A report prepared for Mariana Resources Argentina S.A.

GEOLOGY AND POTENTIAL OF THE SIERRA BLANCA PRECIOUS-METAL PROSPECT, SANTA CRUZ, ARGENTINA

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SUMMARY

- At the Sierra Blanca prospect, the silver-rich Chala and Lucila veins are considered to be of intermediate-sulphidation rather than low-sulphidation epithermal type and, therefore, may be compared most closely with the bonanza-grade Martha silver deposit rather than to the gold deposits in the Deseado massif.

- The Chala and Lucila veins may have a similar structural control but display marked along-strike changes in style and mineralogy. The wide but somewhat irregular Chala Central and Chala splay veins are highly sulphidic and lack through-going quartz ± carbonate, possibly because of the semi-ductile character of the host sedimentary rocks, but are nevertheless locally well mineralized.

- The bonanza (>2,000 g/t) silver grades and accompanying gold values (1-25 g/t) at Chala Central and Chala splay are considered to be largely hypogene in origin rather than being a product of surficial supergene enrichment. The apparently erratic distribution of the high-grade values may reflect the relatively small size and irregular distribution of ore shoots, by analogy with the situation documented at Martha.

- Chala West and Lucila are more formal vein structures, the former dominated by manganoan carbonate and rhodonite and the latter by saccharoidal quartz. Chala West is locally well mineralized, but Lucila returns consistently low silver (<60 g/t) and gold (<1 g/t) values. Lucila could be a shallower expression of the Chala vein, an interpretation that certainly applies to La Cresta vein, 1 km farther west, which is hosted by higher stratigraphy as well as being entirely composed of chalcedony and being rich in antimony.

- Chala Central and West and the Chala splay may contain silver-dominated, bonanza-grade ore shoots, potentially to a depth of at least 150 m, and merit more systematic drill testing. Lucila and La Cresta need to be scout drilled to greater depths in search of concealed ore shoots. The other main components of the Sierra Blanca prospect, the El Tranquilo veins and shallowly dipping Vetarron zone are not recommended for further drilling at this stage.

INTRODUCTION

At the request of John Sutcliffe, the writer spent a week in Argentina in order to visit the Sierra Blanca silver-gold prospect in the Deseado massif of Santa Cruz province, Argentina on behalf of Mariana Resources Argentina S.A. The aim of the visit was to comment on geological features and exploration potential.

Activities at Sierra Blanca comprised field inspections of the main Chala and Lucila veins, the Vetarron zone and El Tranquilo vein zone (Fig. 1) along with examination of the core and cuttings from key drill holes. The main observations, conclusions and recommendations stemming from the fieldwork are summarised in this report.

The work was undertaken with John Sutcliffe, Gustavo Rodríguez, Sebastián Cadile, Juan Pablo Mayer and Nicolás Stoessel, who are thanked for instruction and wide-ranging discussions.

