

GEOLOGY OF THE MAGDALENA BASIN
SONORA, MEXICO

By

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Summary

The Magdalena basin is, by far, the most important and extensively studied area for borates in Mexico. Materias Primas Magdalena S.A. de C.V. (US BORAX-VITRO former joint venture) evaluated the Tinaja del Oso colemanite deposit (TDOCD) located at the western margin of the basin, during the period of 1977 to 1991.

With the releasing of about 95% of the mining claims, the evaluation of the remaining borate potential of the Magdalena basin has been included in the Rio Tinto Industrial Mineral Exploration program since 2002. The encountering of twelve million tons of sodium/calcium borates with 20% B_2O_3 to supply the increasing market for borate-bearing fertilizers and/or boric-acid in Mexico and possibly also Pacific Rim borate requirements has been established as a primary short-medium term target.

The establishments of land position and good community relationships have been essential in the progress of this project. Detailed recognition and prioritization of drill targets, re-definition of the basin's geology and accomplishment of subsequent drilling campaigns has been the follow-up strategy for the progress of this project.

The geology of the Magdalena basin is complicated by its origin. Three stacked sedimentary sequences have been recognized and six drill targets have been defined, prioritized and partly tested with drilling; these targets are: Bellota-Yeso, Cajon, El Tigre, Pozo Nuevo, Escuadra and Syncline. Most targets have been tested with drilling, except the area known as a "Yeso" in the Bellota target and the syncline target which remain untested.

To date, 10,084 meters of drilling in 28 NQ-core holes have been drilled during this project. Most holes have intersected visible borate mineralization in the form of colemanite and howlite. Main mineralized intervals include 5.49 m @ 13.8 % B_2O_3 in Cajon target, 4.57 m @ 17.1 % B_2O_3 in Pozo Nuevo target, 2.44 m @ 18 % B_2O_3 in Tigre target and 6 m with 8.9 % B_2O_3 in Escuadra target.

Drilling has been conducted in five campaigns without major HSEC incidents. Core recovery averages 97.6% and cost averages 99.57 USD per drilled meter, all inclusive.

Other activities in the basin have included geophysical surveys as semi-regional gravity and ground magnetic survey in the south-central portion of the basin. Some volcanic units have been identified through geochemical analyses and age dates.

In order to complete the evaluation of the basin and have a good understanding of the real borate potential, it is recommended to complete the drilling in the Syncline target and the in-fill drilling in Escuadra, Yeso area and Cajon.

The implementation of MT over the Syncline target and possible over the thick gravel coverage in the north and central portions of the basin is also recommended.

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INTRODUCTION

The evaluation of the remaining borate potential of the Magdalena basin has been included in the Rio Tinto Industrial Mineral Exploration program since 2002. The encountering of twelve million tons of sodium/calcium borates with 20% B₂O₃ to supply the increasing market for borate-bearing fertilizers and/or boric-acid in Mexico and possibly also Pacific Rim borate requirements has been established as a primary short-medium term target.

In December 2001, the Mexican mining agency declared as “open ground” about 70% of the basin that had been held since the mid-seventies first by VITRO-US BORAX and later by VITRO-UNIMIN. The southern and other small claims were released later, opening about 95% of the entire basin.

In 2002, MSM staked six claims with a total coverage of 23,815 Ha, but as part of the 2005 annual improvements and after the partial evaluation of the westernmost drill targets, 11,755 Ha were released. Currently MSM holds a total of 12,060 Ha in the eastern and central portions of the basin.

The establishments of 1) a land position with the acquisition of mining claims and 2) good community relationships have been essential in the progress of this project. Detailed recognition and prioritization of drill targets, re-definition of the basin’s geology, and accomplishment of subsequent drilling campaigns has been the follow-up strategy for the progress of this project.

The geology of the Magdalena basin is complicated by its very complex origin. While validating previous geologic information, it was realized that part of the geology needed to be re-interpreted. This work is being integrated as the detailed exploration of the drill targets progresses. Other activities in the basin have included geophysical surveys as semi-regional gravity and ground magnetic survey in the south-central portion of the basin. Some volcanic units have been identified through geochemical analyses and age dates.

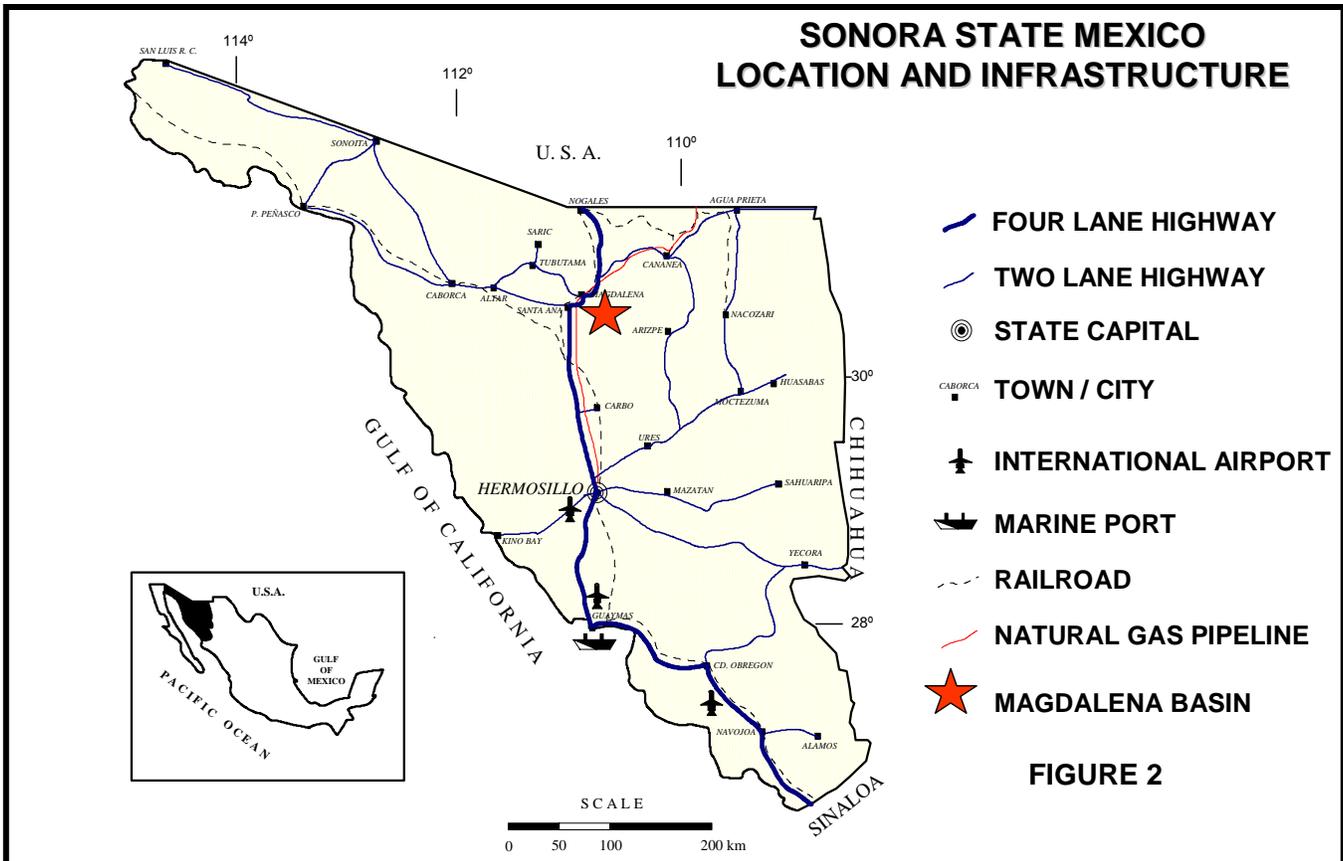
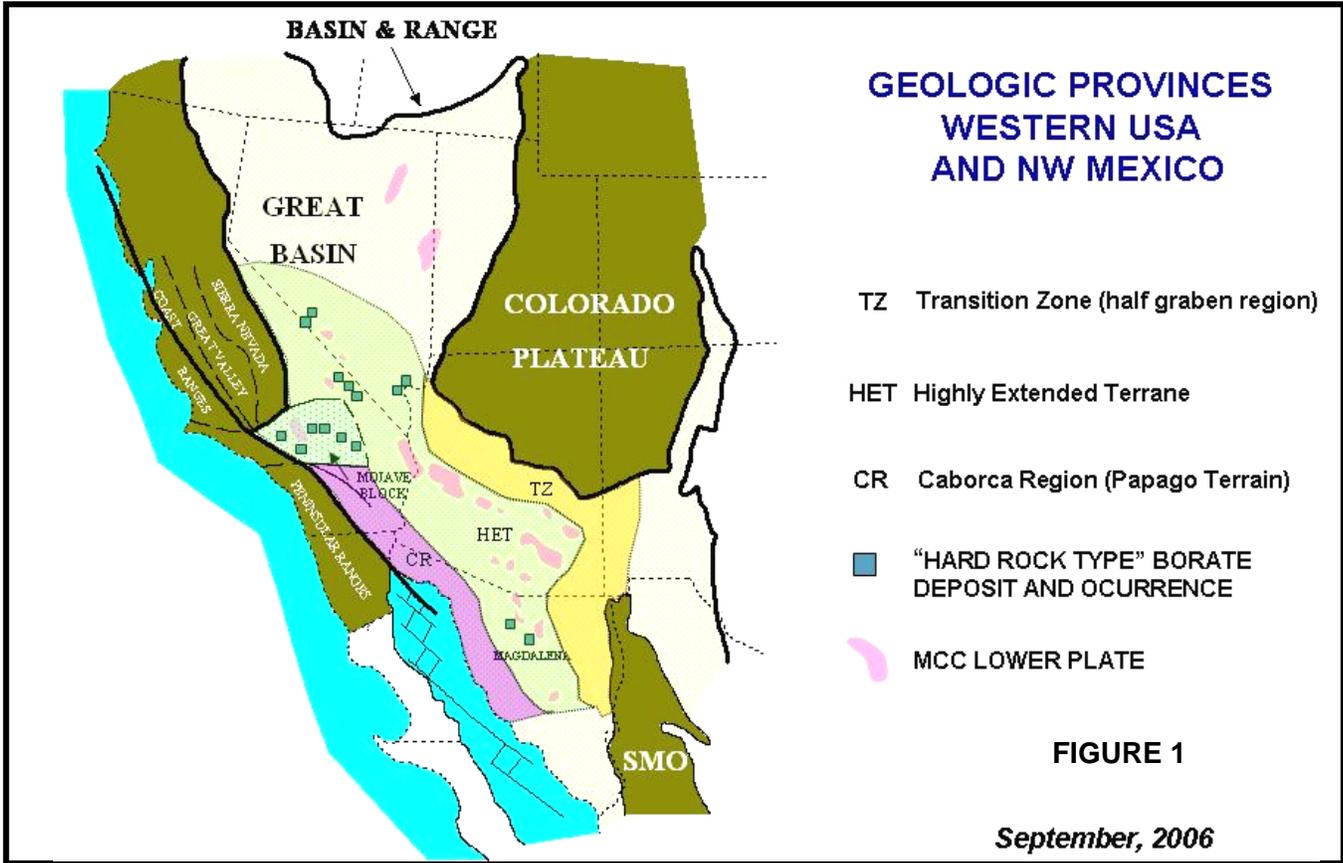
Aided by the detailed exploration and based on previous and new geologic information, six drill targets have been recognized and prioritized in this basin outside of the TDO area: Bellota-Yeso, Cajon, El Tigre, Pozo Nuevo, Escuadra and Syncline. Most targets have been tested with drilling, except the area known as a “Yeso” in the Bellota target and the syncline target which remain untested.

OVERVIEW

Magdalena is a Tertiary, Metamorphic Core Complex-related basin that lies in northern Sonora, Mexico in the southern portion of the Basin & Range province and corresponds to the southernmost portion of the “Great Basin” where all of the known bedded rock-hosted borate occurrences and/or deposits in North America have been reported (see figure 1).

This basin is by far, the most important and intensively studied area for borates in Mexico. Materias Primas Magdalena, S.A. de C.V. (US BORAX-VITRO former joint venture) evaluated the Tinaja Del Oso colemanite deposit (TDOCC), located at the western margin of the basin, during the period of 1977 to 1991. Several publications and abundant internal reports have been written concerning this basin and the TDOCC; but, despite the detail on which this basin has been studied, other targets in the basin remain untested.

The infrastructure emplaced in the region, including the existence of a gypsum mine with visible borate mineralization as well as surface occurrences of colemanite and howlite, are significant features making this basin highly attractive to the development of a systematic borate exploration program (see figure 2).



LAND STATUS

With the releasing of an important amount of ground by VITRO-UNIMIN, MSM staked five claims in two stages. First, the San Francisco claim was staked to cover the north and central portions of the basin in two separate fractions. Later in June 2002, the San Francisco I was staked to cover the southern portion of the basin, and the San Francisco 2, 3, 4 and 5 were staked to infill interior claims, making a total of 23,815 Ha.

Later, and after reviewing the geology and testing the southwestern-most target, 11,755 Ha were released. Currently MSM holds a total of 12,060 Ha in the eastern and central portions of the basin (figure 3 and table 1).

