

Geohazard identification in the Malin Sea

CV06_EM_GEOH

**Preliminary interpretation of towed EM data from
Malin sea in the vicinity of pockmark 2**

55°51'29.90" N 8°08'10.92" W

Prepared by

Xavier Garcia (Dublin Institute for Advanced Studies)



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Introduction

Pockmark 2, in which this study is centered, is the largest in the Malin Sea (Monteys et al., 2005), for this reason the towed EM survey was designed around it and subsequently three passes were realized through it. Figure (1) shows the map of the area with the bathymetry as background image. The colored tracks represent the apparent porosity measured with the 13m receiver. The black lines are main tectonic features and faults of the area. The black diamonds show the position of grab samples or gravity cores.

The towed EM system consists of a transmitter and three receivers. The transmitter generates an EM signal at 7 frequencies, and each receiver is tuned to measure three of these frequencies. The towed EM instrument measures the secondary magnetic field that has been induced in the ground by the transmitted (primary) signal. The data is inverted assuming a one-dimensional¹ earth and a set of resistivities are obtained. These resistivities are then converted to apparent porosities using a simplified Archie's law:

$$\Phi = \alpha^{-\frac{1}{m}}$$

where Φ is the porosity, α is the conductivity contrast and m is the “cementation” factor, with a value from 1.5 to 2.1. To do this last step we need to make some assumptions on the cementation parameter in the equation. The existence of groundtruthing data will provide us with proper values for the equation. Until we don't get the results from the laboratory we are using estimated values and thus the results showed here are only a good estimate and the results shown in this report should be interpreted in a qualitative manner.

As mentioned the instrument contains three receivers at 4m, 13m and 40m. Roughly, it can be stated that the first receiver measures the response of the upper 2m, the second up to 6.5m and the third, up to 20m. Thus, the upper 20m of the seafloor are well-characterized in terms of resistivities/porosities.

EM data

The EM data is of good quality, although one of the receivers (4m) was damaged during shipping and the survey was deprived of good control of the upper 2m. Although for the purpose of this project the 4m receiver would not provide much information. A proof of the excellent quality of the data can be observed in figures (2) and (3) where there exists an excellent correlation between different passes of the instrument over the pockmark.

Once the data was inverted and converted into apparent porosities, maps and profiles have been produced, these will help us with the interpretation and integration with other datasets.

Figure (1) shows a map of the area in which the apparent porosities measured by the 13m receiver are plotted as colored squares with blue hues indicating lower porosities and red higher porosities. This can be interpreted as a porosity map of the upper 6m of the seafloor. As a general feature there seems to be a correlation between pockmarked areas and lower porosities.

Figure (2) shows two maps of porosities measured around pockmark 2. The black line shows clearly that the porosities decrease within the pockmark. Assuming the same type of materials in this pockmarks the only explanation can be either presence of gas or more compacted sediments. The integration with other data collected during this cruise will help determine the origin of the anomalies.

Figure (3) shows the same maps as in figure (2) but the porosities have been linearly interpolated to

1. Given that for the upper 20m we see mostly sediments this assumption is completely correct.

provide a more general map of porosities. This map emphasizes regional features as it penalizes small variations along track. In general shows a good agreement between the three profiles, showing also that porosities decrease inside pockmarks.

Discussion

It seems clear that there is a good correlation between pockmarks and low porosities. There seems to be an increase of the porosity on the edge of the pockmark and a drop below regional levels within. As a reminder, the porosity is calculated from the apparent resistivity. The resistivity of sediments depend of several factors: presence of fresh water, composition, gas, fluids like Cl, etc. The most likely interpretation of the decrease of porosities is that is caused by the presence of gas or by sediments being more compacted. Considering that pockmarks are generated by gas escaping from sediments, then it can be argued that the release of gas caused a re-sedimentation of sediments, being more compacted. The presence of gas will have to be determined through the integration with other datasets.

Again, this is a preliminary interpretation and should be understood in a qualitative way.

References

Monteys, X., E. Doyle and S. Garcia-Gil, 2005. Shallow gas occurrences in the Malin basin, Irish Shelf. In Proceedings of the VIIIth International Conference on Gas in Marine Sediments, Vigo, Spain.