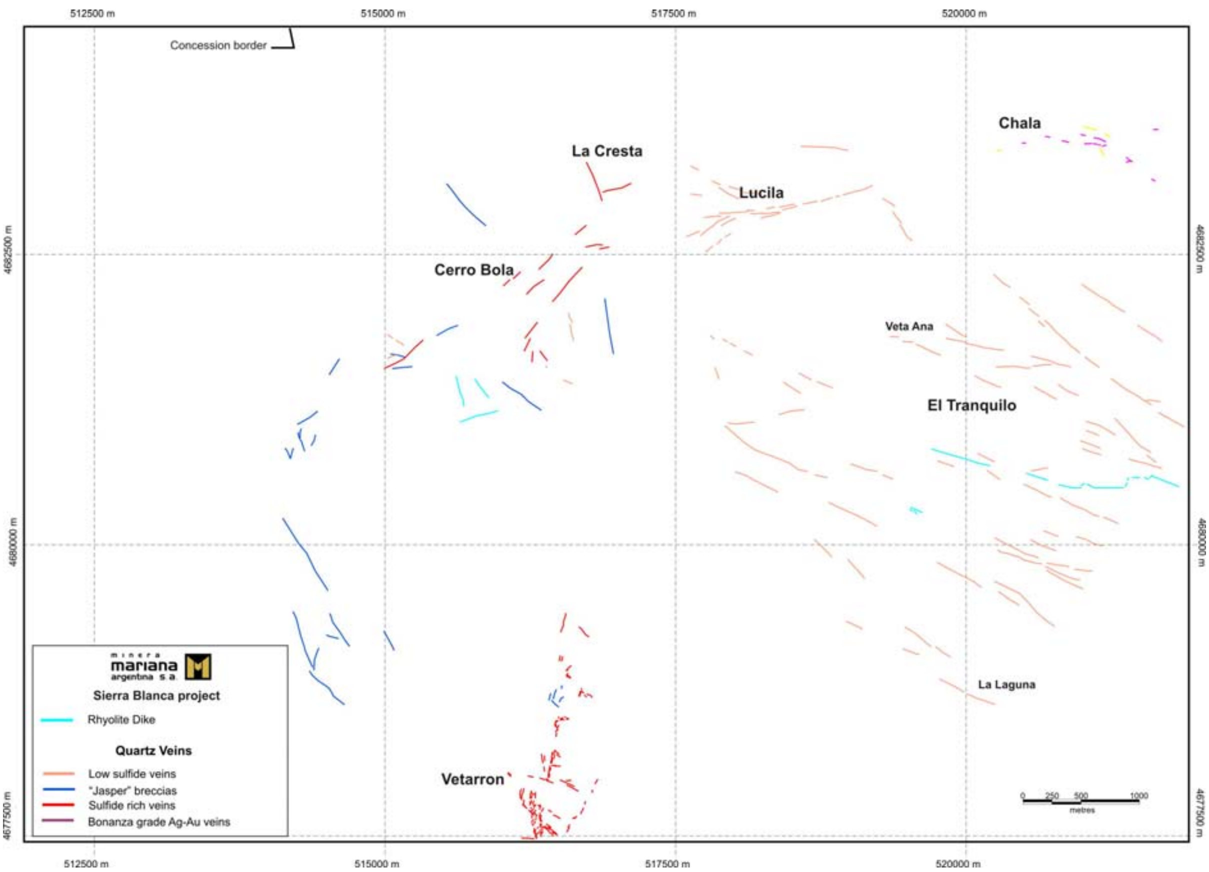

Fig. 1 Location of main veins, Sierra Blanca prospect

SIERRA BLANCA PROSPECT

Geological setting

The Sierra Blanca prospect is largely hosted by the El Tranquilo and unconformably overlying Roca Blanca Formations, which are assigned Late Triassic and Early Jurassic ages, respectively. These rocks underlie the Bajo Pobre and Chon Aike Formations (Fig. 2): the Middle to Late Jurassic volcanic sequences that host most of the epithermal precious-metal deposits and prospects in the Deseado massif of Patagonia.

The El Tranquilo Formation comprises thinly bedded, epiclastic sandstones and siltstones along with prominent carbonaceous mudstone horizons, some of the latter containing visible plant matter. The Roca Blanca Formation is paler in colour, as the name suggests, but is lithologically broadly similar, albeit with a more obvious volcaniclastic component and a few ignimbrite horizons. El Tranquilo rocks in the prospect area dip shallowly eastwards, whereas the Roca Blanca unit is flat lying.

The epithermal mineralization in the Sierra Blanca district appears to be genetically related to a biotite dacite or rhyodacite porphyry dome (Fig. 2) that underlies elevated topography at the northern end of the Vetarron zone. The porphyry is relatively unaltered, but is at least partially surrounded by monomict phreatic breccias, formation of which is believed to have accompanied dome emplacement. The breccias are cemented by jasper.

