Application of Gas Chimney Technology in the Lamprea Area, Offshore GOM

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Summary

Chimney technology focuses on highlighting anomalous and chaotic events on the seismic data and establishing a link between chimney characteristics (occurrence, type and extent) and different geological features. Seismically derived gas chimneys can be used to determine oil and gas migration paths, seal integrity and hydrocarbon phase. The emphasis here will be on how this methodology has been applied and what was learned. We will limit our conclusions to the findings in the Lamprea areas in the Tampico basin of Gulf of Mexico. The pre-drill predictions using chimney data in assessing different risk factors for source and seal will be evaluated against post-drill information.

Chimney Processing and Interpretation

The project was aimed at testing application and usefulness of chimney technology in the Lamprea field. Although the drilling program for the Mercurio well has been decided before this study, the conclusion of this work were of interest before and after well was drilled. Another well (Piloto) is being considered for drilling.

For the background on chimney processing and interpretation we refer the readers to earlier publications: Meldahl et al (2001) and Aminzadeh et al (2002). Briefly, the technique is based on using multitude of seismic attributes to train a neural network to highlight chaotic features on the seismic data with vertical orientation. These features can sometimes be linked to gas chimneys, an indication of hydrocarbon migration to a reservoir or expulsion of gas from a reservoir.

The output of a chimney processing sequence is a 3-D cube with probability of having a chimney at a given location based on the known or suspected chimneys hand picked earlier. Figure 1 shows a time slice of such chimney cube at a deep horizon (3.6 seconds) in the vicinity of Mercurio and Piloto structure. Figure 2 shows evidence of the link between gas chimney cube and the actual gas migration as indicated by both piston core data (red) and side scan sonar. The hydrocarbon show of the piston core could be related to the hydrocarbon migration along the depicted fault line.

Figure 3 may describe the reason for the poor well performance on Mercurio # 1. While there were some gas chimneys in the vicinity of the Mercurio structure, the direction of migration appear to be away from this structure.

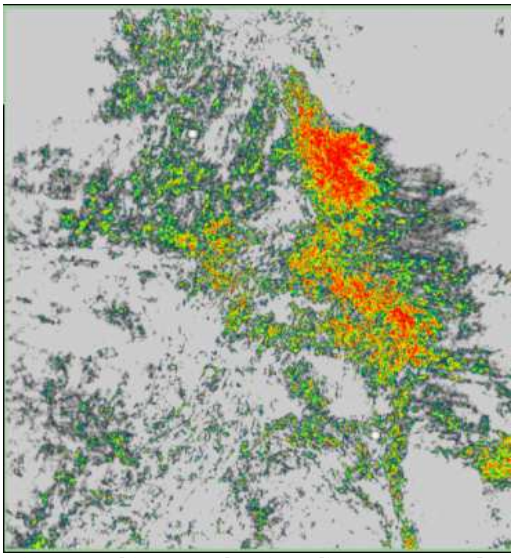

Figure 1- Chimney Cube Time-slice at 3.6 seconds

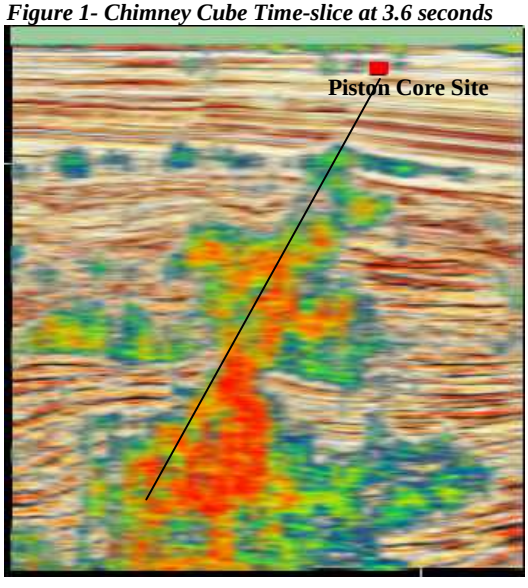

Figure 2- Chimney Cross section, seismic and piston core

Thus, the reservoir is not adequately charged. Note that major chimney to the right of this well is migrating through a different fault block with possible seepage to the surface as described in Figure 1. In contrast, Figure 4 shows the stronger chimneys below the reservoir objective in Piloto, and very little chimney above the objective. This implies that the Piloto is likely to have better seal and charge potential than that experienced by Mercurio #1 well.

