Potential New Reservoir Targets Discovered in Channel and Canyon Features, Offshore Gabon*

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Introduction

This article looks at several exciting potential new channel and canyon systems ranging in age from Paleocene to Miocene observed in deep water, offshore Gabon. The examples are taken from the Gabon MegaSurvey. These features offer new exploration opportunities for detailed geologic, geophysical and reservoir studies to define potential drilling locations for significant reserves.

Gabon MegaSurvey Data

The Gabon MegaSurvey comprises multiple 3D surveys, post-stack merged and currently covers 15,000 km^2 offshore Gabon in West Africa. Prior to merging, the data from the different surveys are conditioned to identify and remove any poor quality areas, to interpolate any missing traces, and to verify that they are correctly geo-referenced. Data are then scaled to a consistent amplitude level and rebinned to a standard regional grid (12.5 x 12.5m bins). Time and phase shift analysis (cross-correlation of traces in overlap zones between surveys) provides the optimum parameters to match the individual datasets to the base; these are then merged and smoothly blended through an overlap zone of approximately 500m to create the final regional seismic dataset.

The present extent of the Gabon project is shown in Figure 1, with two initial delivery and interpretation phases in the offshore northern Gabon area. Tying the interpretation of Phase 1 and Phase 2 was accomplished with 2D seismic lines not shown. Further phases of the project in the offshore southern Gabon area are currently in progress.

To complement the seismic data, an extensive well database was provided by Direction Générale des Hydrocarbures (DGH); all of this information was manually sorted, quality-controlled and standardised for nomenclature over a period of several months. Synthetics

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were generated from the conditioned well files and tied into the seismic to pinpoint impedance horizons that were defined geologically.

Interpretation

The sedimentary basins of offshore Gabon were initiated during the rift phase as the Atlantic Ocean opened and these developed further during the post-rift/sag phase. The basin fill is divided into three major stratigraphic phases, or sedimentary megacycles: the pre-rift phase, the syn-rift phase and the post-rift or sag phase. All major regional horizons interpreted to date in the study belong to the post-rift stage, which is Aptian to Holocene in age. The oldest post-rift sediments consist of clastics and evaporates, which were then overlain by continental, fluvial and lagoonal deposits. As the Atlantic Ocean developed, progradational marine sediments accumulated with a differentiation between platform and basinal environments (Teisserenc and Villemin, 1990).

Several horizons have been interpreted, including the Seabed, the Base Miocene Unconformity, Top Ozouri Formation, Top Cap Lopez Formation and the Top Ezanga Formation (Top Salt). These horizons, chosen due to geological importance and quality of reflector, are shown in Figure 2. Many interesting geological features were noted including multiple generations of large-scale unconformities, widespread salt diapirism and other salt tectonic features, in addition to the channels and canyons, which will be discussed in more detail below.

Canyons and Channels: Relevance and Origins

Neogene channels are a major target reservoir in the Niger and Congo deltas, but they have not yet been targeted in the Gabon offshore area where 4-way dip closures related to salt diapirism have been the dominant trap style. Two generations of canyon and channel incision and fill have been chosen for further investigation.

- The major canyons (see Figures 3 and 4) are linked to westward-tilting in the Neogene, caused by continued continental drift. This tilting heightened the erosion of the continental shelf, forming a regional Miocene unconformity (Brownfield and Charpentier, 2006). All channels are perpendicular to the slope. No turbidite fans are known, but they are predicted to exist in the deep offshore areas. The Miocene unconformity may form hydrocarbon traps and seals where the channels are filled with sandstones and turbidites (Brownfield and Charpentier, 2006).
- Older Ozouri Formation channels (Figures 3 and 5) occur within a unit deposited at a maximum sea level high during the late Paleocene. There is evidence for long established channels migrating across the continental slope and for stacked, cross-cutting channels. These are often associated with seismic bright spots.