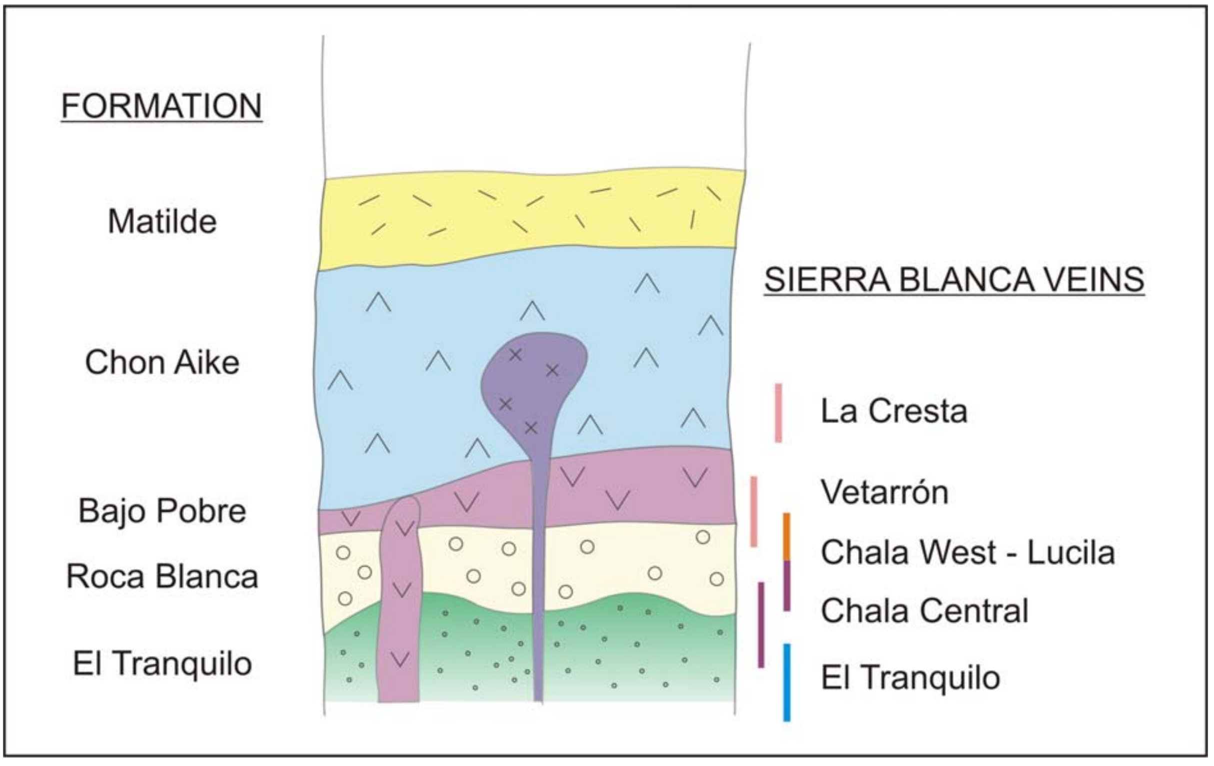

Fig. 2 Schematised stratigraphy and vein positions, Sierra Blanca prospect

The principal fault in the prospect area, marked by a prominent ground-magnetic low, strikes broadly east-northeast. The Chala vein lies just south of this fault whereas, farther west, the Lucila vein is located immediately north of it. In contrast, the El Tranquilo veins strike northwest, in common with the majority of the epithermal veins in the Deseado massif, and the Vetarron zone follows a north-south trend (Fig. 1). The Chala Central vein likely dips steeply south and is controlled by a normal fault that juxtaposes El Tranquilo Formation in the footwall against Roca Blanca Formation in the hanging wall. In contrast, the Lucila vein dips steeply north and appears to lie entirely within the Roca Blanca Formation to the maximum drilled depth of 90 m.

Chala and Lucila vein characteristics

The east- to east-northeast-striking Chala and Lucila veins appear to be controlled by the same structure, although they are separated by a 1-km-wide, alluvium-covered gap (Fig. 1). Nevertheless, the characteristics of the veins change markedly along strike. The Chala Central vein and Chala splay, a southeast-striking offshoot (Fig. 3), are marked by brecciation of the immediate sedimentary wall rocks, irregular quartz veining and locally abundant pyrite that gives rise to gossanous outcrops. Farther west, the Chala vein becomes more manganese rich, with Chala West (Fig. 3) comprising massive manganoan carbonate and rhodonite, oxidised to manganese wad in outcrop, plus subsidiary well-crystallised quartz. Adularia accompanies both the quartz and manganese-rich parts of the Chala vein. In contrast, the Lucila vein (Fig. 1) is almost entirely composed of saccharoidal quartz deficient in both iron and manganese oxides.

