- the mineralized veins often contain irregularly developed vugs and voids in which open-space crystal growth may commonly be seen;
- where groundwater penetration extends to the vein horizons, pervasive limonite deposition in vugs, voids and along open structures is evident (which vein characteristics can be developed at depths far in excess of the main weathered zone, albeit with ever-reducing amounts of limonite as the intersection depth increases); and
- where vugs and voids are lacking or are not well-developed and where open joints are not intersected, the vein intersections comprise good to very good quality material.

2.1.2 Comments

The general rockmass characteristics outlined suggest a low stress environment that precludes the possibility of rock bursting and, for the most part, stress-related damage to underground excavations too. The presence of groundwater to depths of at least 350 m bs suggests that excellent hydraulic continuity probably exists within the general rockmass and that the tensile fractures outlined must, therefore, be laterally and/or transversely continuous (in the sense that they persistently interact within the general rockmass). Locally developed, possibly short-term and sometimes significant groundwater inflows from pit walls and underground excavations may occur in consequence of this.

In AMEC's opinion, it is the vuggy nature of the mineralized veins that resulted in sometimes extensive drillcore damage during the drilling process, due to what AMEC interprets as high bit pressures and drillcore grinding across intersected vugs, voids and sometimes open joints. This key point is emphasized because the resultant, sometimes closely fractured nature of retrieved drillcore could otherwise be interpreted as being structurally related, especially if limonite is present.

2.1.3 Recommendations

The possibility of short-term groundwater inflows is emphasized because the storage capacity of the rockmass might be limited, although the presence of what have been verbally reported by Orko Silver Corp. to be rapidly recharging, local surface dams and ponds should be noted. Whatever the case, AMEC recommends that a hydrogeological investigation of the La Preciosa rockmass is carried out, to establish its groundwater storage, conductivity and recharge characteristics. This is emphasized because groundwater issues could be minor only, but they could equally be persistent and problematic, not least because of the evidently high permeability of the general rockmass.

AMEC further recommends that the in situ condition of the mineralized veins that are targeted for underground mining is confirmed, by means of drilling and logging carefully located and orientated, triple tube (cored) geotechnical holes, at the pre-feasibility level of Project development. Safety risk management would also best be served by structured and targeted trial mining, with rockmass monitoring as appropriate, to test both the selected stoping methods and the efficacy of the selected stoping spans (that will be selected and defined as part of the preliminary studies, going forward). In this manner an optimized balance between cashflow objectives and sustainable production rates for open pit and underground mining could be achieved at least project risk.

2.2 Surface Weathering

2.2.1 The Main Surface Weathering Zone

The base of the main weathered zone is marked by the deepest expression of persistent alteration / leaching of the rocks' fabrics, which depth varies according to the type of sub-outcropping rock. For example, away from the approximately east-west trending fault zones in which much deeper surface weathering is developed, the following may be observed:

- where the andesites of the Lower Volcanic Series ("LVS") sub-outcrop, the surface soil cover can be up to 3 m thick and the main surface weathered zone can extend to between approximately 20 m and 30 m bs (see Section 3.2 for explanations of the rock types and district stratigraphy); whereas
- where a basalt sub-outcrops, the surface soil can be less than one metre thick and the main surface weathered zone can extend to only a few metres below surface.

In either case, the weathered material may be described as loosely consolidated, weak to very weak, water-bearing and clay-rich. It is only where quartz veining extends to surface that hard, abrasive material is encountered, but this appears to comprise various small- to medium-sized boulders surrounded by deeply weathered, residual vein material. Such deeply weathered vein material is, however, limited in terms of its developed depth.

2.2.2 Paleo-Weathering

The details of the surface weathering profiles are made more complex by the presence of a paleosurface at the base of the basalt sequence that extends over much (but not all) of the local Project area. It is marked by a stiff clay / soil that, in the 40 drillholes in which the characteristics of the paleosurface were assessed, is between 0.2 m and 12 m thick (average 4.0 m) and some 5 m to 45 m below surface (average approximately 30 m bs to the bottom clay / soil contact).

Rock fabric alteration / leaching extends up into the basalts, for a few metres from the top contact of the paleosurface. A paleo-weathering zone extends for between 5 m and 25 m below the bottom contact of the paleosurface, depending on its depth below surface hence its interaction (or lack thereof) with the main surface weathered zone. Where the paleo-weathering zone falls within or close to the main surface weathered zone, the result can be deeply weathered / leached rocks to depths of as much as 65 m bs overall.

2.2.3 Recommendations

The level of detail required to accommodate all possible variations of near surface geology within the scope of open pit optimization and design is not currently available, which data gap needs to be filled at the pre-feasibility level of Project development. In view of this limitation, AMEC recommends that the following are assumed for purposes of preliminary analysis of open pit options:

- where andesites of the LVS sub-outcrop at surface, an average worst case depth to the base of the main surface weathered zone of 30 m bs; and
- where the paleosurface is developed, an average worst case depth to the base of the main paleo-weathering zone of 40 m bs.

2.3 East-West Faulting

2.3.1 Characteristics

The approximately east-west trending faults appear to comprise composite fault zones containing a number (or series) of minor to intermediate offsets. The one exception might be the possibly large-scale, strike-slip fault that is postulated to mark the northern boundary of the identified La Preciosa silver-gold mineralization (Finch et al, 2011). Each of the fault zones contains loose, closely jointed, generally weathered and water-bearing material.

2.3.2 Comments

The presence of east-west faulting will inevitably influence planning and design considerations for both open pit and underground mining. For example, they could affect pit slope positions and profiles. They would certainly have to be developed through (as opposed to stoped through) underground, with the result that they should be considered to be sources of geological losses within the scope of Mineral Reserve estimation for underground mining.

2.3.3 Recommendation

The specific positions, trends and widths of the approximately east-west trending fault zones have yet to be established, which data would be central to the completion of any design and planning study at the pre-feasibility stage of Project development. AMEC recommends that a three-dimensional fault model is compiled through consideration and analysis of the positions of the fault planes and fault zones intersected in the completed drillholes, using a suitable geological modeling package.

2.4 Alteration

2.4.1 Characteristics

Four main alteration types have been identified:

- minor zones of severe, pervasive hematite alteration are locally developed in porphyritic andesites of the LVS in particular (AMEC's provisional and preliminary estimate is that some 5% of the total length all development hosted in LVS andesites might be affected);
- amongst the logged drillcores, what appears to be intense chloritic alteration was seen in two narrow, discrete zones within the andesites of the LVS (this alteration type appears to be constrained to the original hot-fluid conduits that might have originally been fault- or shear-zones);
- clay-type alteration can locally occur in the sedimentary sequence (AMEC's provisional and preliminary estimate is that less than 2% of the total length all development hosted in the sedimentary sequence might be affected); and
- what might be clay-type alteration appears to be extensively developed along and immediately around the nonconformable contact between the Permian schists and early Cretaceous sedimentary sequence (see Section 3.2 for details of the rock types and district Stratigraphy; the alteration type outlined is termed propylitic alteration in the available drillcore geology logs).

2.4.2 Comments

In each case the altered rocks can variously but progressively degrade to weak or very weak, clay-rich masses, if they are exposed to either water or to atmospheric moisture. In the case of severe, pervasive hematite alteration, the degradation process can occur in situ, where the affected material is located within the surface weathered zone or within an east-west trending fault zone.

The importance of sealing, with shotcrete, areas or zones of hematite-altered andesite is emphasized. In the case of chloritic- and clay-type alteration, a suitable chemical sealant should be used (i.e. one that bonds firmly to the exposed rock or rocks and which precludes the possibility of water-related rock degradation). Shotcrete is not suitable in these specific cases because it is water-bearing when applied, with the result that a thin layer of clay can develop at the shotcrete-rock interface. This alters the performance characteristics of the applied shotcrete, to the point where the failure of sometimes large, de-bonded shotcrete slabs can occur.

In the specific case of clay-type alteration at and around the nonconformable schist-sedimentary contact:

- special measures might have to be taken to ensure stable pit slopes that could selectively fail by sliding either along or around the nonconformable contact area (the likelihood of such failures depends on the local pit wall and contact geometries and the local continuity of the altered/clay-rich contact zone); and
- special stabilization measures would have to be taken if the contact was located above the footwall elevation of any planned stope or drift, to minimize overbreak/unplanned dilution and to preclude longer-term instability risk (by the same token, mining should be avoided in any planned stope or drift that was expected to have the contact zone at or immediately above its hangingwall position); and
- an aggregate working floor would have to be thrown if the contact zone was at or near to the footwall elevation of any planned stopes or drifts.

It is not possible at this stage to assess the potential scope for the types of schist-sedimentary, contact-specific issues outlined because analysis depends in large measure on the outcomes of the updated block model and the results of preliminary mine planning. It can, however, be stated that it would be unwise to mine any stopes if a persistently weak/clay-rich horizon was located at, near or above a stope's hangingwall position.

2.4.3 Recommendations

Uncertainty exists as to the nature, distribution and continuity of clay-type alteration in particular. It is because of this that whole question of alteration types and mineralogies should closely be investigated at the pre-feasibility stage of Project development. This is emphasized because if a system suitable for the identification of altered sediments in the production environment could be found and defined, preventative action could *selectively* be taken to prevent degradation and related instability issues. The alternative would be to assume that alteration is randomly developed and difficult to identify in the production environment, with the result that any exposed wallrock comprising any material would have to be sealed, to the detriment of mine operating costs.

AMEC further recommends that the distribution and/or continuity of chloritic alteration in particular should be assessed through three-dimensional analysis of drillcore intersections. This key point is emphasized because if the alteration is confined to persistent conduits, they could act as planes of preferential rockmass parting that could affect the bulk stability of either open pit slopes or underground stopes, depending on their position or positions relative to a planned or mined excavation.

2.5 Open Pit Mining

2.5.1 Average Slope Profiles

In AMEC's opinion, the quality of the general rockmass is such that beneath the surface weathered zone, the paleosurface and the paleo-weathering zone (the latter two where developed), an average inter-ramp angle of 52º could safely be achieved at wall heights of up to 350 m. The potential impacts of one or more east-west trending fault zones on safely achievable slope geometries should, however, be emphasized.

A potential exists for rock slope instability caused by sloughing of the paleosurface, where it is developed. In consequence of this, AMEC recommends that suitably dimensioned catch-benches should be cut at the base of the underlying paleo-weathering zone. For purposes of preliminary assessment and with the average weathering profiles defined in Section 2.2.3 in mind, AMEC recommends that:

- a 10 m wide catch-bench is cut at the base of the main paleo-weathering zone (i.e. 40 m bs, for purposes of preliminary analysis and design), above which the average inter-ramp angle should be limited to 40º; and
- where the andesites of the LVS sub-outcrop on surface, a 6 m wide catch bench is cut at the base of the main surface weathered zone (i.e. 30 m bs, for purposes of preliminary analysis and design), above which an average inter-ramp angle should be limited to 40º.

2.5.2 Bench Configurations

Assuming very high catch bench reliability, based on good quality mining practice, an average inter-ramp angle of 52º could be achieved if 12 m high benches were cut with 5.0 m wide catch benches and a bench face angle of 70º. With a similar constraint in mind, an average inter-ramp angle of 40º could be achieved if 12 m high benches were cut with 6.0 m wide catch benches and a bench face angle of 55º. In either case, selective mining of high-grade, narrow veins would be facilitated if the 12 m high benches were taken in two, 6.0 m lifts.

2.6 Underground Mine Design and Planning

2.6.1 Methods and Dimensions

In AMEC's opinion, there is nothing to suggest that productive mining could not safely take place in the type of rockmass conditions earlier outlined. For example:

- 5 m by 5 m drifts, declines and ramps could safely and productively be developed, without the need for extensive, systematic support (the sole exception is development in the Permian schists, for the reasons described below); and
- room & pillar workings with 8 m to 10 m wide headings could be mined with 5 m square pillars (minimum final dimensions) to 3.0 m stoping heights, as long as appropriate support strategies were adopted.

The scope for productive room & pillar mining will be established once the updated block model becomes available. Least cost and most productive stoping methods only will be considered within the scope of analysis and design for underground mining, which methods might or might not include room & pillar mining.

2.6.2 The Permian Schists

Mining in the schists could be problematic, due to their strongly anisotropic nature. For example, if schist is present along the footwall of any drift, decline or stope, it would readily be ripped by the passage of trackless mining equipment that could, as a result, be expected to suffer increased tire damage and elevated wear rates to differentials. In some cases minor, platey footwall heave could occur, especially at depths in excess of approximately 300 m bs. This would exacerbate the types of issues outlined, which could be overcome by over-cutting an affected footwall and by throwing an aggregate-type working floor.

The strongly anisotropic nature of the schists, combined with the potential for minor stress-related damage at depths greater than 300 m bs and the generally weak schistose parting planes, suggests that small span and well-supported excavations only should be mined where schist is expected to be at the hangingwall elevation of individual drifts or stopes. The presence and potential impacts of alteration along and around the schist contact zones with the metasediments only serves to emphasize this key point.

2.6.3 The Early Cretaceous Breccio-Conglomerates

Minor wallrock frittering could be experienced where mining extends through the breccio-conglomerates of the sedimentary sequence, if the excavations were over-blasted by virtue of the inter-hole burdens of the peripheral blastholes and/or the powder factor employed. Although wallrock frittering would in itself not be problematic, safety and 'house-keeping' benefits would be derived if it was reduced to a practical minimum through the use of post-split blasting. Similar problems are not anticipated in the andesites of the LVS.

2.6.4 Stope Production Blasting

Despite their cost, cartridge explosives might be required for stope production blasting because of:

- the frequency of vugs, voids and other open structures in the mineralized veins (potentially significant gas-venting would occur if high gas, low VoD blasting agents such as ANFO were used, thereby inducing occasionally poor fracturation/large lumps sizes in vein material, as well as otherwise avoidable, unplanned dilution); and
- the presence of groundwater (ANFO is water-soluble, with the result that misfires commonly occur in wet ground).

Blasting agents such as ANFO could selectively be used in development ends, if cover drilling was carried out to determine the presence or lack of groundwater in advance of individual development ends. Cartridge-type explosives would, however, have to be used where groundwater inflows were experienced or expected. AMEC recommends that cover drilling is routinely carried out, especially around and within the east-west fault zones, at least until such time as confidence in the groundwater regime reaches a level that is consistent with least risk mining practice.

2.6.5 Drilling and Advance Rates

Good blasthole penetration rates can reasonably be expected in the andesites of the LVS and the breccio-conglomerates of the sedimentary sequence. Equipment dependent, average blasthole penetration rates can be expected in the comparatively much tougher and abrasive mineralized veins. Moderate to low bit wear rates can be expected in andesites of the LVS in particular, due mainly to the lack of quartz/silica within their mineral assemblages. Slightly elevated bit wear rates can be expected in the sedimentary sequence, due to the presence of quartz clasts. High bit wear rates can be expected in vein material and the immediately surrounding, silicified rocks, due to the abundant presence of quartz.

Although a length-of-pull of 3.5 m could often be achieved in development ends, the advance rates would have to be reduced in altered and locally weathered ground. With this in mind, AMEC recommends that an average advance rate of 3.0 m per round is assumed for purposes of preliminary mine planning, with an average daily advance of no more than 5.5 m in active development ends, for a two-shift production cycle. Development through the Permian schists and east-west trending fault zones would have to be slowed, due to the nature of the ground and the requirement for additional support. In these cases:

- an average, per-round advance rate of 2.5 m and an average an average daily advance of no more than 5.0 m in active development ends, for a two-shift production cycle, for development located in the Permian schists; and
- for development advanced through the east-west fault zones, an average, per-round advance rate of 2.0 m and a 1.5 day average production cycle should be assumed.

3.0 BACKGROUND GEOLOGY

To understand the La Preciosa rockmass it is first necessary to consider the deposit's regional geological context, as well as the principal lithologies found across the Project area. This is stated because geotechnical rockmass characteristics are nearly always strongly influenced by the regional structural / tectonic history and the prevailing rock types. Short descriptions of the relevant features are presented in the following text. Their importance is evident from the discussions of later sections.

3.1 Regional Geological Context

The La Preciosa area is located on the eastern flank of Sierra Madre Occidental ("SMO"), a mountain range that extends along western Mexico (Figure 2). The range trends approximately north-northwest – south-southeast, from immediately south of the Sonora-Arizona border to Guanajuato. At Guanajuato, the SMO joins with Sierra Madre del Sur and Eje Transverse Volcanic Axis (or Eje Volcánico Transversal) of southern Mexico.

Figure 2: An Annotated Google Earth Image of the Principal Mountain Ranges in Mexico

The SMO was formed during the Laramide orogeny, a mountain building period that affected the western portion of North America, from Mexico to Alaska (English et al, 2004, Liu et al, 2010, Saleeby et al, 2003 and Schellart et al, 2010). Although different start and end dates for the orogeny are stated in the available references (for example, compare snobear.colorado.edu/Markw/Mountains/08/ColoradoMtns/laramide.pdf with the previously stated references and Conner et al, 2003), the balance of available information suggests that it started in the late Cretaceous period (70 to 80 million years ago ["Ma"]) and ended during the middle- to late-Paleogene period, some 35 to 55 Ma.