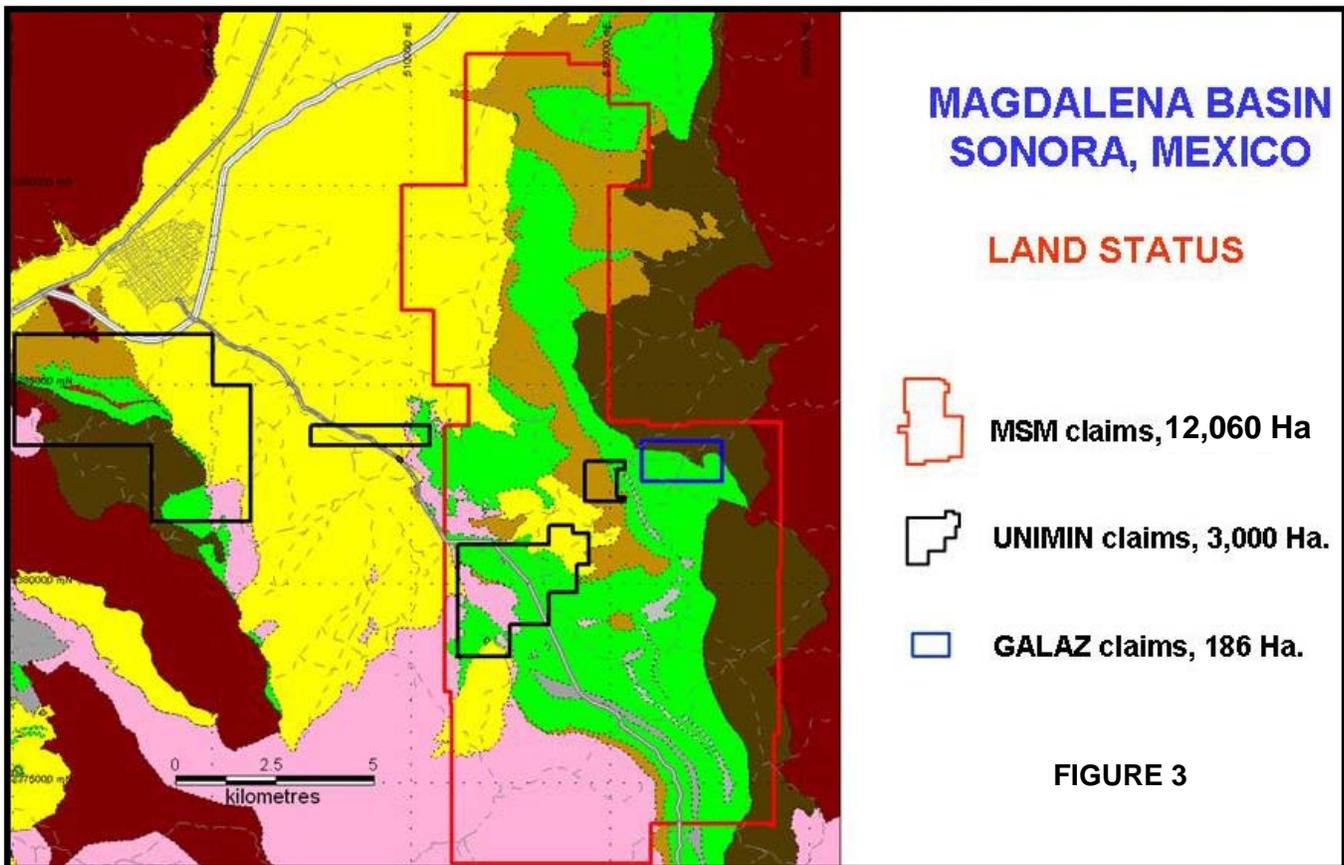


Table 1

MSM CLAIMS. AREA, VALID DATES AND HOLDING TAXES 2007 (USD)					
CLAIM	Area (Ha.)	Date of Title	Expire	1st half	2nd half
San Francisco Fraccion 1	2343.8336	5/17/2002	5/16/2052	963.00	
San Francisco Fraccion 2	4980.1368	5/17/2002	5/16/2052	755.00	
San Francisco 1	2302.8356	8/13/2002	8/12/2052	147.00	
San Francisco 2	582.9098	9/18/2002	9/17/2052	939.00	
San Francisco 3	350.7713	9/18/2002	9/17/2052	981.00	
San Francisco 5	1500.0000	9/30/2003	9/29/2053	2083.00	
	12060.4871			5,865.00	

GEOLOGY

The Magdalena basin is a topographic depression floored and surrounded by metamorphic and volcanic rocks. It has been recognized as the upper plate of the Magdalena-Madera Metamorphic Core Complex. Two types of basement have been observed: 1) Metamorphic, composed of mylonites, gneisses and leucogranites from La Madera and Magdalena ranges and 2) volcanic, composed of a latite flow from La Ventana range (see figure 4 for a general geologic map).

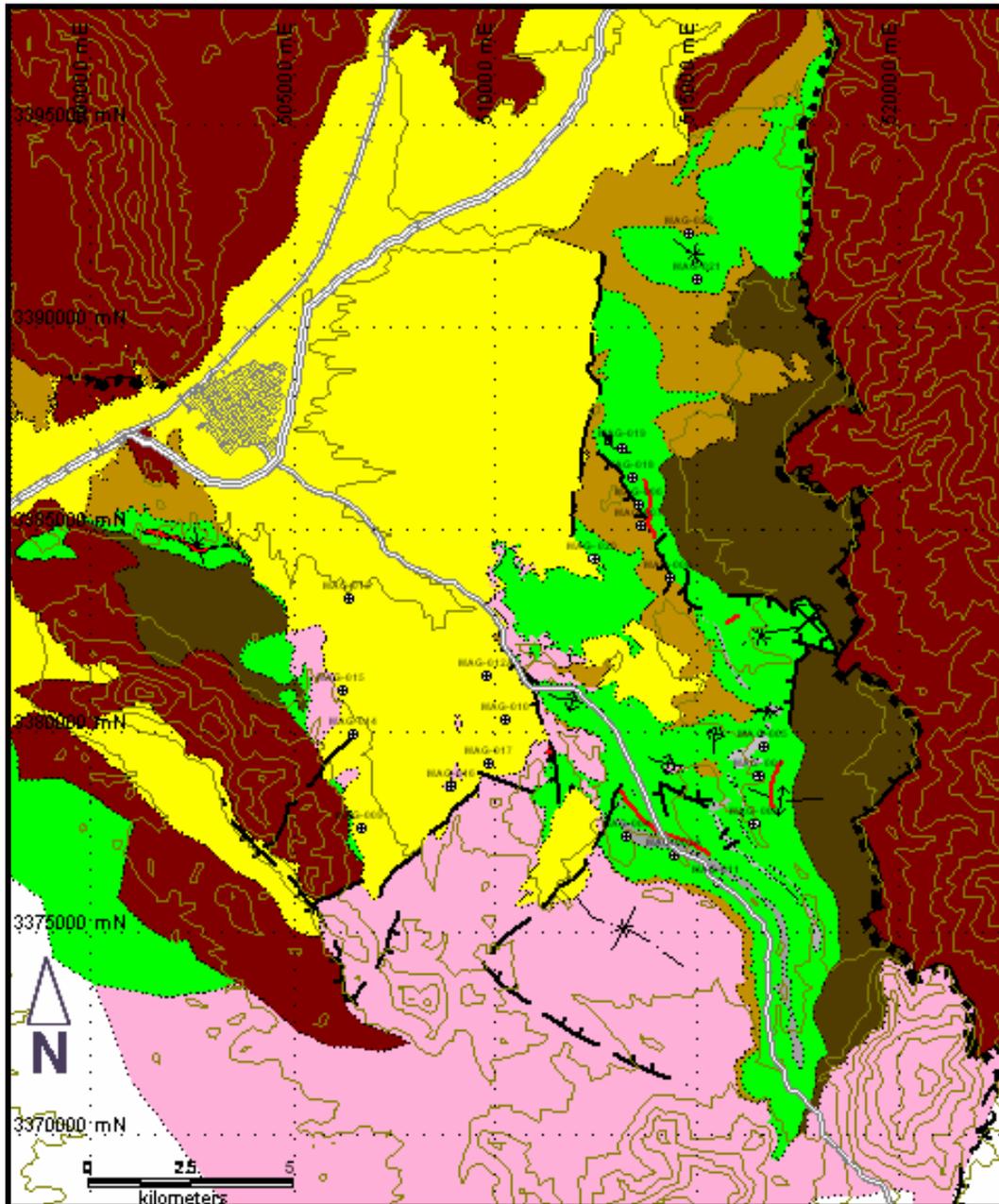
Local Geology – Fluvial lacustrine sequences

Three stacked sedimentary sequences containing fluvial-lacustrine members have been recognized in the basin, herein only the fluvial-lacustrine members of each sequence will be described in detail (see figure 5 for a composed stratigraphic column).

Bellota Sequence: The lowermost sequence is known as “Bellota”. It is composed of a basal conglomerate (alluvial fan that covers most eastern portion of the basin), a lower transition, a fluvial-lacustrine member, an upper transition and an upper conglomerate. A basaltic flow with an intrusive component is interbedded within the upper conglomerate. The “Bellota” fluvial-lacustrine member is located in the eastern portion of the basin and includes the area surrounding the “Yeso” Mine and Ranch. It is composed of thin-medium bedded, brown and greenish mudstone and black shale with scarce siltstone and sandy horizons. It becomes tuffaceous in the upper portion and is highly calcareous. It contains abundant gypsum in beds and veinlets and, in fact, a gypsum deposit is being mined from this unit. Thickness varies from 200 to 600 meters. The sequence presents the characteristic features of soft sediment deformation. This unit also contains a carbonate replacement zone similar to the surface expression of the TDO colemanite deposit. Thickness ranges between 4-8 m. Good geochemical B and pathfinder element anomalies have been reported. This horizon contains abundant calcite in masses and nodules (after borate?).

Cajon Sequence: The second sequence is known as “Cajon” and is composed of a lithic tuff closely associated with tuffites and tuffaceous sandstone, a fluvial-lacustrine member, and an upper transition that rapidly changes into a tuffaceous matrix conglomerate. The “Cajon” fluvial-lacustrine unit is located in the central portion of the basin and includes the “Tigre, Cajon and Pozo Nuevo” areas. It is composed of thin-medium bedded, greenish, pink and light gray tuffaceous-calcareous mudstone with scarce siltstone and sandy horizons. Thickness varies from 200 to 600 meters. This unit also contains a carbonate replacement zone (CRO) with a thickness between 8 and 12 meters and good geochemical B and pathfinder element anomalies. This horizon contains abundant calcite in masses and nodules with radial structures (after borate?). It also contains scarce gypsum in veinlets and howlite and colemanite surface occurrences have been reported. This unit also contains an interbedded basaltic flow that has been denominated “Cajon” basalt. It is composed of greenish-gray basalt with a characteristic diabasic texture. It is highly oxidized, gas-rich in some places with calcite filling cavities and fractures. Thickness roughly ranges from 40 up to 80 meters.

TDO Sequence: The youngest sequence is known as “TDO” and is composed of a lower conglomerate (which in Escuadra area correlates with is the basal conglomerate in the Bellota sequence), a lower transition, a fluvial-lacustrine member, an upper transition and an upper conglomerate (with a characteristic red color). The “TDO-Escuadra” fluvial-lacustrine unit is exposed in two separated areas into the basin: The northeastern portion that includes the “Escuadra” area and the western portion which includes the “TDO” area. Although these areas are separated they were correlated by its stratigraphic similarities. This unit is composed of shale, some of them carbonaceous, interbedded with little sandstone to the bottom. The medium zone is the Tinaja Del Oso Colemanite Ore-body in the western portion of the basin and is composed of black carbonaceous shale and marls with borates, and gypsum. Mudstone breccias (slumping)



GEOLOGY OF THE MAGDALENA BASIN

POST-BASIN ROCKS

- Alluvium and young gravels
- Upper volcanics (20.6 my and younger)

BASIN ROCKS

- Upper conglomerate
 - Fluvial-Lac. sequence
 - Basal conglomerate
- Basaltic flows 22.6-21.4 my
 Carbonate Replacement Outcrop

