The Use of the Ground Penetrating Radar in Exploration For Alluvial Diamond Deposits

A Case-History From a Survey Conducted in Minas Gerais, Brazil

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INTRODUCTION

In the fall of 1995, Geophysics GPR International Inc. conducted a ground penetrating radar survey in the province of Minas Gerais, Brazil for AMBREX Mining Corporation Limited. The survey could be described as orientation work for:

- Finding and mapping Paleochannels;
- Identify the sand/gravel interface when present;
- Define potential diamond traps in different types of gravel deposits.

The surface geological set up is essentially an alluvial environment consisting in multi-level terraces, slumps, eroded remnants of channels over a schist bedrock. The overburden material consists of fine to coarse sand on the beaches and lower terraces along the river becoming more argillaceous and lateralized away from the river.

The topography is relatively rugged with steep slopes and dense vegetation in some areas.

FIELD PROCEDURES

The survey lines were prepared by cutting lines and clearing 1 m wide through vegetation and chaining and marking along the lines. Line spacing was 50 m and covered an area of approximately 14 km^2 along the present day meandering river.

A preliminary on-site interpretation was done to locate calibration test pits. This interpretation was crude with no mapping nor correlation in between lines. The locations were picked on the basis of high amplitude returns on the radar signal suggesting the presence of gravel regardless of the possible depositional model. Field work lasted 10 days during which 40 line-km of data was recorded.

RESULTS

To give a model of an actual channel for correlation with the data acquired on shore, one marine radar profile was acquired across the river. The profile is shown on Figure 1.

One has to keep in mind however that a “land equivalent profile” would have its vertical axis compressed by 3 as the velocity of radar waves in water is 3 to 4 times slower than it is through earth materials.

On the marine georadar profile of Figure 1, one can see the bedrock profile, the coarse sand and gravel deposits in the talweg of the river and what appears as buried former channel. Many similar features have be found on land revealing the prints of the ancient riverbed.

The example shown on Figure 2 is a good example of a channel as it appears on a land radar profile. One can see on this example a sequence of channel fill material that appear like coarse sand on the top and gravel at the bottom as the amplitude of the signal return is higher (brighter colour). By correlating the location of the channel from line to line we can actually map the course of this ancient channel.

The same radar data has also shown evidence of point bar deposits. These “point bar signatures” always appear next to a channel as it results from lateral movement of the river. These point bar may also be good diamond traps as the base of this sequence is filled with channel bottom sand and gravel deposits.

On some profiles we have interpreted what appears to be natural levees built up deposited during flood events. The thickest and coarsest sediments would then be deposited at channel edges well identified on some radar profiles. These again may form good diamond traps.

Another potential diamond trap is the pothole. However, more difficult to find because of its relatively small size, it offers the greatest potential of finding high concentration of diamonds. A few possible pot holes have been found as shown on the example of Figure 3. Formed by erosion of the bedrock it does not show any lateral continuity we can

In “Proceedings of Exploration 97: Fourth Decennial International Conference on Mineral Exploration” *edited by* A.G. Gubins, 1997, p. 567–570