The channels are located on the continental slope and cannot be directly observed from a seismic time-slice, as they are also difficult to pick by using horizon interpretation. Seismic attributes are a great tool to analyse the channel system; in this project, we have used

many attributes to try to image these features and used Trace envelope, RMS/MaxAbs amplitude, Coherency and Spectral Decomposition as the best to analyse the data set.

Conclusions

We propose that the well developed canyon and channel systems identified in the Gabon offshore area can be considered a potential new reservoir target, analogous to channels already targeted in the Niger and Congo deltas. Furthermore, these systems can be traced into deeper waters and may link with deep offshore turbidite fans. Significant more work needs to be done to determine facies quality, lateral extent and potential reserves. Existing drilled fields and reservoirs are all related to closures over salt features. There is potential for further structural closures and of course the opportunity to find many stratigraphic traps in these channels and canyons that could hold significant hydrocarbon reserves. Preliminary prospectivity analysis of this area has already yielded a significant number of seismic anomalies. The next step is to have each of these anomalies classified, ranked and given the right reservoir characteristics and economics (risk), and drilled.

Acknowledgements

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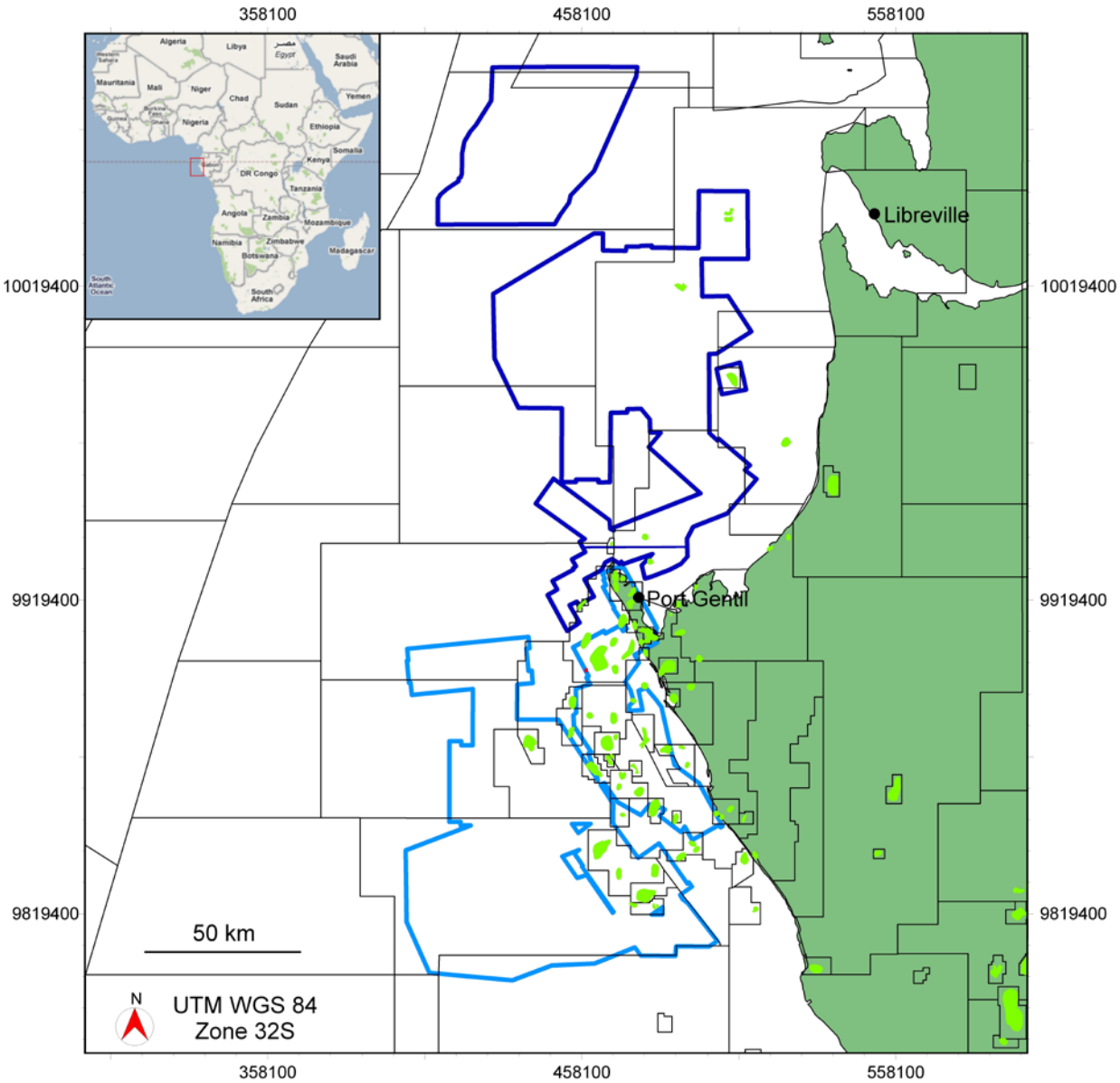