The orogeny is commonly attributed to events off the west coast of North America, when the Kula and Farallon tectonic plates were sliding under the North American plate. The end of the orogeny is commonly attributed to a waning of subduction activity and the onset of crustal extension throughout northern and central Mexico, with the latter coinciding with onset of extensive volcanism. Expressions of crustal extension can be seen across large swathes of western and northwestern Mexico, as evidenced by locally developed and sometimes very large, rigid block slumps along mountain flanks and by the development of north to northwest trending, linear graben structures. A graben is developed to the immediate east of the main La Preciosa exploration area (the "local Project area", see Figure 1) where the bedrocks are covered by thick gravel accumulations of the late Quaternary period (Finch et al, 2011).

Intermittent periods of crustal extension might have continued beyond the late-Paleogene period, possibly to as recently as the Pleistocene epoch (2.59 to 11,700 years before present ["BP"]) when the last expression of volcanic (basalt) extrusive activity occurred across the Durango regional area (see Section 3.2). This is evidenced by the wide range of variously mineralized and/or infilled, open structures that can readily be seen in La Preciosa drillcores, hence the length of time that crustal extension activity must have occurred. For example (and in no particular order):

- occasional expressions of silicified fault breccias can be seen (for example, Figures 3 & 4);
- there exists, of course, silver-gold vein mineralization on the property, which was selectively developed along open void, or at least relative tension structures that have similar trends to that of the regionally developed graben structures (the former as evidenced by the extensive presence of vugs, voids and open void crystal growth of both barite and quartz);
- sometimes coarse crystalline calcite/quartz infillings can be seen within discrete, irregularly and infrequently developed voids that occur throughout the rockmass, for example:

  - at 149.75 m, 149.90 m, 179.85 m and 329.75 m in drillhole BP05-022,
  - at 105.47 m, 151.69 m and 152.90 m in drillhole BP08-205,
  - at 161.30 m, 164.21 m, 169.20 m, 224.74 m, 227.37 m and 235.59 m in drillhole BP08-266,
  - at 331.72 m and 332.94 m, as well as between 343.90 m and 344.85 m (Figure 5);
- small, irregular but frequently developed and unmineralized open voids were observed in drillcore intersections located near the margin of the graben structure to the east of the local Project area (as can readily be seen in drillholes BP05-002, -003, -004 and -005);
- occasional, undulating and probably steeply inclined discontinuities with well-developed, open void quartz/calcite mineral growth can occasionally be seen in the drillcore (for example, Figure 6);
- similarly undulating and probably steeply inclined but unmineralized and open joints with rough surfaces are regularly developed along all the examined drillcores (for example Figure 7, which joint type forms the vast majority of the discontinuities seen in the examined drillcore);
- occasional planar joints with slicken-sided surfaces are locally and infrequently developed (which AMEC interprets to have flat- to moderate-dips with the direction of movement, suggested by the slicken-siding, to be approximately west to east), for example –
  - at 113.24 m, 130.39 m, 130.68 m, 132.30 m, 133.27 m, 133.97 m and 142.90 m in drillhole BP08-205,
  - between 95.37 m and 100.24 m in drillhole BP08-254,
  - between 67.18 m and 68.10 m and at 95.40 m, 176.40 m and 239.68 m in drillhole BP08-266,
  - between 162.35 m and 162.55 m and between 197.21 m and 198.30 m in drillhole BP09-431, and
  - between 199.88 m and 203.18 m in drillhole BP10-549; and

- a small number of basalt dykes, which are probably related to Pleistocene volcanic activity (see Section 3.2), have been encountered in the drillholes (other intrusives include the few dioritic dykes and micro-sills that have been intersected in holes drilled on the Property – Finch et al, 2011).

Figure 3: A Silicified Fault Breccia in a Sequence of Partial Altered (Chlorite) Andesite Tuffs

(drillhole BP10-560, Box 80 – 174.35 m to 176.45 m, top of section at bottom left)
(taken during AMEC's January/February 2012 site visit)

Figure 4: A Healed but Slightly Weathered Open Void Structure

(note the lack of wallrock alteration/weathering in the andesite agglomerate wallrocks)
(drillhole BP05-022, 86.94 m to 89.12 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit

Figure 5: Coarse Crystalline Infillings in Open Void Structures in a Section of Weakly (hematite) Altered Andesite

(drillhole BP10-673, 343.00 m to 345.10 m, top of section at top left)
(taken shortly after the hole was drilled, supplied by Pan American)

Figure 6: An Undulating and Steeply Inclined to Sub-Vertical Discontinuity with Well-Developed, Open Void Mineral Growth

(drillhole BP10-673, 347.45 m to 349.85 m, top of section at top left)
(taken shortly after the hole was drilled, supplied by Pan American)

Figure 7: An Example of a Steeply Inclined, Undulating and Rough, Unmineralized but Limonite-Stained, Open Joint in Association with a Silicifed Vein Intersection and a Hematite-Altered and Slightly Weathered / Leached Andesite

(note the drilling-related damage to the core along which the discontinuity is developed)
(drillhole BP05-022, 86.94 m to 89.12 m top of section at top left)
(taken during AMEC's January/February 2012 site visit)

3.2 District Stratigraphy

The Property is located in a geological sub-province known as the Altas Llanuras, or High Plains (Finch, 2011). The sub-province comprises a volcanic highland composed of a Tertiary (Paleocene, 65.5 to 56 Ma) to Quaternary (Pleistocene, 2.59 to 11,700 BP) sequence of andesites (oldest), dacite-rhyolites and basalts (youngest) that rest on early Cretaceous sediments (from 146 Ma) underlain by Permian metamorphic rocks (299 to 251 Ma) (Figures 8 & 9).

The metamorphic sequence comprises metasedimentary, graphite- and chlorite-schists with intermittent layers or lenses of quartzite (Finch et al, 2011). The thickly developed, early Cretaceous sedimentary sequence lies nonconformably on the Permian schists; it comprises a massive to macro-bedded, widely to very widely jointed and unremarkable mass of unmetamorphosed and unmineralized polymictic breccio-conglomerates[1] with infrequent layers or lenses of arkosic sandstone. Very occasionally minor zones of weathering-prone, unaltered sedimentary material can be observed, as evidenced by progressive, in-box degradation of the locally clay-rich matrix (Figure 10).

The top of the sedimentary sequence is marked by an angular unconformity with the overlying andesite tuffs and agglomerates of the regionally developed Lower Volcanic Series ("LVS") of the Paleocene to Eocene epochs. According to the dates stated in Finch et al (2011, 65.5 to 34 Ma), the formation of the LVS approximately coincides with the onset of the Laramide orogeny. Drillcore observations show that in places the flows are porphyritic and the tuffs are partly welded. Very locally the LVS contacts the Permian schists (for example, Figure 11), but this stratigraphic variant was not seen in the drillcore examined within the scope of the investigations reported here.

According to Finch et al (2011) the LVS is overlain by thick sequences of rhyolite and dacite ignimbrite, tuff and volcanic breccia of the Oligocene (34 to 23 Ma) Upper Volcanic Series ("UVS"). The UVS is reported to not be present on the Property (Finch et al, 2011) - the closest expressions are exposed in cliffs to the west of the Property area that were not examined during AMEC's site visits.

1 The term breccio-conglomerate, which is used in this report, refers to a rudaceous sedimentary clastic rock containing both angular and rounded clasts. The Cretaceous sequence of breccio-conglomerates found at the La Preciosa project site varies between a sedimentary clastic breccia and a sedimentary clastic breccia conglomerate, which rocks types are sometimes intimately mixed.

Figure 8: A Generalized Stratigraphy of the La Preciosa Project Area

(compiled by AMEC from consideration of the established stratigraphy for the La Preciosa project [as stated in Finch et al, 2011], coupled with drillcore observations made during AMEC's site visit)

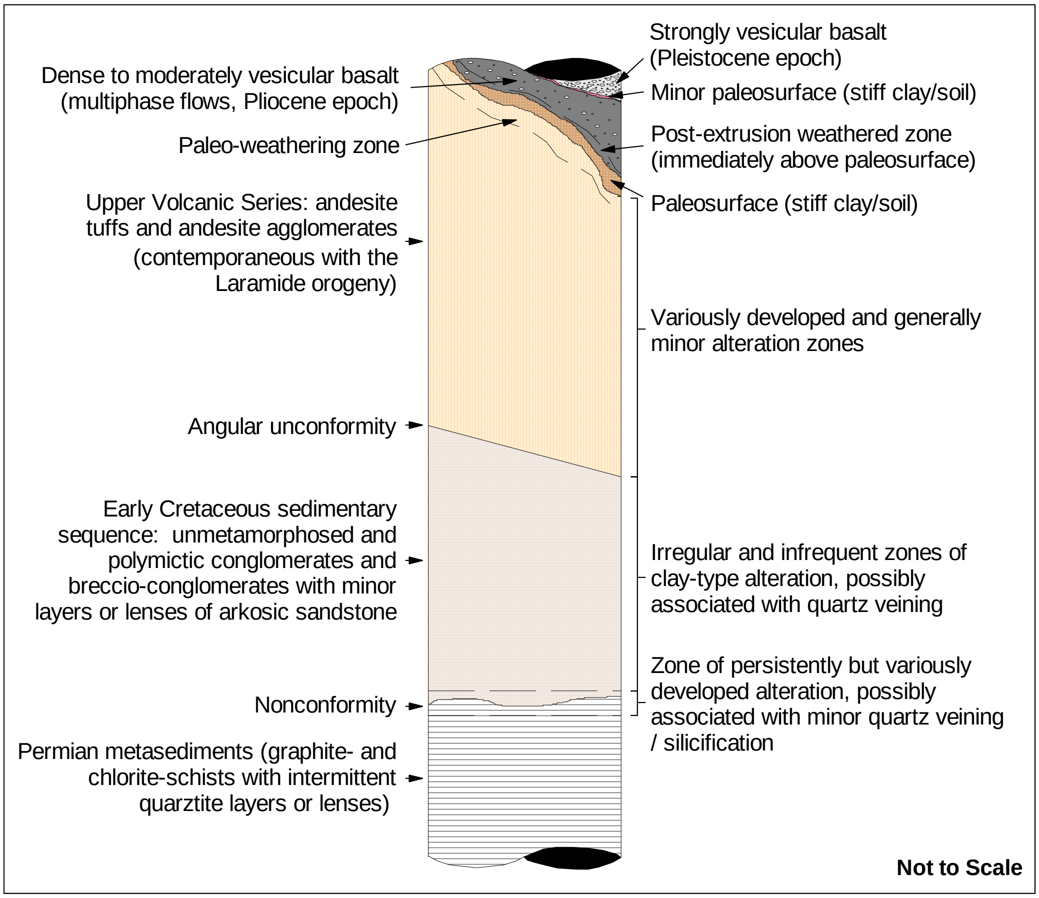


Figure 9: A Sequence of Geological Eras, Periods and Epochs, from the Late Carboniferous Period

(compiled by AMEC from information contained in this report)

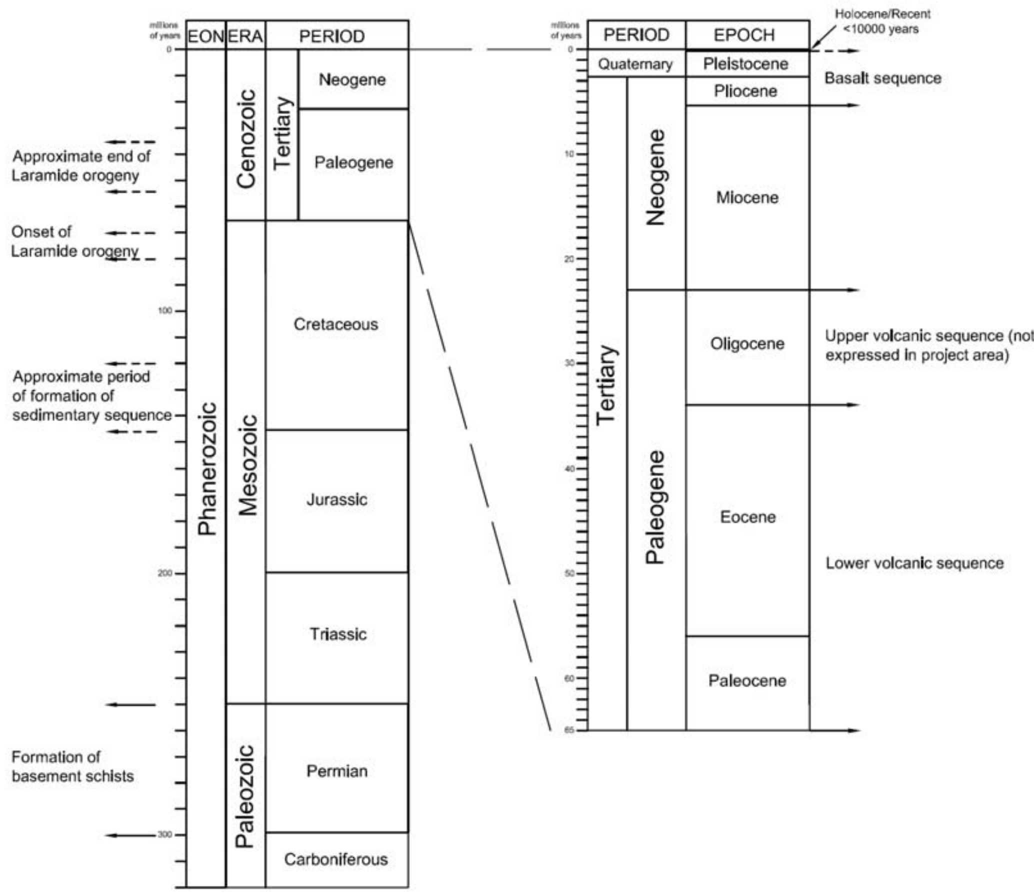
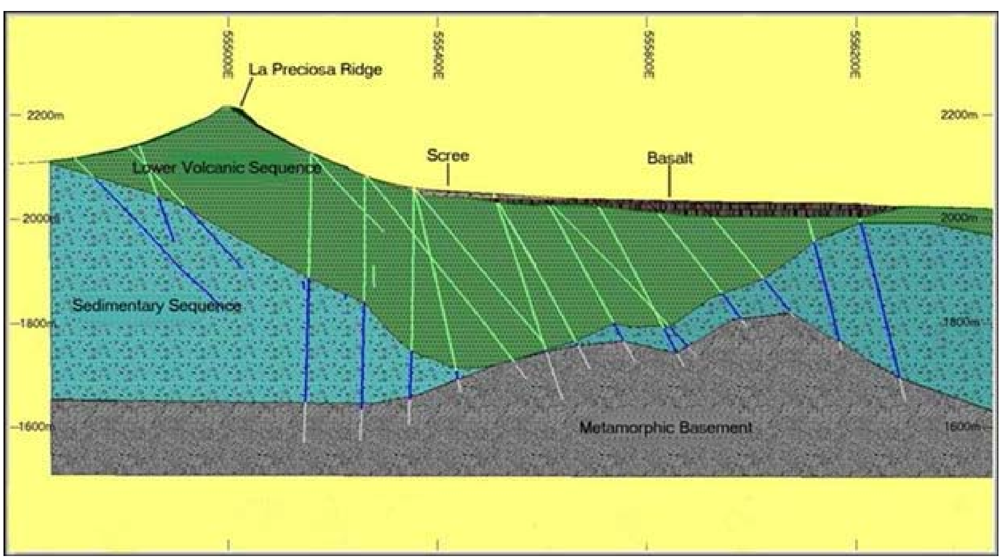


Figure 10: An Example of Progressive Degradation of a Weathering-Susceptible Section of Unaltered Breccia of the Breccio-Conglomerate Sequence

(drillhole BB05-06, 91.55 m to 93.69 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

Figure 11: Geology Section 2701780 mN, La Preciosa Project

(from 'Preliminary Economic Assessment – Technical Report', by Snowden and dated 30 June 2011)



Drillcore evidence shows that the youngest rocks found across the general Property area comprise basalt flows of variable thickness that lie unconformably on the LVS across much of the local Project area. According to Finch et al (2011) they were developed during the Pliocene (5.33 to 2.59 Ma) and Pleistocene (2.59 to 11,700 BP) epochs.

The LVS-basalt unconformity is marked by a generally well-developed paleosurface that comprises a stiff clay/soil with occasional small boulders of silicified material and weathered andesite. Weathering typically extends up into the immediately overlying basalts, for a few metres. Paleo-weathering is evident for up to 15 m below the paleosurface (for example, Figures 12A to G & 13A to F), although the extent and severity of weathering is increased by current/modern-day weathering activity, where the paleo-weathering zone is close to surface.

Figures 12 & 13 demonstrate that at least two main, basalt extrusive phases are present across the local Project area. The lower unit comprises a multiphase package of dense, fine grained and vesicular basalt. The upper flow appears to be thinly developed and it usually has a well-developed vesicular structure.