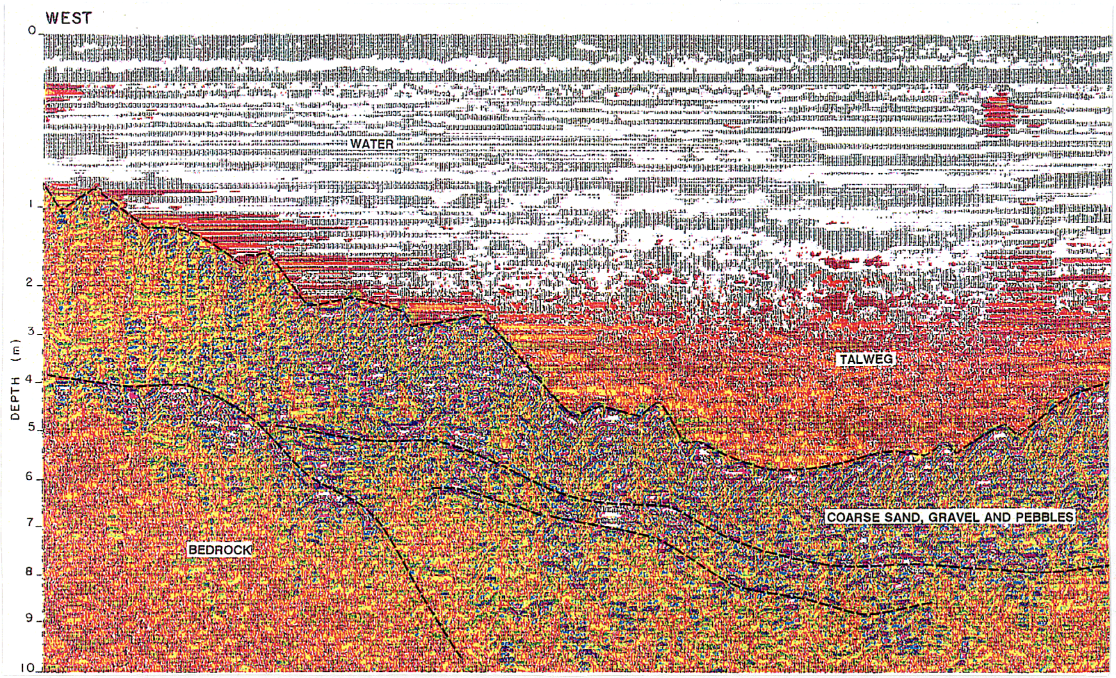

Figure 1: *Example marine radar profile.*

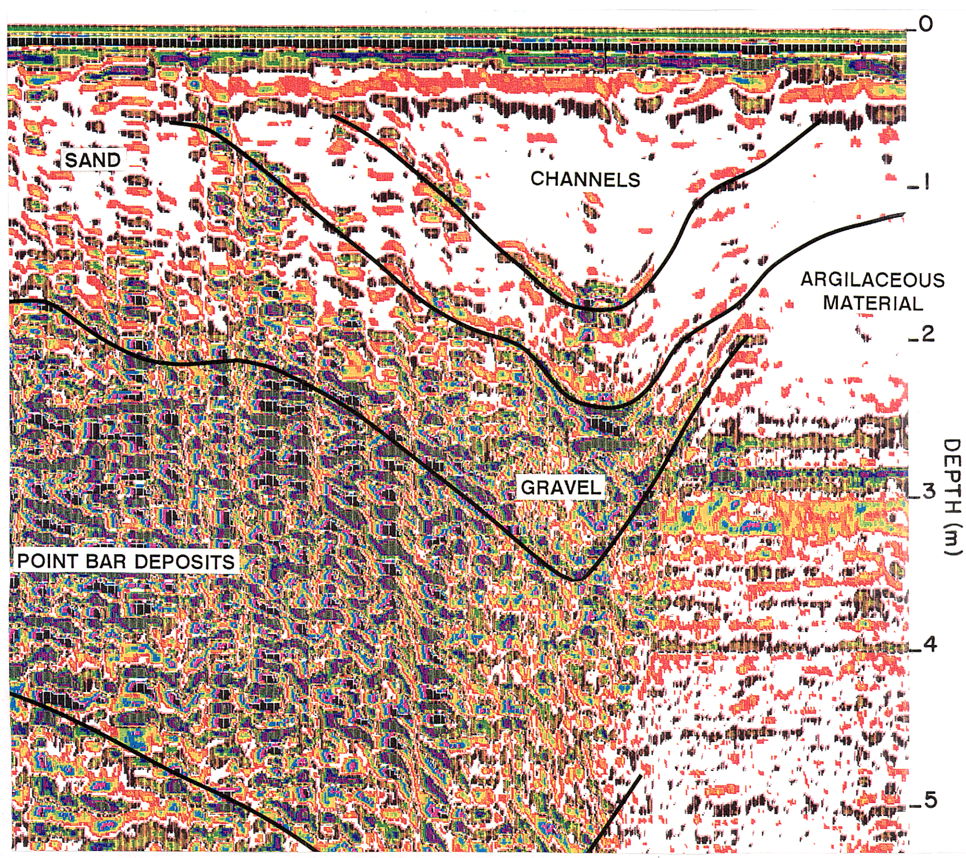

Figure 2: *Point bar deposits.*

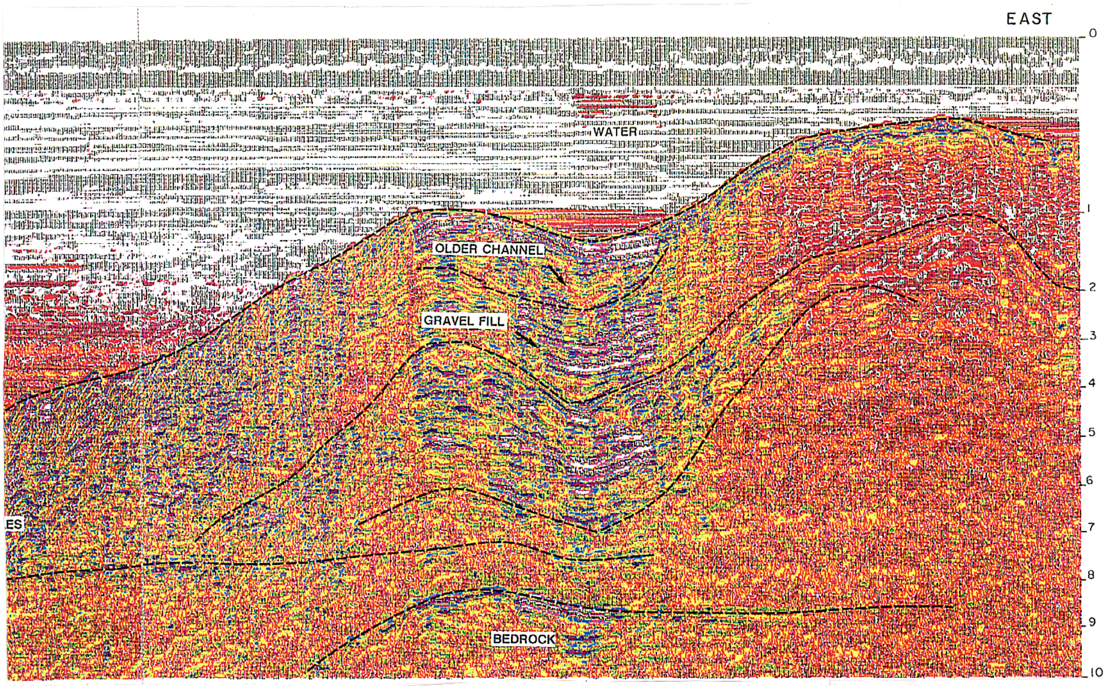

Figure 1 (continued): *Example marine radar profile.*

correlate from line to line. This example offers a good similarity to the actual river profile shown above. A higher density of radar lines would be necessary to find more of those.

Along the known paleochannels some bedrock depressions may be interpreted as alternating deeps and shallows in the straight reach of the river. In this case the coarser material interpreted would correspond to the riffle that may also be diamond bearing.

Finally, a dominant feature that often appears on the profiles over the lower terraces are possible fault scarp filled by fan sediments deposited by stream as it adjusts its profile. However, such a sequence has been tested during the on-site groundtruthing, and revealed only a thick sandy overburden (5 meters and more).

All these possible diamond bearing targets have been correlated from line to line and mapped from which locations were identified to orientate the test pitting program.

Some 21 testing locations have been identified and located. Positioning of these tests is very important as the dimension of these features may be only a few meters wide.

Our test profile on the river did indicate the presence of potential deep traps. In considered most prospective areas (such as in the river elbows) the subsurface of the river bed can also rapidly be scanned by the Ground Penetrating Radar to locate subsurficial traps as the one identified on our test profile (Figure 1).

A complementary geophysical method that used with the Ground Penetrating Radar is the seismic refraction. It would help calibrate more accurately the radar data, map the bedrock topography with high degree of confidence and identify trends of bedrock topography thus defining possible paleovalleys or channels.

CONCLUSION

The Ground Penetrating Radar survey yielded detailed information as it allowed to map channels, point bar deposits, levees and other related features.

Overall, the quantity and quality of information is impressive and can certainly be used to orientate future work in the areas.