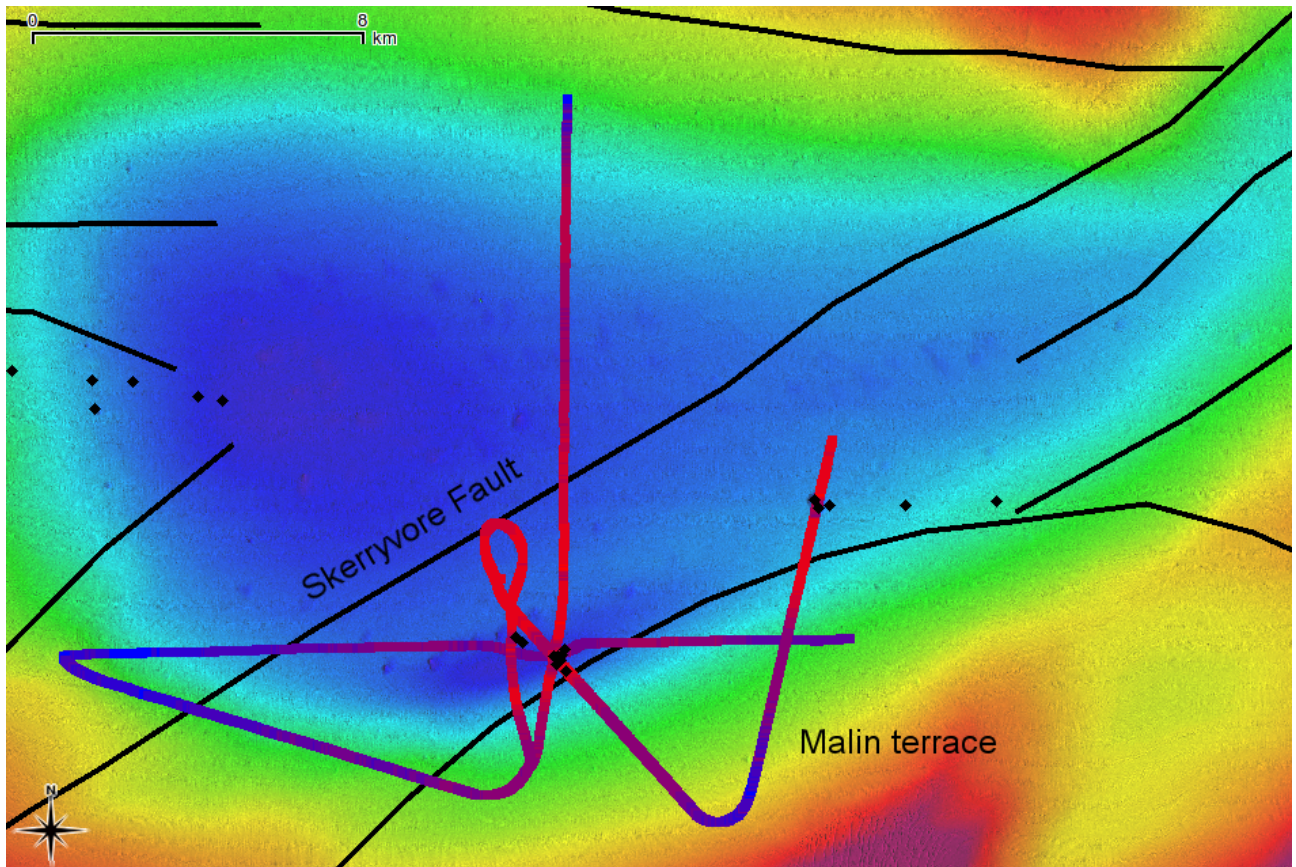


Fig. 1. Map of the study area showing the shaded bathymetry (©GSI,2003)in the background. Black lines: main tectonic features. Black diamonds: location of grab samples and gravity cores. Colored line: towed EM track colored according to porosities for the upper 6m, blue: low porosity, red: high porosity.

