PROSPECTION OF GLAUBERITE DEPOSITS WITH ELECTRICAL RESISTIVITY IMAGING

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INTRODUCTION

Glauberite deposits (together with gypsum, anhydrite and thenardite) are the currently exploited sulphate rocks for industrial purposes. In addition to the expensive drilling projects, geophysical techniques can be considered to estimate the economical potential of these deposits (Lugo et al. 2008).

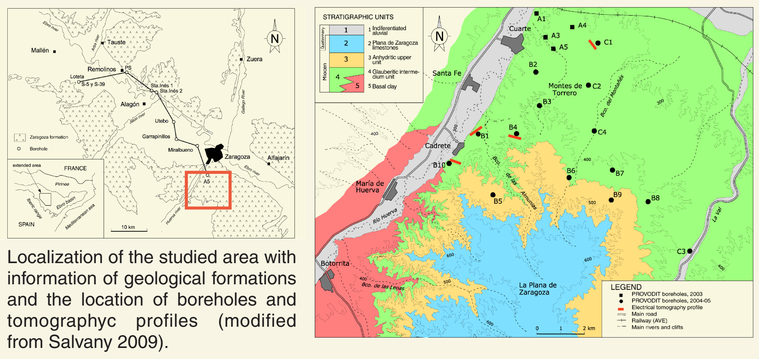
The scope of this study is to characterize the geoelectrical response of glauberite rocks, to define their range of resistivity and to evaluate the influence of accompanying minerals in glauberite formations.

Resistivity values for glauberite rocks or isolate glauberite minerals are not defined in the literature. The expected resistivity values for glauberite rocks ($CaNa_2(SO_4)_2$) would be higher than the gypsum ($CaSO_4 \cdot 2H_2O$) ones, and probably similar to those of the anhydrite ($CaSO_4$), due to their anhydre nature. The problem with this type of deposits is that the glauberite rocks are usually included in a clayly or marly matrix or are replaced by gypsum (in the outcropping glauberite deposits).

GEOLOGICAL SETTING AND METHODS

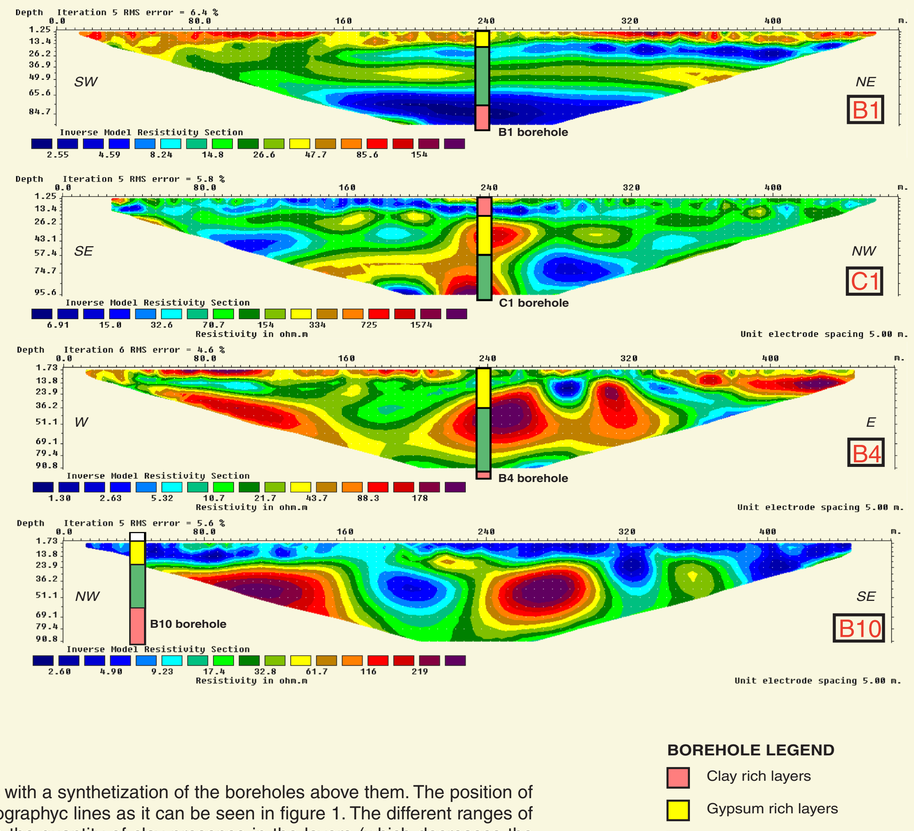
An electrical tomographyc study was performed in the Montes de Torrero area (Zaragoza, Spain) (Fig.1), in the Zaragoza Gypsum and Anhydrite Formation (Ebro basin, Miocene), where glauberite was found at depth in some boreholes (Salvany 2009) (Fig.2). The tomographyc study has allowed us to evaluate the morphology of the glauberite body.

FIGURE 1



Localization of the studied area with information of geological formations and the location of boreholes and tomographyc profiles (modified from Salvany 2009).