Figure 12A to G: **An Example of a Paleosurface and Paleo-Weathering Zone**
(drillhole BP10-560, 0.00 m to 54.25 m, with the lower basalt sequence from 3.30 m to 39.80 m missing)
(taken during AMEC's January/February 2012 site visit)

Figure 12A: 0.00 m – 3.30 m (top of section at bottom left)

Figure 12B: 37.65 m – 39.80 m (boxes 2 to 16 missing – basalt sequence only)

Figure 12C: 39.80 m – 41.85 m (top of section at bottom left)

Figure 12D: 41.85 m – 44.90 m (top of section at bottom left)

Figure 12E: 44.90 m – 48.95 m (top of section at bottom left)

Figure 12F: 48.95 m – 51.25 m (top of section at bottom left)

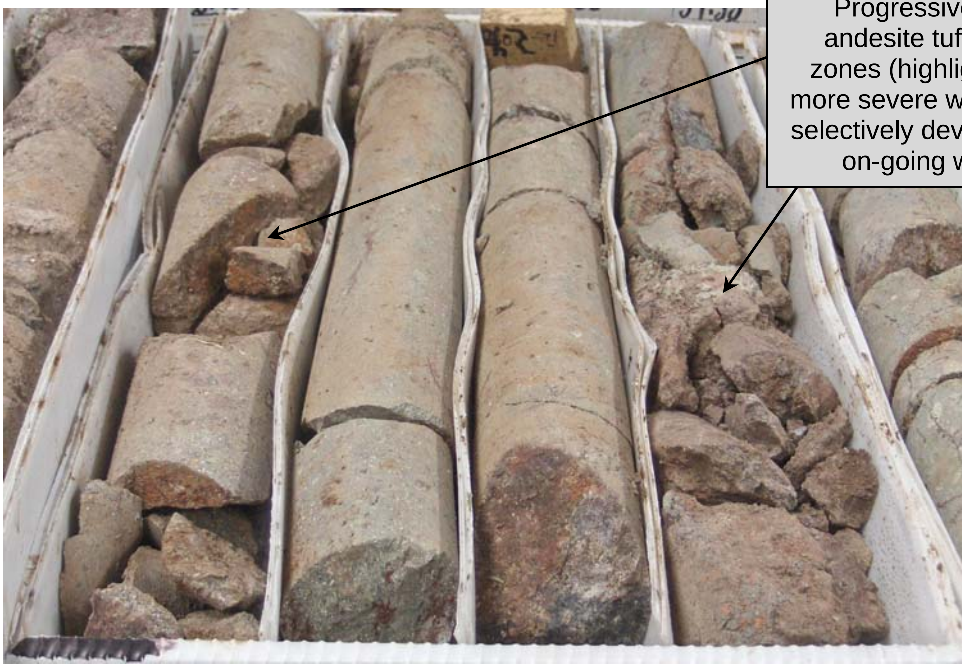


Figure 12G: 51.25 m – 54.25 m (top of section at bottom left)

Figure 13A to F: A Second Example of Paleosurfaces and Paleo-Weathering Zones
(drillhole BP09-431, 20.35 m to 33.10 m)
(taken during AMEC's January/February 2012 site visit)

Figure 13A: 20.35 m – 22.75 m (top of section at top left)

Figure 13B: 22.75 m – 25.00 m (top of section at top left)

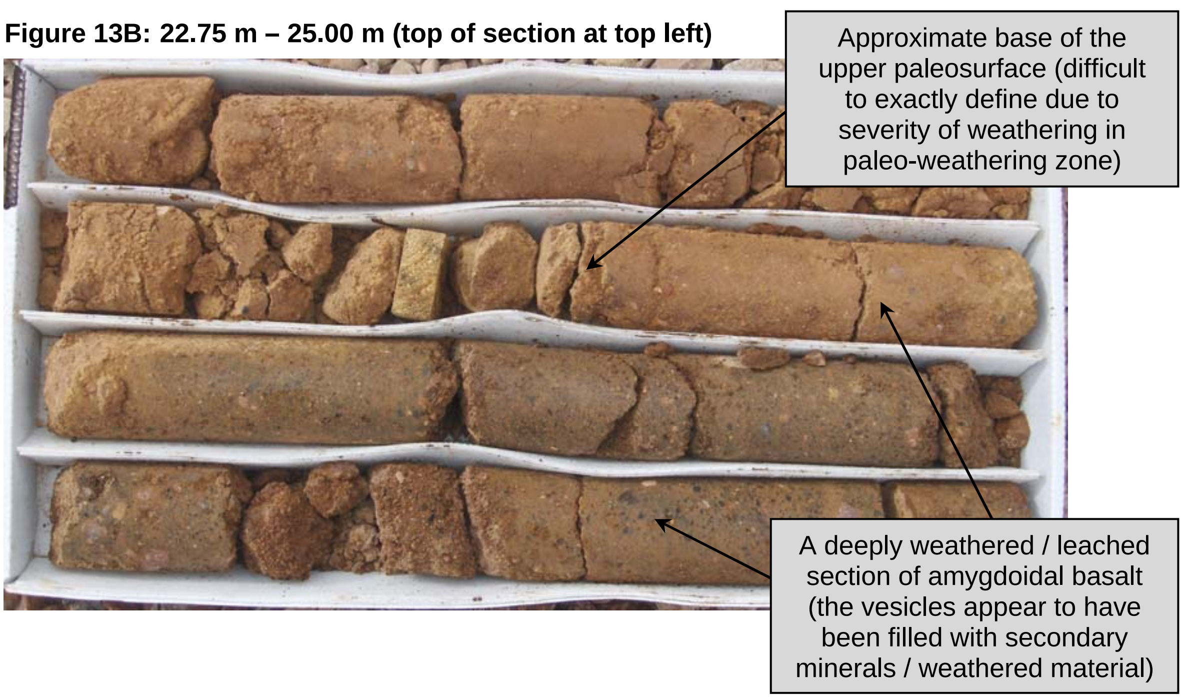


Figure 13C: 25.00 m – 27.35 m (top of section at top left)

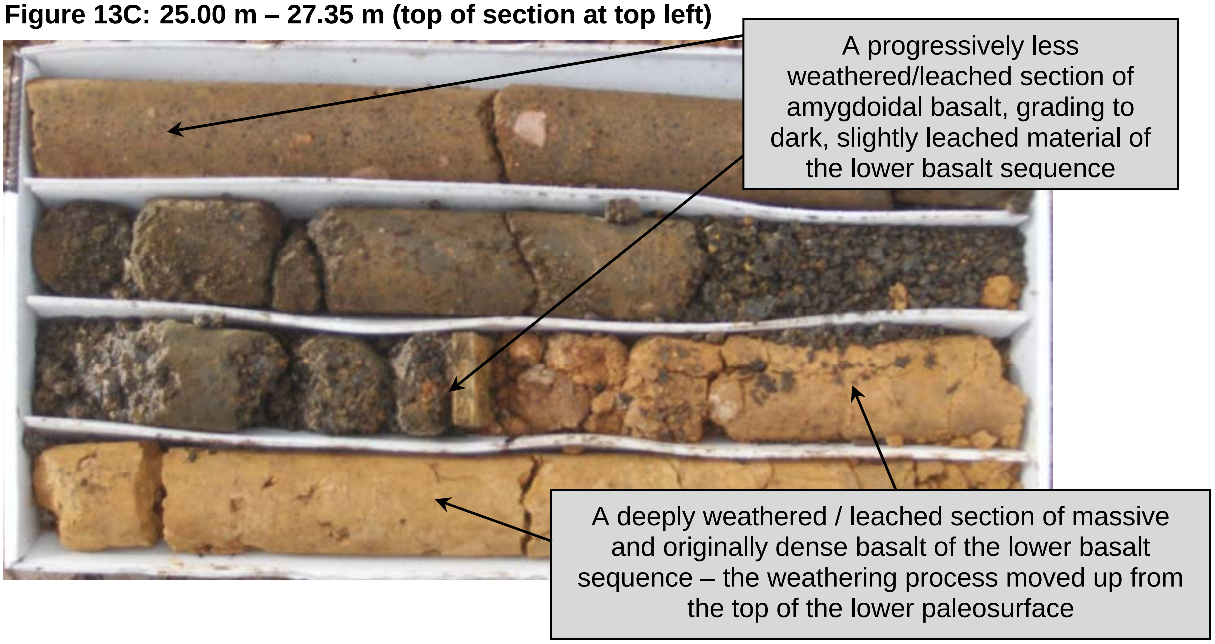


Figure 13D: 27.35 m – 28.65 m (top of section at top left)

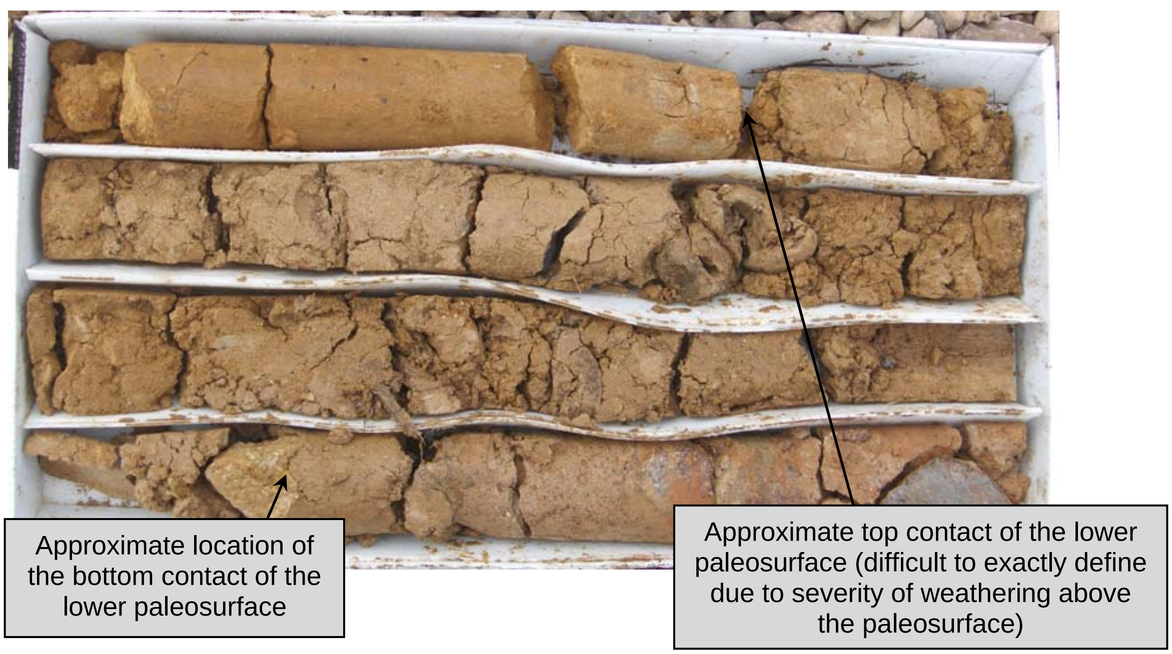


Figure 13E: 28.65 m – 30.80 m (top of section at top left)

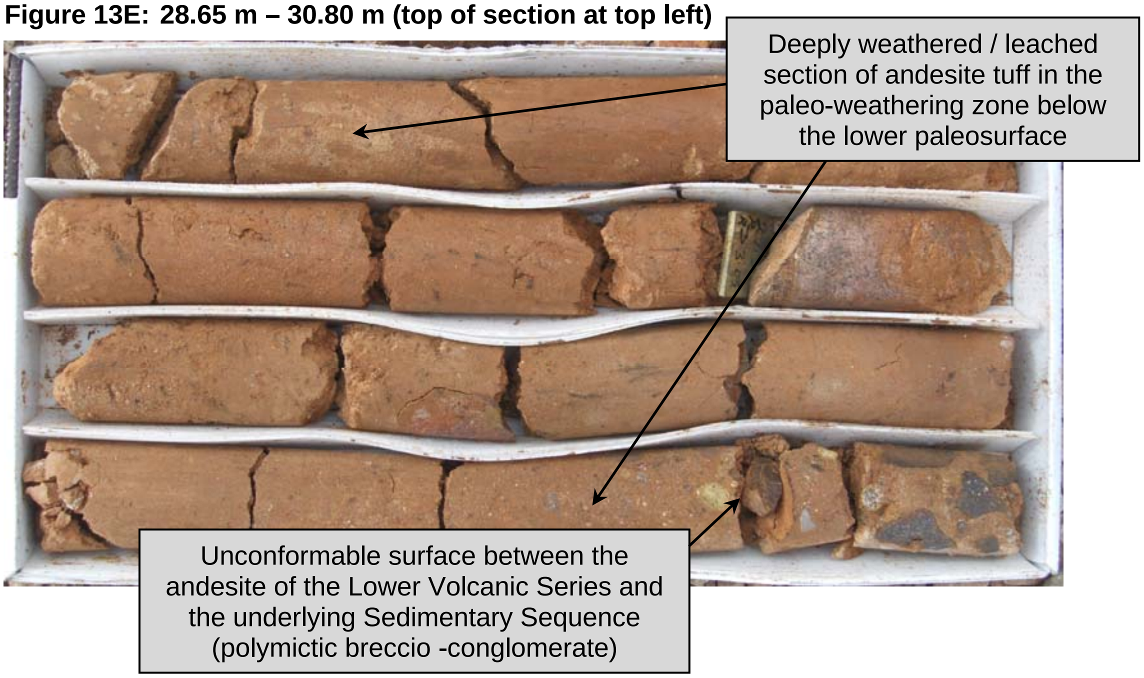
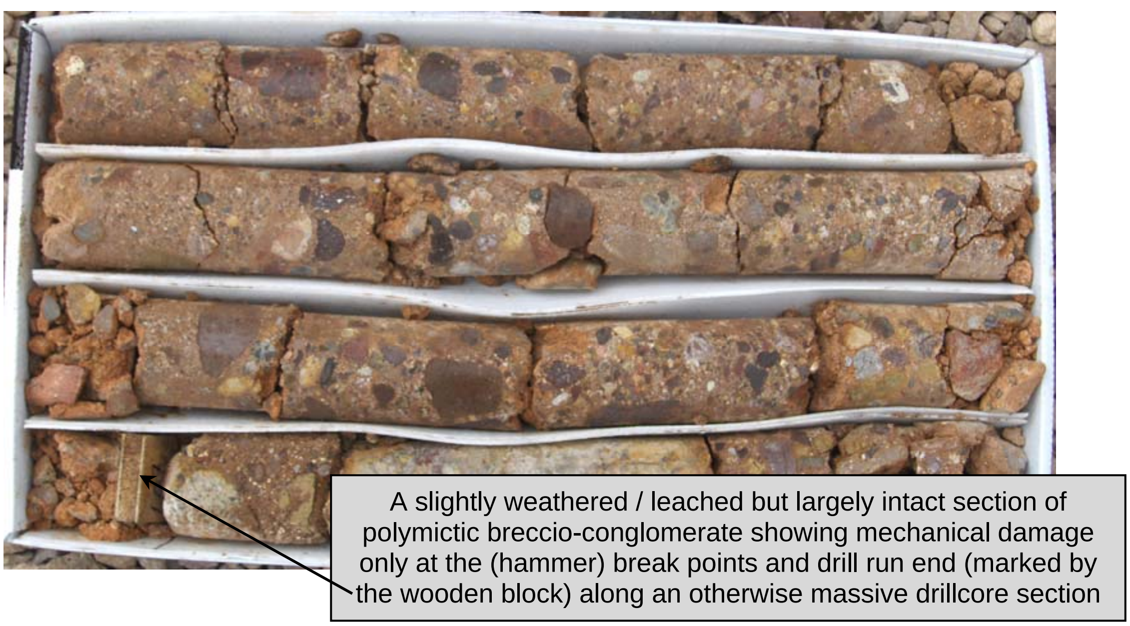


Figure 13F: 30.80 m – 33.10 m (top of section at top left)



The flows were extruded from numerous basaltic volcanic cones and domes that can readily be seen across and around the general Project area; four such vents are located to the immediate north, south and west of the local Project area. Cerro Prieto (Figure 14) in particular appears to be largely intact and unweathered, which suggests that it is probably a geologically recent feature that might date to near the end of the Pleistocene period (which extends to 11,700 BP).

Figure 14: A General View, Looking North from the Side of a Core Shed at the La Preciosa Project Site, of Cerro Prieto, a Basaltic Volcanic Vent
(taken during AMEC's early January 2012 site visit)

3.3 Mineralization

The Tertiary-age, silver-plus-minor-gold mineralization at the Property is predominantly, but not exclusively, vein-hosted (significant grades sometimes extend into the adjacent host rocks). The early Cretaceous sedimentary sequence and the andesites of the early Tertiary LVS are the main host rocks, but the mineralized veins are reported to occasionally extend into the Permian schists (Finch et al, 2011).