PRE-BASIN ROCKS

- Metamorphic/Volcanic basement

- MSM drillhole
- X Gypsum mine
- TDO colemanite deposit
- Paved road

Figure 4

COMPOSED STRATIGRAPHIC COLUMN. MAGDALENA BASIN

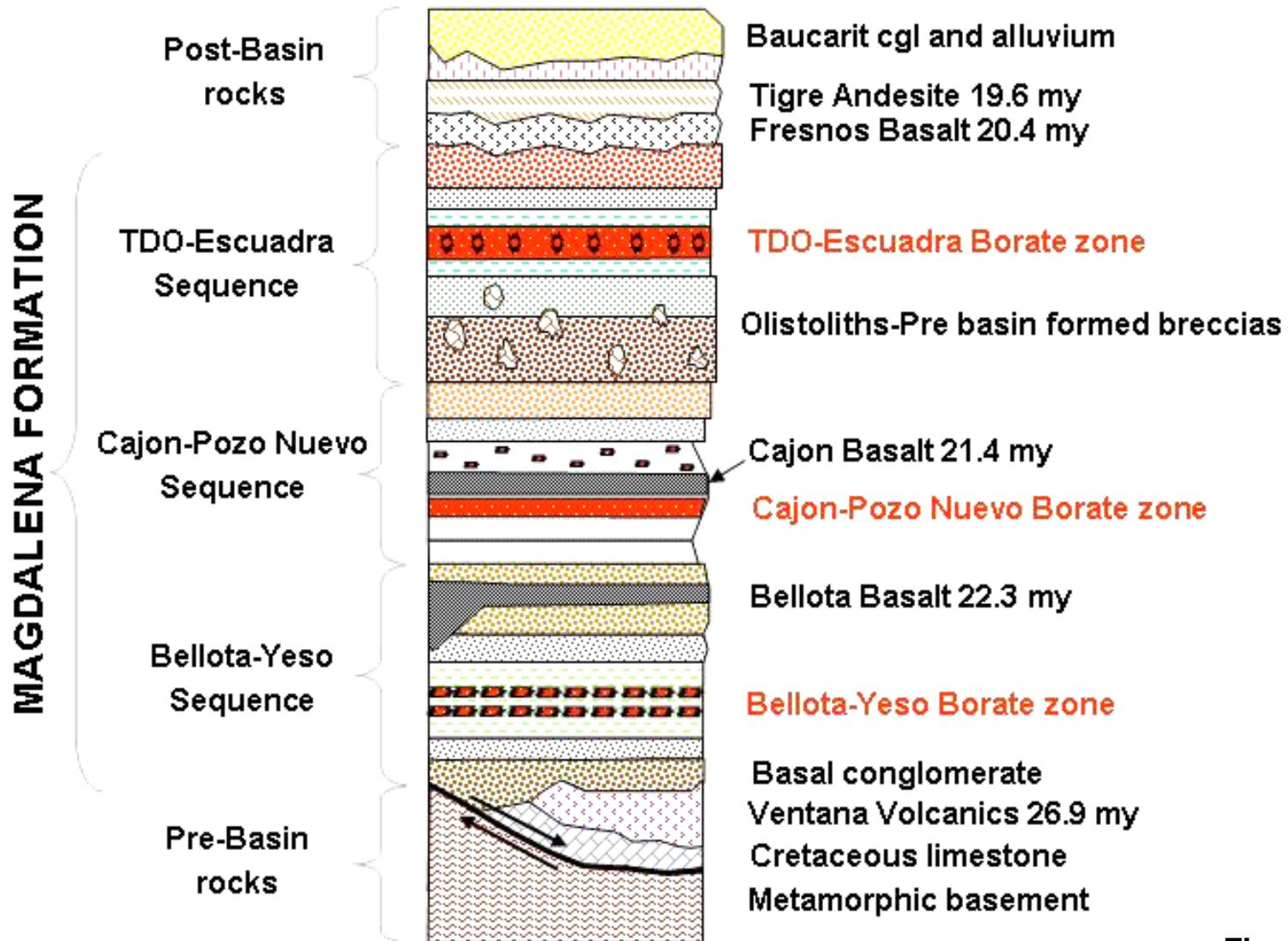


Figure 5

are common features in this unit. The outcropping colemanite ore-body (CRO) is composed of calcite, aragonite and clays in vuggy masses. Scarce howlite, cannite, strontianite and orpiment zones are found. Several sedimentary breccia lenses are interbedded in the lower and middle portions. The upper portion contains more sandstone and siltstone than the middle portion, but the clay content is still high.

In general, the fluvial-lacustrine sediments of the Magdalena Formation are highly distorted. It is common to observe mudflows, turbidites, slumping breccias and "olistoliths" (big boulders composed of pre-basin rocks), cutting the sedimentary bedding. In addition, a series of anticlines and synclines as well as listric faults delimiting structural blocks are common structures along the basin. The associated borate mineralization is undoubtedly a product of diagenetic processes.

TECTONIC EVOLUTION

Recent thermo-chronologic analyses have reported that the exhumation of the lower plate at the Madera-Magdalena core complex was ongoing during the period of 25-22 Ma. This, along with the first evidences of cooling, dated in 29.3-28.1 Ma, the emplacement of the Ventana volcanics about 26.9 Ma and the closure of the basin about 20.6 Ma are good elements to establish space and genetic relationships between the Magdalena basin and the development of the MCC. Other age dates on intra-basin and post-basin units contribute to define the evolution of the region. Structural relationships between lower plate and post-basin rocks indicate posterior movements of the MCC.

Tectonic Setting

During the late Cretaceous-early Tertiary, NW Mexico and SW USA were highly affected by the Laramide Orogeny developed by the shallow subduction of the oceanic floor under the continental American plate. The steeping of the flat slab changed the tectonic regime, from compressional to extensional. Once the pressure applied by the subduction was released, the continent relaxed and the voluminous amount of magma generated beneath the continent by the subduction was explosively erupted. Although the relationship between the SMO volcanism and the beginning of the extension has not been completely clarified, two different events have been recognized associated to this extension: The first one is Eocene in age (55-40 Ma) in northern USA and Oligocene-Miocene in the south (35-16 Ma). The second extensional event is known as Basin & Range (16-13 Ma to present). The main distinction between the two events is that the former resulted from a dynamic, horizontal displacement in a softened and hot lithosphere, whereas the latter was manifested by high-angle normal faulting in a relatively cold and rigid crust where vertical displacements exceeded horizontal movements and where magmatism was mainly sub-crustal.

Magdalena Basin Evolution

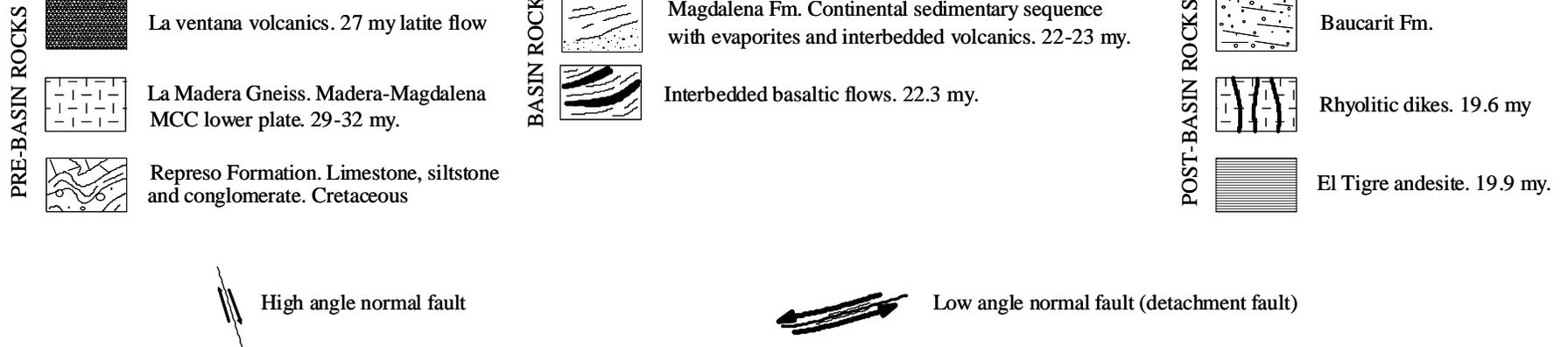
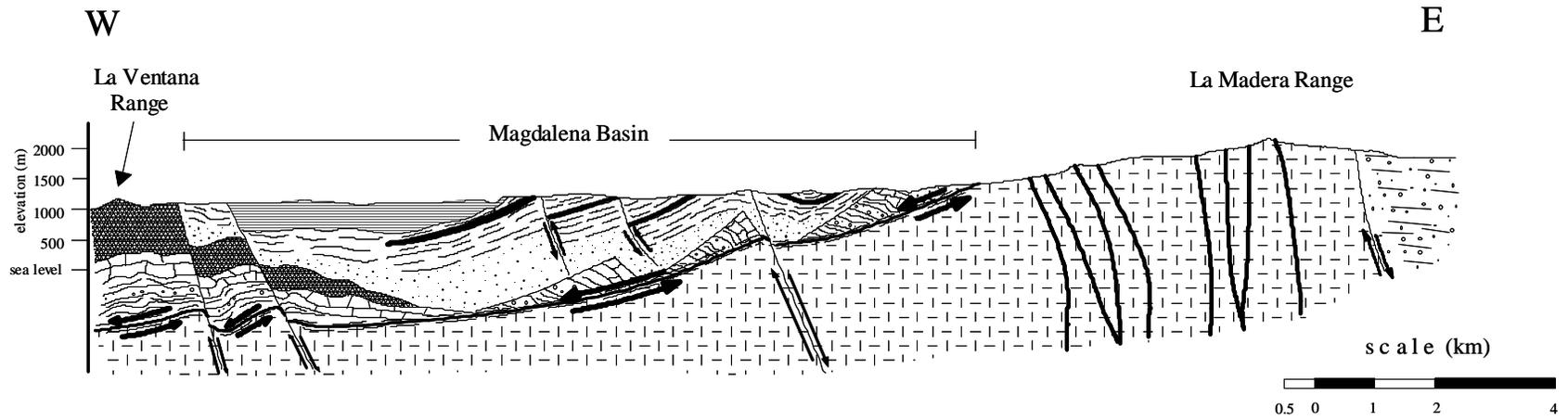
First evidences of high extension and upper mantle uplift (cooling) in the region has been reported, occurring between **29-27 Ma**; two samples of lower plate rock from Sierra Magdalena were dated by Ar/Ar in muscovite, reporting an age of **29.1 ± 0.2 and 28.7 ± 0.6** respectively (Figure 6).

Also, two samples from Sierra de la Madera were analyzed for thermo-chronology reporting very flat K-feldspar age spectra from **25-22 Ma**, indicating that the exhumation of the lower plate at the Madera-Magdalena core complex was ongoing during that period. Diffusion modeling of these data indicate rapid cooling (rates of >50°C/m.y.). The muscovite age is consistent with these results, also giving an age of **25.1 Ma** with a flat plateau in the age spectrum. The total cooling of the footwall at Magdalena must be >150°C during exhumation.

About 27 Ma, an andesitic volcanic flow (Ventana, **26.9 ± 0.6** K-Ar, biotite) was deposited over a cretaceous sequence (Represo Formation) and displaced and rotated from the incipient lower plate

SCHEMATIC CROSS SECTION OF THE MAGDALENA BASIN

Figure 6



along a low angle fault (detachment) creating the Magdalena basin. The deposition of the thick basal alluvial fan occurred during that period, extending probably until **24-23 Ma**.

The basin was filled out with the Magdalena Formation sediments between **23 Ma** to **20.6 ± 0.1 Ma**, which is the date of the lowermost post-basin unit and records the end of the basin.

Post-basin bimodal volcanic rocks in contact with the MCC lower plate clearly slid along a detachment fault, demonstrating posterior movements of the MCC, probably during the basin and range type extension. The second member of the bimodal sequence has been dated by K-Ar in **19.6 ± 0.9 Ma**.

Borates

At least three pulses of borate mineralization are recognized in Magdalena. The first one occurred during a period of relative tectonic stability that allowed the deposition of the “Bellota” fluvial-lacustrine sequence and the first borate pulse. Another period of tectonism is recorded by the upper “Bellota” conglomerate and the “Bellota” basalt, dated in **22.3 ± 0.3 Ma** (Ar/Ar-whole rock) therefore, the lowermost borate mineralization occurred after the deposition of the Basal conglomerate and prior to the extrusion of the “Bellota” basalt between **24-23?** to **22.3 Ma**.

The second borate pulse is associated to a period of local stability but abundant volcanic activity in the region. The “Cajon” basalt is interbedded within the fluvial-lacustrine sequence and borates occur both beneath and above the basaltic flow. The “Cajon” basalt has been dated in **21.4 ± 1.0 Ma** (K-Ar).

After another period of tectonic instability, remarked by presence of boulders of pre-basin breccias and conglomerates, the youngest and more important borate mineralization occurred in the basin with the deposition of the Tinaja Del Oso in the west and Escuadra sequences in the northeast. No volcanic activity has been recorded during that period, but it can be bracketed between **21.4 ± 1.0 Ma** and **20.6 ± 0.1** which is the period between the deposition of the “Cajon” basalt and the reported age of the “Fresnos” basalt, which is the first post-basin unit that records the end of the Magdalena basin (see appendix 1 for complete age date results).

GEOCHEMISTRY OF VOLCANIC UNITS

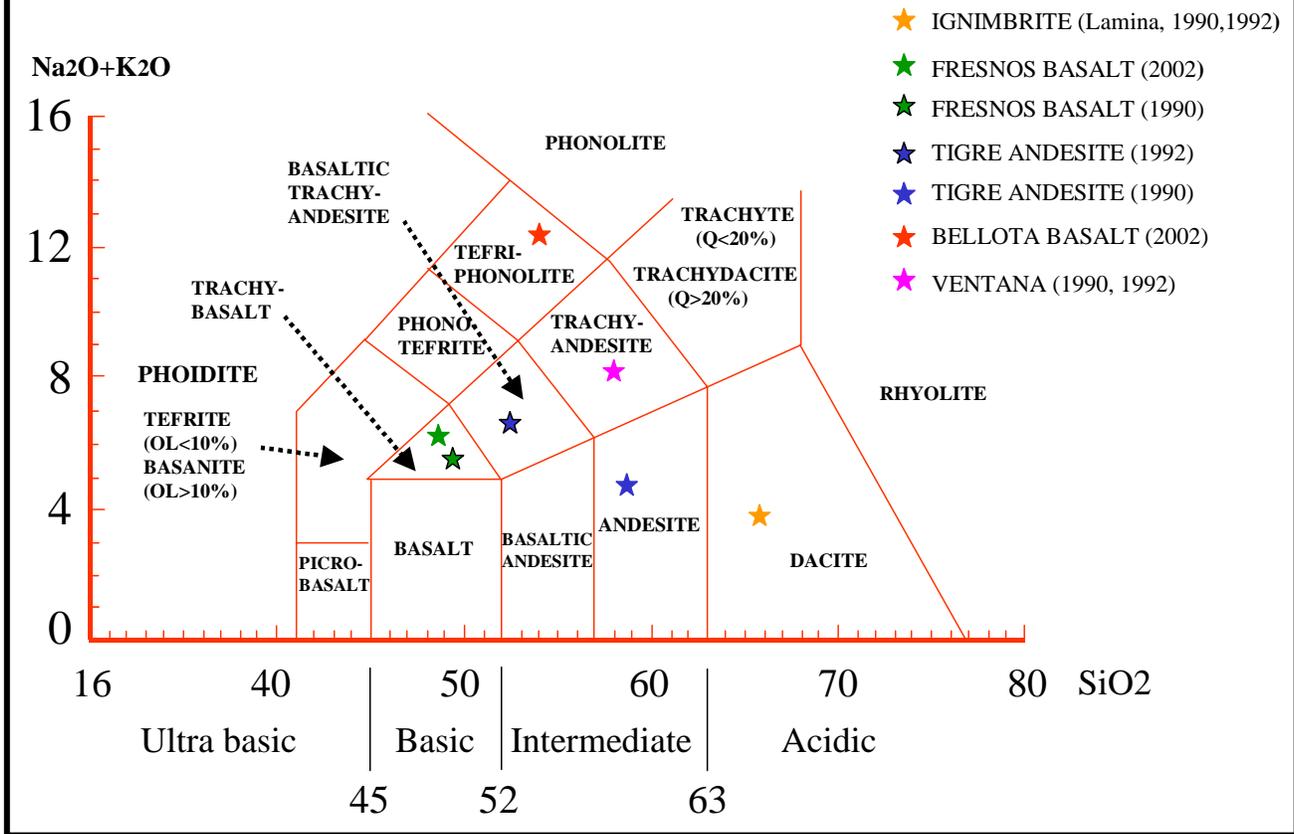
Major oxides analyses have been conducted on most of the recognized volcanic unit in the Magdalena basin. An interpretation of these results is presented here in the form of diagrams to determine the rock classification according to the alkali versus silica contents (see T.A.S. diagram) and the type of volcanism developed in the region (see Kuno diagram).