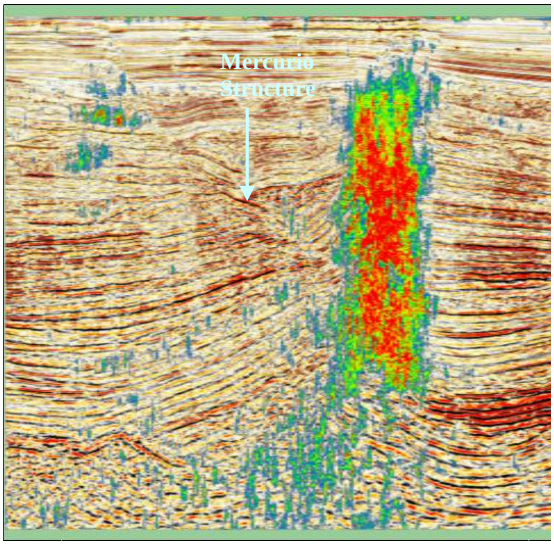

Figure 3- Chimney Cross section, Mercurio #1 well

Conclusions

In general, prominent chimneys in the GOM should indicate general charging on a basin scale. However, individual reservoir charge should be examined carefully. The following are some of the key conclusions of the work in the Lamprea area:

1- The main chimneys recognized in this dataset represent deep hydrocarbon migration. This is confirmed by both piston core and shallow hazard surveys. However these main gas expulsion features are in more shale prone areas, are often associated with high geo-pressures, and do not represent good exploration targets.

2- There are shallow chimneys in the dataset which are not hydrocarbon related and represent shallow de-watering of mudstones.

3- Chimneys generally stop at the shallow low energy zone between 0.6-1.1 seconds which probably represents an effective regional seal.
4- Chimneys generally represent low flux seepage such that carbonate precipitation by hydrocarbon feeding chemosynthetic communities is common.

5- Top-seal at the Mercurio structure is low risk, but there is a moderate to high risk of fault-seal failure.

6- The Mercurio structure showed some evidence of vertical migration into the main objective interval and subtle leakage of hydrocarbons from the shallower objectives. However chimneys feeding the structure were not as extensive as those feeding other offshore gas discoveries.

7- The reservoir objectives are not in direct communication with the observed chimneys. Thus there is a probable charge limitation for this trap.

8- These chimneys are a means by which source rock is transported from Mesozoic source rocks into Tertiary reservoirs, often via basement structural lineaments and faulting.
9- At Lamprea chimney often occur when deep faults are linked with shallow faults.

10- The reservoirs of the Piloto prospect show a clearer link to deep chimneys, although there is moderate risk of seal failure.

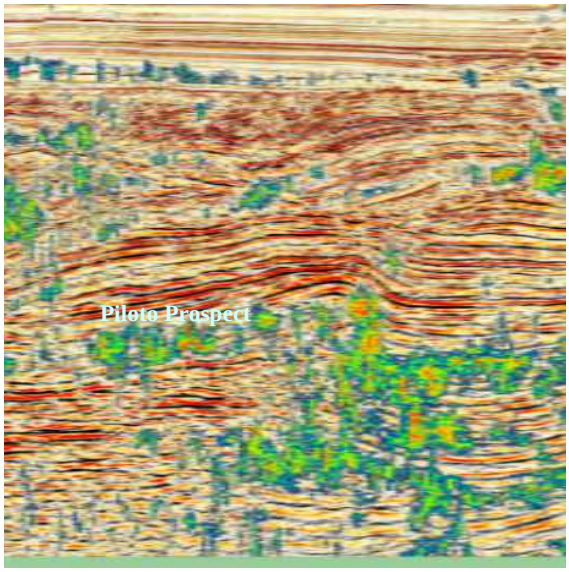

Figure 4- Chimney Cross section, around Piloto prospect

We believe the poor well results could be linked to the lack of closures and relatively high risk predicted under items 5 and 6 above.

Acknowledgements

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References

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