According to Finch et al (2011), '*eighteen geologically continuous veins have been defined by extensive diamond drilling intersections. The principal vein, Martha Alta, extends along strike for a distance of 3 km and has a width of approximately 1.5 km.*

All the vein sets strike roughly north-south except for two cross cutting veins (Transversal Norte and Transversal Sur). The dip of the individual veins varies, with some steeply dipping vein sets to the northwest close to surface, and others dipping shallowly, either close to the surface or at depth. There are three main sets of veins present at La Preciosa, including:

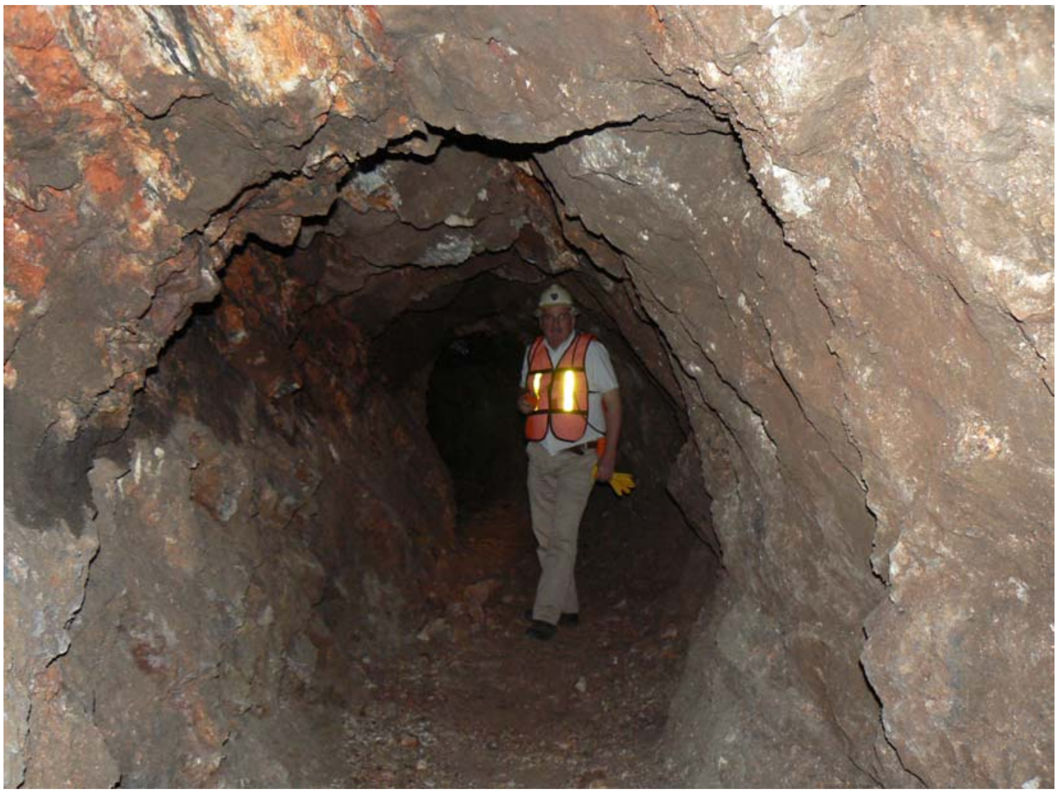
- *Martha veins dipping at moderate angles (approximately 20° to 30°) towards the southwest (235° to 260°);*
- *steeper dipping veins sitting above Martha (approximately 55° to 70° dip towards around 260°); and*
- *Transverse veins (50° dip towards 170°)'.*

According to Finch et al (2011), the veins may be described as discrete, poly-phase quartz veins that often display banded, smoky, drusy and chalcedony textures. Fluorite, amethyst, a substantial number of barite laths and both calcite and rhodocrosite can also be present. Base metal, sulphide mineralization occurs in the form of sphalerite, galena, pyrite and chalcopyrite; iron and manganese oxides have also been noted in drillcore. The principal silver-bearing mineral is acanthite (a low temperature modification of silver sulphide) that is pseudomorphed after argentite or is developed as microcrystalline to amorphous grains. Sparse native silver and free gold are also present (Finch et al, 2011).

4.0 HISTORICAL MINING ACTIVITY

There are some 2.5 km of underground drifts and associated stopes that follow the Abundancia and La Gloria veins, as well as a small portion of the Transversal vein. The original workings comprise drifts that are up to approximately 1.9 m high and approximately 1.5 m wide (for example, Figure 15) that are reported by Orko Silver Corp. to be over 100 years old.

Figure 15: An Example of the Early, Abundancia Vein Workings at La Preciosa
(taken during AMEC's early January 2012 site visit)

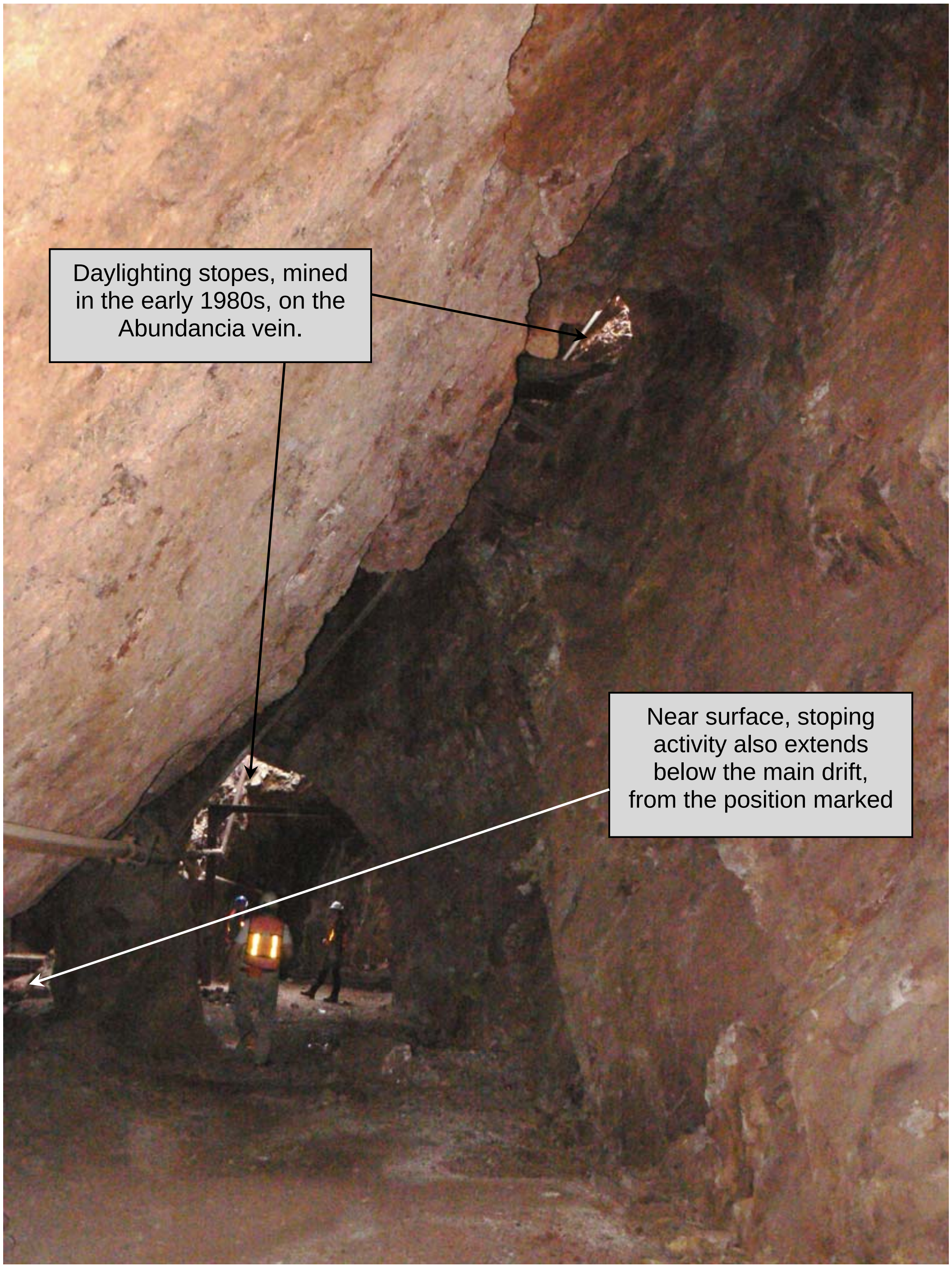


In the early 1980s, approximately 60% of the drifts were roughly slashed / slyped to nominal dimensions of 3 m by 3 m (information supplied by Orko Silver Corp.), although widths of up to 5 m were locally seen during AMEC's underground visit. A large-span, unsupported intersection exists where a slashed / slyped crosscut joins the slashed / slyped Abundancia vein drift (Figure 16). Largely unsupported, open stopes with local spans of up to approximately 20 m (estimated underground by AMEC) were occasionally mined, especially near surface (for example, Figure 17). Some of the stopes daylight at surface, the evidence for which can readily be seen both underground and at surface, the latter along the eastern flank of La Preciosa Ridge, immediately up-slope of the core storage sheds.

Figure 16: A General View, Looking Approximately West) of the Large Span Intersection Area Where A Crosscut Meets the Adundancia Vein Drift
(note the lack of any support and the limited amount fallen material on the footwall of the drift)
(taken during AMEC's early January 2012 site visit)

Figure 17: A General View, Looking Approximately North, of Some of the Near Surface and Large Span, Abundancia Vein Stopes in the Historical La Preciosa Workings

(note the lack of any support and lack of any fallen material on the footwall of the drive)
(taken during AMEC's early January 2012 site visit)



5.0 ROCKMASS CHARACTERISTICS

5.1 Structural Considerations

5.1.1 East-West Faulting

The local Project area is disturbed by a number of approximately east-west trending faults:

- fault structures are clearly evident in a number of drillcores (for example BP09-438 and BP10-560);
- the northern limit of the La Preciosa mineralization is probably marked by a strike-slip fault (Finch et al, 2011); and
- the Tranversal vein, that trends approximately east-west, is selectively developed along a south-dipping fault with an approximate east-west trend.

The available drillcore evidence suggests that the approximately east-west trending faults are probably composite fault zones comprising a number (or series) of minor to intermediate offsets, which general lack of displacement is confirmed by the available La Preciosa block model that suggests minor fault displacements only. The one exception might be the strike-slip fault that is postulated to mark the northern boundary of the identified La Preciosa silver-gold mineralization.

The available drillcore evidence shows that the fault zones are comprised of loose, closely jointed, generally weathered and water-bearing material. It may, therefore, reasonably be anticipated that the fault zones will inevitably influence planning and design considerations for both open pit and underground mining. For example, they could affect pit slope positions and profiles. They would certainly have to be developed through (as opposed to stoped through) underground, with the result that they should be considered to be sources of geological losses within the scope of Mineral Reserve estimation for underground mining.

The specific positions, trends and widths of the approximately east-west trending fault zones have yet to be established, which data would be central to the completion of any design and planning study at the pre-feasibility stage of Project development. AMEC recommends that a three-dimensional fault model is compiled through consideration and analysis of the positions of the fault planes and fault zones intersected in the completed drillholes, using a suitable geological modeling package. For example:

- identified fault zones can be treated as lithological intervals along individual drillcores strings and, by rotating the compiled model in three-dimensional space, structural trends can be defined; however
- drillholes that do not contain any fault zones / evidence of faulting activity should be included in the model to ensure that fault zones or trends are not interpolated or extrapolated within or through undisturbed rockmass areas; and
- sometimes very long fault zone intersections can reasonably be expected in a number of the drillcores, which does not necessarily reflect either substantial or widely developed fault zones –
  - the estimated, average faulting trend is closely similar to the predominantly west to east direction of exploration drilling that has been completed to date, and the majority of the completed holes were drilled at 60º to 65º, and
  - it is because of this that it would be advisable to test the validity of a compiled three-dimensional fault model by drilling (triple tube) cored and selectively positioned, orientated holes to intersect the interpreted fault zones, as close to perpendicular direction of their average inclination as possible.

It appears from consideration of the available drillcore geology logs that the fault zone intervals were not consistently logged. In view of this, AMEC suggests that a refreshed database of fault zone intersections be compiled, using the original / immediate post-drilling photologs as the basis for analysis. The latter point is emphasized because of the current condition of the drillcores and the scope for misinterpreting clay-rich and mechanically degraded intersections as fault zones, as later described.

5.1.2 Localized Jointing

Apart from the fault structures outlined, no evidence for conventional fault zones (i.e. closely jointed areas immediately adjacent to a fault plane) or shear zones (i.e. clusters of approximately parallel discontinuities suggesting localized, minor rockmass displacement) could be found in the examined drillcores. Indeed, the available drillcore evidence suggests the bulk of the La Preciosa rockmass is not persistently disturbed by well-defined discontinuity sets that could interact to consistently form discrete blocks, slabs and wedges. It may instead be described as massive to widely jointed, between and away from the approximately east-west trending faults.

Observations made underground only serve to emphasize the points made. However, the evidence of the surface outcrops along the La Preciosa ridge, along with observations made underground, highlights the presence of persistent joint planes parallel to the average dip of individual veins. A general lack of cross-cutting discontinuities is nevertheless apparent, which key point was confirmed by observations made underground:

- only a few, small and irregularly developed wedges were seen in the crowns / inverts / hangingwalls of the drifts; but
- a 'saw tooth' (or more conventionally a 'factory-roof') type failure profile was seen in the east-west orientated crosscut excavations that were developed in the dip direction of the veins and vein-parallel joints.

The extent of wallrock instability was doubtless made worse by the poor quality of slashing / slyping along the drifts and crosscuts (blasting sockets at approximately 45º to the average plane of the drift hangingwall/invert/crown were seen). Despite this the ground may, on average and excluding the east-west trending fault zones, be classified as good and locally very good. In AMEC's opinion, there is no readily available evidence to suggest that instability potential arising from vein-associated jointing could not successfully be controlled through the use of appropriate support strategies.

5.1.3 Mineralized Veins

The vein material typically contains irregularly developed vugs and voids in which open-space crystal growth may commonly be seen. This important characteristic resulted in sometimes extensive drillcore damage during the drilling process, which was probably caused by high bit pressures (that are typical of production-type exploration drilling) and drillcore grinding across intersected vugs, voids and and open joints. Figures 18, 19 & 20 provide examples of the type of drillcore damage outlined. Where vugs and voids are lacking or not well-developed and where open joints are not intersected, the available evidence suggests that the vein intersections comprise good to very good quality material.

Examination of drillcore intersections of the veins in which historical mining took place confirmed the observation made: although the drillcore intersections are sometimes closely broken by drilling activity, underground the same veins appear massive and intact, albeit that bulk strength-reducing vugs and voids are randomly distributed and irregularly developed.

Figure 18: An Example of Moderately Drilling-Damaged, Vuggy Vein Material with Minor, Selective Limonite Accumulations
(drillhole BP06-079, 71.98 m to 74.29 m)
(taken during AMEC's January/February 2012 site visit)

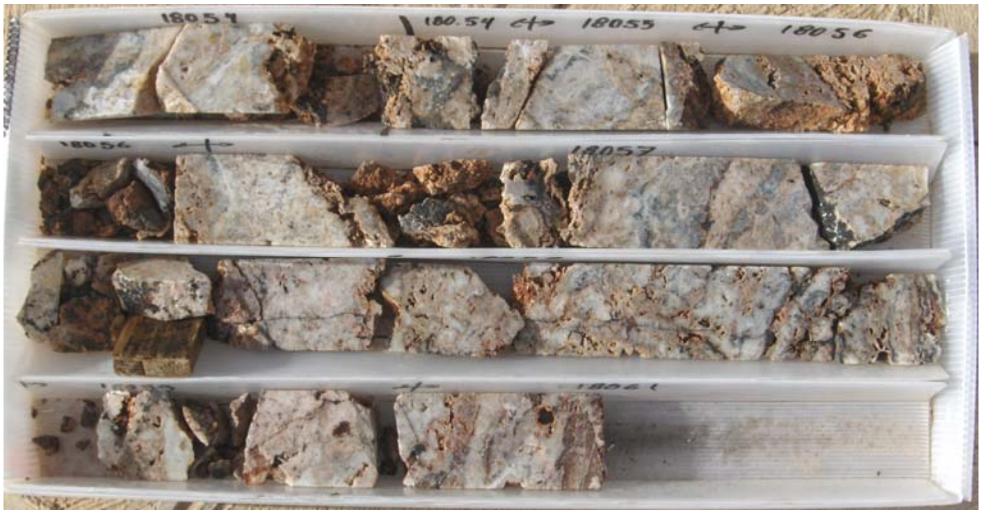


Figure 19: An Example of Extensively Drilling-Damaged, Vuggy Vein Material with Minor, Selective Limonite Accumulations
(drillhole BP06-079, 116.05 m to 118.11 m)
(taken during AMEC's January/February 2012 site visit)

Figure 20: An Example of Extensively Drilling-Damaged Vein Material, due to the Presence of Minor Vugs and, Most Importantly, Sub-Vertical, Open Joints
(drillhole BP10-467, 121.80 m to 123.95 m)
(taken in 2010, shortly after the hole was drilled, photolog supplied by Pan American)

To depths of at least 150 m below surface ("bs") the vugs and voids can contain limonite (for example, Figures 18 & 19) which, in combination with drilling-related damage of the type outlined, can lend the appearance of fault-affected (or at least disturbed) drillcore sections of vein material. Again, the visual evidence of vein material seen underground shows this not to be the case – where surface weathering extends to the vein horizons, pervasive groundwater penetration and limonite deposition in vugs, voids and along open structures is evident.

5.2 Weathering & Groundwater Penetration

5.2.1 The Main Surface Weathered Zone

The paleo-weathering zone described in Section 3.2 is a distinct rockmass feature that is separate from the main surface weathered zone: the former is closely associated with the stiff clay/soil paleosurface; whereas the latter extends from the current surface. The base of the main weathered zone is marked by the deepest expression of persistent alteration / leaching of the rocks' fabrics, which depth varies widely according to the type of sub-outcropping rock. For example, away from the approximately east-west trending fault zones in which much deeper surface weathering may reasonably be expected to be selectively developed, the following may be observed:

- where the LVS sub-outcrops the surface soil cover can be up to 3 m thick and the main surface weathered zone can extend to between approximately 20 m and 30 m bs (as, for example, can be seen in drillcores BB05-005 and BP06-079); whereas
- where a basalt sub-outcrops, the surface soil can be less than one metre thick and the main surface weathered zone can extend to only a few metres below surface (as, for example, can be seen in drillcore BP10-560); however,
- where the paleo-weathering zone falls within or close to the main surface weathered zone, the result can be deeply weathered / leached rocks to depths of as much as 65 m bs (as, for example, can be seen in drillcore BP10-579).