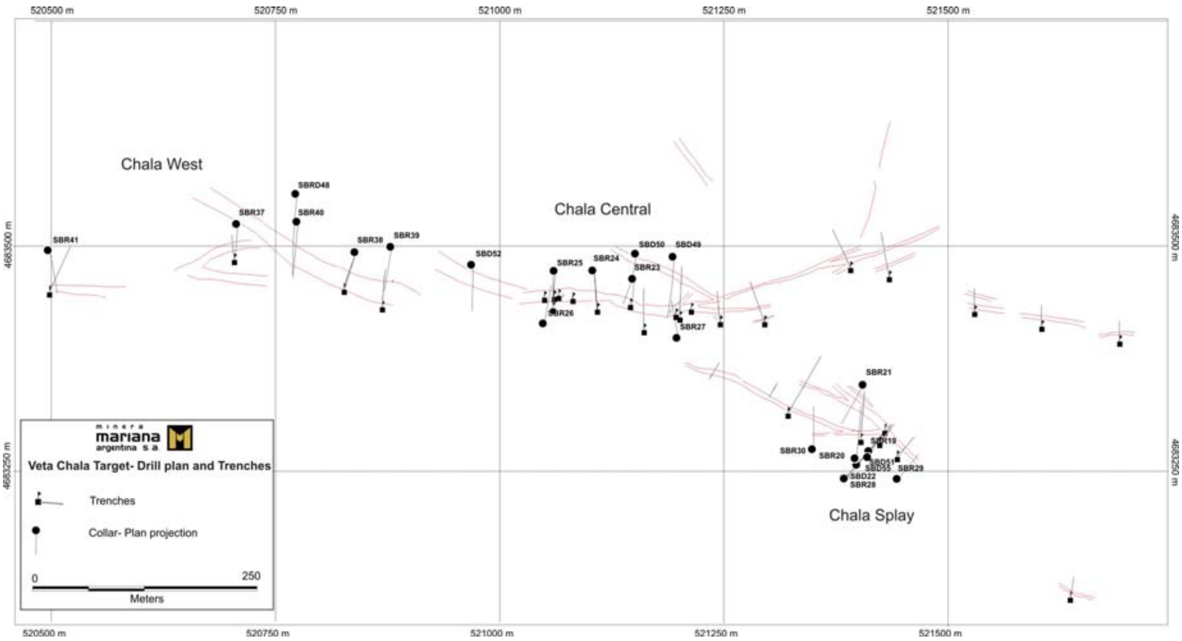

Fig. 3 Trenches and drill holes, Chala vein, Sierra Blanca prospect

The highest precious-metal values occur in the Chala Central vein and Chala splay, where at least 10 trench and drill-core/cutting samples average >2,000 g/t Ag equivalent over minimum 1-m sample widths. These high-grade samples comprise either porous, gossanous quartz or thinly bedded sandstone and siltstone cut by only minor quartz-limonite veinlets, the latter material constituting the marginal parts of the vein. The high silver values are at least partially attributable to the presence of the visible chlorargyrite (AgCl) and native silver. These high-grade silver samples also contain gold, ranging from 1-25 g/t, although there is a distinct tendency for the two metals to occur in adjoining samples rather than together. The manganese-rich western part of the Chala vein contains lower precious-metal values, with maxima of 800 g/t Ag and 6 g/t Au, based on the trenching and drilling to date. The Lucila vein is consistently mineralized, but with generally low tenors of both silver (<60 g/t) and gold (<1 g/t).

Minor amounts of base metals, principally zinc and lead, accompany the silver and gold in the Chala and Lucila veins, although total base-metal contents are generally <1 wt %. Sphalerite is a pale-coloured, iron-poor variety. There is a notable difference between the average base metal, antimony and arsenic contents of the Chala and Lucila veins. Base metals are an order of magnitude lower in the Lucila than in the Chala vein, whereas antimony and arsenic are approximately 10x and 2x higher, respectively. Lucila antimony values range from 10-500 ppm. The poorly exposed, chalcedony-dominated Cresta vein (Fig. 1), hosted by Chon Aike ignimbrite located some 70 m topographically higher than Lucila, appears to be even more antimony rich, with one of just a few rock-chip samples averaging 1 % Sb (plus 150 g/t Ag and 0.2 g/t Au).

The Chala and Lucila veins are both closely associated with illite alteration, which is typically more prominent in the immediate hanging-wall rocks. Mixed-layer illite-smectite is developed in places at greater distances from the Chala vein. The vein footwalls are generally sharper and less strongly altered, but marked by post-mineral fault gouge and brecciation. Locally, fine-grained quartz and adularia were observed as alteration products of the wall rocks within 20 cm or so of the Chala vein.