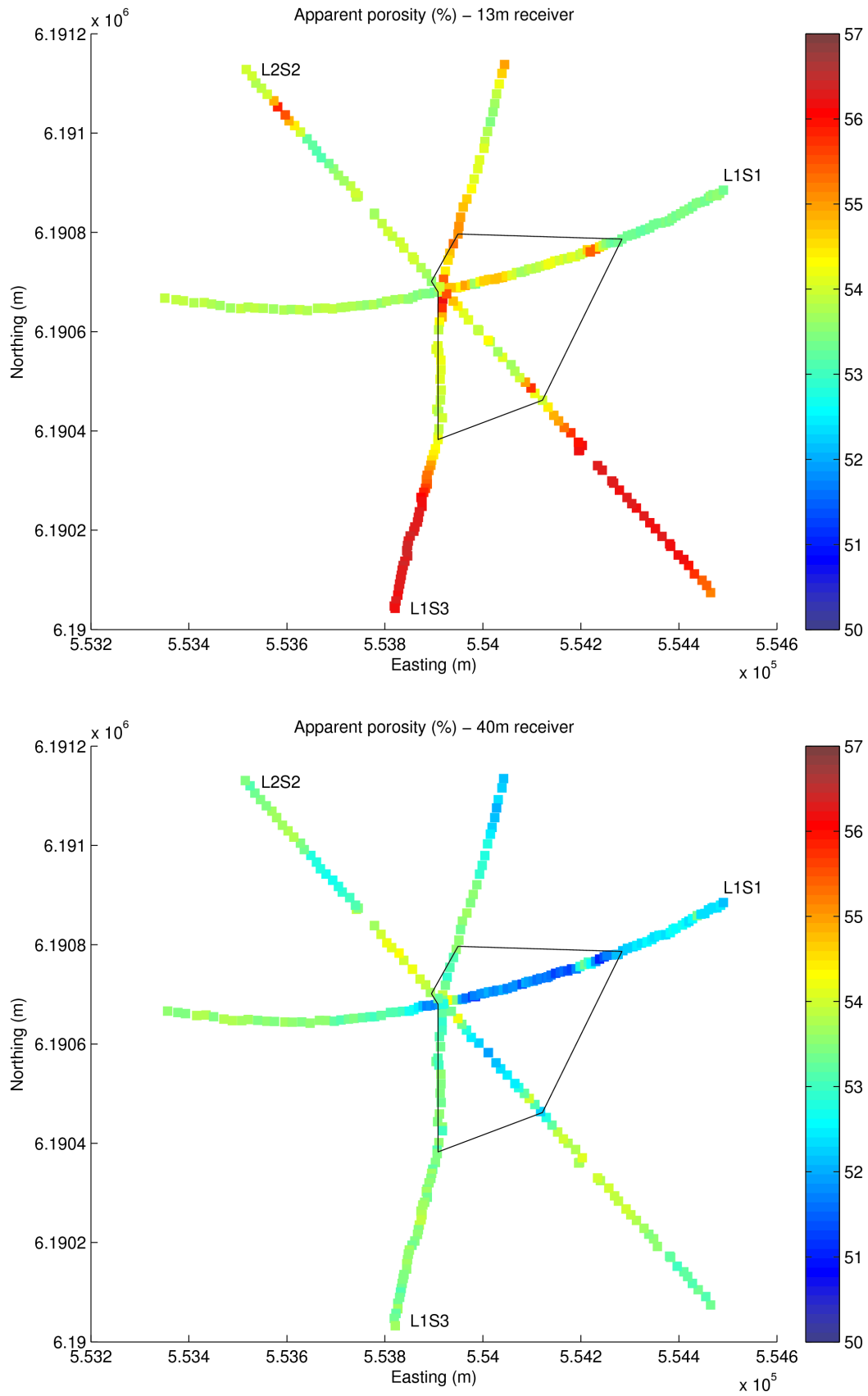


Fig 2. Map of apparent porosities showing a zoom around pockmark 2. The black line shows an outline of the pockmark. Top: map of the upper 6m (13m receiver). Bottom: map of the upper 20m (40m receiver).