In each case, the weathered material may be described as loosely consolidated, weak to very weak, water-bearing and clay-rich. It is only where quartz veining extends to surface that hard, abrasive material is encountered, but this appears to comprise various small- to medium-sized boulders surrounded by deeply weathered, residual vein material.

5.2.2 Groundwater Penetration

The extent and severity of selective weathering below the main surface weathered zone is controlled by the presence or lack of groundwater, hence the type / aperture and presence or lack of discontinuities, as well as the prevailing rock type. The most common water-bearing discontinuities are by far the sub-vertical, undulating open joints of the type earlier outlined (for example, Figure 7 and supporting text) that may readily be identified throughout the general rockmass. Near surface, they can contain more than one centimetre of clay with small rock fragments (Figure 21), which infilling type can be seen underground in the historical mine workings.

Figure 21: Sub-Vertical and Undulating Open Void Joint with Thick Limonite Infillings
(drillhole BP08-254, 7.95 m to 10.16 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

There is a general thinning of limonite infillings with increasing depth, although the details of the locally developed thicknesses are complex: in large measure they reflect the quantity of groundwater movement, hence the aperture and continuity of what may reasonably be described as weakly compressed, loose or even open structures, the frequency and details of which vary across the local Project area. Figure 22 provides an example of a fairly deep drillcore section (320 m along the drillcore, or approximately 300 m bs) that intersects what is interpreted to be a steeply dipping to sub-vertical and undulating, open joint with a minor limonite clay infilling[2]. In other drillcores, little or no limonite infilling may be present at similar depths, although minor limonite infillings tend to persist to at least 320 m bs. At greater depths, the presence of groundwater in discrete discontinuities is in general marked by iron staining only. No evidence of groundwater movement was seen in the examined drillcores at depths greater than approximately 350 m bs.

[2] The dip of the type of undulating discontinuities seen on Figures 21 & 22 must, as a minimum, approximate to the inclination of the drillhole for them to be expressed in the manner shown (the holes were usually drilled at between 60° to 65° to the east, some were drilled at 90° but BP08-254 and BP08-266 were drilled at 75º to the east). That they must be open, or least weakly compressed, is suggested by what must be excellent (but selective) hydraulic continuity throughout the general rockmass for groundwater to have penetrated to at least 350 m bs. Put another way, the discontinuity seen on Figure 21 could only be open, hence water-bearing and limonite infilled, if it was steeply inclined:

- the vertical component of pre-mining stress must approximate to cover load at any point of interest; therefore
- at 300 m bs its magnitude would approximate to 8 MPa, which amount would tend to tightly compress any moderate- to flat-dipping feature (as much is suggested by the preferential development of limonite infillings along steeply inclined discontinuities - infillings along flat-dipping structures that are intersected at similar depths tend to comprise iron oxide staining only).

Figure 22: Sub-Vertical and Undulating Open Void Joint with Minor Limonite Infilling
(drillhole BP08-266, 320.26 m to 323.01 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

Figures 21 & 22 also demonstrate that porphyritic andesite of the LVS and the breccio-conglomerates of the early Cretaceous sedimentary sequence tend to be weathering resistant (the extent of wallrock alteration / leaching below the main weathered zone is typically very limited). The exceptions include zones where clay mineral assemblages are present in the sedimentary sequence (for example, Figure 9 above) or where intense alteration activity is locally developed (Section 5.3). Very occasionally, clay-rich infillings can also infrequently be found along discrete discontinuities in the sedimentary sequence (for example, Figure 23), which suggests locally above-average groundwater penetration, or even flow, along open discontinuities.

Figure 23: A Rare Example of Severe Local Weathering of Otherwise Intact and Fresh Breccio-Conglomerate, the Former as Marked by the Clay-Rich Material Near the Top of the Drillcore Section
(drillhole BP08-266, 158.99 m to 161.88 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

In marked contrast, unaltered andesite-agglomerates and -tuffs can be especially sensitive to surface weathering effects, resulting in broad sequences of intermingled, unweathered and partly weathered material that can extend to depths of approximately 180 m bs. The weathered sections within such sequences are always associated with water-bearing structures that are invariably steeply inclined to vertical (AMEC's interpretation, as earlier described), undulating and infilled with variable amounts of limonite. Figures 24 to 27, inclusive, provide examples of this. In each case the strength of the weathered material can be reduced over short intersection lengths. More typically, fabric leaching results in only minor strength reductions, compared with unweathered material. However, any micro-veinlets, that can sometimes be extensively developed, tend to reflect minor in situ weathering that causes them to break readily in the drillcore trays (but not necessarily during the drilling process). In these cases, selective weathering is typically evidenced by often weakly developed iron oxide staining and a sometimes crumbly nature of thinly developed calcitic infillings in particular.

Figure 24: An Example of Local Weathering / Leaching of an Otherwise Intact and Fresh but Locally (hematite) Altered Andesite Tuff of the LVS
(drillhole BP05-006, 105.70 m to 107.95 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

Figure 25: An Example of Selectively but Deeply Weathered / Leached Andesite Agglomerate of the LVS, in a Zone Affected by Sub-Vertical Open Joints (marked by limonite infillings) Approximately 50 m below the Base of the Main Surface Weathered Zone
(drillhole BP08-211, 63.98 m to 66.35 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

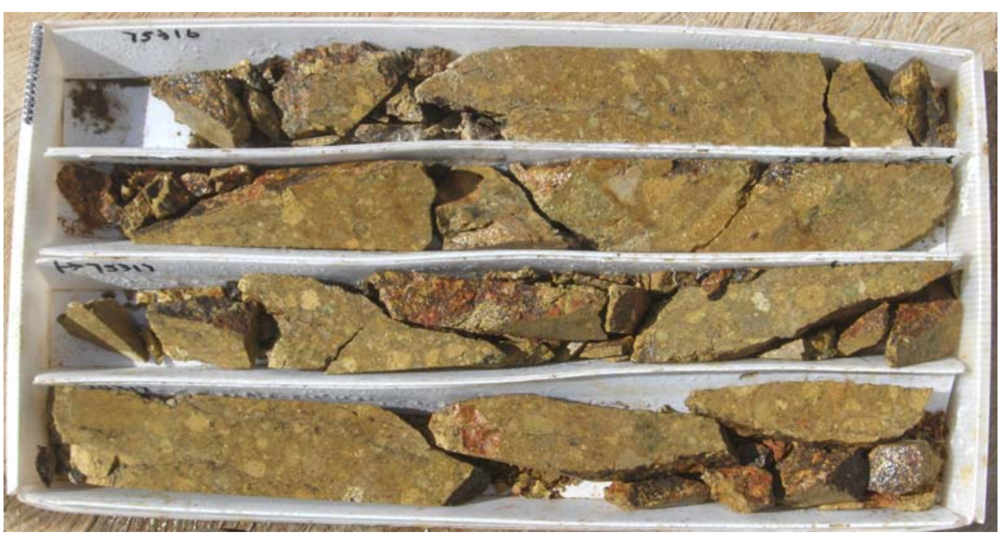


Figure 26: An Example of Selectively and Slightly Weathered / Leached Andesite Agglomerate of the LVS, in a Zone of Otherwise Massive, Fresh and Unweathered Material
(drillhole BP10-673, 116.40 m to 118.65 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

Figure 27: An Example of Selectively and Slightly Weathered / Leached Andesite Agglomerate of the LVS, in a Zone of Micro-Fracturing Associated with Hematite Alteration
(drillhole BP10-560, 192.35 m to 194.35 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

5.3 Alteration

The wallrocks adjacent to the mineralized veins are variously silicified (Finch et al, 2011). Hematite alteration is especially common within the LVS (it appears to be absent in the sedimentary sequence and schists), but it is nevertheless selectively distributed in what appear to be narrow zones within an otherwise routine sequence of variously developed andesites. Propylitic alteration is reported to be distally developed (Finch et al, 2011), but no direct evidence of this alteration type was seen in the examined drillcores - although:

- what appears to be intense chloritic alteration was seen in two narrow, discrete zones in the LVS;
- a clay-alteration type was seen in the early Cretaceous sedimentary sequence; and
- what is termed propylitic alteration in the available drillcore geology logs appears to be selectively developed at and around the nonconformable schist-sedimentary contact, in association with minor quartz veining that appears to be of the high temperature type (as distinct from the mineralized veins).

5.3.1 Hematite Alteration

Hematite alteration appears to be sporadically developed throughout the LVS. At its lowest intensity it appears as micro-veinlets marked by dark red to purple infillings and minor wallrock penetration of the alteration fluids (for example, Figure 28). With increasing severity, minor pervasive alteration develops (for example, Figure 29). Where severe, pervasive alteration occurred the affected drillcore sections can degrade in-box, insofar as opening along alteration-related micro-fractures tends to occur, reducing what might otherwise be largely intact drillcore lengths to loose masses of angular fragments. With the addition of water (as a result of drilling, during logging, in preparation for core photography or during drillcore splitting) or as a consequence of progressive in-tray degradation under the influence of atmospheric moisture, pervasively altered rocks can eventually break-down to closely fragmented masses with little or no intrinsic strength.

The degradation of severely (hematite) altered porphyritic andesite is especially noticeable when surface weathering is added to the mix (for example, Figure 30). In these cases, the balance of information suggests that the degradation process can occur in situ, or at least that leaching of the altered rock fabric can reduce it to residual rock with little or no intrinsic strength. With further, in-box degradation the rock can reduce to the type of loosely consolidated mass suggested by Figure 31. In these cases, the presence of a water-bearing discontinuity (i.e. the source of the rock fabric-leaching agent) is evidenced by the localized presence of limonite clay, which infill type is typical and widespread to depths of at least 320 m bs, as earlier outlined.

Figure 28: An Example of Selective to Minor Pervasive Hematite Alteration and Wallrock Weathering / Leaching in Andesite Tuff of the LVS
(drillhole BB05-006, 116.43 m to 118.61 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

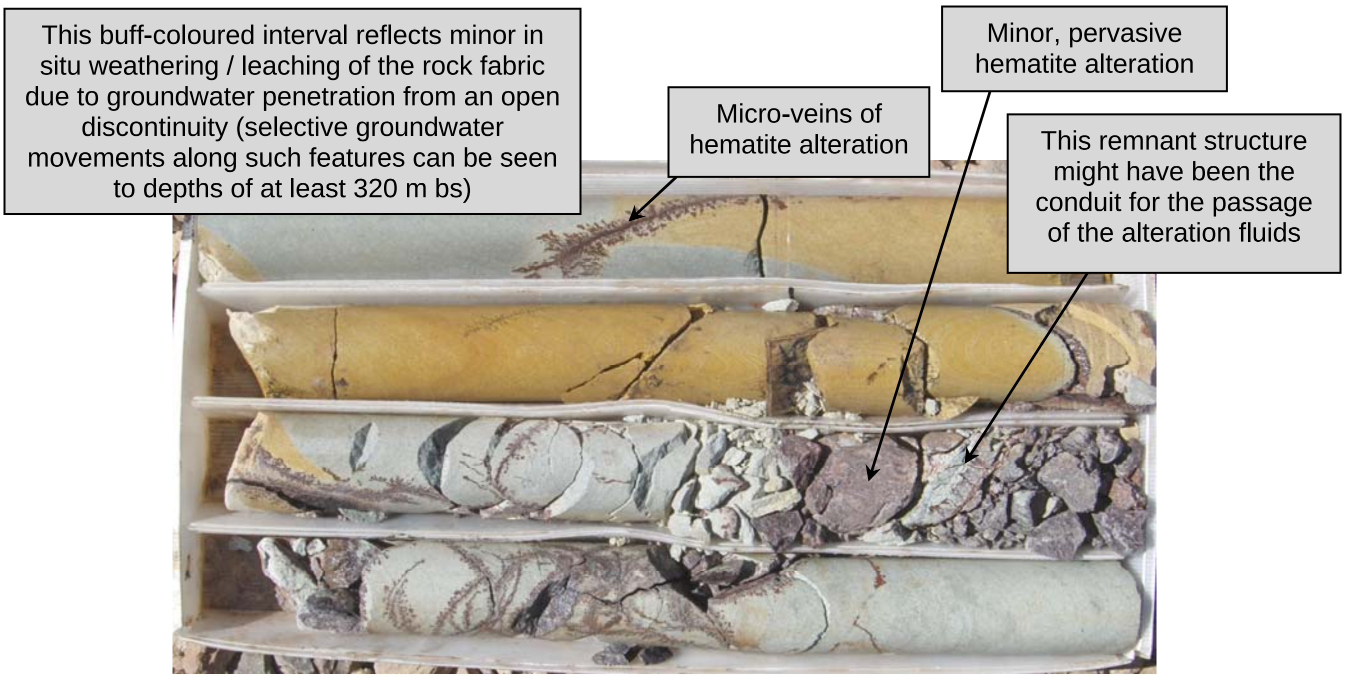


Figure 29: An Example of Minor Pervasive Hematite Alteration and Wallrock Weathering (leaching) of Andesite Tuff of the LVS
(drillhole BB05-022, 95.70 m to 97.80 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

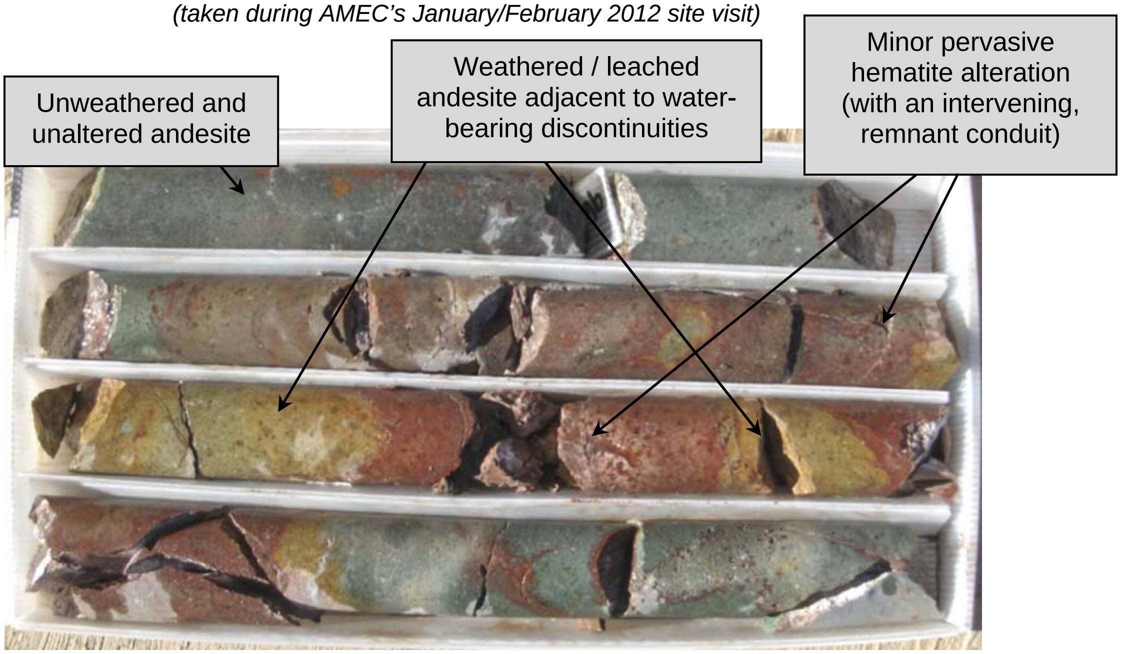


Figure 30: An Example of Surface Weathering Effects on Minor Zones of Pervasive Hematite Alteration within a Generally Weathered (leached) Section of Andesite Tuff of the Lower Volcanic Series
(drillhole BP06-079, 133.50 m to 135.71 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

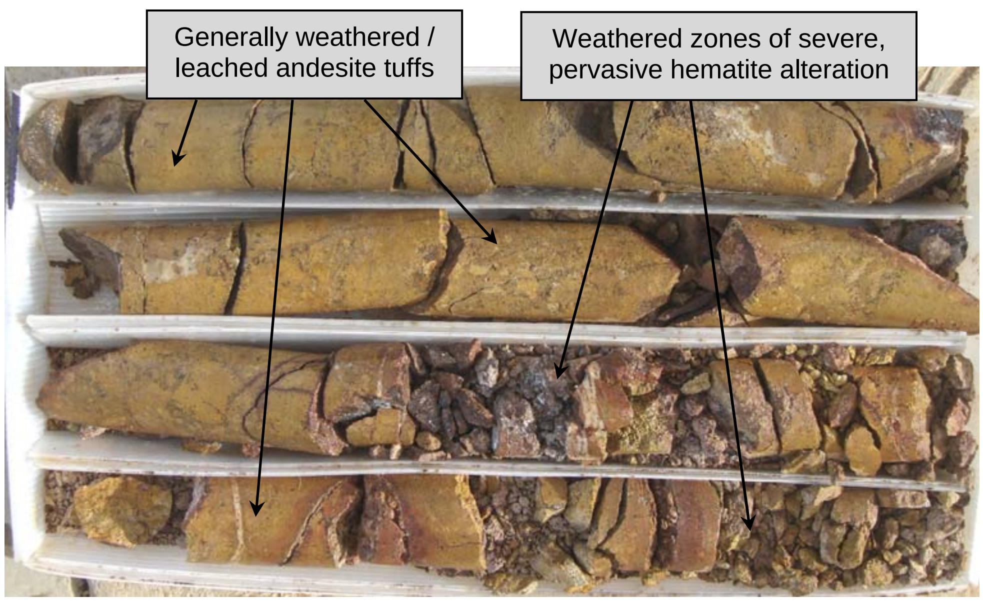


Figure 31: An Example of In situ Weathering Effects and In-Box Degradation of a Zone of Severe and Pervasive Hematite Alteration of Porphyritic Andesite of the Lower Volcanic Series
(note the lack of any limonite)
(drillhole BP06-079, 146.19 m to 148.40 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)