Supergene oxidation of the Chala vein appears to be shallowly developed and, normally, <25 m deep. However, oxidation attains a depth of 50 m in the wide, high-grade portion of the Chala splay. The base of oxidation is generally abrupt, with little development of mixed oxide-sulphide mineralization.

Chala and Lucila vein interpretation

The Chala and Lucila veins are difficult to classify because of the profound changes in their characteristics along strike. Nevertheless, in view of the abundant manganoan carbonate and rhodonite in the western part of Chala, exceptionally high Ag/Au ratios, local abundance of semi-massive pyrite and predominance of iron-poor (rather than iron-rich) sphalerite, an intermediate-sulphidation rather than low-sulphidation affiliation is preferred. However, it is recognised that base-metal contents are low compared to most intermediate-sulphidation epithermal vein deposits, although sulphide- and base metal-rich ore shoots, containing anomalous contents of Sn, W, Bi and In, do occur in northwest-striking veins on the contiguous Pinguino property.

The Chala Central vein and Chala splay differ from most epithermal veins in the Deseado massif in lacking through-going, crustiform-banded vein material. The development of irregularly distributed, open-space-filling quartz in combination with brecciation and sulphide replacement rather than a formal vein may be attributed to the marked rheological difference between the thinly bedded epiclastic host rocks of the El Tranquilo and Roca Blanca Formations at Chala and the massive welded ignimbrite that acts as wall rock to most of the Deseado veins. It is suspected that the sedimentary rocks were relatively ductile and unable to sustain a clean fracture that was incrementally opened during vein filling. Nevertheless, the Chala West and Lucila veins display more continuity and coherence, notwithstanding the fact that they also have epiclastic host rocks, albeit only the Roca Blanca Formation at observed levels.

Although the saw-cut samples taken from the well-constructed backhoe trenches across the Chala vein returned highly encouraging results, including bonanza-grade silver values, the subsequent drilling at Chala was much less successful. At first sight, this disparity might be attributed to the effects of supergene silver enrichment, whereby silver values are increased at the immediate surface. Although some limited silver and gold enrichment resulting from reductions in specific gravity consequent upon sulphide, carbonate and rhodonite oxidation may have occurred, wholesale chemical enrichment seems most unlikely. Indeed, silver is commonly depleted in the uppermost metre or two of silver veins rather than being enriched. Furthermore, the highest-grade silver assays were returned by limonitic material in which chlorargyrite or native silver is observed rather than from the manganese wad, which readily incorporates silver in either lattice or adsorbed forms.

At this stage of understanding, the failure of a number of the shallow drill holes to intersect appreciable precious-metal values seems to be best explained by either an erratic hypogene distribution of silver and gold values or the confinement of the values to small, isolated and irregular ore shoots. However, poorly understood structural complications caused by post-mineral cross faults may also have played a role where holes failed to encounter even barren vein material. Interestingly, the ore shoots at the bonanza-grade Martha silver deposit in the Deseado massif, also east- and east-southeast-striking and of intermediate-sulphidation affiliation, are small and apparently randomly distributed within the two main productive veins, as schematised in Figure 4.

Figure 4 also attempts to compare the Chala vein, including Chala splay, with Martha by contouring the highest silver equivalent values (in g/t) obtained over 1-m intervals in all the trenches and drill holes. The fact that the plotted values are commonly only small parts of multi-metre vein intersections is ignored. Gustavo Rodríguez contoured the Chala vein values digitally so parts of the illustrated ore shoots may be artefacts of the sparse data coverage. Nevertheless, a broad similarity between Martha and Chala may be appreciated, lending support to the notion that small, irregularly distributed, bonanza-grade ore shoots may have been missed at Chala by the widely spaced, shallow drill holes.

The presence of adularia and carbonate-replacement texture in the Chala vein from surface to at least 70 m, the maximum drill-tested depth, provides supporting evidence for this interval, and potentially deeper levels still, being conducive to ore-shoot development. The dominance of illite alteration would also support relatively shallow vein emplacement. There is a possibility, however, that the saccharoidal quartz vein at Lucila, up to 50 m topographically higher than Chala and hosted at shallow levels entirely by the Roca Blanca Formation (Fig. 2), may represent higher parts of the system in which silver and gold values are subeconomic. The much lower base metal but higher antimony and arsenic contents compared to Chala would support this idea. Certainly, La Cresta vein, dominated by chalcedony and hosted by stratigraphically higher Chon Aike Formation ignimbrite (Fig. 2), is a high-level vein; potentially overlying an epithermal ore shoot. The 1 % Sb value further supports this interpretation.