Figure 1. The present extent of the Gabon project showing Phase 1 in light blue and Phase 2 in dark blue.

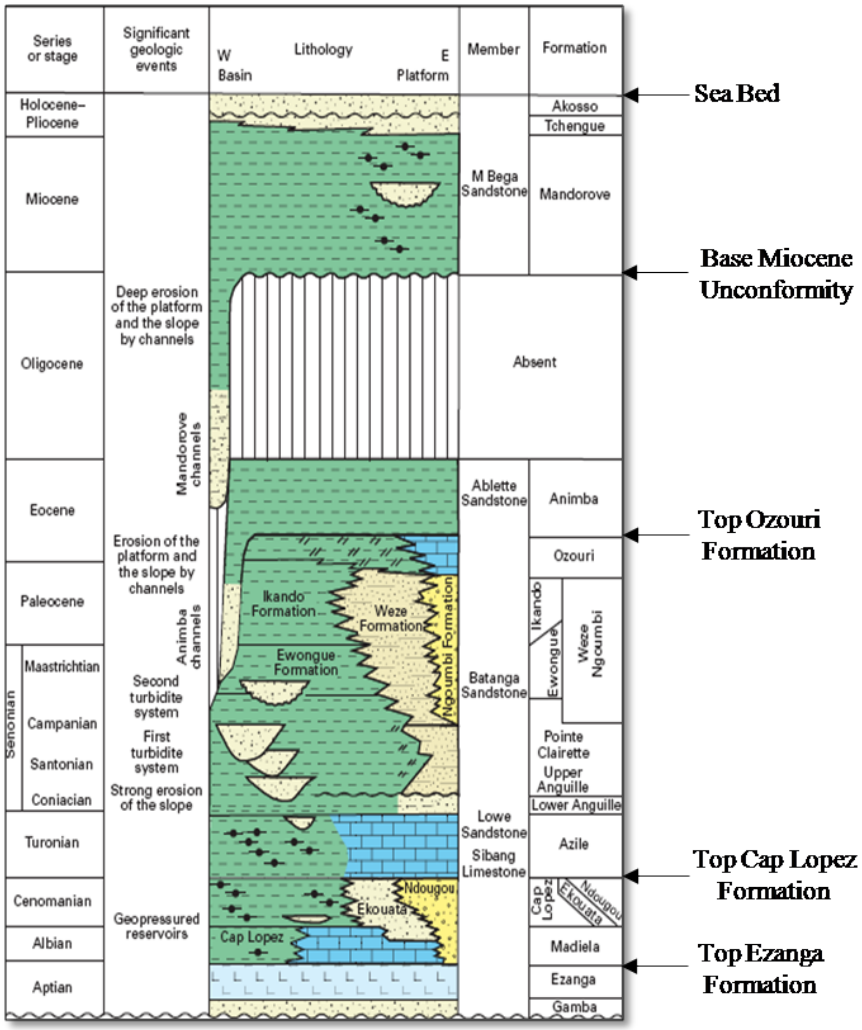

Figure 2. Generalised stratigraphic column for the post-rift stage of the North Gabon and South Gabon subbasins, showing regional horizons interpreted (after Brownfield and Charpentier, 2006)