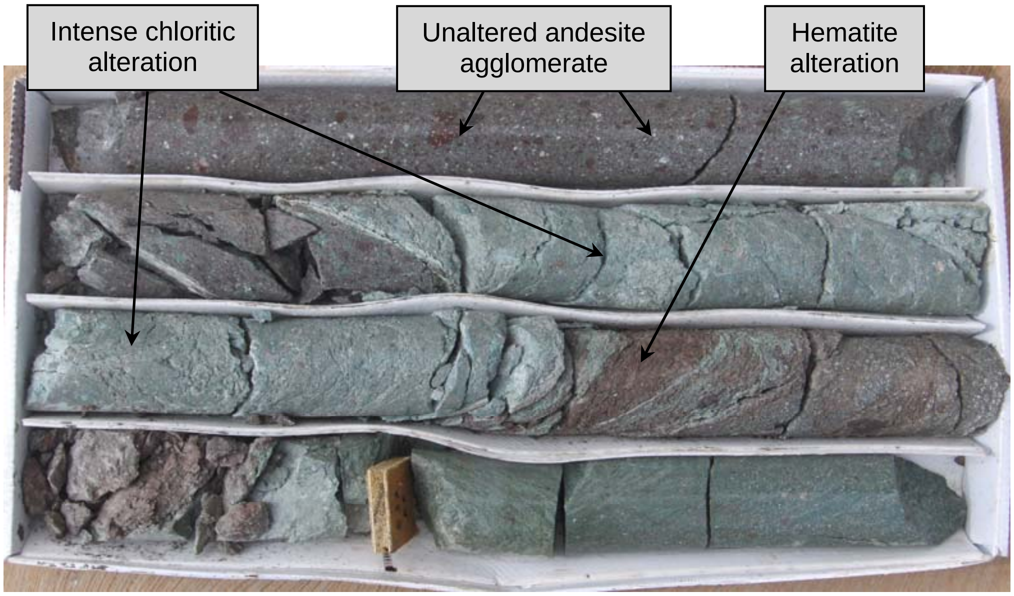
Variations on the theme of hematite alteration-related rockmass degradation are wide and complex. However, the same key findings pertain - where hematite alteration is pervasive and severe and especially where porphyritic andesites are developed:

- if left exposed / in an uncontrolled state, progressively worsening, local rock slope and underground wallrock degradation can be expected, even where no percolating groundwater is experienced; and
- where pervasive or selective rockmass weathering is in addition present, locally rapid degradation to a weak, residual mass can be expected in both open pit and underground excavations.

5.3.2 Chloritic Alteration

Locally intense chloritic alteration was seen along short drillcore lengths, in what appear to be narrow, discrete zones within andesites of the LVS. Figure 32 provides an example of this, from which it can be seen that the affected drillcore is breaking-down into a weak, loosely consolidated mass.

Figure 32: An Example of Locally Intense Chloritic Alteration of an Andesite Agglomerate of the LVS
(drillhole BP09-431, 161.85 m to 164.00 m, top of section at top left)
(taken during AMEC's January/February 2012 site visit)



A remnant structure is apparent in the altered section shown on Figure 32, which may be weak foliation or an expression of ductile deformation. This suggests that the observed alteration might be closely confined within the original hot-fluid conduit. The close proximity of apparently fresh and unaltered andesite tends to confirm this assumption, hence the potential for continuous structural conduits that might originally have been fault- or shear-zones. Whatever the case, AMEC recommends that the continuity of these structures should be assessed through three-dimensional analysis of drillcore intersections. This key point is emphasized because if the alteration is confined to persistent conduits, they could act as planes of preferential rockmass parting that could affect the bulk stability of either open pit slopes or underground stopes, depending on their position or positions relative to a planned or mined excavation.

5.3.3 Clay Alteration

Figures 33A/B to 36A/B, inclusive, are paired photologs of drillcore intersections of clay-altered breccio-conglomerate of the early Cretaceous sedimentary sequence. The A-series of photologs were taken shortly after the holes were drilled in 2010 (they were supplied by Pan American Silver); the B-series were taken during AMEC's January/February 2012 site visit. It is clear that significant drillcore degradation has occurred, from the massive, competent and intact condition photographed in 2010 to the clay-rich, highly broken and weak to very weak state of remnant material that currently exists.

Close examination of the remnant material, evident in the B-series photologs, showed that while uncertainty exists as to the reasons for the presence of clay, it is probably a consequence of alteration. This is stated because the affected drillcore has the general appearance of being slightly bleached (in marked contrast to unweathered material of the same sedimentary sequence, it appears to be grey to light grey, with a light green tinge). The degradation process was probably the result of the addition of water (during drilling and logging, in preparation for core photography or during drillcore splitting) and/or progressive in-tray degradation due to the influence of atmospheric moisture.

Figure 33A/B: **Drillhole BP10-673, 355.95 m to 358.10 m**
(top of section at top left in either case)
(note the hematite alteration of andesite, which alteration
(type/mineralogy is lacking in the breccio-conglomerates)

Figure 33A: photolog taken in 2010 (supplied by Pan American Silver)

Figure 33B – photolog of the same drillcore as seen in Figure 33A, taken during AMEC's January/February 2012 site visit

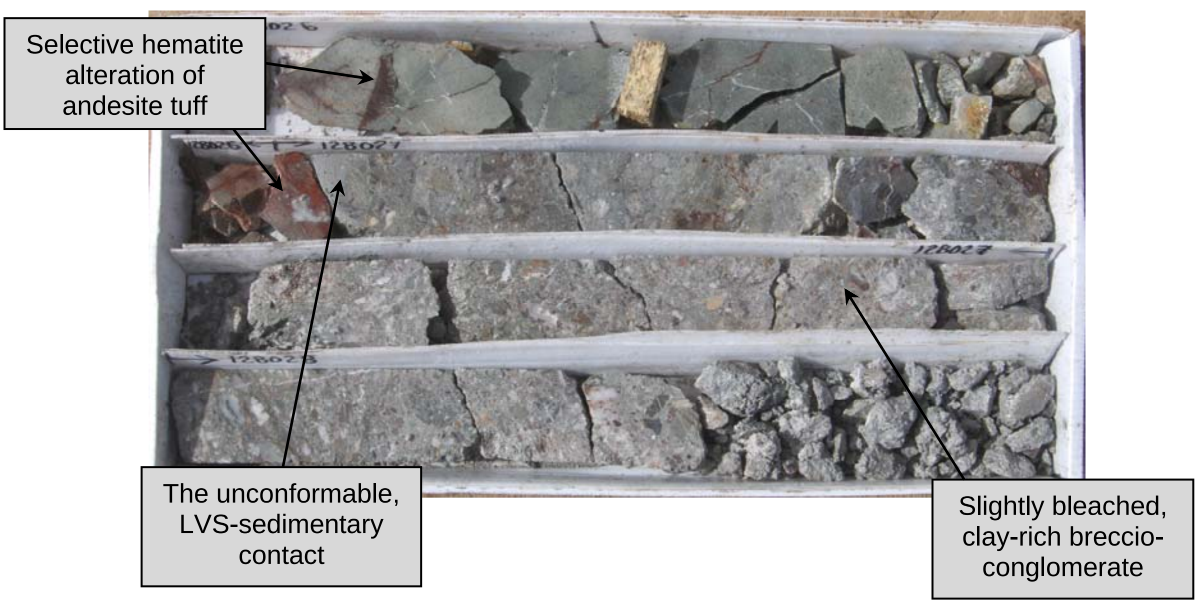


Figure 34A/B: **Drillhole BP10-673, 358.10 m to 360.35 m**
(top of section at top left in either case)

Figure 34A: photolog taken in 2010 (supplied by Pan American Silver)

Figure 34B: photolog of the same drillcore as seen in Figure 34A, taken during AMEC's January/February 2012 site visit

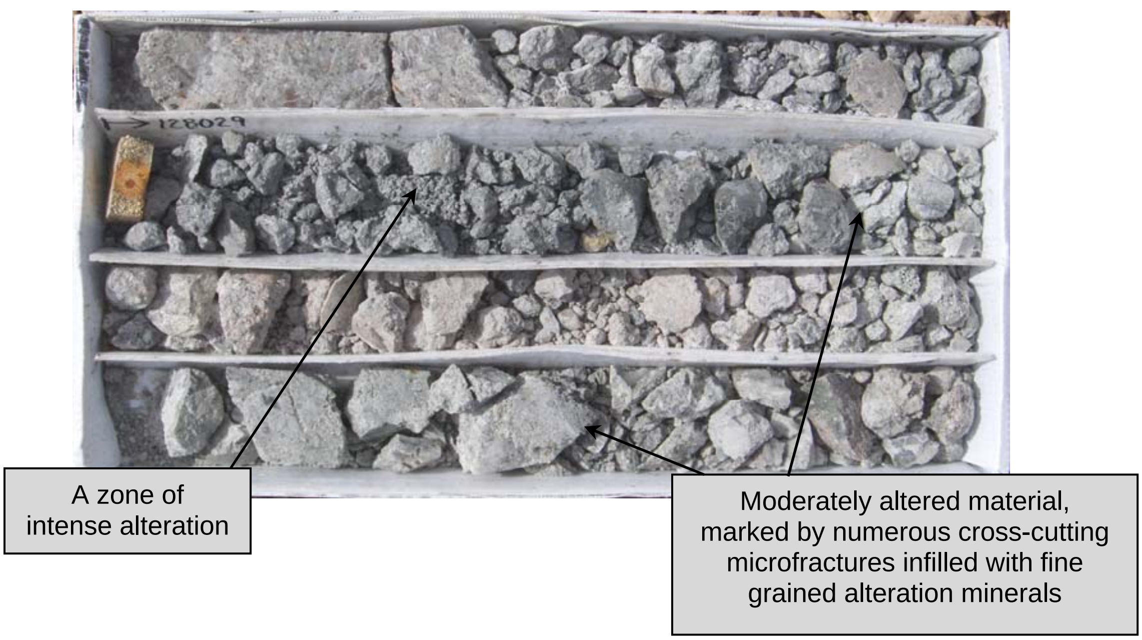


Figure 35A/B: **Drillhole BP10-673, 360.35 m to 362.60 m**
(top of section at top left in either case)

Figure 35A: photolog taken in 2010 (supplied by Pan American Silver)

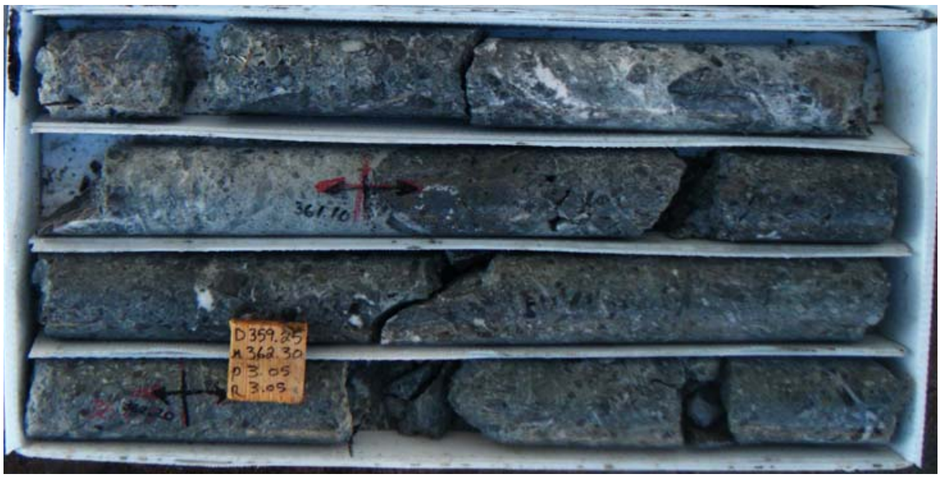


Figure 35B: photolog of the same drillcore as seen in Figure 35A, taken during AMEC's January/February 2012 site visit

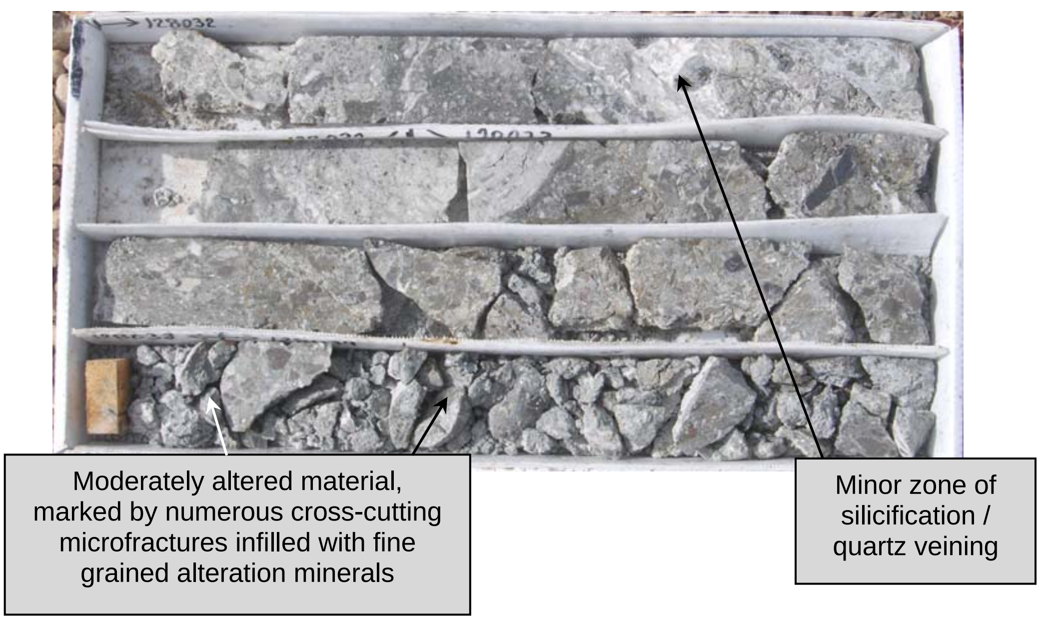
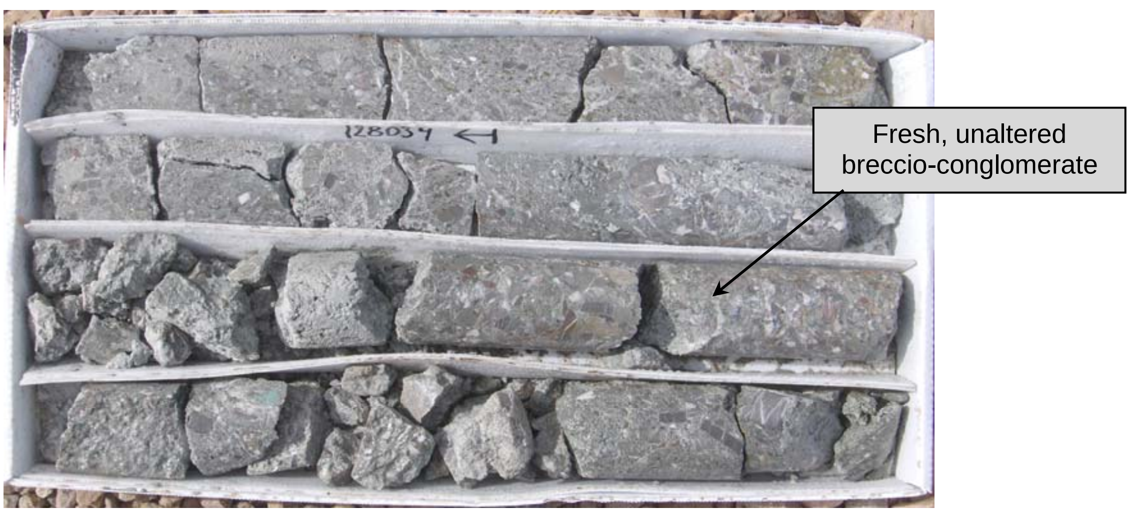


Figure 36A/B: **Drillhole BP10-673, 362.60 m to 364.55 m**
(top of section at top left in either case)

Figure 36A: photolog taken in 2010 (supplied by Pan American Silver)

Figure 36B: photolog of the same drillcore as seen in Figure 36A, taken during AMEC's January/February 2012 site visit



5.3.4 Propylitic Alteration

What is reported in the available geology logs to be sometimes severe propylitic alteration appears to be consistently developed around the nonconformity that marks the contact between the Permian schists and the overlying, early Cretaceous sedimentary sequence. Direct evidence for the presence of alteration was seen by AMEC in the drillholes listed on Table 1. This data shows that zones of moderate to severe alteration can be developed exclusively in the schists, in the sediments or in both the schists and sediments. In each case the alteration appears to be associated with minor quartz veining; minor accumulations of pyrite are also commonly present.