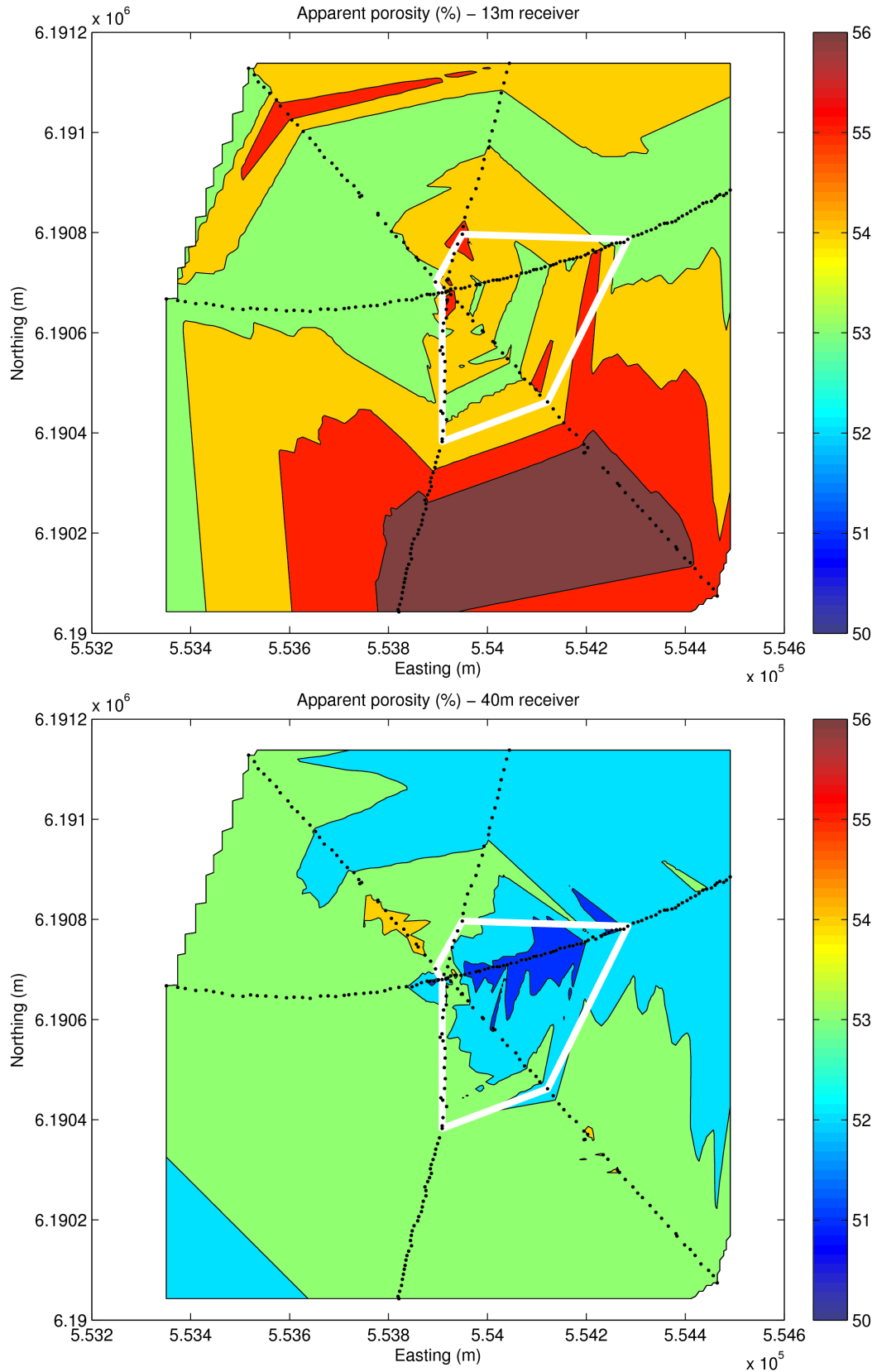


Fig 3. Map of linearly interpolated apparent porosities around pockmark 2. The thick white line shows an outline of the pockmark. Top: map of the upper 6m (13m receiver). Bottom: map of the upper 20m (40m receiver).