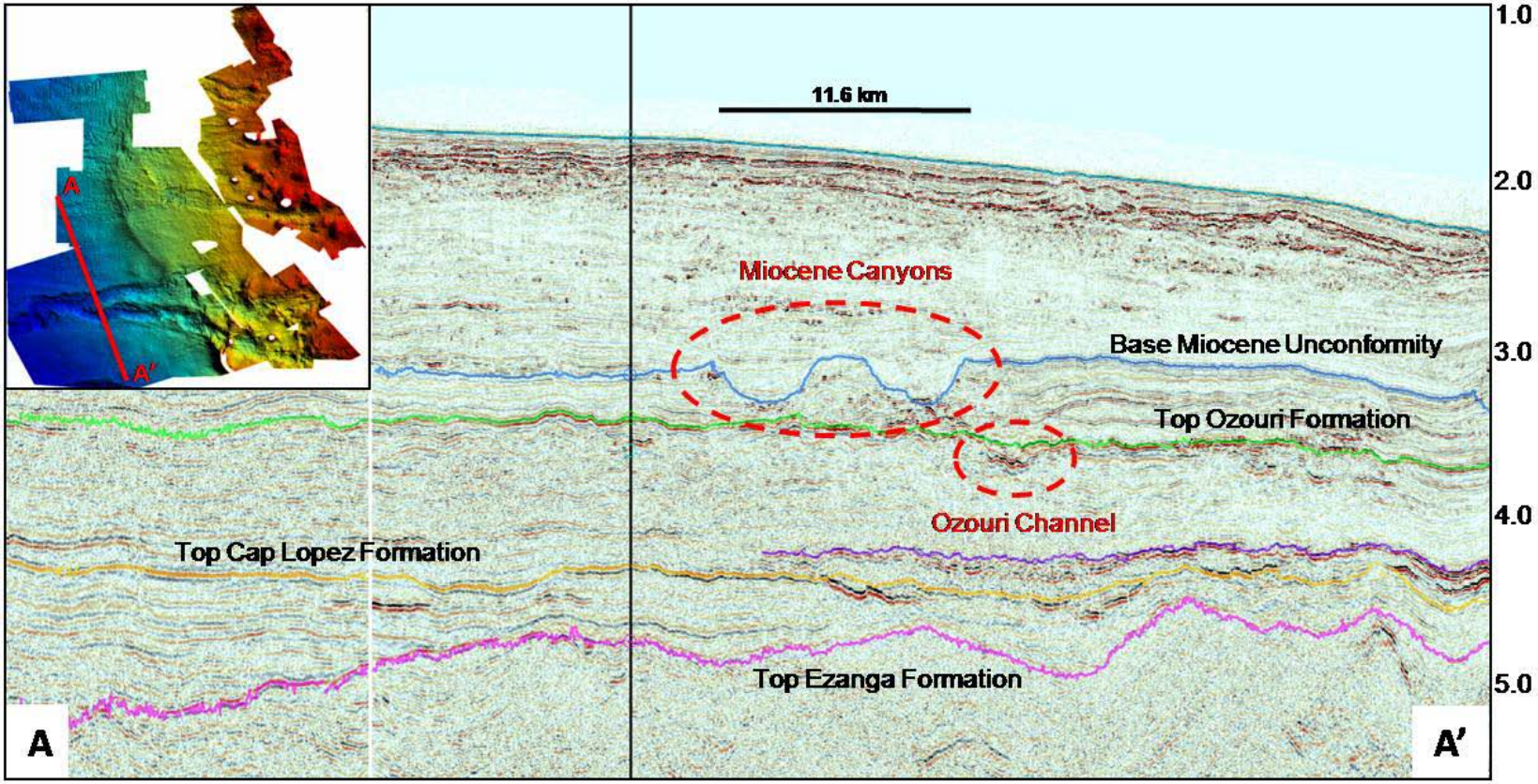

Figure 3. Cross section showing interpreted horizons and location of Miocene canyons and Ozouri channel feature.