FIGURE 3



The figure shows a display of electrical tomographyc profiles with a synthetization of the boreholes above them. The position of boreholes does not coincide exactly with the location of tomographyc lines as it can be seen in figure 1. The different ranges of resistivity to similar materials on different profiles are due to the quantity of clay presence in the layers (which decreases the resistivity values).

BOREHOLE LEGEND

- Clay rich layers
- Gypsum rich layers
- Glauberite rich layers

RESULTS AND DISCUSSION

The measured resistivity values were different for each glauberite layer at the levels where the glauberite was supposed to be cut, displaying a wide range of values between 15 and 1500 ohm.m. Nevertheless, the tomographyc profiles showed a change in the geoelectrical response at the same depth were the uppermost boundary of the glauberite deposits occurred (Fig.2).

The highest values are related to the presence of anhydrite and the lowest ones correspond to lutite-rich glauberite rocks. Thus, the limit between the glauberite bearing levels and the layers over them were determined in the tomographyc lines. Additionally, lateral variations in the resistivity values (related to changes in the bulk rock composition) were observed.

The electrical resistivity imaging has been compared with the lithology of the cores (Fig.3 and Fig. 4D, 4E, 4F) and the information of the regional outcrops (Fig. 4A, 4B, 4C). It can be observed that the boundaries between main lithologic units match with resistivity changes. However, these boundaries are not accurately defined in the profile because of the high heterogeneity of this type of rocks (principally due to the variation in the lutite contains).

FIGURE 2

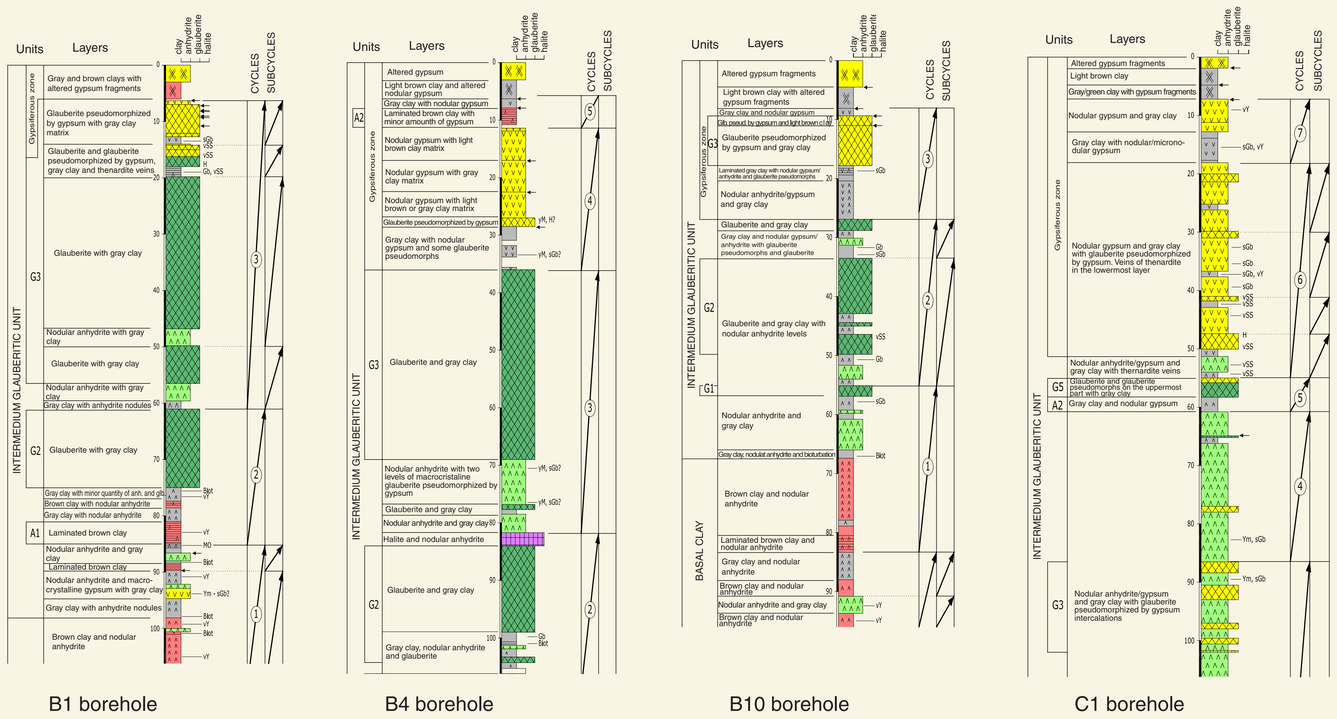
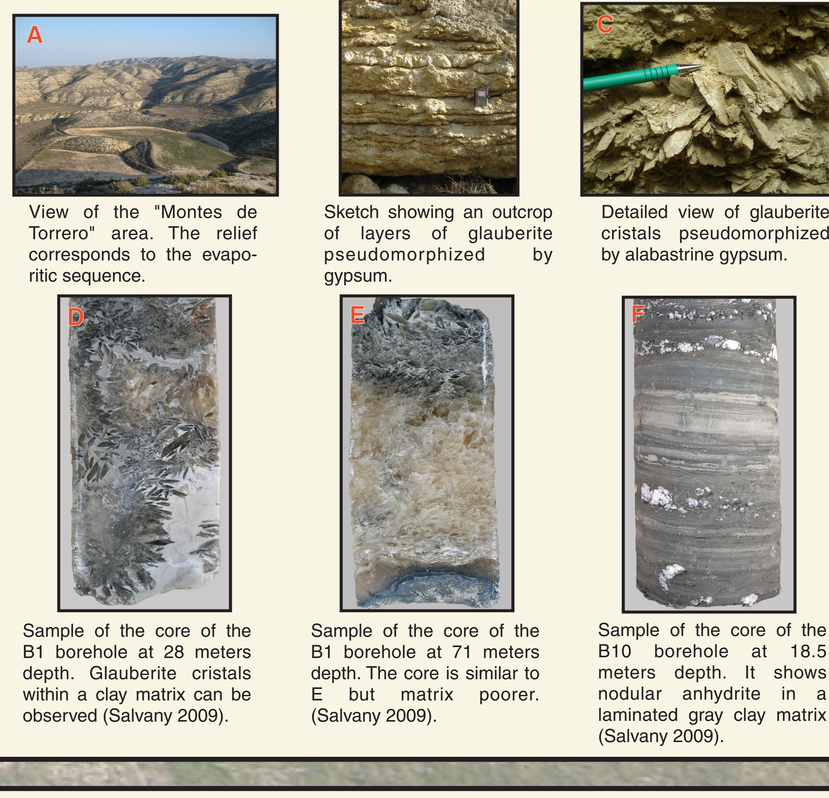