From the T.A.S. diagram, we can observe that the Ventana volcanics (pre-basin unit) fall in the trachy-andesite field; however these rocks are K-metasomatized (k-feldspar replacing plagioclase), so a different approach is necessary to determine the real (or original) k-feldspar content. It is suggested herein that this unit was originally an andesite.

The Bellota basalt falls in the tefri-phonolite range because its silica content is little bit higher than regular basalts. Perhaps a “fresher” sample would better define this unit since the analysis was conducted on an altered sample.

The Fresnos basalt is the best-analyzed unit. Two samples, one collected in 1990 and the other collected in 2002 fall in the trachy-basalt field.

T.A.S. chemical classification for volcanic rocks (Le Bas et al., 1986)



Two analyses from El Tigre andesite give discouraging results, confusing whether the samples were collected from the same or different units. Both silica and alkali contents are different suggesting two different compositions. The collection of another sample is recommended for this unit to verify its real composition.

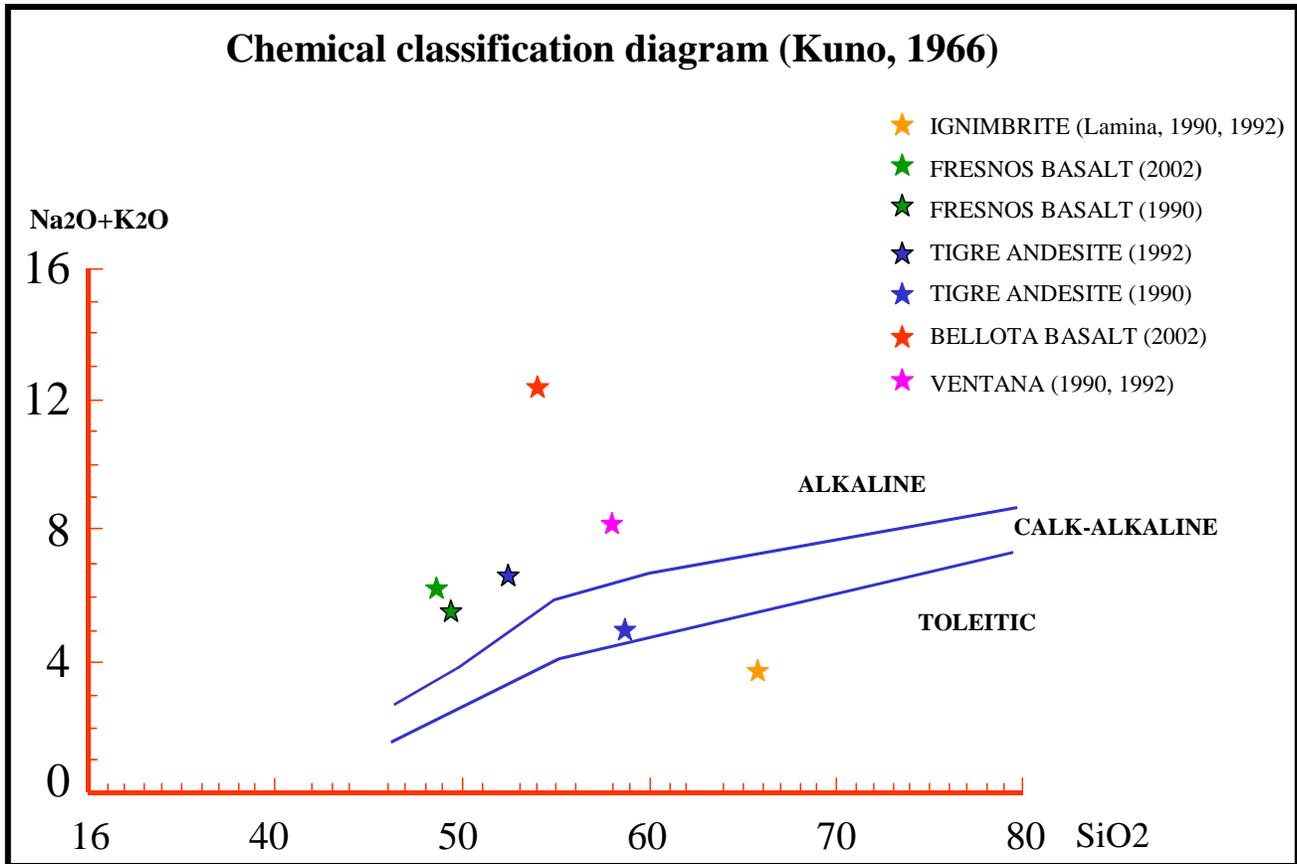
An analysis over an ignimbrite from the La Lamina range that could be correlated with the TIt unit was collected in 1990. It falls in the dacite field and very well could be called dacitic tuff. However, a sample from the outcropping tuff in the La Cantera area (southern portion of the mapped area) is recommended.

Regarding the type of volcanism recorded in this region, a diagram that classifies the volcanism according to the alkali versus the silica content was used (Kuno, 1966).

From this diagram, two types of volcanism are distinguished in the basin. The first one is contemporaneous with the development of the Magdalena basin (mid-Tertiary syn-extensional volcanism), characterized by being K-rich and of low silica content, and falling in the alkaline field. The post-basin "Fresnos" basalt falls in this field also, as a relict of this volcanism.

Younger volcanic rocks from the Lamina-Torreón bimodal sequence represent the second volcanic event. This event is tholeiitic and is related to the Basin and Range extensional period.

One sample from the “Tigre” andesite shows a transitional step between the two types of volcanism and could represent the first evidence of post-basin volcanism. However, another sample does not show the same behavior, so the data is contradictory and no valid conclusions can be obtained.



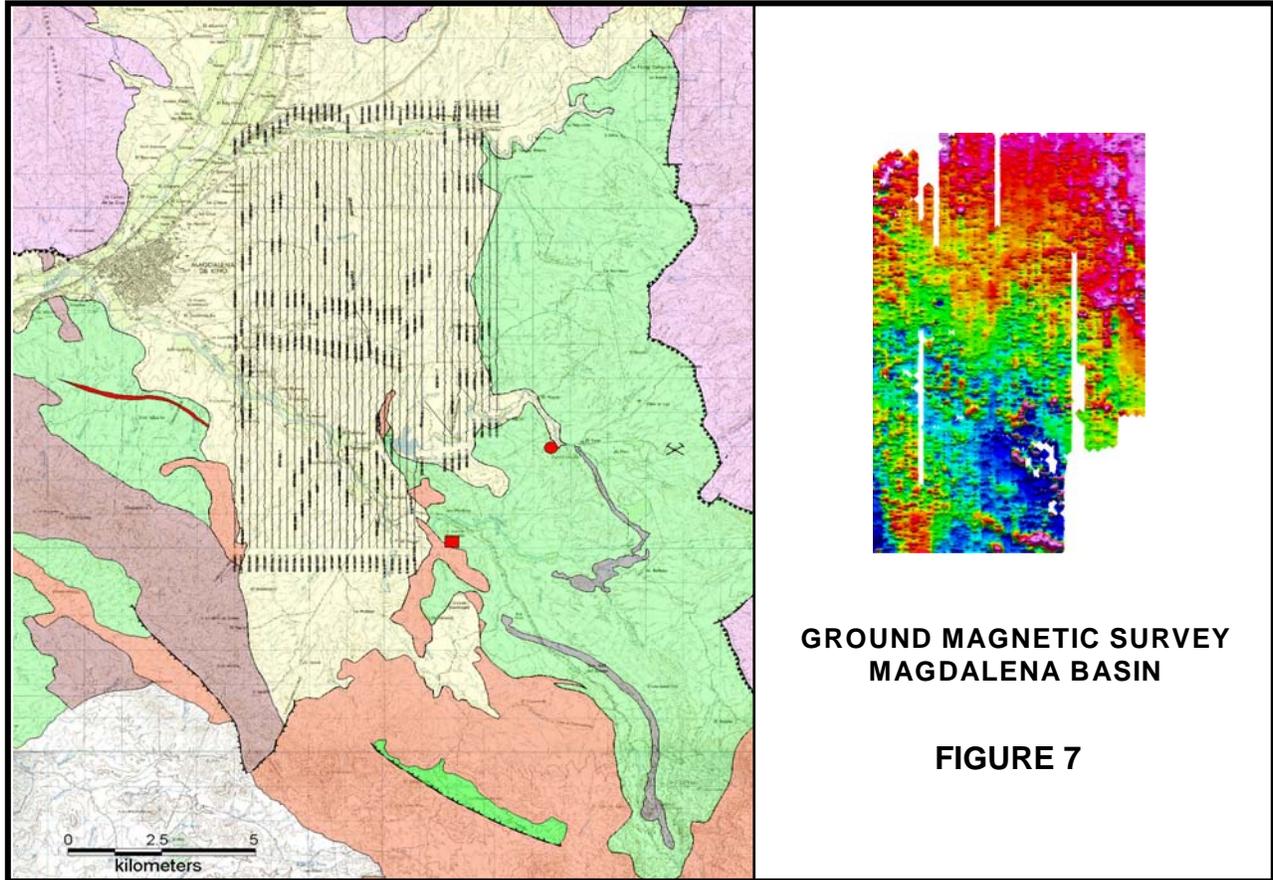
GEOPHYSICS

In order to determine covered structures, volcanic rocks, extension of sediments under coverage and the basement’s configuration, a ground magnetic survey in the central portion of the basin and a semi-regional gravity survey were conducted in the Magdalena project during 2002. More gravity stations were added in February 2005.

Ground magnetics

A ground magnetic survey, 200 m spaced lines with 10 m stations, was conducted in May 2002 in the central portion of the basin in order to identify geologic features under the pervasive gravel coverage. The survey extended far enough south and east to take readings in known Magdalena sedimentary outcrops in order to have a basis for comparison. Figure 7 shows the area covered with the survey and a rough interpretation expressed in nano-teslas. From the figure, a northwesterly trending magnetic low is observed across the southern portion of the surveyed area along Sasabe wash which is the major drainage in this portion of the basin. This might suggest the continuation to the northwest (toward the town of Magdalena) of the soft sediments of the Magdalena Formation. The upper volcanic rocks also show up in picks of high magnetic response.

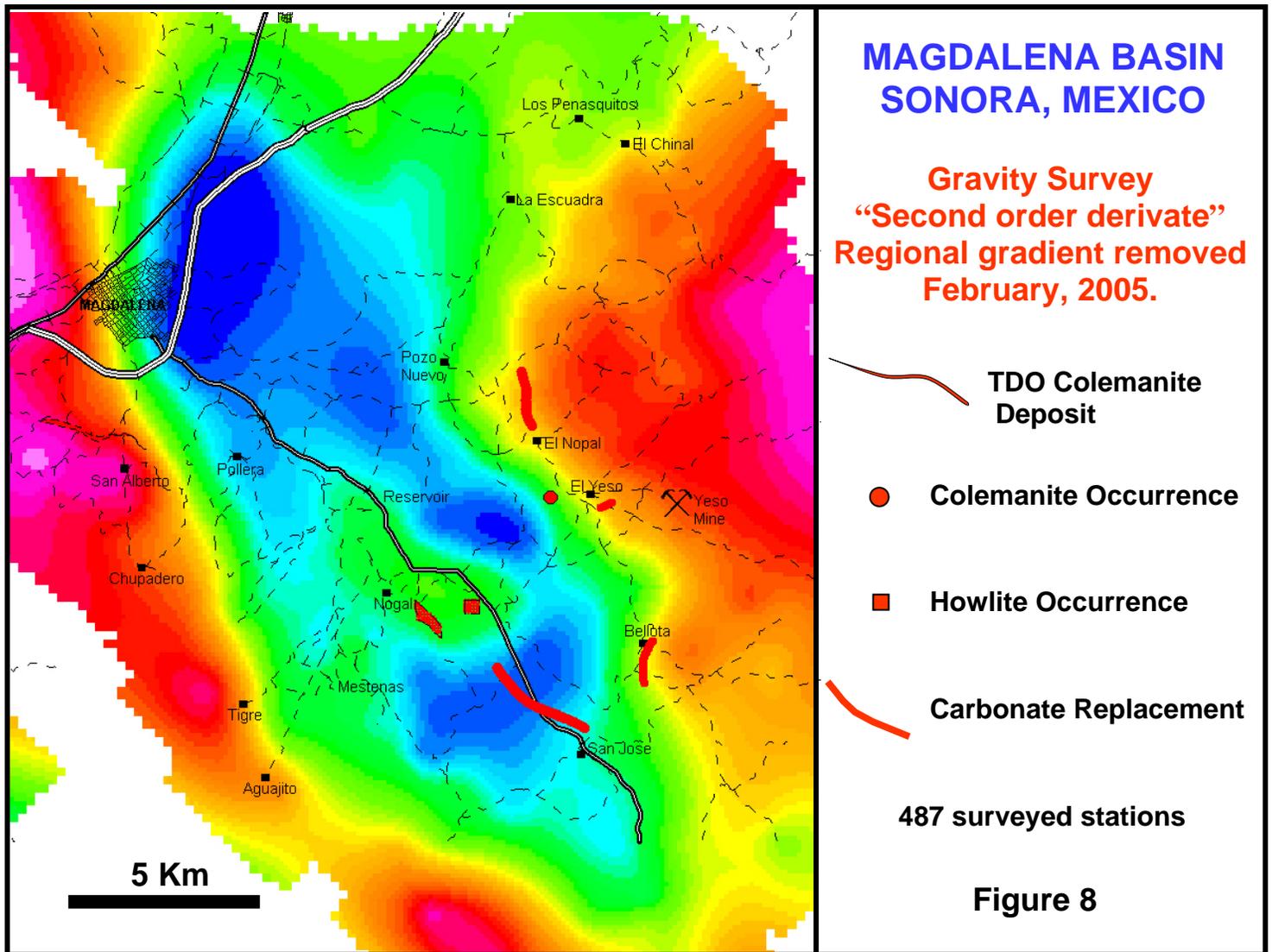
From the central portion of the surveyed area to the north, an increasing magnetic response is observed. This might represent a gradual thickening of the gravel cover.