ACKNOWLEDGEMENTS

We wish to thank Mr. Bill Fisher, president of Ambrex Mining Corporation, for the permission to use the material shown here.

REFERENCE

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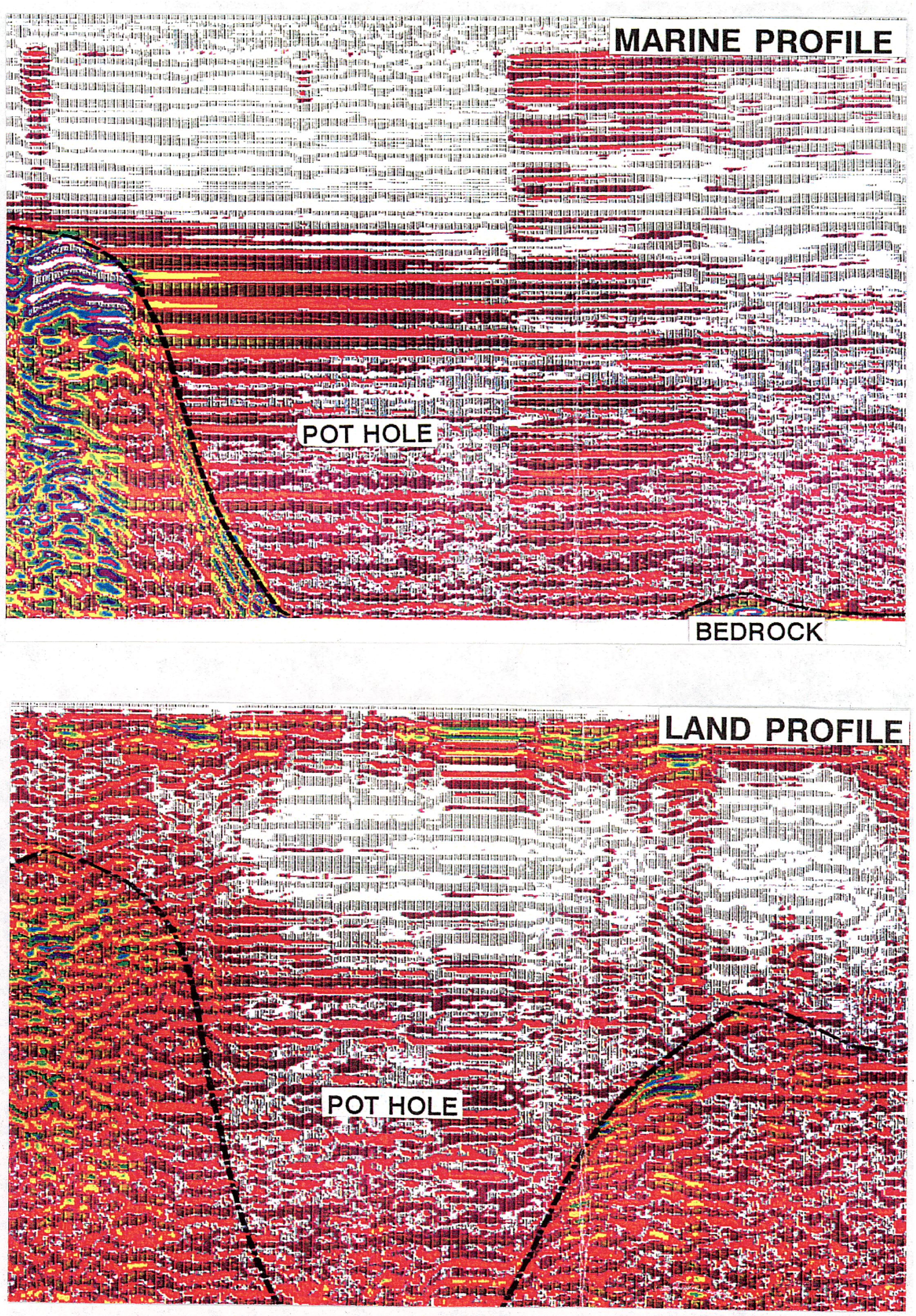

Figure 3: *Example of possible pot holes.*