Chala and Lucila vein potential

The Chala vein and Chala splay have a cumulative strike length of ~1,200 m, within which a 150-m interval is alluvium covered and yet to be shown to possess vein development. The easternmost 550 m of the vein, including the splay, appears on the basis of current data to be the best mineralized. The vein and its immediate sedimentary wall rocks are typically mineralized over widths of 5-10 m, although up to 16 m are recorded locally. In view of these positive features and the bonanza-grade silver and accompanying gold values obtained from several trenches and a few drill holes, untested potential is considered to exist at Chala. This potential is further emphasised when the current situation at Chala is compared to that at Martha during the early stages of exploration (Fig. 4).

On the basis of the analogy drawn above with Martha, relatively small but irregularly distributed ore shoots may occur within the Chala vein and Chala splay, potentially to a subsurface depth of 150-200 m, although no concrete evidence for this depth extent is currently available. Even small ore shoots may be of possible interest if the exceptionally high-grade silver values already obtained prove to be more widely developed. The target ore shoots would be largely unoxidised and therefore potentially amenable to precious-metal recovery using conventional flotation.

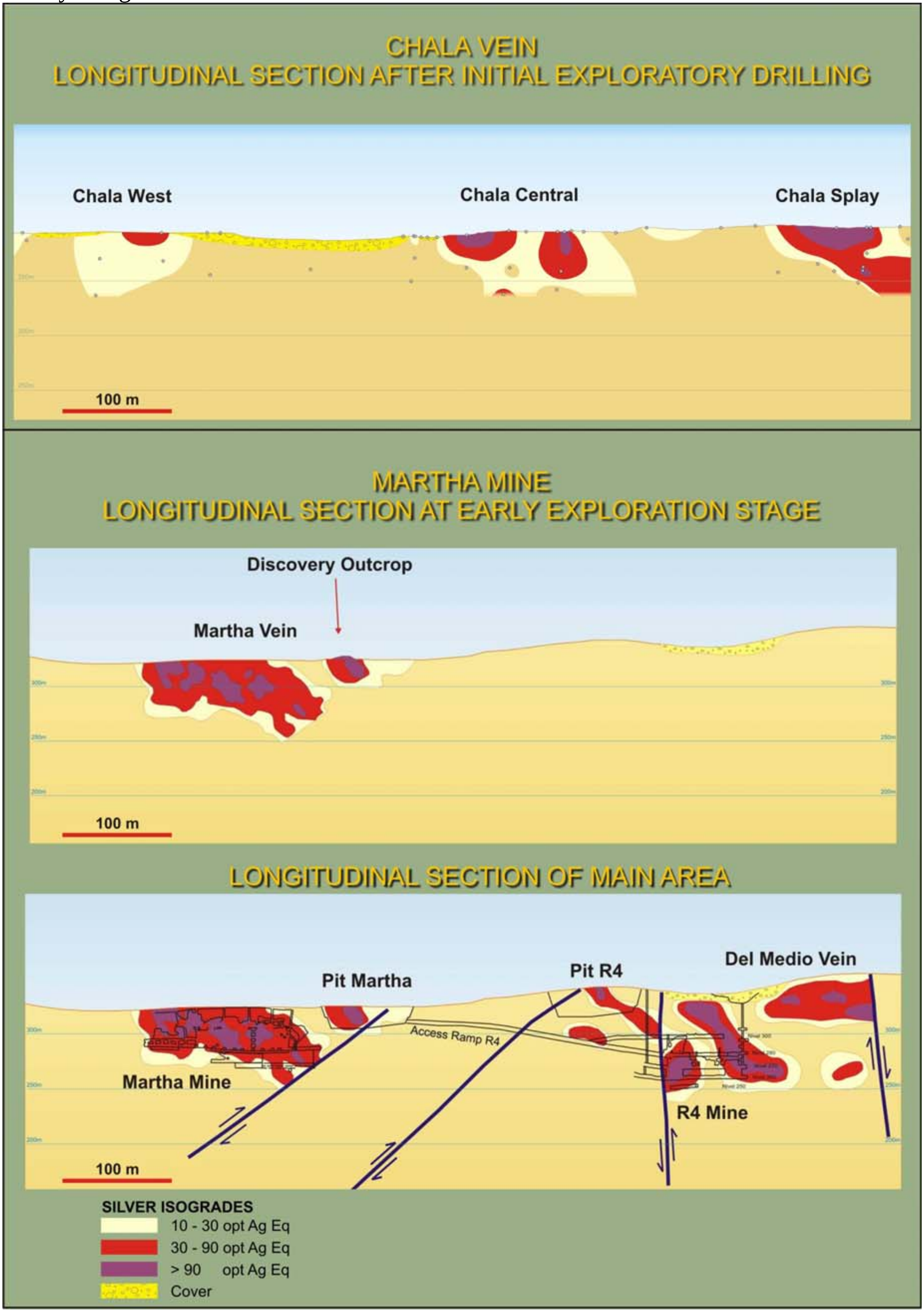

Fig. 4 Comparative longitudinal sections of the Chala and Martha veins

Although drilling to a maximum depth of 90 m has failed to encounter potentially ore-grade silver and gold values in the Lucila vein, higher-grade mineralization could exist at greater depths. The same conclusion also applies to La Cresta vein, although there any ore-shoot development is anticipated to be deeper still because the outcropping chalcedony is interpreted as a particularly shallow-level feature.

El Tranquilo veins

Based on the inspection of a single vein and discussions with the Mariana Resources team, the northwest-striking El Tranquilo veins (Fig. 1) are largely composed of white, crystalline quartz deficient in sulphide minerals, silver and gold. Crustiform banding is largely absent and carbonate-replacement texture only sparsely developed. In the vein examined, pyrobitumen is abundant as stringers and clots in the vein quartz and immediate wall rocks, the El Tranquilo Formation (Fig. 2).

The crystalline nature of the quartz, combined with the low antimony and arsenic values reported from rock-chip samples, suggest that the El Tranquilo veins may represent the root zones of Chala-type veins in which precious-metal values are uniformly low.

Vetarron zone