Gravity

In December of 2002, a semi-regional gravity survey was conducted with 351 stations. Raw data was submitted to a Kennecott geophysicist for filtering and terrain corrections. Figure 8 shows the “residual gravity field” obtained from the survey. In the figure, the Magdalena basin is shown as a closed basin with a northwesterly trending gravity low. An “island” of higher gravity is observed in the central portion of the basin. It could be produced either by a tilted block that glided along the detachment fault or by a vent area from the upper volcanic rocks. The TDO colemanite deposit lies in the western flank of the gravity low. This behavior has been observed in other borate deposits (e.g. Boron). The deep blue gravity lows might represent thick sequences of young and loose gravels, mainly in the central-northern portions of the basin as noted from the ground-mag survey. A northwesterly “trench” along the area between Pozo Nuevo, Yeso and Bellota ranches and the Magdalena-Cucurpe road is seen which could represent tilted blocks along the detachment fault, or could be a distortion effects during interpretation.

A follow-up survey was conducted in February 2005 adding more stations making a total of 487. A figure with the second order derivate was the clearest figure obtained from the survey. Drillholes, Carbonate Replacement Outcrops and borate surface occurrences were plotted, not observing a direct relationship between gravity lows and borates. This might represent the fact that borates are deposited in marginal areas (near to shore of lake) and not necessary in the basin’s depocenters.



DRILLING

Targets and Results

Six drill targets have been recognized and prioritized in this basin outside of the TDO area: Bellota-Yeso, Cajon, El Tigre, Pozo Nuevo, Esquadra and Syncline. Mapping, sampling and a partly drilling have been conducted in the first five but the last one remains untested. Figure show the location of these targets and the conducted/scheduled work on them (figure 9). Twenty-eight NQ-core holes have been drilled in the basin by MSM in different campaigns (table 2 shows the main mineralized intervals intersected in drillholes) (see drillhole location table in appendix 2).

Bellota: Drillholes MAG-1, 3 and 5 were drilled in order to test the sediments exposed in a broad northwesterly plunging anticline. All drillholes intersected low grade borate mineralized zones (from 1% up to 10 % B_2O_3). The intercepts in the Bellota target reported both disseminated colemanite and howlite. An important feature in this target is the presence of halite that appears well crystallized and forming a 100 meters thick dispersion “halo”. Borates in that interval are in the form of powdery ulexite and howlite (see drillhole correlation table. Figure 10).

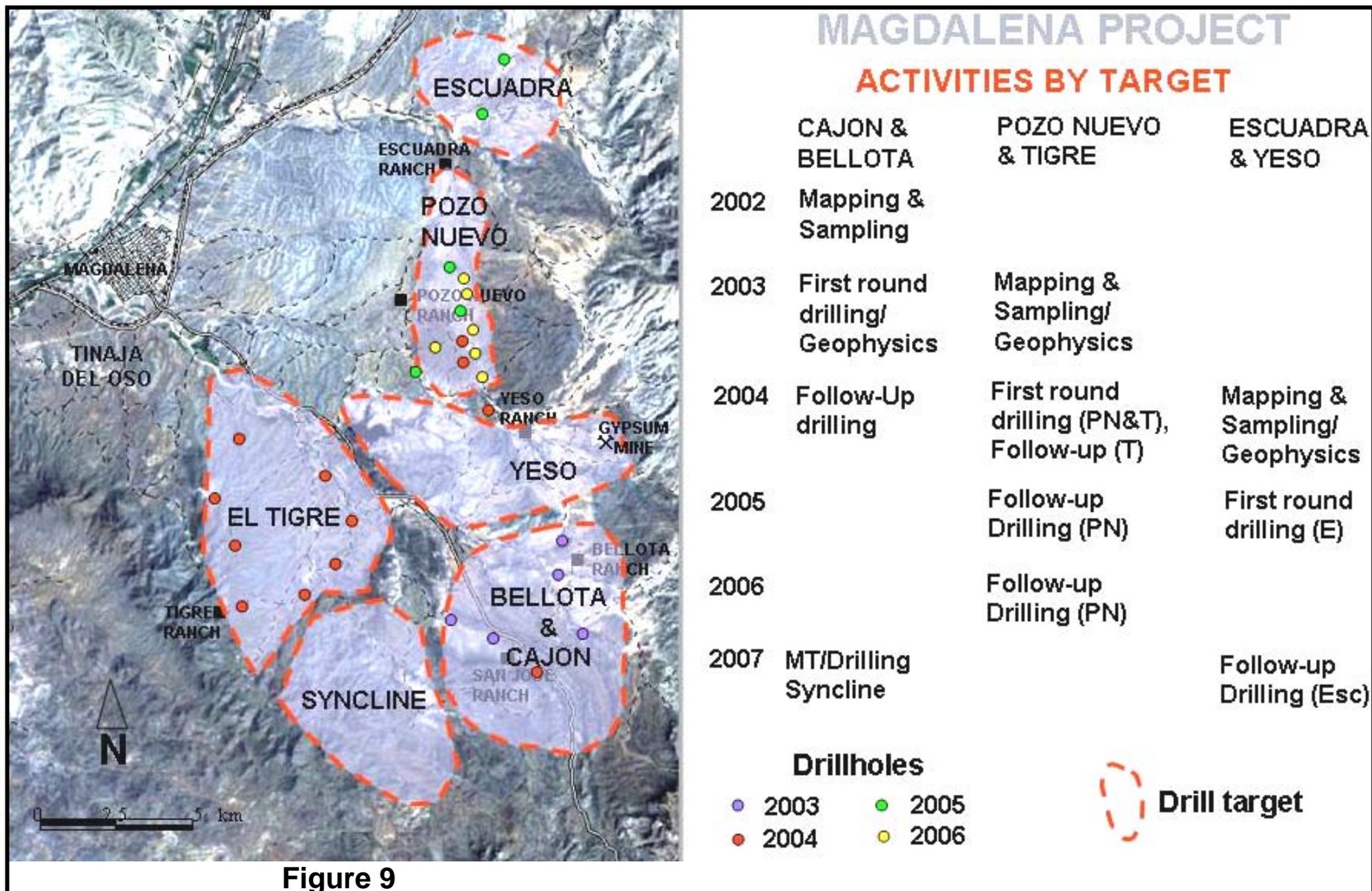


Figure 9

Schematic correlation table, Bellota sequence. MSM drilling

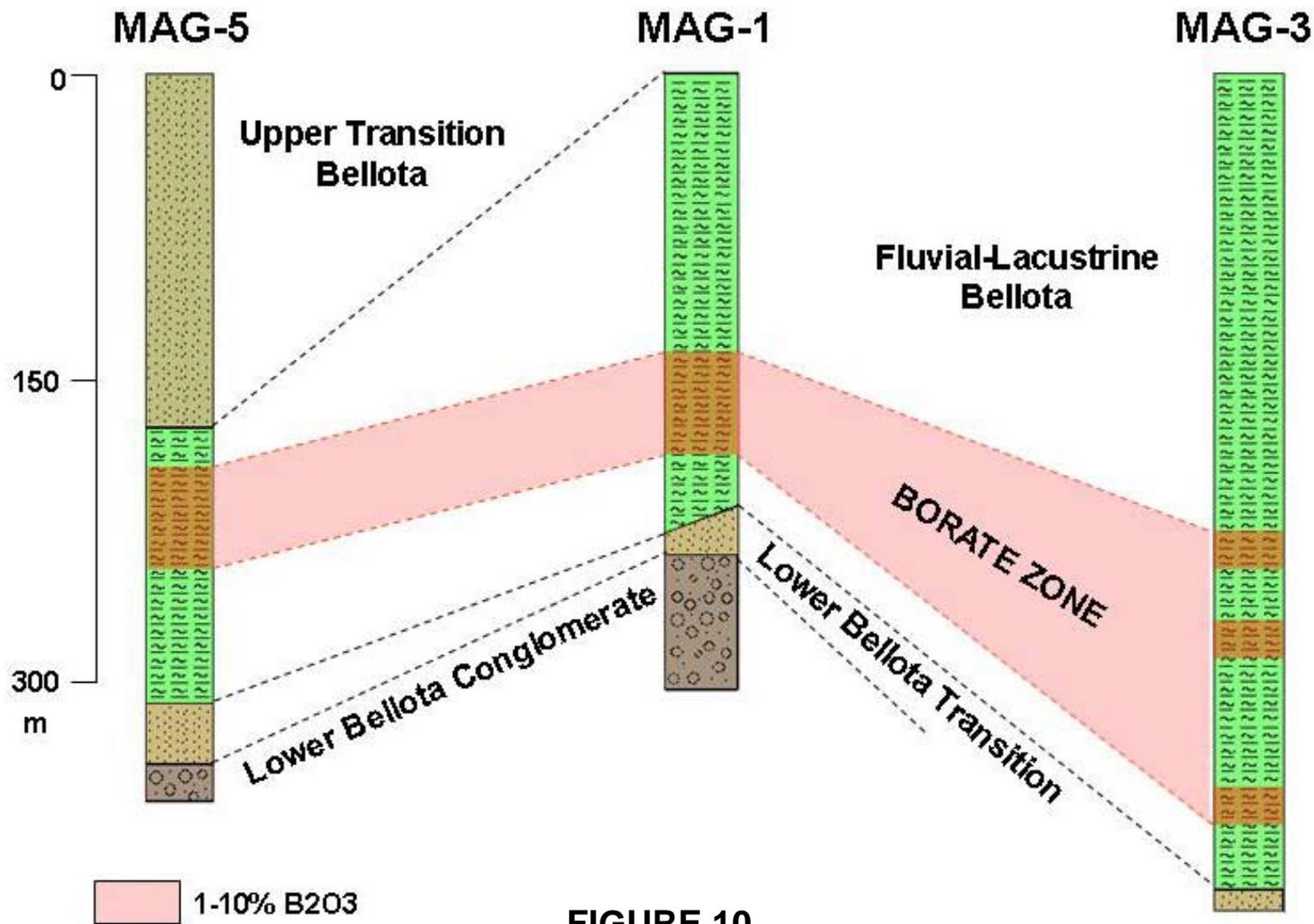


FIGURE 10

Cajon: The mineralized zone in this target is thicker than the one in the Bellota target. In drillhole MAG-2A the upper Cajon sediments and the “Cajon” basalt were drilled with rotary. The sediments below the basalt contain visible borate mineralization (mainly howlite and colemanite) and abundant gypsum in veinlets. The mineralization is concentrated in low and high grade zones, including a 7 meters thick zone which contains an average 12.1 % B₂O₃, including 2.43 m (180.1-182.5 m) at 21.3% B₂O₃ or 4.9 m with 15% B₂O₃ (see drillhole MAG-2A in figure 11). In this target, drillholes MAG-4 and MAG-11 were drilled in both sides of MAG 2A in about 1.2 km centers. Low grade mineralization was cut in these holes (see Cajon Sequence drillhole correlation table in figure 12).

Pozo Nuevo: in this target, drillhole MAG-6 cut a 41.5 meters thick mineralized zone (mostly colemanite, minor howlite and abundant gypsum) with an average of 6.5 % B₂O₃, including 5.5 meters with 15.3% B₂O₃ at relatively shallow depth (115-156 m, see (see drillhole MAG-6 figure in figure 13). This hole intersected the entire Pozo Nuevo sequence from the upper transition down to the lower conglomerate, including the lacustrine section and the lower transition. Pathfinder elements are moderately anomalous. MAG-7 and MAG- 8 were drilled to define the correlation between the Pozo Nuevo section and Cajon sequence to the south, toward the Yeso Ranch colemanite showing. Both holes were drilled at the down-thrown block of a high angle normal fault that displaced the lacustrine sequence at the western portion of the target. Both holes cut the upper conglomerate and crossed through the fault zone down into the up-thrown block intersecting the lower portion of the lacustrine sequence, missing the CRO or borate zone. In MAG-7 the pathfinder elements are highly anomalous in the encountered lacustrine section. In MAG-8 several gypsum “rosettes” were observed to the bottom. No B anomalies were reported (see Pozo Nuevo Sequence drillhole correlation table figure 14). Further drilling in this target showed low grade mineralization zones. In MAG-24 a 16 meters thick zone contains an average of 6.2 B₂O₃ with colemanite in masses, disseminated and crystallized in zones with 1-5 mm crystals. MAG-25 presented howlite in nodules in a 2.6 meters thick zone. MAG-26 showed a 9.14 meters thick section with 7.0 % B₂O₃ with recrystallized colemanite with small crystal of 0.5 cm in diameter. It also contains colemanite “cementing” the core. Drillhole MAG-27 intersected a zone with disseminated colemanite in masses, blebs and crystallized (crystals 1-2 mm Ø). This zone is 7.92 meters thick and averages 5.3% B₂O₃.