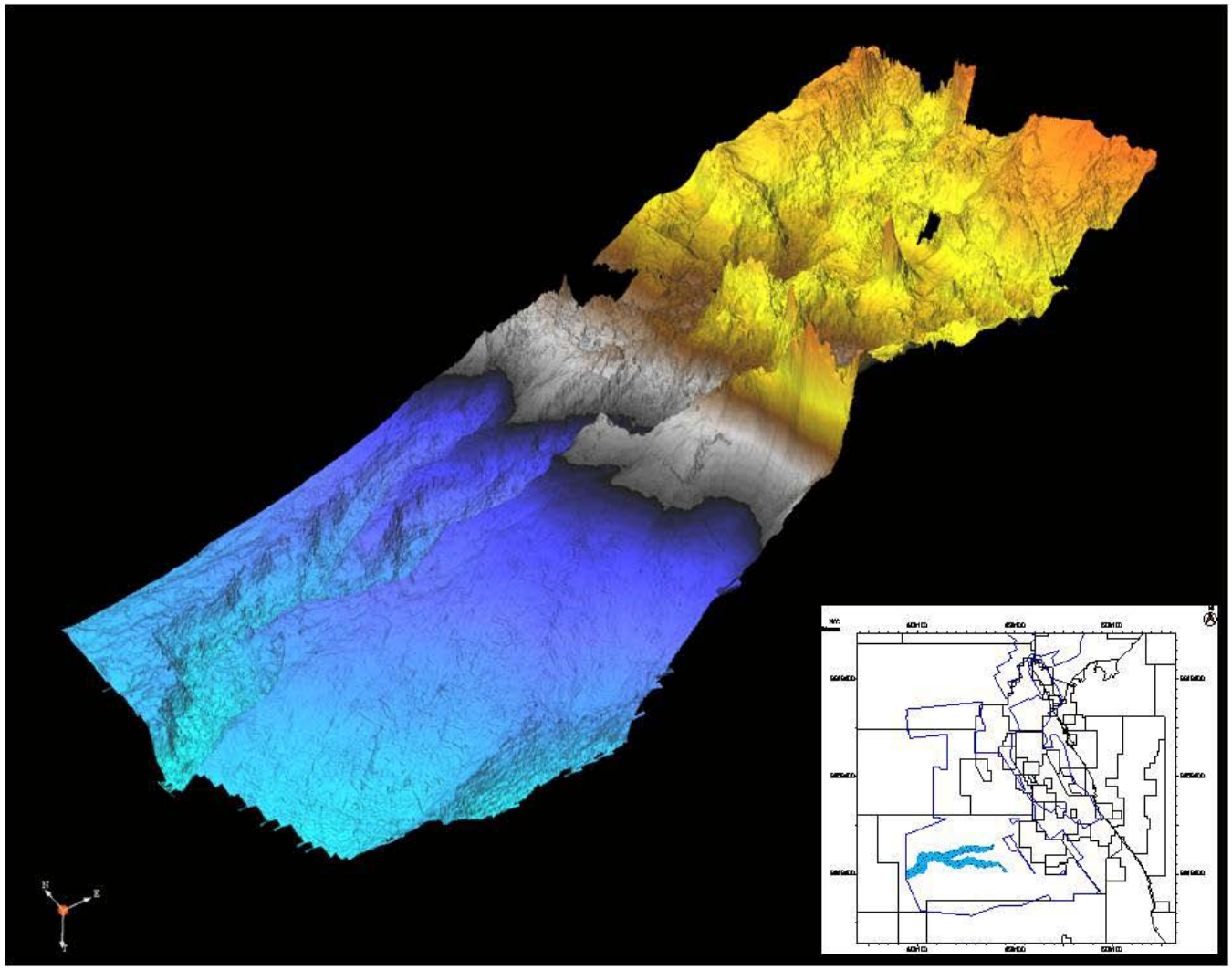

Figure 4. 3D view of Miocene canyon and location.