Table 1: A Summary of the Observed Zones of Significant Alteration at and Around the Schist-Sedimentary Nonconformity

Drillcore	Alteration from – to (m)	Clay Rich Remnant Core	Total Core Recovery Box	from – to (m)	Amount	Comments
BP07-131	321.80 – 329.20	-	-	-	-	Broad alteration zone within schists
BP07-138	438.60 – 455.00	from 451.98 m	184	441.28 – 445.91	58.53%	Loss associated with zone of intense alteration (442.87 m – 444.79 m).
BP08-173	270.76 – 280.87	278.87 – 279.02	-	-	-	Minor loss in severe alteration zone zone
BP08-183	375.5 – 376.1	-	-	-	-	Minor alteration in schists
BP08-205	313.68 – 314.43	-	-	-	-	Minor alteration in LVS, adjacent to contact.
BP08-230	271.28 – 273.16	throughout zone	92 93	268.74 – 272.49 272.49 – 275.54	76.27% 95.08%	Alteration only in schists, core loss associated with zone of intense alteration.
BP08-254	439.46 – 444.38	At 439.46 m	168	439.11 – 441.72	85.44%	Alteration only in LVS, adjacent to contact. Loss associated with closely fractured rock in alteration zone.
BP08-266	??? – 335.32	333.99 – 334.14	117	331.66 – 334.24	86.82%	Alteration only in schists, from top contact.
BP09-431	305.30 – 305.65	-	-	-	-	Zone of intense alteration in LVS, above contact.
BP10-560	377.09 – 377.61	-	176	376.00 – 378.15	90.70%	Zone of intense alteration across contact.

In common with the zones of clay alteration described above, severely altered drillcore sections can rapidly break down to loosely consolidated, clay-rich masses that have little or no intrinsic strength. As much can be seen by photolog evidence for drillhole BP10-560, from 376.00 m to 378.15 m (Figure 37A/B):

- the 'A' photograph taken in 2010, shortly after the hole was drilled, reflects weak ground (drilling-related damage is evident and minor core loss was reported); however
- after the core had been logged, split and stored in core boxes for at least a year it had degraded to a loose, clay-rich mass that had in part reconsolidated to a stiff, dry mass (see Figure 37B, which remnant drillcore characteristic is also seen in BP08-254, as suggested by Figure 38A/B).

Figure 37A/B: A Photolog of Severely Altered Schists Immediately Below the Nonconformable Schist-Sediment Contact
(drillhole BP10-560, 376.00 m to 378.15 m, top of section at top left)

Figure 37A: photolog taken in 2010 (supplied by Pan American Silver)

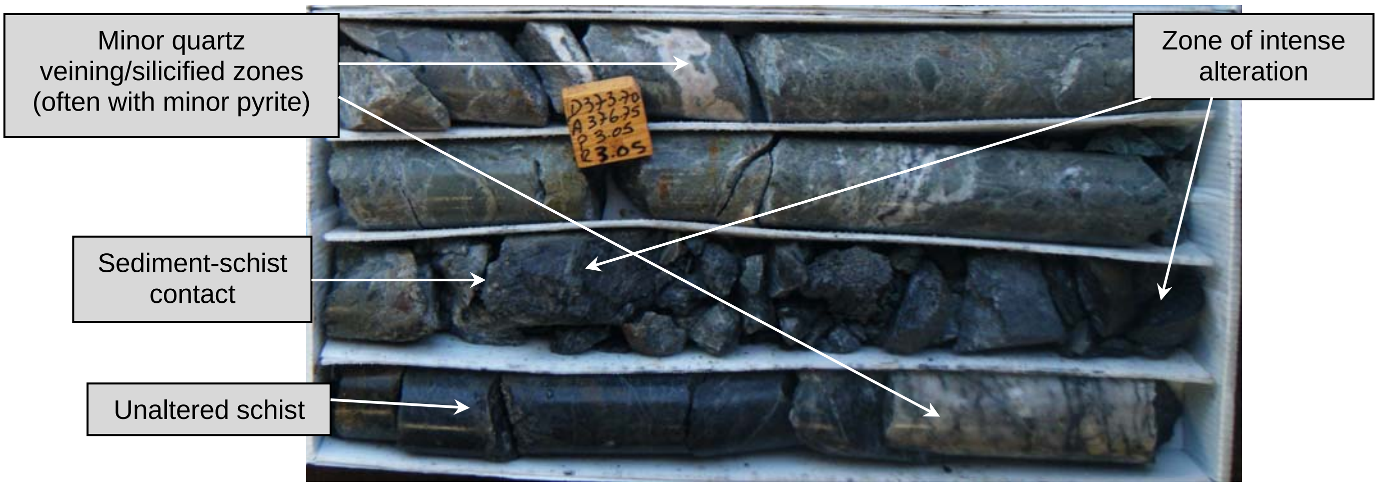


Figure 37B: photolog of the same drillcore as seen in Figure 37A, taken during AMEC's January/February 2012 site visit

(total core recovery = 90.7% with an estimated 0.2 m lost)

Figure 38A/B: An Example of an In-Box Degraded, Broad Zone of Occasionally Intense Propylitic Alteration Around the Schist-Sedimentary Nonconformable Contact

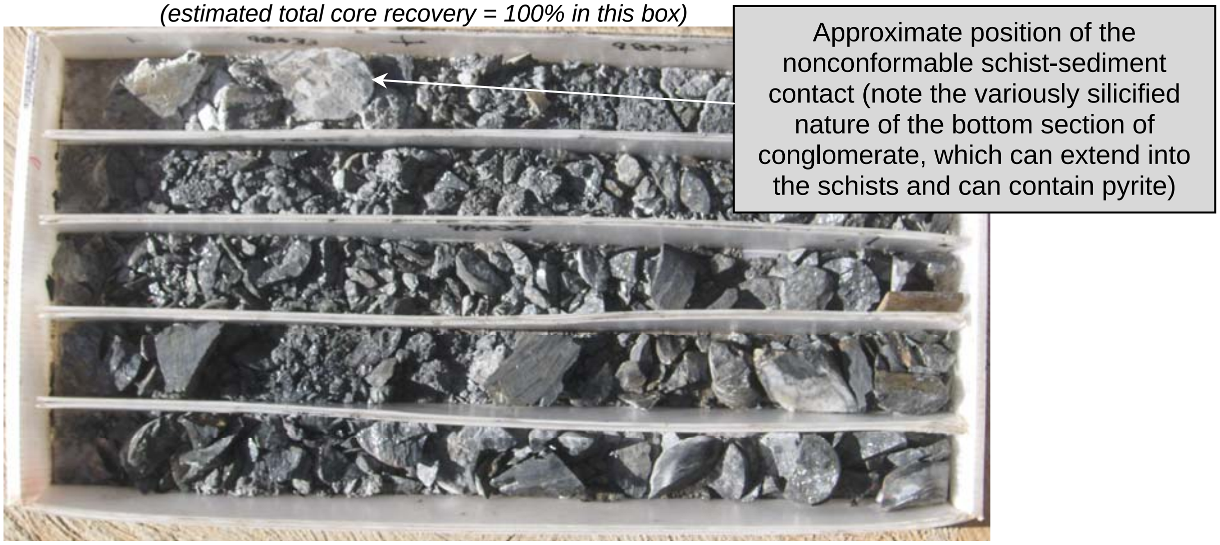
(drillhole BP08-254, 436.39 m to 447.18 m)
(taken during AMEC's January/February 2012 site visit)

Figure 38A: Drillhole BP08-254 - 439.11 m to 441.72 m (top of section at top left)

(estimated total core recovery = 85.4% in this box, with an estimated 0.34 m lost)

Figure 38B: Drillhole BP08-254 - 441.72 m to 444.38 m (top of section at top left)

(estimated total core recovery = 100% in this box)



AMEC interprets the drillcore degradation process as being the same as, or at least similar to, that described for clay-altered sections of the sedimentary sequence: degradation caused by the action of water on a weathering-susceptible alteration mineralogy. However, as earlier outlined, clay is not usually associated with propylitic alteration-related mineral assemblages. A number of alternative sources could therefore in theory apply. For example:

- it could be the consequence of some other form of unspecified, discrete hydrothermal alteration associated with the evidently high-temperature quartz veins;
- it could represent some other form of unspecified but localized hydrothermal alteration along the splay-ends of locally developed, elongate, sigmoidal tensile structures;
- it could be the result of localized, high pressure alteration yielding smectite clays that disintegrate on contact with water or atmospheric moisture; or
- it could be the result of argillic alteration to create kaolinite and/or montmorillonite, as a result of the action of low temperature, acidic water.

It is difficult at this stage to define the source and nature of what is evidently some form of localized alteration. However, from a mineability viewpoint the result is essentially the same:

- special measures would have to be taken to ensure stable pit slopes that could selectively fail by sliding either along or around the nonconformable contact area (the likelihood of such failures depends on the local pit wall and contact geometries and the local continuity of the altered/clay-rich contact zone); and
- special stabilization measures would have to be taken if the contact was located above the footwall elevation of any planned stope or drift, to minimize overbreak/unplanned dilution and to preclude longer-term instability risk (by the same token, mining should be avoided in any planned stope or drift that was expected to have the contact zone at or immediately above its hangingwall position); and
- the alteration/clay-rich zone would have to be sealed with a chemical sealant and an aggregate working floor thrown if the contact zone was at or near to the footwall elevation of any planned stopes or drifts (which floor would also have to be thrown if the footwall any planned stope or drift was located on or the schists, to preclude excessive slippage hence tire wear and damage to the differentials of trackless production equipment).

It is not possible at this stage to assess the potential scope for the types issues outlined because analysis depends in large measure on the outcomes of the updated block model and the results of preliminary mine planning. It can, however, be stated that it would be unwise to mine any stopes if a persistently weak/clay-rich horizon was located at, near or above the hangingwall position.

5.4 Other Sources of Drillcore Degradation

The importance of close examination and interpretation of the available drillcore, rather than detailed geotechnical logging aimed at defining average rockmass ratings, is further emphasized by the extent of drilling-related and in-box mechanical degradation of the examined drillcores. The effect of drilling damage on vein intersections is emphasized in Section 5.1.3. Similarly extensive damage can also be seen where loose / open, sub-vertical and undulating discontinuities of the type described in Section 3.1 are intersected, especially where cross-cutting discontinuities are developed. This is a common drillcore characteristic when high bit pressures are used, as is inevitably the case when the emphasis is on production drilling for drillcore metres. Figure 39 provides an example of the type of outcome drilling-related damage can cause, although at least some of observed degradation almost certainly occurred in-box.

Figure 39: An Example of Extensive Drilling Damage to a Section of Slightly Altered (Hematite), Andesite Agglomerate Drillcore Affected by Steeply Inclined, Irregular Discontinuities, with Minor Limonite Infilling
(drillhole BP08-211, 87.23 m to 89.27 m, top of section at top left)

The extent of in-box mechanical degradation seen in the drillcore is emphasized by the photo-pair presented as Figure 40A/B. Figure 40A shows the drillcore shortly after it was drilled in 2010. It appears to be closely jointed because weathering along microveinlets, as evidenced by the presence of limonite and iron oxide staining, has caused them to open-up within the generally weathered section of altered and weathered andesite. Despite this, the core is still largely intact. Figure 40B shows the same drillcore that was photographed during AMEC's January/February 2012 site visit. The extent to which it has degraded through mechanical attrition is self-evident.

Figure 40A/B: An Example of Significant In-Box Mechanical Degradation of Drillcore
(drillhole BP10-673, 21.90 m to 23.75 m)
(top of section at top left in either case)

Figure 40A: Photolog taken in 2010 (supplied by Pan American Silver)

Figure 40B: Photolog of the same drillcore as seen in Figure 40A, taken during AMEC's January/February 2012 site visit

The impact of in-box degradation is emphasized because without the benefit of cross-referencing a drillhole's original photologs, it might be tempting to classify the drillcore section seen on Figure 40B as faulted, or at least disturbed. In this regard it should be emphasized that no evidence for conventional fault zones could be found in the examined drillcores, besides the approximately east-west trending fault zones that are known or are postulated to cross the local Project area.

In-box mechanical degradation of drillcore is also apparent along drillcore sections that are affected by micro-veining. Figure 41A/B provides an example of this – although selective weathering due to the presence of groundwater is evident in the core, AMEC interprets all the other fractures to be mechanical breaks of what in situ would be competent, massive rock. This interpretation is made because:

- there is no evidence of weathering (limonite or iron staining) along the calcite infilled micro-veins, which might reasonably be expected given the extensive and deep penetration of groundwater into the general rockmass (although a slight reduction in the strength of the mineral infilling can be seen, as evidenced by its reduction to somewhat loose, fine grained material);
- the characteristics of the vein-associated fractures are identical to those when a new fracture along a previously intact micro-vein is made; and
- reference to photologs of similarly veined drillcore sections, taken shortly after the core was drilled, show them to be intact.

Figure 41A/B: An Example of Significant In-Box Mechanical Degradation of Micro-Veined Drillcore
(Drillhole BP10-549, 77.65 m to 79.97 m, top of section at top left in either case)

Figure 41A: photolog taken in 2010 (supplied by Pan American Silver)

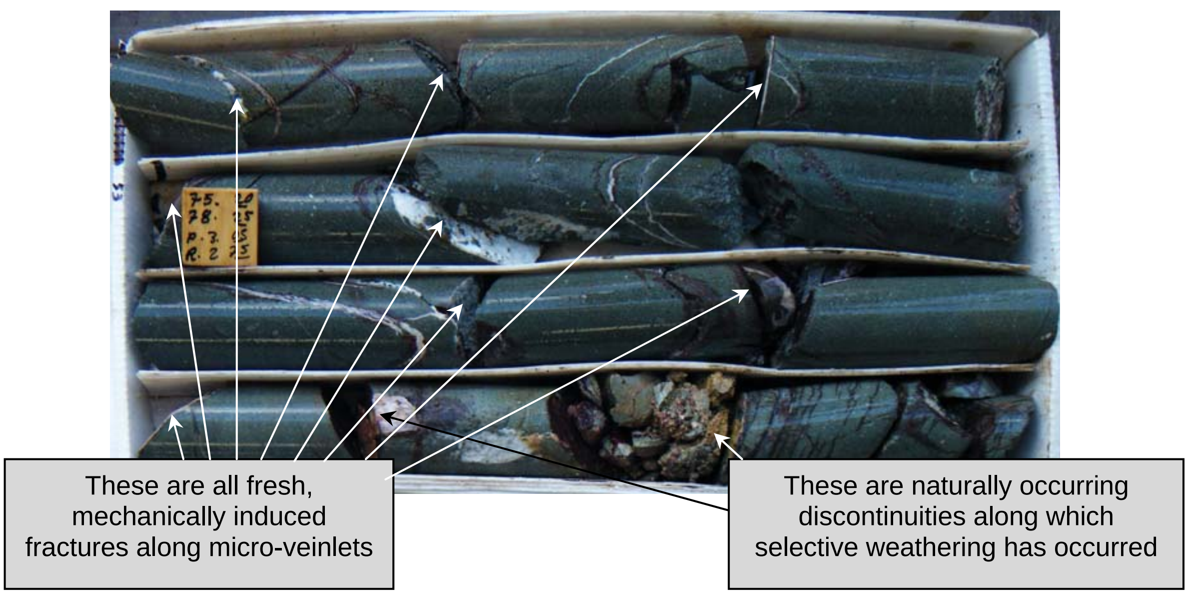


Figure 41B: photolog of the same drillcore as seen in Figure 41A, taken during AMEC's January/February 2012 site visit

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Compressive Tectonic Impacts

The fact that the early Cretaceous sedimentary sequence long-predates the onset of the Laramide orogeny is an important feature of the La Preciosa rockmass:

- the Laramide orogeny resulted in the development of a significant mountain chain along the western portion of Mexico (the Sierra Madre Occidental, or SMO); and
- the La Preciosa project area is on the eastern flank of the SMO; however
- away from the east-west fault zones, very few of the discontinuities seen in the examined drillcore intersections of sedimentary material could be attributed to compressive tectonic activity (such features are typically planar to planar-undulating, usually thinly infilled and/or tight); and
- because the LVS is contemporaneous with the main phase of the Laramide orogeny, logic dictates that it cannot be any more structurally disturbed than the underlying sedimentary sequence, which detailed examination of LVS drillcore intersections showed to be the case.

In other words, despite the substantial magnitudes of compressive stress that must have existed during the mountain building phase of the Laramide orogeny, the general La Preciosa rockmass, away from the east-west faults, remained in a largely undisturbed state. Reference to the photologs for many of the drilled holes confirms this key point.

6.2 Crustal Extension Impacts

6.2.1 Mineralized Veining

It is established in Section 3.3 that the mineralization found across the local Project area is predominantly quartz vein hosted. The veins appear to represent infillings of pre-existing, large-scale tensile gashes that might have developed at or towards the end of the Laramide orogeny. The presence of sometimes coarse quartz crystals and barite laths within the vein structures tends to support the presence of pre-existing voids. It is also pertinent to note that on average, the veins strike approximately north-south, which trend is remarkably similar to the average trend of the regionally developed graben structures. Overall, the structural trends outlined suggest that the direction of crustal extension was approximately east-west.