Tigre: In this target, drillhole MAG-9 encounter 50 m of dark gray, carbonaceous claystone with abundant calcite as product of borate alteration. Remnants of borate mineralization were reported as some samples ran up to 2.7% B₂O₃. As result of this positive indication drillhole MAG-10 was drilled at the eastern margin, in order to check the continuation of such sequence across the target. MAG-10 cut 265 m of a fluvial-lacustrine sequence, beneath a basalt flow (Los Fresnos). The sequence is mineralized with colemanite, scarce howlite and abundant gypsum. One zone, 33 meters thick with 7.6% B₂O₃ were intersected including a high grade zone with 7.6 m with 13.5 % B₂O₃ (see drillhole MAG-10 IN figure 15). The sequence is deep (421-474 m), but can be expected to occur at shallower depths in other portions of the El Tigre target. Further drilling was conducted in this target with two objectives; 1) To check the possible continuation of the “Tinaja Del Oso” colemanite mineralization to correlate it with the “Tigre” sequence which is exposed in the southwestern most portion of the basin and that was intercepted in previous holes and 2) To find “Magdalena Formation” sediments beneath the thick post-basin “Fresnos” basaltic flow at the central and eastern portions of the target. In order to complete the early objective, 3 holes were drilled at the western portion of the target meanwhile another 3 were drilled at the central-eastern portion to evaluate the later. No visible borate mineralization was intersected in the eastern portion and only low grade mineralization (<5% B₂O₃) was found in the eastern portion in MAG-17. The area that covers this target has been released by MSM. No further activities are recommended (see Tigre Sequence drillhole correlation table in figure 16).

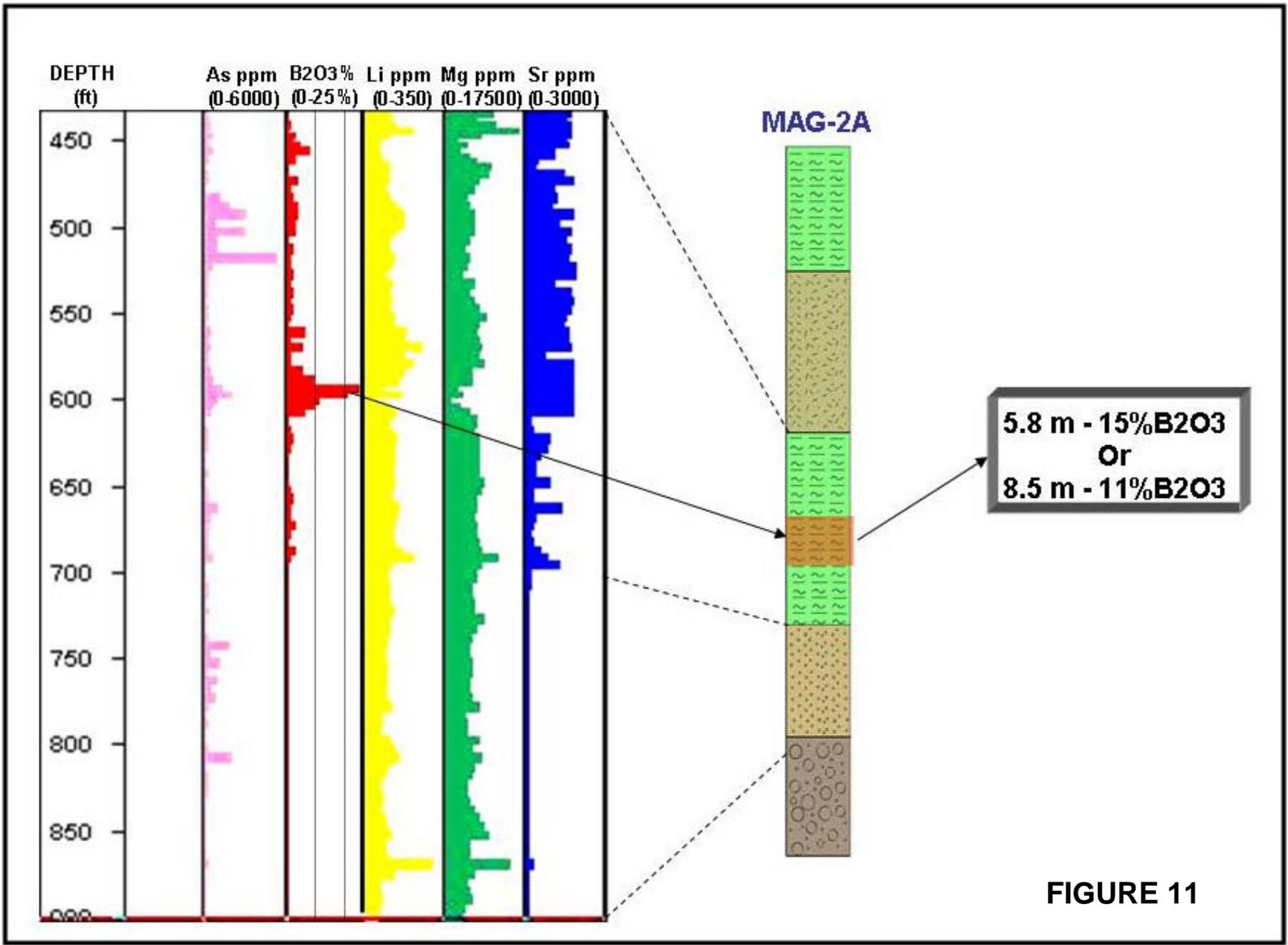


FIGURE 11

SCHEMATIC CORRELATION SECTION. CAJON AREA. MSM DRILLING

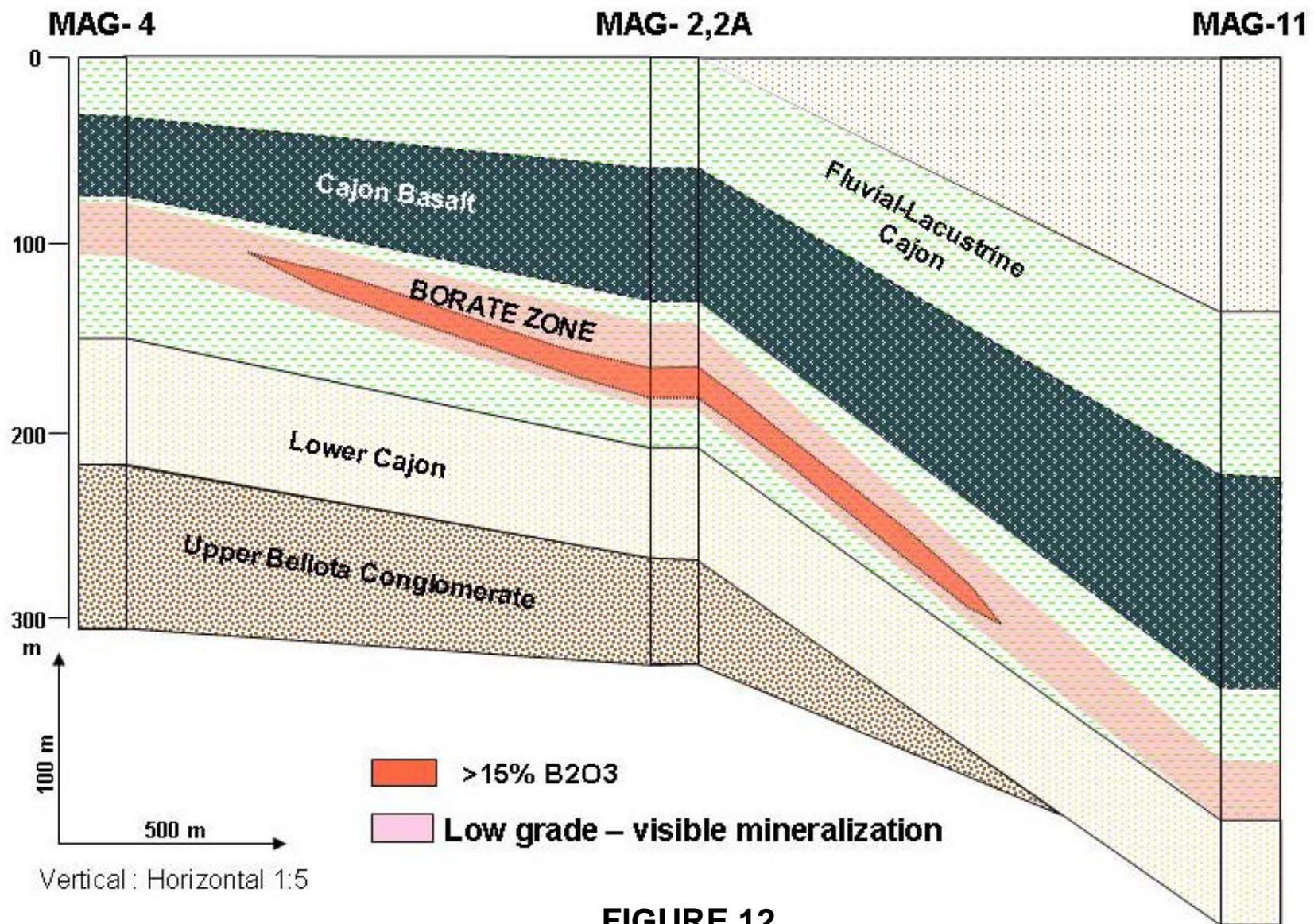
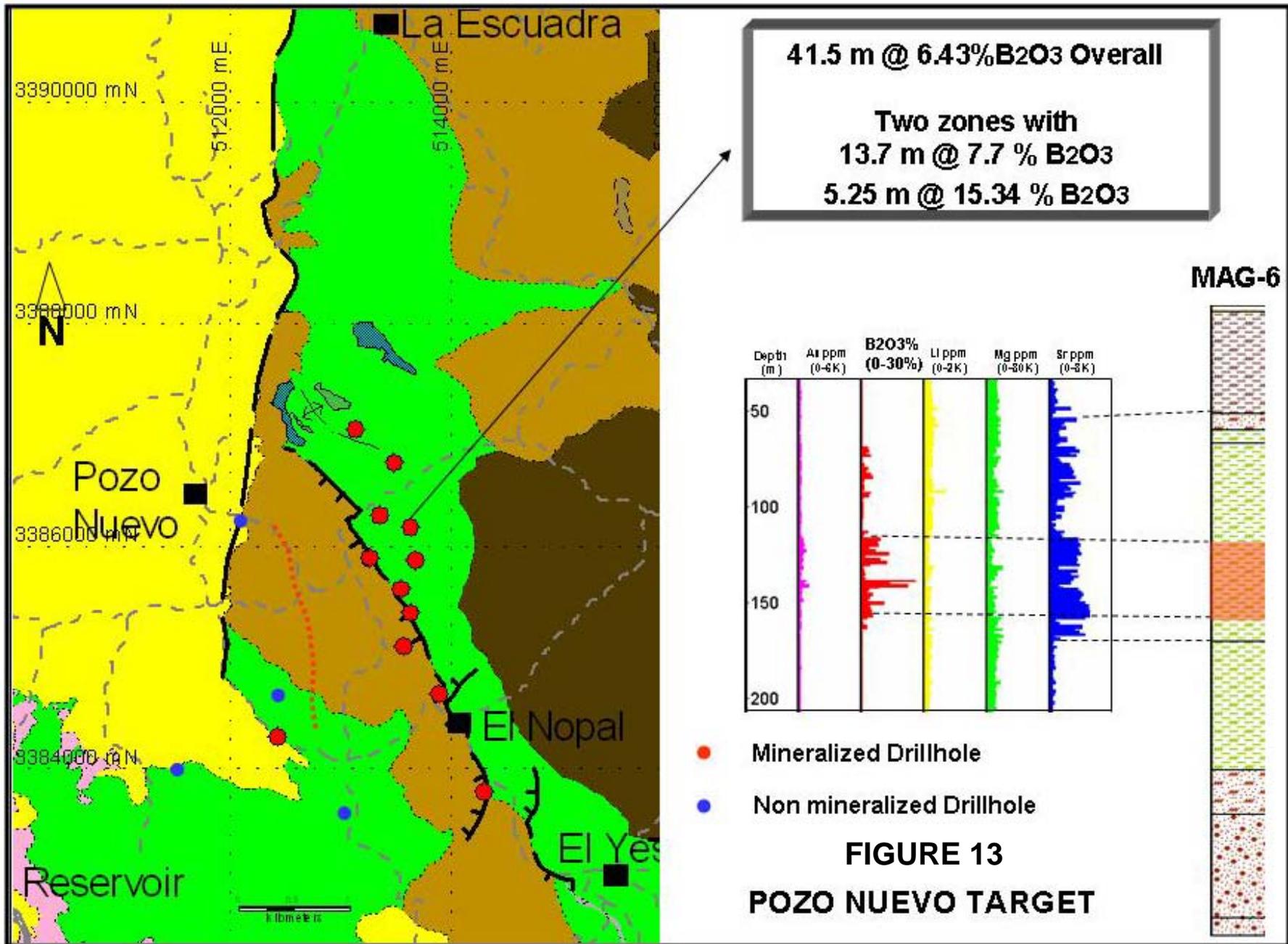
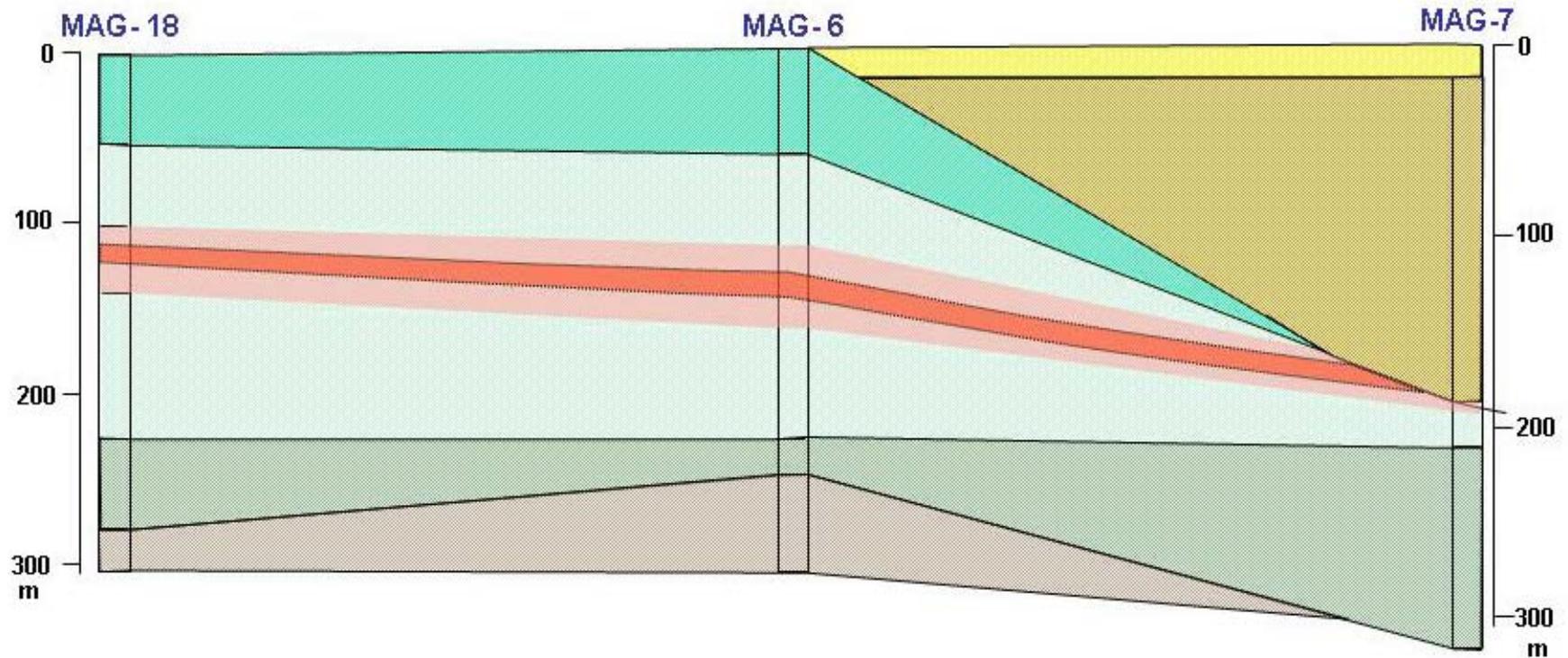