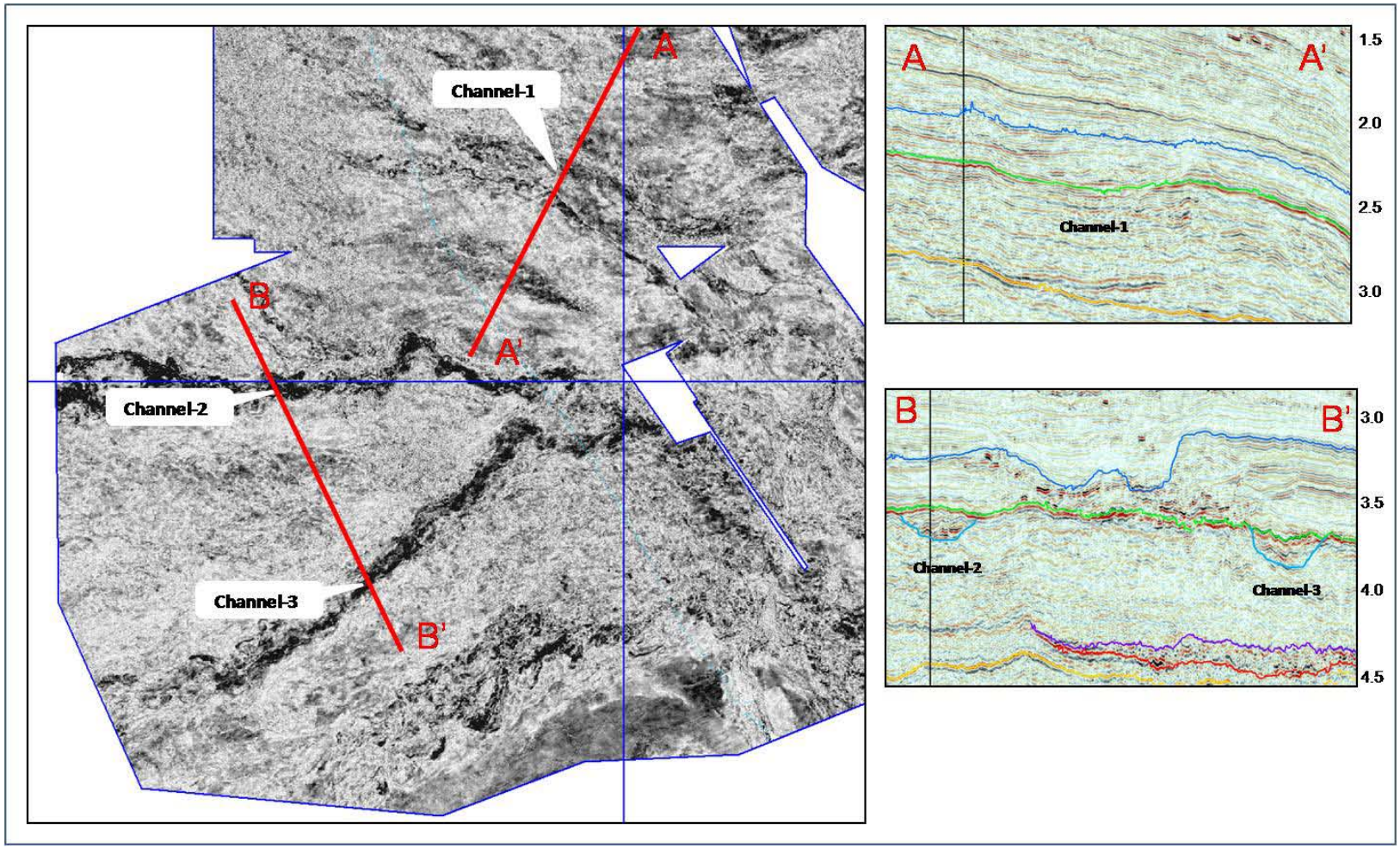

Figure 5. Trace envelope on horizon slice 124ms below Top Ozouri Formation, showing channels.