The presence of vugs and voids within the mineralized veins is in Section 5.1 interpreted as the cause of the sometimes extensive drillcore damage during the drilling process, resulting from high bit pressures and drillcore grinding. It is also stated in Section 5.1 that where vugs and voids are either lacking or not well-developed and where open joints are not intersected, the drillcore vein intersections reflect good to very good quality material. These key points are emphasized because, apart from the east-west faults that are known to cross the local Project area, no evidence for conventional fault zones (or indeed shear zones) could be found within the general rockmass. As such, a faulted vein model is difficult to conceptualize. One might also question why the veins would be selectively disturbed by shear-type displacements.

The vein contacts could, however, locally be affected by the presence of elongate, open sigmoidal tensile structures / tension gashes. In theory at least, such structures can preferentially degrade to horsetail endings along a differential stiffness interface between comparatively stiff vein material and less stiff country rock. However, it is difficult to see how this would lead to the type of broken vein intersections seen in some drillcores.

6.2.2 Other Tensile Structures

The presence of open sigmoidal tensile structures (tension gashes) is suggested by the dominant / most commonly developed discontinuity type found in the examined drillcore: open or loosely clamped, undulating joints with rough surfaces that are nearly always steeply to very steeply inclined. In AMEC's experience:

- such discontinuity characteristics are typical outcomes of bulk in situ, tensile rockmass failure, expressed as rupturing along a direction that is, on average, perpendicular to the direction of maximum tensile stress;
- open sigmoidal structures tend to occur as randomly developed features throughout an affected rockmass, although an element of selectivity can develop at weak rockmass horizons or at differential stiffness interfaces; and
- displacements across individual structures tend at worst to be minor to very minor only.

6.2.3 The State of Pre-Mining Stress

The presence and various infillings of the types of tensile structures outlined points to an extended period of crustal extension that might have persisted from the end of the Laramide orogeny to recent times. Whether or not the discontinuities became mineralized and/or infilled with calcite and quartz, whether or not they acted as the conduits for hot alteration fluids and whether they remained open and unmineralized depended on the timing of their formation with respect to the various mineralization and alteration phases that arose in geological time. That the fresh, unmineralized features remain open, hence loosely clamped, suggests that the rockmass remains in a state of relative tension, or at least in a state of low lateral compression (for the reasons described in footnotes to Section 5.2.2).

The abundant evidence for groundwater penetration to depths of approximately 350 m bs within the general rockmass tends to further suggest that it is probably in relative tension, or at least that a conventional compressive stress environment is unlikely to exist. If this was not the case, given the nature of the rocks and joint plane infillings as earlier described, it might reasonably be expected that groundwater penetration would be substantially less than that interpreted from consideration of the drillcore characteristics. The exception is the vertical component of pre-mining stress, the magnitude of which probably varies in linear proportion to the depth below surface (i.e. its magnitude approximates to cover load at any depth of interest).

The state of stress outlined precludes the possibility of rock bursting and, for the most part, stress-related damage to underground excavations too. This may be stated because the magnitude of vertical stress, at the maximum depth for underground mining of approximately 350 m bs, will approximate to 10 MPa, so the magnitude of total stress acting around the periphery of cut excavations is unlikely to exceed approximately 25 MPa. AMEC's preliminary, qualitative assessments of rock strengths suggest that unaltered and unweathered andesite and breccio-conglomerate have uniaxial compressive strengths approximating to 100 MPa (this needs to be confirmed by means of structured laboratory strength tests). Alteration and fabric leaching due to weathering effects will reduce their average compressive strengths, but it is only when pervasive alteration or severe fabric weathering is developed that the rock strengths are reduced to the point where stress-related wallrock failure could in theory occur.

The available drillcore evidence shows that severe fabric alteration / leaching is developed only within the east-west trending fault zones, in the surface weathered zone and selectively along open discontinuities to approximately 180 m bs. As such, elevated instability potential, due to stress-related effects, would be unlikely to exist and special support measures would not be needed, beyond those required to stabilize the weak, blocky, loose and water-bearing ground that characterizes the east-west trending fault zones and the surface weathered zone (a combination of bolts, screen and shotcrete would be required). It is in such areas that support might in any event be required to stabilize any zones of severe hematite alteration which, for the reasons earlier outlined, can be expected to comprise weak to very weak material.

Mining in the Permian schists could also be problematic, due to their strongly anisotropic nature. If schist is present along the footwall of any drift, decline or stope, it would readily be ripped by the passage of trackless mining equipment that could, as a result, be expected to suffer increased tire damage and elevated wear rates to differentials. In some cases minor, platey footwall heave could occur, especially at depths in excess of approximately 300 m bs. This would exacerbate the types of issues outlined, which could readily be overcome by over-cutting an affected footwall and by throwing an aggregate-type working floor.

The strongly anisotropic nature of the schists, combined with the potential for minor stress related damage at depths greater than 300 m bs and the generally weak schistose parting planes, suggests that small span and well-supported excavations only should be mined where schist is expected to be at the hangingwall elevation of individual drifts or stopes. The presence and potential impacts of alteration along and around the schist contact zones with the overlying sedimentary sequence only serves to emphasize this key point.

6.2.4 The Groundwater Regime

Scrutiny of the selected drillholes shows that limonite accumulations and/or iron oxide staining is commonly developed along voids and open structures and that patches or zones of minor wallrock leaching are common to depths of approximately 180 m bs. This suggests that excellent hydraulic continuity probably exists within the general rockmass and that the structures outlined must, therefore, be laterally and transversely continuous (in the sense that they persistently interact with other, similar discontinuities within the general rockmass). Locally developed, possibly short-term and sometimes significant groundwater inflows from pit walls and underground excavations may occur in consequence of this. The possibility of short-term inflows is emphasized because the storage capacity of the rockmass might be limited, although the presence of what are reported by Orko Silver Corp. to be rapidly recharging, local surface dams and ponds should be noted.

The need for a hydrogeological investigation of the La Preciosa rockmass is clear, to establish its groundwater storage, conductivity and recharge characteristics. This is emphasized because groundwater issues could be minor only, but they could equally be persistent and problematic, not least because of the evidently high permeability of the general rockmass.

6.3 Alteration Impacts

It is established in Section 5.3 that:

- minor zones of severe, pervasive hematite alteration are locally developed in porphyritic andesites in particular (AMEC's provisional and preliminary estimate is that some 5% of the total length all development hosted in andesites of the LVS might be affected);
- clay-type alteration can locally occur in the sedimentary sequence (AMEC's provisional and preliminary estimate is that less than 2% of the total length all development hosted in the sedimentary sequence might be affected); and
- what might be clay-type alteration appears to be extensively developed along and immediately around the nonconformable schist-sedimentary contact.

In each case the altered rocks can variously but progressively degrade to weak or very weak, clay-rich masses if they are exposed to either water or to atmospheric moisture. In the case of severe, pervasive hematite alteration, the degradation process can occur in situ, where the affected material is located within the surface weathered zone or within an east-west trending fault zone.

The importance of sealing, with shotcrete, areas or zones of hematite-altered andesite is earlier emphasized (such support would in any event be required in the surface weathered zone and in east-west trending fault zones, in which severely altered andesite is expected to have already degraded to a weak, residual mass). In the case of clay-type alteration, uncertainty exists as to the nature and distribution and continuity of the alteration. It is because of this that AMEC recommends that the whole question of alteration types and mineralogies should closely be investigated at the pre-feasibility stage of Project development. This is emphasized because if a system suitable for the identification of altered sediments in the production environment could be found and defined, preventative action could *selectively* be taken to prevent degradation leading to instability of both open pit slopes and underground excavations. The alternative would be to assume that alteration is randomly developed and difficult to identify in the production environment, with the result that any exposed wallrock comprising any material of the sedimentary sequence would have to be sealed, to the detriment of mine operating costs.

Excavation stability can be ensured if exposed areas of altered rock are sealed with a suitable chemical sealant that precludes the possibility of water-related rock degradation. Shotcrete is not suitable in this role because it is water-bearing when applied, with the result that a thin layer of clay can develop at the shotcrete-rock interface. This alters the performance characteristics of the applied shotcrete, insofar as any subsequent rockmass movement can result in its early failure leading to the peeling of sometimes large shotcrete slabs. Suitable chemical sealants (or thin skin liners) are readily available in the market place; a suitable, project-specific product would have to be established by means of testing during the early phase of mine development.

6.4 Open Pit Mining

6.4.1 Slope Configuration – Unweathered Rockmass

In AMEC's opinion, the quality of the general rockmass is such that beneath the surface weathered zone, the paleosurface and the paleo-weathering zone (the latter two where developed), an average inter-ramp angle of 52º could safely be achieved at wall heights of up to 350 m. With detailed stability analyses at the pre-feasibility level of Project development and depending on the depth below surface of the final pit floor, it might prove possible to increase the inter-ramp angle outlined.

6.4.2 Slope Configuration – Main Surface Weathered Zone and Paleosurface

Many possible variations of near surface geology exist across the local Project area. For example, scrutiny of the available drillcore geology logs and photologs for 40 of the completed drillholes suggests that where the paleosurface is developed it can be between 0.2 m and 12 m thick (average 4.0 m) and its bottom contact can be between approximately 5 m and 40 m bs (average approximately 30 m bs – Table 2). The base of the associated paleo-weathering zone can extend for between 5 m and 25 m below the bottom contact of the paleosurface, depending on its depth below surface hence its interaction (or lack thereof) with the main surface weathered zone. It is also known that the andesites of the LVS sub-outcrop over at least a portion of the local Project area, which rocks tend to be pervasively weathered to greater depths than the basalts.

Table 2: A Summary of the Intersection Depths of the Main Paleosurface, as found in 40 Drillholes Across the Local Project Area

(depths not corrected for drillhole inclinations)
(compiled by AMEC from the available drillhole geology logs and photologs)

	Intersection Depth (m)		
Parameter	**Average**	**Maximum**	**Minimum**
Start	26.6	33.9	3.9
End	30.7	41.5	4.8
Thickness	4.0	11.7	0.2

The level of detail required to accommodate all possible variations of near surface geology within the scope of open pit optimization and design is not currently available, which data gap needs to be filled at the pre-feasibility level of Project development. In view of the current limitation, AMEC recommends that the following are assumed for purposes of preliminary analysis of open pit options:

- where LVS andesites sub-outcrop at surface, an average worst case depth to the base of the main surface weathered zone of 30 m bs; and
- where the paleosurface is developed, an average worst case depth to the base of the main paleo-weathering zone of 40 m bs.

A potential exists for rock slope instability caused by sloughing of the paleosurface, where it is developed. In view of this, a suitably dimensioned catch-bench, located at the base of the heavily leached rock in the underlying paleo-weathering zone, would be required to preclude the ingress of sloughed material into the main pit area. In this regard it is recommended for purposes of preliminary analysis that:

- for the average surface weathering profile outlined, a 10 m wide catch-bench is cut at the base of the main paleo-weathering zone (i.e. at 40 m bs), above which an average inter-ramp angle of 40º is recommended; and
- in areas where the andesites of the LVS sub-outcrop on surface, a 6 m wide catch bench is recommended at the base of the main surface weathered zone (i.e. at 30 m bs), above which an average inter-ramp angle of 40º is recommended.

6.5 Underground Mining

6.5.1 Excavation Spans and Support

In AMEC's opinion, there is no readily identifiable reason to suggest that 5 m by 5 m development ends could not safely and productively be mined in the La Preciosa rockmass, as long as:

- clay-alteration zones were sealed using an appropriate product, as earlier outlined;
- systematic support in the form of tensioned bolts and screen was employed; and
- long anchors were installed at large span intersections.

Ideally, full column grouted and tensioned/active anchors (i.e. support that imparts active support loads to a rockmass, by virtue of its installation) should be employed, due to the postulated low stress environment and presence of groundwater. Friction bolt types would be inappropriate because they are a passive support type (they require rockmass deformation to mobilize their full support potential) and they could corrode within the life span of the mine, thereby necessitating their replacement to the detriment of mining costs.

In AMEC's opinion, there exists no readily identifiable reason to suggest that 8 m to 10 m wide stopes, rooms and splits (the latter in room & pillar workings) could not safely and productively be mined, as long as appropriate, active support systems were employed and clay-altered ground was appropriately sealed. Indeed, as the knowledge and experience of the rockmass conditions grows with stoping advance, it might prove possible to safely mine to larger spans.

Despite the findings outlined, it would be prudent to confirm the in situ condition of the mineralized veins that are targeted for underground mining by drilling carefully positioned and orientated, triple tube (cored) geotechnical holes, as part of the feasibility process leading to mine development. Safety risk management would also best be served by structured and targeted trial mining, with rockmass monitoring as appropriate, to test both the selected stoping methods and the efficacy of the selected stoping spans. In this manner an optimized balance between cashflow objectives and a sustainable production rate for underground mining could be achieved at least project risk.

6.5.2 Pillar Sizes

The presence of irregularly developed vugs and voids within typical vein material affects its bulk in situ strength, hence the strength of cut pillars. Targeted uniaxial and triaxial compressive strength tests are required to determine an average Hoek-Brown strength envelope for vein material, from which pillar sizes for underground mining can be assessed.

The dimensions of cut pillars will, of course, depend on the mined heights of individual stopes. Stoping methods suitable for mining target vein areas have not yet been defined because such considerations depend on the outcomes of the updated block model. However, based on the conditions observed in the drillcore and underground, it is AMEC's opinion that *final* pillar dimensions of 5 m by 5 m would be adequate for room & pillar mining to 3 m stoping heights at 350 m bs when 8 m to 10 m wide rooms and splits are cut.

Emphasis is placed on *final* pillar dimensions, insofar as design/planned pillar dimensions invariably need to be larger to accommodate the downside impacts of out-of-line mining. In AMEC's experience, out-of-line mining can be as much as 1.0 m along each pillar sidewall, but this is the rare exception rather than the rule. In well-managed mines, out-of-line mining of up to 0.5 m along each pillar sidewall is typical, reducing to as little as 0.5 m across a pillar width or pillar length when pillar control survey lines are strictly employed. For purposes of preliminary analysis, it is proposed that out-of-line pillar cutting of 0.5 m along any pillar sidewall is assumed, which means that *final* pillar dimensions of 5.0 m by 5.0 m require design/planned pillar dimensions of 6 m by 6 m to ensure long-term pillar stability.

6.5.3 Blasting Practice

Minor wallrock frittering might be experienced where mining extends through the breccio-conglomerates of the sedimentary sequence, if the excavations were over-blasted by virtue of the inter-hole burdens of the peripheral blastholes and/or the powder factor employed. Although wallrock frittering would in itself not be problematic, safety and ‘house-keeping’ benefits would be derived if it was reduced to a practical minimum through the use of post-split blasting practice (which could readily be achieved / should readily be achieveable if jumbo operators were adequately trained in the art of drilling direction control). Similar problems are not anticipated in the andesites of the LVS.

Despite their cost, cartridge explosives might be required for stope production blasting because of:

- the frequency of open structures in the mineralized veins (potentially significant gas-venting would occur if high gas, low VoD blasting agents such as ANFO were used, thereby inducing occasionally poor fracturation/large lumps sizes in vein material, as well as otherwise avoidable, unplanned dilution); and
- the presence of groundwater (ANFO is water-soluble, with the result that misfires commonly occur in wet ground).

Blasting agents such as ANFO could selectively be used in development ends, if cover drilling was carried out to determine the presence or lack of groundwater in advance of individual development ends. Cartridge-type explosives would, however, have to be used where groundwater inflows were experienced or expected. AMEC recommends that cover drilling is routinely carried out, especially around and within the east-west fault zones, at least until such time as confidence in the groundwater regime reaches a level that is consistent with least risk mining practice.

6.5.4 Drilling and Advance Rates

Good blasthole penetration rates can reasonably be expected in the andesites of the LVS and the breccio-conglomerates of the sedimentary sequence. Equipment dependent, average blasthole penetration rates can be expected in the comparatively much tougher and abrasive mineralized veins. Moderate bit wear rates can be expected in andesites of the LVS in particular, due mainly to the lack of quartz/silica within their mineral assemblages. Slightly elevated bit wear rates can be expected in the sedimentary sequence, due to the presence of quartz clasts. High bit wear rates can be expected in vein material and the immediately surrounding, silicified rocks, due to the abundant presence of quartz.

Although a length-of-pull of 3.5 m could often be achieved in development ends, the advance rates would have to be reduced in altered and locally weathered ground. With this in mind, AMEC recommends that, based on its knowledge and experience of similar ground conditions, an average advance rate of 3.0 m per round is assumed for purposes of preliminary mine planning, with an average daily advance of no more than 5.5 m in active development ends, for a two-shift production cycle. Development through the Permian schists and east-west trending fault zones would have to be slowed, due to the nature of the ground and the requirement for additional support. In these cases:

- an average, per-round advance rate of 2.5 m and an average an average daily advance of no more than 5.0 m in active development ends, for a two-shift production cycle, for development located in the Permian schists; and
- for development advanced through the east-west fault zones, an average, per-round advance rate of 2.0 m and a 1.5 day average production cycle should be assumed.

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