FIGURE 12



SCHEMATIC CORRELATION SECTION. POZO NUEVO AREA. MSM DRILLING

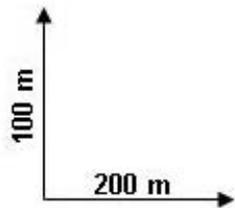


POZO NUEVO SEQUENCE

- Sand-gravel (Qal)
- Upper conglomerate (Ucgp)
- Upper Transition (Utc)
- Fluvial-lacustrine seds (Lacc)
- Lower transition (Ltp)
- Conglomerate (Ucgb)

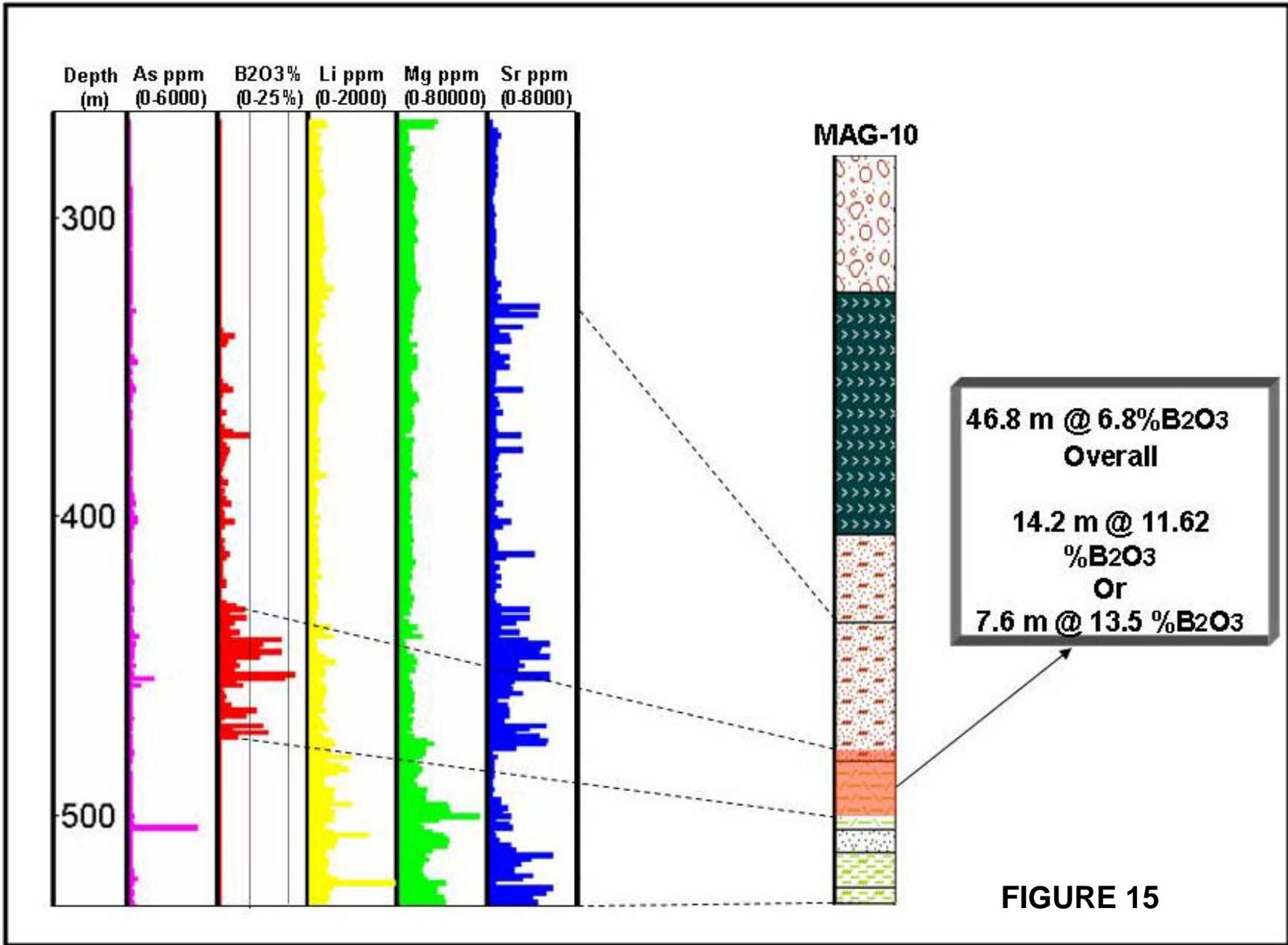
BORATE ZONE

- High grade >15% B₂O₃
- Low grade – visible mineralization

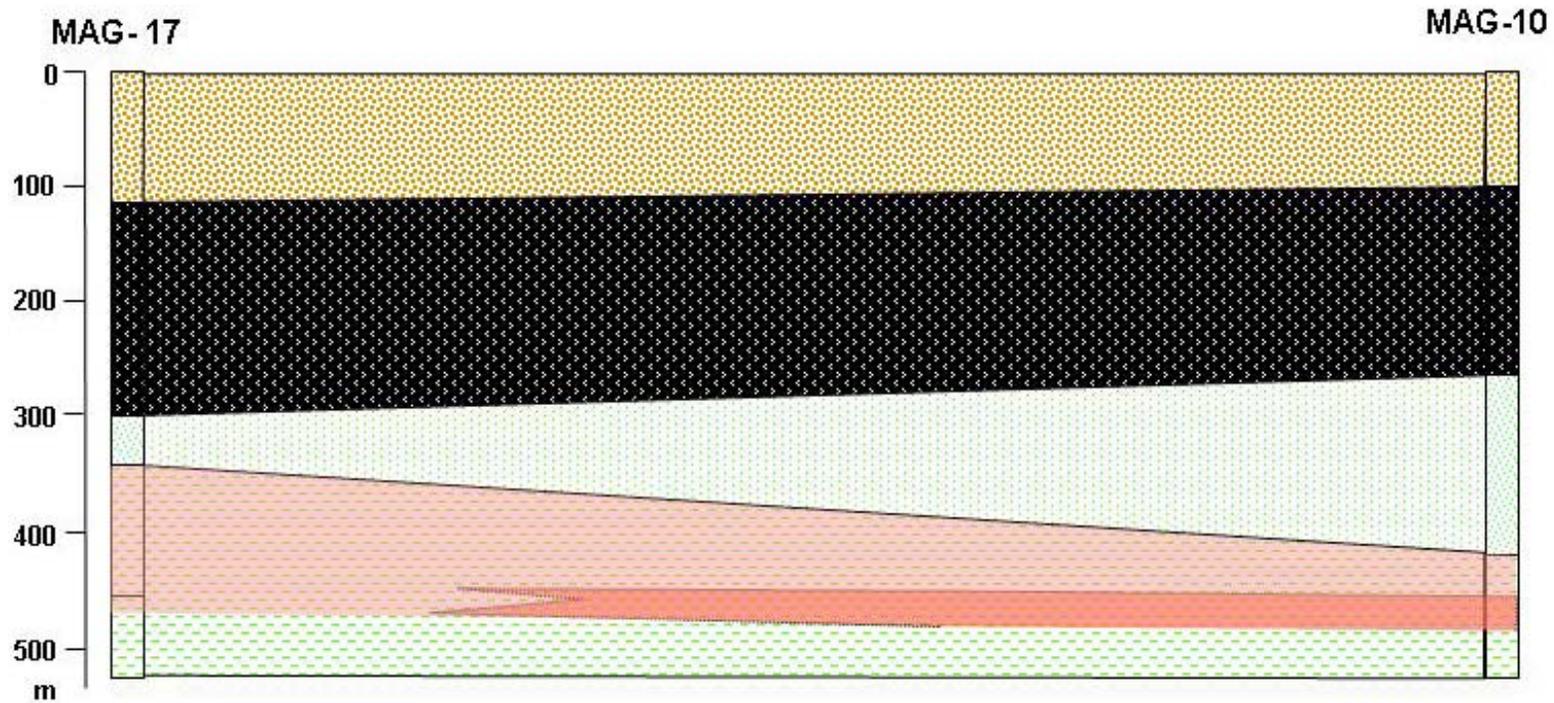


Vertical : Horizontal 1:2

FIGURE 14



SCHEMATIC CORRELATION SECTION. TIGRE AREA. MSM DRILLING



- TIGRE SEQUENCE**
- Baucarit cgl.
 - Fresnos basalt
 - Upper sandstone
 - Fluvial-lacustrine seds

- Borate zone**
- High grade >15% B₂O₃
 - Low grade - visible mineralization

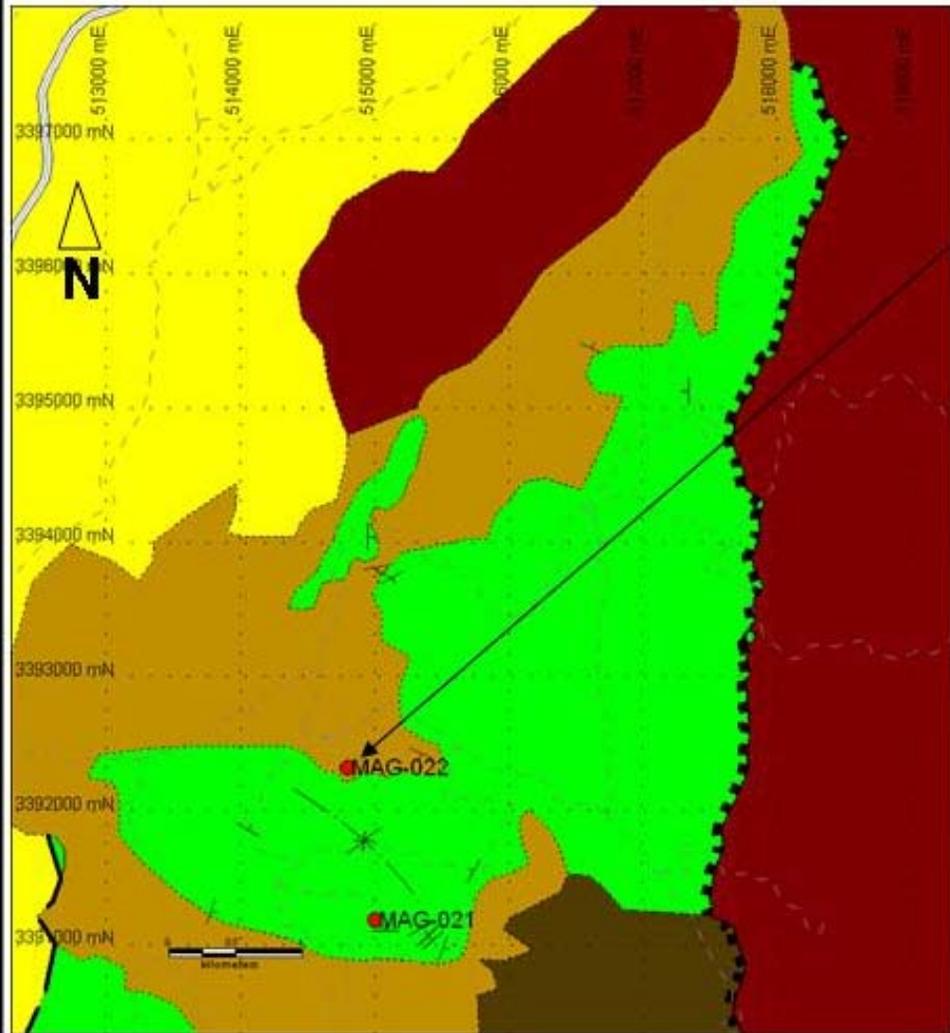
FIGURE 16

Escuadra: In this target, both limbs of a northwesterly plunging syncline were drilled. The southern limb was tested with MAG-21 and very low grade colemanite and howlite mineralization was found in a thick fine grained section. In MAG-22 located at the northern portion of the syncline, a section of 7 meters with howlite in nodules was intersected yielding an average of 6 % B₂O₃. Below that, a 3.7 m zone with 13% B₂O₃ was intersected with disseminated colemanite “cementing” the hole and a lower zone containing re-crystallized colemanite reported 3.5 m with 17% B₂O₃ (see drillhole MAG-22 in figure 17).