FIGURE 4



View of the "Montes de Torrero" area. The relief corresponds to the evaporitic sequence.

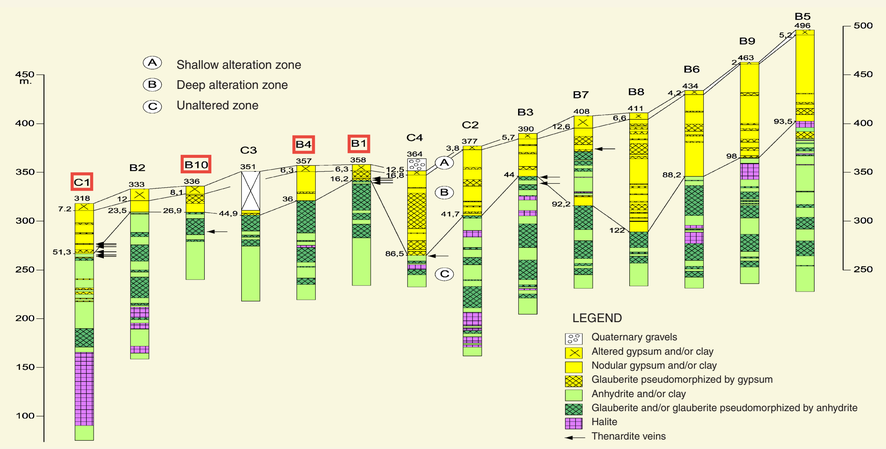
Sketch showing an outcrop of layers of glauberite pseudomorphized by gypsum.

Detailed view of glauberite cristals pseudomorphized by alabastrine gypsum.

Sample of the core of the B1 borehole at 28 meters depth. Glauberite cristals within a clay matrix can be observed (Salvany 2009).

Sample of the core of the B1 borehole at 71 meters depth. The core is similar to E but matrix poorer. (Salvany 2009).

Sample of the core of the B10 borehole at 18.5 meters depth. It shows nodular anhydrite in a laminated gray clay matrix (Salvany 2009).



Upper part:
Stratigraphic columns of the boreholes B1, B4, B10 and C1 (related to the tomographic profiles). Those columns were elaborated from the accurate testification of the cores (Salvany 2006).

Lower part:
Sketch showing the estratigraphic correlation of the boreholes (Salvany 2009). Lateral variations in the thickness and composition of the layers are observed.

CONCLUSIONS

The results of the study show that electric resistivity lines could be useful in prospection of glauberite deposits, supported by drilling works. The number of required boreholes could decrease considerably with this electrical imaging technique. However, imaging prospecting must be supported by an accurate petrological study of the deposits in order to properly interpret the resistivity profiles.

Because of the presence of lutites, the value of resistivity decreases dramatically and it is difficult to detect glauberite bodies without additional information (as boreholes).

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-Salvany, J.M. (2006): Modelización gelógica conceptual del yacimiento glauberítico de montes de Torrero (Zaragoza). Informe para Provodit Ingeniería S.A.
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SPAIN CHINA SYMPOSIUM ON GEOPHYSICAL & GEOCHEMICAL GEOSYSTEMS
JUNE 2009