The poorly understood Vetarron zone (Fig. 1) comprises two shallowly east-dipping bodies of quartz, including vein material and silicification of pre-existing rocks, both El Tranquilo Formation sedimentary units and andesitic/basaltic material of Bajo Pobre type (Fig. 2). The two siliceous mantos, up 20-30 m in true thickness, may be parts of a single horizon displaced by a steep, north-striking normal fault, although this interpretation could not be corroborated during this brief visit. The quartz and silicified rock is extensively brecciated, apparently as a result of post-mineral faulting along the mantos themselves, thereby suggesting that the original veining and silicification may have been controlled by low-angle faulting, possibly listric in character. Gold values are generally low, typically ~0.3 g/t, and erratic although values reportedly increase somewhat eastwards.

The Vetarron zone is tentatively considered to comprise either one or two fault-localised zones of silicification and quartz veining, which at shallow levels appear to be relatively poorly mineralized. It is impossible to predict whether or not precious-metal values remain roughly the same or increase at greater depths. The existence in one of the trenches of a 1-m-wide, vertical quartz vein leads to speculation regarding the possible existence of feeders to the Vetarron manto(s).

General recommendations

In view of the possibility that precious-metal ore shoots containing bonanza-grade silver values may remain to be defined in the Chala vein, and bearing in mind the erratic distribution of potentially similar ore shoots at the Martha deposit, additional drilling is recommended. Future holes need, at least initially, to test the Chala vein and Chala splay at vertical depths of 75 and 150 m. Holes should be drilled from south to north to avoid the ambiguity surrounding the results of some of the south-directed holes, which may have been stopped before cutting the main vein structure. A stage-1 programme might comprise approximately 3,500 m in 20 holes.

It is also considered worthwhile to test the Lucila vein at a depth of 150-200 m, with at least five holes steeply inclined from north to south. Four holes in La Cresta vein, in search of a deep ore shoot, are also recommended. The holes could be drilled as two fences designed to intersect the vein at vertical depths of 150 and 250 m.

Ideally, were unlimited funds available, the Chala and Lucila sectors would be subjected to north-south fence drilling in search of additional, concealed veins. The fences would include the main concealed east-striking fault structure revealed by the ground magnetics.

At the present time, no further work is recommended on the El Tranquilo veins or the Vetarron zone, where results to date have not been particularly encouraging.

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15th February 2009

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