Table 2: Main mineralized intervals (>5% B₂O₃), MSM drilling.

HoleID	From (m)	To (m)	Thickness (m)	B2O3 (%)	Mineral1_Comment	Mineral2_Comment
MAG-02A	182.58	185.62	3.05	7.8	Colemanite - Masses and disseminated in the matrix.	Howlite - Nodules as big as ½" in Ø
MAG-02A	177.09	182.58	5.49	13.8	Colemanite - Masses and disseminated in the matrix.	Howlite - Nodules as big as ½" in Ø
MAG-05	278.28	293.83	15.54	5.1	Colemanite – Diss. along the core	Howlite – Nodules
MAG-06	116.13	131.06	14.94	5.9	Colemanite - Crystals (1mm Ø).	Howlite - Nodules (~3mm Ø)
MAG-06	138.07	142.65	4.57	17.1	Howlite – Nodules (>10cm Ø)	Colemanite – Masses
MAG-10	430.68	434.64	3.96	5.2	Colemanite - Crystals (>1mm Ø) and cementing the core.	
MAG-10	444.70	452.32	7.62	8.1	Colemanite - Diss. in the matrix and re-crystallized	
MAG-10	469.70	473.05	3.35	8.8	Colemanite - Crystals (<1mm Ø) and diss.	
MAG-10	440.44	444.70	4.27	12.0	Colemanite – Masses, disseminated along the core.	
MAG-10	452.32	454.76	2.44	18.0	Colemanite - Blebs, disseminated and crystallized (<1mm Ø).	
MAG-22	332.00	347.00	15.00	4.9	Howlite - Nodules (<3 cm)	Colemanite – Diss.
MAG-22	287.43	294.13	6.70	6.7	Colemanite – Disseminated in the matrix	Howlite - Nodules (<1 cm)
MAG-22	322.00	328.00	6.00	8.9	Colemanite – Diss. In the matrix	Howlite - Nodules (>1 cm)
MAG-24	113.84	129.84	16.00	6.2	Colemanite - in and crystals (1-5 mm Ø)	Howlite – Nodules
MAG-25	279.35	281.94	2.59	5.2	Howlite in nodules (1 cm Ø)	
MAG-26	40.23	49.38	9.14	7.0	Colemanite - Crystals (0.5 cm Ø) Diss. in the matrix.	
MAG-27	33.53	41.45	7.92	5.3	Colemanite - Diss. In masses, blebs and crystals (1 mm Ø)	Howlite nodules

ESCUADRA TARGET



Three zones with
 7 m @ 6 % B₂O₃
 3.7 m @ 13 % B₂O₃
 3.5 m @ 17 % B₂O₃

MAG-22

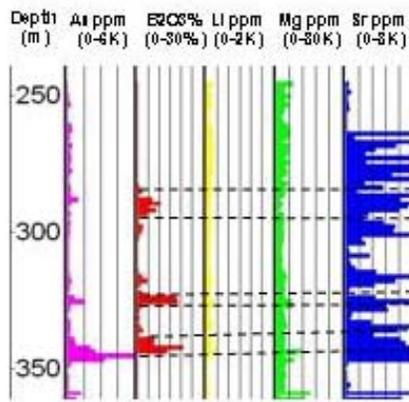


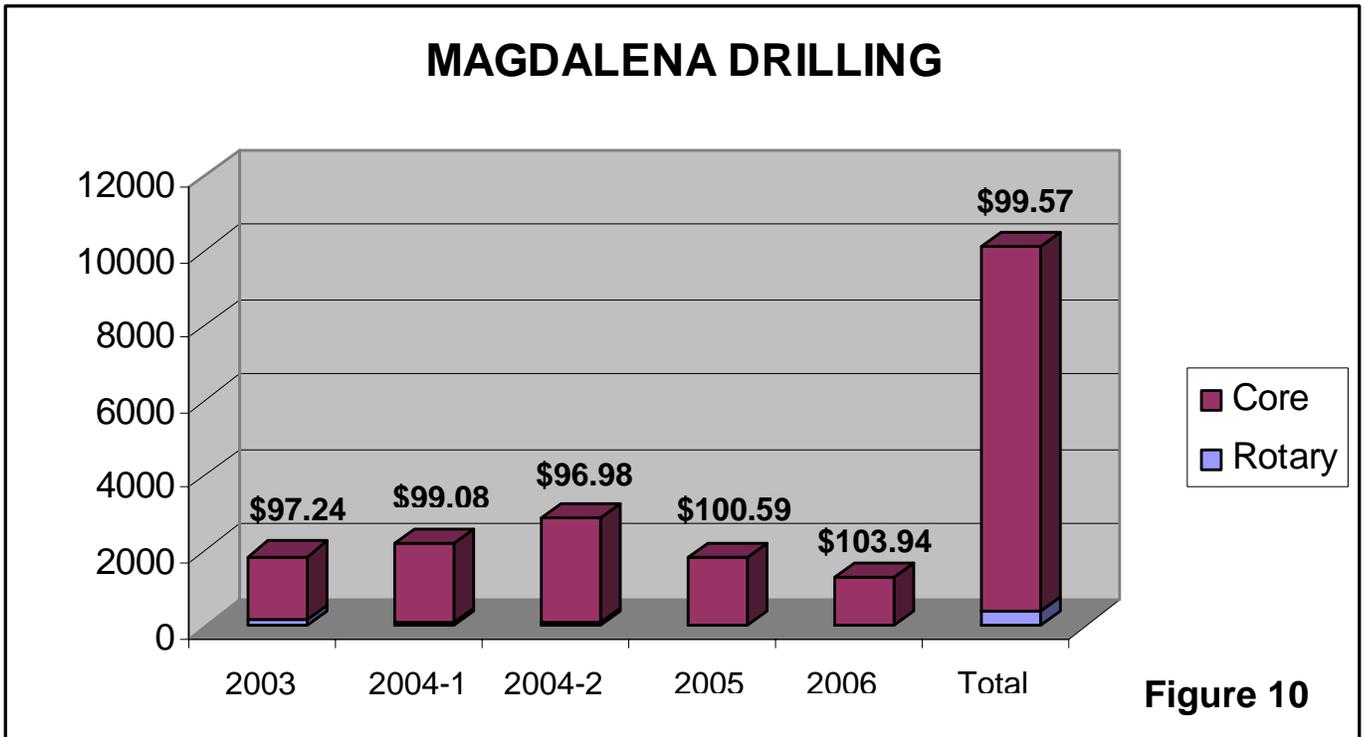
FIGURE 17

Drilling Stats

A total of 10,084.91 meters have been drilled in 28 holes in Magdalena by MSM in five campaigns. 9,680.47 meters have been drilled with core and 404.46 meters with rotary. Total core recovery is 97.6% and the cost averages \$99.57 USD per meter. Godbe Drilling LLC subsidiary Perforaciones Godbe de Mexico S.A. de C.V. has been the drill contractor for all of the campaigns. No major HSEC incidents have been reported in the project during drilling, table 3 and figure 10 summarizes the total drilling, core recovery and cost.

Table 3

YEAR	HOLES	ROTARY (m)	CORE (m)	CORE REC (%)	TOTAL(m)	USD/m
2003	5	182.88	1,689.51	95.93	1,872.39	97.24
2004-1	6	85.34	2,136.34	97.47	2,221.69	99.08
2004-2	6	87.48	2,775.81	99.07	2,863.29	96.98
2005	5	27.43	1,805.94	98.10	1,833.37	100.59
2006	6	21.34	1,272.84	96.12	1,294.18	103.94
TOTAL	28	404.47	9,680.45	97.60	10,084.92	99.57



CONCLUSIONS AND RECOMMENDATIONS

Magdalena is an attractive region for borate exploration. The infrastructure and correct geologic environment are important factors to consider in the development of this project.

The geology of the Magdalena basin is very complex due to its origin and development, but a better understanding is being achieved as we advance in the detailed fieldwork. Some inaccuracies were detected from previous works, but a re-interpretation is in progress.

More fieldwork, supported with new and more accurate geo-chronological techniques, more geochemistry in order to differentiate volcanic units, and the integration of the new generated data, is highly recommended to obtain an integral understanding of borate deposits and its implementation in other projects.

It is recommended to complete the drilling in the Syncline target and the in-fill drilling in Escuadra, Yeso area and Cajon.

The implementation of MT over the Syncline target and possible over the thick gravel coverage in the north and central portions of the basin is also recommended.

APPENDIX 1: AGE DATES, MAGDALENA BASIN

Sample ID	Easting	Northing	Age (Ma)	Err (Ma)	Method	Rock type	Unit
48	520826	3372699	19.8	0.4	K/Ar	Rhyo/Dike	Dike-Madera
S/N	520826	3372699	19.8	0.4	K/Ar	Rhyolite	Dike-Madera
S/N	520826	3372699	19.8	0.4	K/Ar	Rhyolite	Dike-Madera
S/N	515643	3373466	19.6	0.9	K/Ar	Andesite	Tigre
S/N	515643	3373466	19.6	0.9	K/Ar	Andesite	Tigre
47	515739	3373466	19.6	0.9	K/Ar	Andesite	Tigre
UAKA87-101	507245	3374898	22.7	0.5	K/Ar	Dacite	?
46	513910	3377342	21.4	1	K/Ar	Basalt	Cajon Basalt
S/N	513910	3377342	21.4	1	K/Ar	Basalt	Cajon Basalt
S/N	513910	3377342	21	1	K/Ar	Basalt	Cajon Basalt
Alamo wash	512372	3380443	21.8	0.5	K/Ar	Bas/And	Cajon Basalt
44	503069	3381212	26.9	0.6	K/Ar	Latite	Tventana
45	503069	3381212	27.6	0.6	K/Ar	Basalt	Tventana
S/N	503069	3381212	26.9	0.6	K/Ar	Latite	Tventana
S/N	503069	3381212	27.3	0.6	K/Ar	Basalt	?
S/N	503069	3381212	27	0.6	K/Ar	Basalt	?
S/N	503069	3381212	26.7	0.6	K/Ar	Latite	Tventana
UAKA82-019	523929	3401739	26.3	0.6	K/Ar	Granite	?
UAKA82-018	523929	3401739	26.2	0.6	K/Ar	Diorite	?
SN-91216	499000	3400850	29.1	0.2	Ar/Ar	Gneiss meta-pegmatite	Lower plate, Sierra Magdalena
SN-91218	499000	3400850	28.7	0.6	Ar/Ar	Mylonitic micaschist	Lower plate, Sierra Magdalena
MAG-1	518809	3381853	25.1		Ar/Ar	Feldespatic gneiss	Sierra de la Madera
04PGS-110	515859	3381690	22.3	0.3	Ar/Ar	Bellota Basalt	Yeso Ranch-mine road
04PGS-113	510812	3384041	20.6	0.1	Ar/Ar	Fresnos Basalt	North of Yeso Dam

APPENDIX 2: DRILLHOLE LOCATION, MAG HOLES. MSM DRILLING

Hole	Easting	Northing	Elev (m)	Depth (m)	Azimuth	Inclination	Area	Projection
MAG-01	516517	3378874	896.81	309.68	0	-90	Bellota	UTM12 NAD27 MEXICO
MAG-02A	514421	3376971	901.42	331.00	0	-90	Cajon	UTM12 NAD27 MEXICO
MAG-03	516423	3377707	906.54	419.10	0	-90	Bellota	UTM12 NAD27 MEXICO
MAG-04	513230	3377439	886.40	304.80	0	-90	Cajon	UTM12 NAD27 MEXICO
MAG-05	516637	3379600	910.56	365.76	0	-90	Bellota	UTM12 NAD27 MEXICO
MAG-06	513550	3385625	870.00	312.72	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-07	513565	3385100	875.00	355.09	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-08	514300	3383800	860.00	326.75	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-09	506685	3377650	940.00	226.16	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-10	510250	3380295	835.00	540.72	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-11	515506	3376256	915.00	469.70	0	-90	Cajon	UTM12 NAD27 MEXICO
MAG-12A	509770	3381390	815.00	485.54	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-13	506350	3383250	805.00	457.20	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-14	506500	3379900	930.00	455.98	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-15	506200	3381000	885.00	334.06	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-16	508900	3378600	865.00	519.98	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-17	509840	3379180	835.00	442.26	0	-90	Tigre	UTM12 NAD27 MEXICO
MAG-18	513350	3386290	881.00	303.50	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-19	513130	3387050	870.00	346.25	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-20	512431	3384276	838.00	388.92	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-21	515003	3391186	845.00	349.00	0	-90	Escuadra	UTM12 NAD27 MEXICO
MAG-22	514803	3392319	838.00	388.92	0	-90	Escuadra	UTM12 NAD27 MEXICO
MAG-23	513887	3384676	855.00	257.86	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-24	513632	3385404	870.00	233.48	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-25	513270	3385900	890.00	346.25	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-26	513686	3385878	870.00	132.89	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-27	513630	3386180	870.00	175.56	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO
MAG-28	513490	3386750	870.00	145.08	0	-90	Pozo Nuevo	UTM12 NAD27 MEXICO